user's guide

hp StorageWorks disk system 2405

Edition E0902

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Notice

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WARNING	Identifies a hazard that can cause personal injury
Caution	Identifies a hazard that can cause hardware or software damage
Note	Identifies significant concepts or operating instructions

`this font` - used for all text to be typed verbatim: all commands, path names, file names, and directory names also, text displayed on the screen

<*this font*> - used for variables used in commands

this font - used for GUI menu options and screen controls

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Revision History

First Edition	March 2002
Second Edition	June 2002
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Product Description

1

General Description

Hewlett-Packard's StorageWorks Disk System 2405 (referred to in this guide as the disk system) is a high-availability Fibre Channel (FC) storage product. Dual optical fiber ports on dual link controllers provide Fibre Channel connections to the host. Fifteen slots accept high-speed, high-capacity FC disks connected to a FC midplane. Data throughput is 200 Mbytes/sec. Thirteen disk systems fill a 2-meter System/E rack. Filled with 18-Gbyte disks, the 2-meter Rack System/E yields 3.51 Terabytes of storage; with 36-Gbyte disks, 7.02 Terabytes of storage; and with 73-Gbyte disk, 14.23 Terabytes.

Modular and redundant components are easy to upgrade and maintain. Disks, power supplies, and link control cards (LCCs) are replaceable parts that plug into individual slots in the front and back of the disk system. Redundant power supply/fan modules and LCCs can be removed and replaced without interrupting storage operations. Disks can be replaced with the system on, and only the affected file systems taken off-line. Hewlett-Packard technical support is optional for these procedures.

Special electronics and HP-UX software enable remote monitoring and diagnostics. Sensors on the LCCs monitor the disk system environment, including temperature, voltage, fan speed, and component status. Hewlett-Packard's Command View SDM reports any changes in environmental status to user-defined locations. Standard HP-UX diagnostic utilities also report environmental data for enhanced troubleshooting.

Features

The disk system occupies 3 EIA units in a standard 19-inch rack. Disk drives mount in the front of the system. Redundant power supplies, fans, and LCCs mount in the back. See the figures below.

Figure 1. Disk System Front View

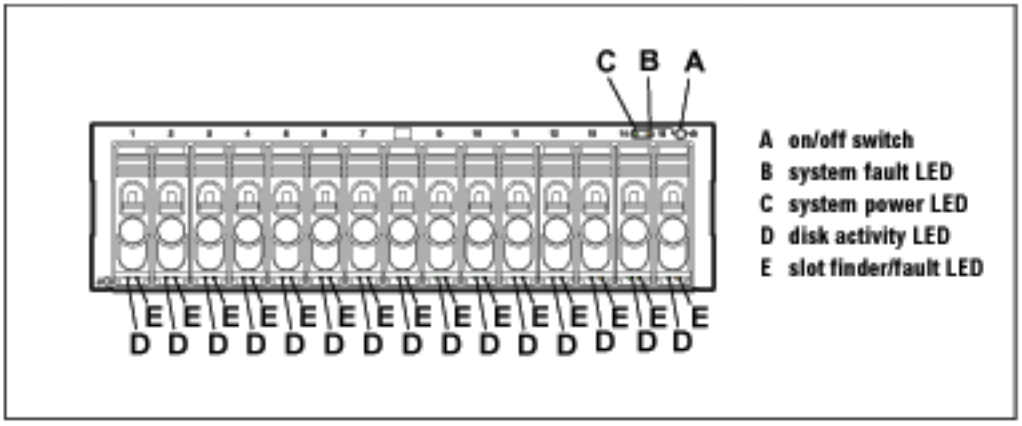
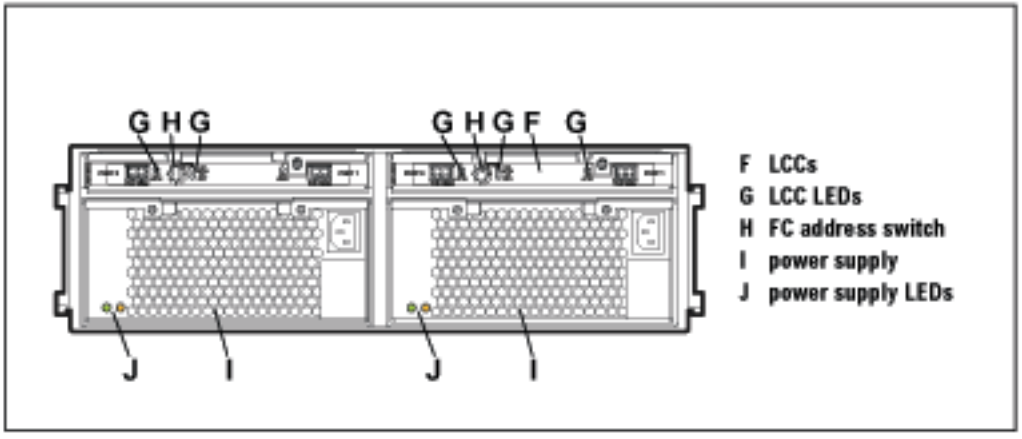


Figure 2. Disk System Back View



Status Indicators

LEDs on the disk system enable you to detect and replace failed components and thereby prevent or minimize users' downtime. For additional information about LEDs, see chapter 4, Troubleshooting.

On the front of the disk system, a pair of LEDs indicates the status of the disk system, and an LED for each slot shows disk I/O activity:

- The system power LED (B in Figure 1) indicates that power is on or off.
- The system fault LED (C in Figure 1) indicates whether or not a fault has occurred anywhere in the disk system.
- At the bottom of each disk module, the left LED (D in Figure 1) indicates the presence of I/O activity on the disk.
- The right LED, at the bottom of each disk module (E in Figure 1), can be flashed to help a customer engineer (CE) locate the disk for physical inspection or removal.

LEDs (G and J in Figure 2) on the back of the disk system indicate the status of replaceable components. See chapter 4, Troubleshooting, for specific LED information.

Power/Standby Switch

Located in the upper right corner of the front of the disk system, the power switch (A in Figure 1) interrupts power from the power supplies to the LCCs and other internal components. Power to the power supplies is controlled by the power cords and the AC source.

High Availability

High availability is a general term describing computer systems that are designed to minimize unplanned downtime. The disk system supports high availability requirements through the following features:

- Hot-pluggable, high-capacity, high-speed disks
- Redundant, hot-pluggable, user-replaceable power supplies and LCCs
- Support for mirrored disks in the HP-UX environment
- Online firmware upgrades
- Hardware event monitoring and real-time error reporting

Upgradability

You can increase disk system storage capacity by:

- Replacing disk drives with higher-capacity disk drives
- Adding disks in unused slots
- Adding another disk system to a FC loop

None of these actions require shutting down the product, but some may require the use of system utilities to manage file systems.

Disk and LCC firmware is downloadable using the supported tools.

Environmental Services

Environmental services circuitry monitors the following elements:

- Fan rotation
- Power supply output
- Power supply and fan status
- Disk drive status, including fault conditions
- LCC status
- Temperature
- Self-test results

Each LCC reports the status of all elements in the disk system, even if the LCC does not have direct access to the element.

Additionally, the EEPROM on each LCC stores 2 Kbytes of configuration information and user-defined data, including the manufacturer serial number and product number.

Components

User-replaceable components enable high availability and easy maintenance. This section describes the following components:

- Disks and disk fillers
- LCCs
- Power supply/fan modules

Disks and Disk Fillers

Disks, shown in Figure 3, are 3.5-inch Low Profile disks in open metal carriers. Disks are Fibre Channel.

The open carrier design requires careful handling to avoid disk damage by breakage and static electricity. Avoid personal contact with hot surfaces.

WARNING Touching exposed circuits can cause electrical discharge and disable the disk. Disks require careful handling and ESD precautions.

The plastic parts of the disk are safe to touch:

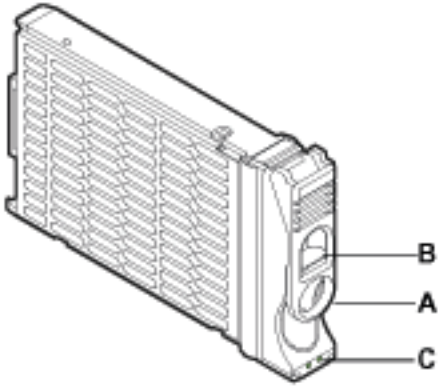
- Extraction handle (A in Figure 3)
- Latch tab (B in Figure 3)

The initial disk options for this product are 73-Gbyte, 36-GByte and 18-GByte drives. A label on the disk carrier shows the storage capacity and rotational speed of the installed disk. Obtain information about the latest disk options from HP sales representatives.

Disk fillers occupy unused slots to balance the air flow.

Caution Fillers must be installed in unused slots in order to maintain even cooling around the remaining slots.

Figure 3. Disk Module



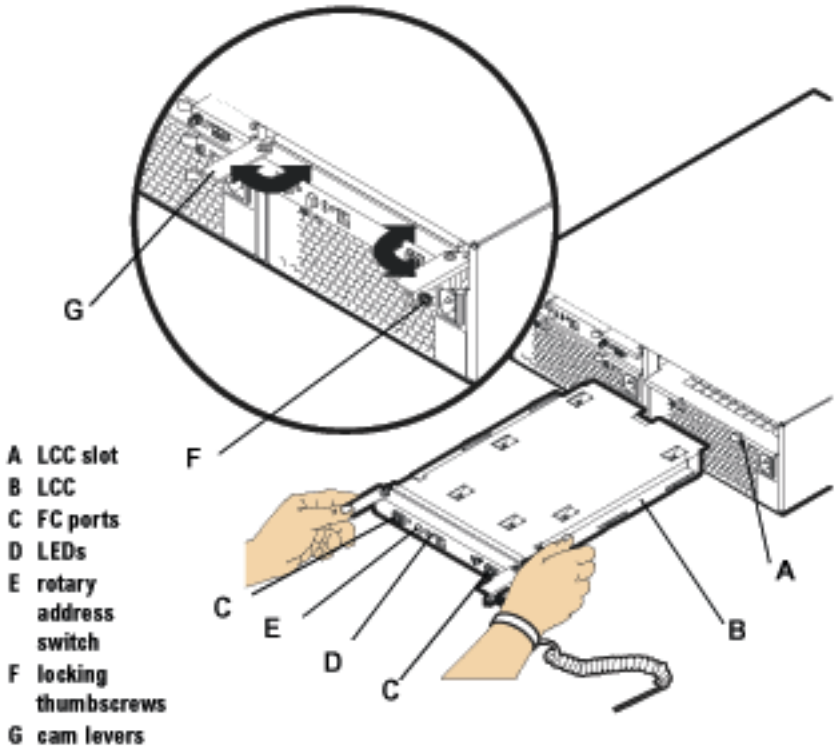
A extraction handle
B latch tab
C disk LED

LCCs

LCCs (Link Control Cards) plug into two slots in the back of the disk system. Viewed from the rear, the LCC in the left slot is LCC A, and in the right slot LCC B. Each LCC connects to independent Fibre Channel loops inside the disk system.

Two Fibre Channel ports (C in Figure 4) on each LCC provide dual connections to the same or separate hosts. The second port can be daisy chained to another disk system.

Figure 4. LCC



Other features of the LCC are:

- LEDs (D) indicating LCC status and bus configuration
- Rotary switch (E)
- Configuration switch with four settings:
  1. Link Speed (1.0625 Gb/s or 2.125 Gb/s)
  2. Reserved
  3. Reserved
  4. Power fail warning (enable/disable)
- Locking screws (F)
- Cam levers (G)

LCC circuitry provides the following functions:

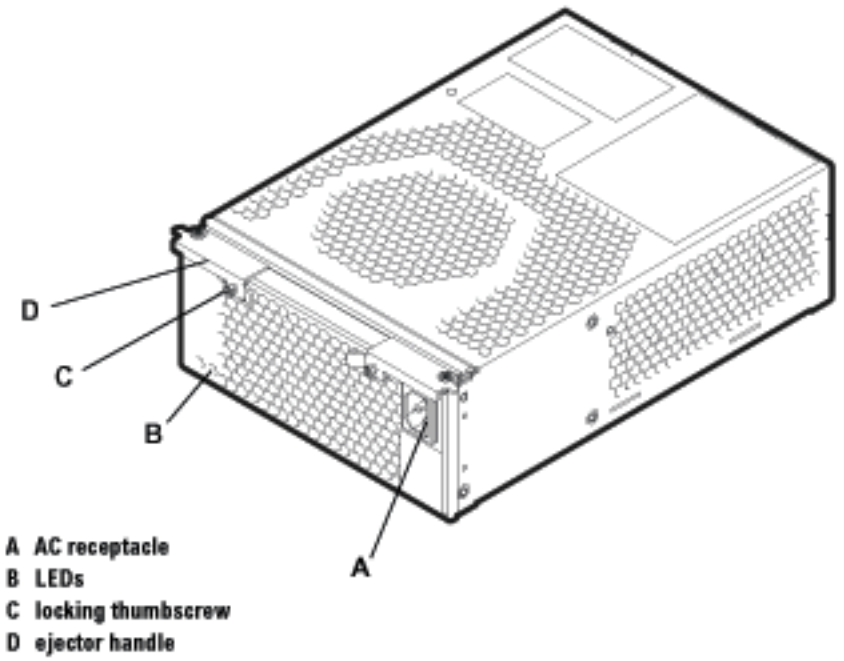
- System fault detection
- Disk address generation

Caution If an LCC fails, do not remove it from the disk system until you are ready to replace it with a new one. The failed LCC should remain installed to assure proper cooling for the disk system.

Power Supply/Fan Module

Redundant, hot-pluggable 340-watt power supplies convert wide-ranging AC voltage from an external main to stable DC output and deliver it to the midplane. Each power supply has an internal fan, an AC receptacle (A in Figure 5), two ejector handles (D) with thumbscrews (C), and 2 LEDs (B). Internal control prevents the rear DC output connector from becoming energized when the power supply is removed from the disk system.

Figure 5. Power Supply/Fan Module



Power supplies share the load reciprocally; that is, each supply automatically increases its output to compensate for reduced output from the other, and vice versa. If one power supply fails, the other delivers the entire load.

Internal circuitry triggers a fault when the internal fan or other part fails. At the same time, the power fault LED (amber) illuminates, and, if enabled, the hardware event monitor sends an event message. The power supply fan remains on if other parts fail in order to maintain cooling air flow through the system. If the fan fails, the power supply shuts down. The fan in the other working power supply will increase to full speed to compensate for the failed fan. The failed power supply/fan module must be removed and the replacement power supply/fan module installed within two minutes. In the event of a failure, if a replacement fan module/power supply is not available, leave the failed power supply/fan module installed until you are ready to replace it. This should be done to maintain proper cooling for the disk system.

Internal circuitry senses fan motion and triggers a fault when the speed of the power supply's internal fan falls below a critical level. At the same time, the LED turns amber, and, if enabled, the hardware event monitor sends an event message.

Hardware/Software Requirements

The disk system is supported on the following operating systems:

- HP-UX 11.00 with HWE 0302 or greater
- HP-UX 11.11 with HWE 0302 or greater

For supported servers, see the latest HP 9000 Configuration and Ordering Guide.

One of the following Fibre Channel HBAs must be installed in the host:

- A5158A, 1 Gb PCI Fibre Channel HBA
- A6684A, 1 Gb HSC Fibre Channel HBA
- A6685A, 1 Gb HSC Fibre Channel HBA
- A6795A, 2 Gb PCI FIbre Channel HBA

Topologies

The disk system supports high availability through redundant components and redundant connections to redundant hosts. Each port on a LCC can be connected to a different host bus adapter in the same or different hosts. Mirroring inside a disk system is not a high availability solution to the extent that a midplane failure would necessitate downtime.

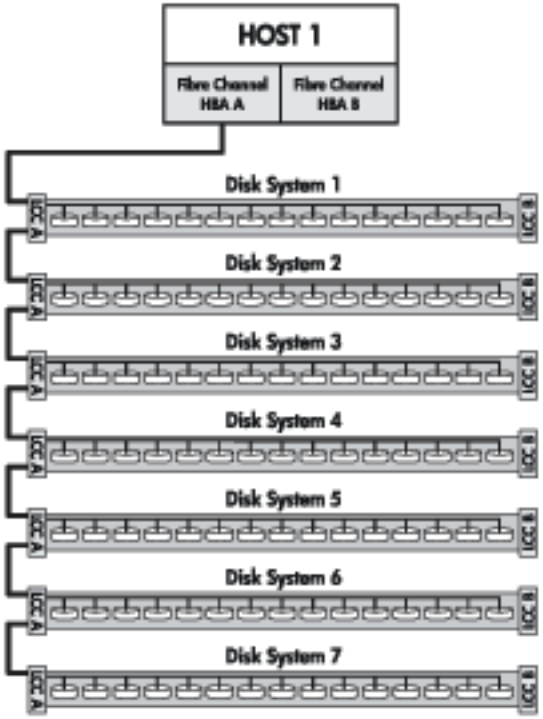
Basic high availability topologies are described on the following pages. For information about specific supported topologies, consult an HP sales representative.

Single Host Basic Configuration

The maximum number of disk systems supported on a Fibre Channel Arbitrated Loop (FC-AL) is seven. The maximum storage capacity with this configuration is approximately 7.5 Terabytes (105 disk modules at the 73 Gbyte capacity point). This configuration does not provide any redundancy to the data path, however there is some hardware redundancy provided by the enclosures themselves (power supplies). With the utilization of Mirror/UX software, one or more mirrors can be created on the hardware path to provide a basic level of data protection.

The performance of this configuration depends on the number of disk systems on the loop. Using the maximum supported number of disk systems reduces the performance of the loop. To get the maximum performance (200 MB/s or maximum number of I/Os), the number of disk systems should be limited to four.

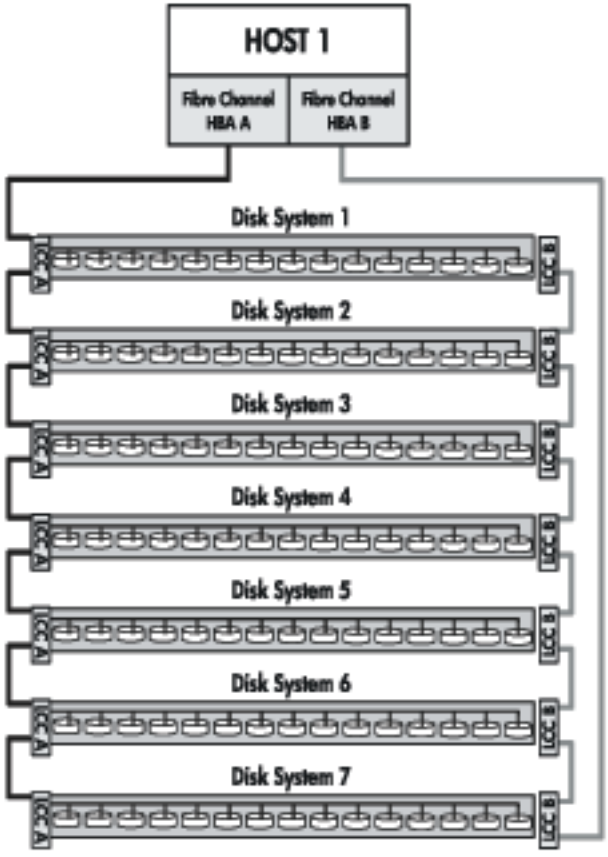
Figure 6. Single Initiator Basic Configuration



Single Host PV Links Configuration

Data path redundancy can be achieved with the configuration shown in Figure . Using an additional host bus adapter and the LVM software, pvlinks can be created to provide a redundant path to data. A separate mirror path can be created for data protection, also. This configuration protects against any single component failure (cables, HBAs, disks). Like the single host basic configuration, each loop is capable of 200 MB/s which translates to 400 MB/s for this configuration.

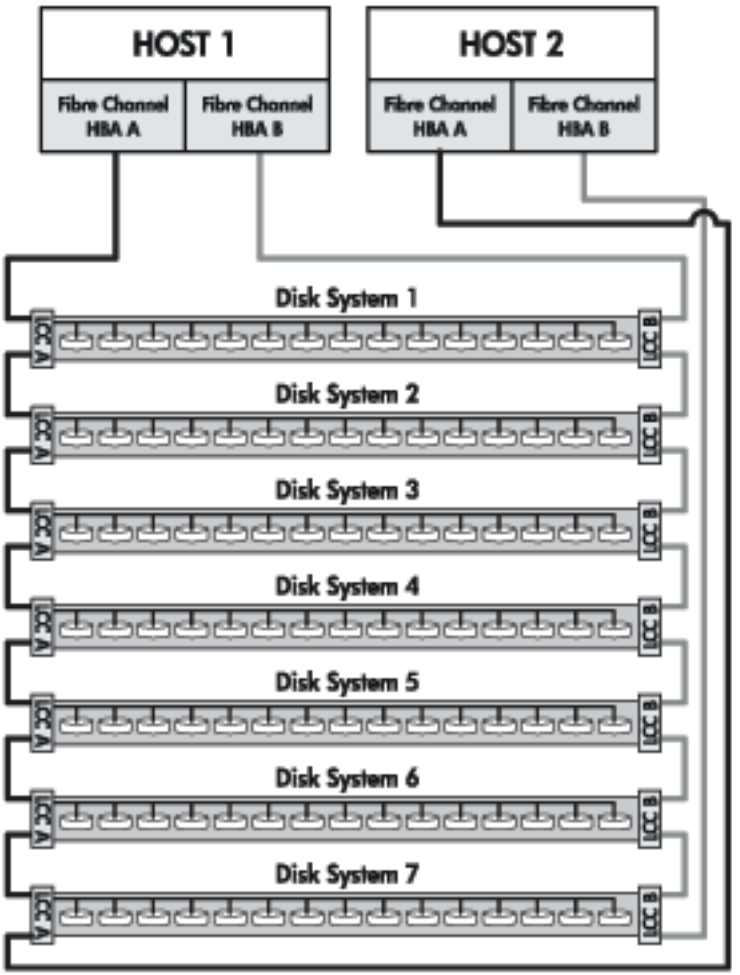
Figure 7. Single Host PV Links Configuration



Two Host High Availability Configuration

Figure 8 shows a basic high availability configuration. Each disk system can still be configured using pvlinks and mirroring. High availability software protects against a disk system failure. A failure in a cable or LCC will result in a loop failure. Adding FC-AL loops or switches makes this configuration more robust.

Figure 8. Two Host High Availability Configuration

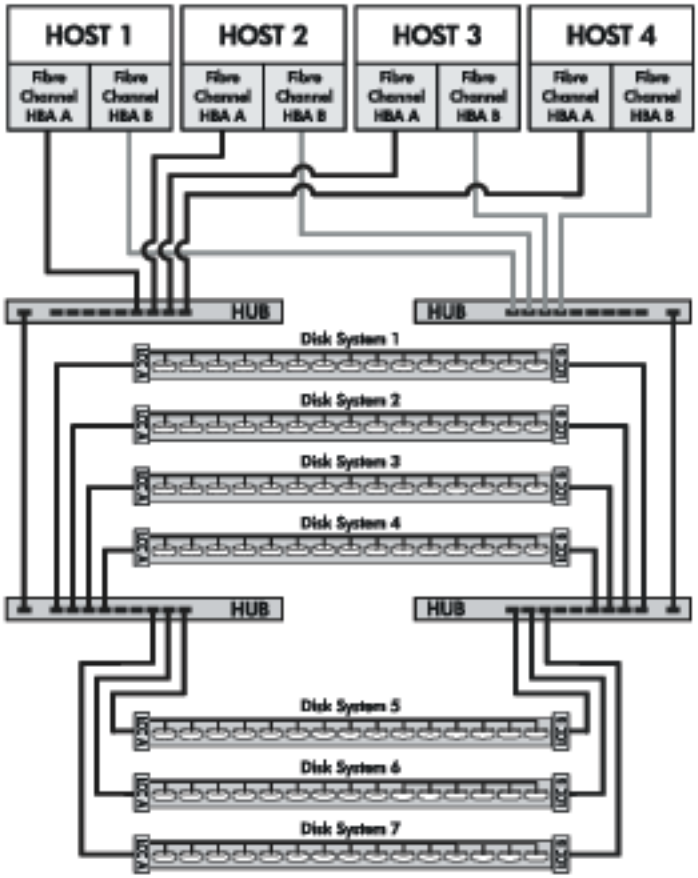


Four Host Hub Configuration

The disk system can run at 2 Gb/s speed. For legacy systems a four host configuration could be used for an advanced high availability environment at 1 Gb/s speed. See Figure 9, below.

The performance of this configuration is limited to a maximum of 200MB/s (100 MB/s per loop). The performance issues discussed with the single initiator basic configuration also apply with this configuration.

Figure 9. Four Host Hub Configuration



Definitions

The following terms have specific meanings in the context of this guide:

High availability (HA)

HA describes hardware and software systems that are designed to minimize planned and unplanned downtime. High availability is measured at the system level and stated as the percentage of time the system is in a state to do useful work; for example, 99.95% availability translates to four hours of downtime per year.

Hot-pluggable

Hot-pluggable signifies the ability of a component to be installed or replaced without interrupting storage operations and within the restrictions of the operating environment. All customer-replaceable disk system components can be replaced under power. Adding or replacing disks or LCCs may require the use of HP-UX commands to manage file systems.

JBOD

Pronounced jay-bod, a JBOD (Just a Bunch Of Disks) is an enclosed group of disks that are addressed individually by the host.

PDU and PDRU

PDUs (power distribution units) distribute power from a single inlet to multiple outlets. PRUs (power relay units) connect one or more PDU inlets to a single on/off switch, such as a cabinet power switch. Units that both distribute and switch power are referred to as PDRUs.

Short Wave

Lasers or LEDs that emit light with wavelengths around 780 nm or 850 nm. Short wave lasers are used for Fibre Channel links up to approximately 700 m. They are typically used with multimode fiber. The preferred fiber core size is 50 microns since this fiber has large bandwidth so the distance is limited by fiber attenuation. A 62.5 micron core size is also supported for compatibility with existing FDDI installations. Fiber of this type has smaller bandwidth and, in this case, the distance is limited by fiber bandwidth.

Multimode

A type of fiber optic cable that allows more than one mode (rays of light) to be guided.

Arbitrated Loop (FC-AL)

A Fibre Channel topology that provides a low-cost solution to attach multiple communicating ports in a loop without hubs and switches.

Arbitrated Loop Physical Address (AL_PA)

A unique one-byte valid value assigned during Loop Initialization to each NL_Port or FL_Port on a Loop.

Installation

2

Preparation

Before installing the disk system, make sure (1) electrical wiring, breakers, and PDUs meet power needs, (2) the required support software is installed on the host, and (3) if you are connecting the disk system to a V-class server, auto-termination is enabled on the host bus adapter. This section covers all three of these topics.

Electrical Requirements

All electrical wiring to the service point (plug) must be sized to carry the appropriate inrush (20 amps per power supply) and steady state currents. See the following table for examples.

Table 1. Inrush (Surge) Current and Duration

No. of Disk Systems on Circuit (2 power supplies per disk system)	Inrush Current and Duration
1	40 amps declining over 100 ms (5 cycles)
2	80 amps declining over 100 ms (5 cycles)
3	120 amps declining over 100 ms (5 cycles)
4	160 amps declining over 100 ms (5 cycles)

Table 2. Maximum Operating Current

Incoming Voltage AC RMS	Maximum RMS Current Drawn by One Disk System
100 – 120 volts	4.8 amps
200 – 240 volts	2.0 amps

Caution Adding disk systems to 120V circuits rapidly increases amp requirements. Always make sure that the total current drawn does not exceed circuit capacity.

Circuit breakers must be adequately rated for inrush and operating currents. Hewlett-Packard recommends magnetic-type circuit breakers, which are capable of handling large inrush currents for short durations (10 to 12 cycles) and are rated adequately for steady state currents.

Choosing PDUs

Peak power requirements and PDU capacity affect the number of disk systems that can be installed in a rack. For example, to install more than four disk systems in Hewlett-Packard legacy racks (HP C2785A, C2786A, and C2787A), you must upgrade to 19-inch PDUs.

Besides rack density, the following factors can help you choose PDUs:

- Redundant power source. To connect redundant power supplies to separate PDUs, install redundant PDUs.
- Number of cords to the AC source. Using 30-amp PDRUs instead of 16-amp PDUs reduces the number of cords to the wall.
- Future needs. Installing surplus PDU capacity allows you to add disk system units later.
- Inrush margins. For installations that require four or more 16-amp PDUs, Hewlett-Packard recommends HP 30-amp PDRUs (E7681A, E7682A) for their inherent inrush protection.
- On/Off switch capability. Some PDU/PDRU options support the use of a single-point on/off switch.

The following tables show how many and what kind of PDU/PDRUs are needed to install one or more disk systems in an HP rack. Data assumes 220V AC

nominal power and redundant PDU/PDRUs. For nonredundant configurations, divide the number of recommended PDU/PDRUs by 2.

Table 3. Recommended PDU/PDRUs for Multiple Disk Systems in HP Legacy Racks

No. of Disk Systems	1.1 meter (21 U)	1.6 meter (32 U)	2.0 meter (41 U)
1 – 5	2 3-foot/16-amp PDUs ***or*** 2 19-inch/16-amp PDUs	2 5-foot/16-amp PDUs[1] ***or*** 2 19-inch/16-amp PDUs	
6 – 8	NA[2]	4 19-inch/16-amp PDRUs ***or*** 4 19-inch/30-amp PDRUs	
9 – 10	NA[2]	NA[2]	4 19-inch/ 30-amp PDRUs

1.Supports cabinet on/off switch.
2.Rack height does not allow additional disk systems.

Table 4. Recommended PDU/PDRUs for Multiple Disk Systems in HP System/E Racks

No. of Disk Systems	1.25 meter (25 U)	1.6 meter (33 U)	2.0 meter (41 U)
1 – 4	2 19-inch/16-amp PDUs ***or*** 2 19-inch/30-amp PDRUs[1]		
5 – 8	NA[2]	2 19-inch/30-amp PDRUs[1] 4 19-inch/30-amp PDRUs	
9 – 11	NA[2]	NA[2]	4 19-inch/ 30-amp PDRUs
12-13	NA[2]	NA[2]	4 19-inch/ 30-amp PDRUs

1.Supports cabinet on/off switch.
2.Rack height does not allow additional disk systems.

Installing PDU/PDRUs

The 19-inch PDUs and PDRUs can be installed vertically or horizontally in the rack. Choose PDU/PDRU locations with the following guidelines in mind:

- Place PDU/PDRUs within the reach of disk system cords.
- Place PDU/PDRUs vertically whenever possible. See sample installations in Figure 10 and Figure 11. Installing PDU/PDRUs horizontally interferes with the ability to service disk systems that are behind the PDU/PDRU.
- Place vertical PDU/PDRUs on each side of the disk system so that the cord from either power supply does not cross over replaceable components in the middle of the product.
- To achieve maximum density in 2-meter racks, install 30-amp PDRUs on hinged brackets directly behind disk systems. Hinges allow the PDRU (HP E7681A and E7682A) to swing aside for servicing obscured components. (See Figure 11.)

Figure 10. PDRU Placement in 1.6-Meter Rack

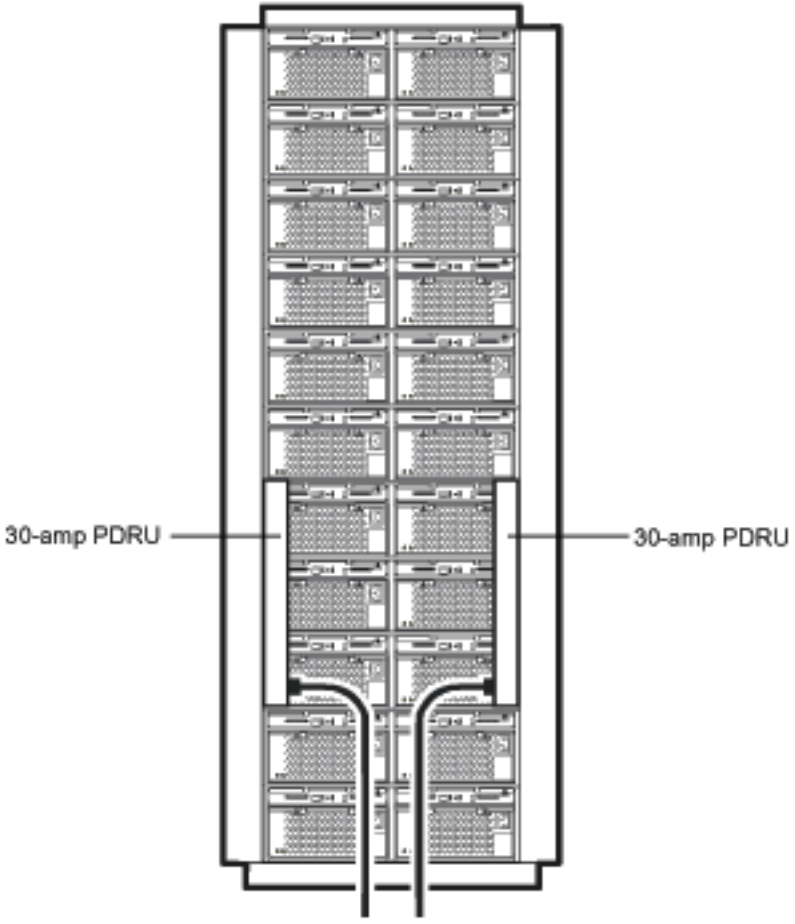
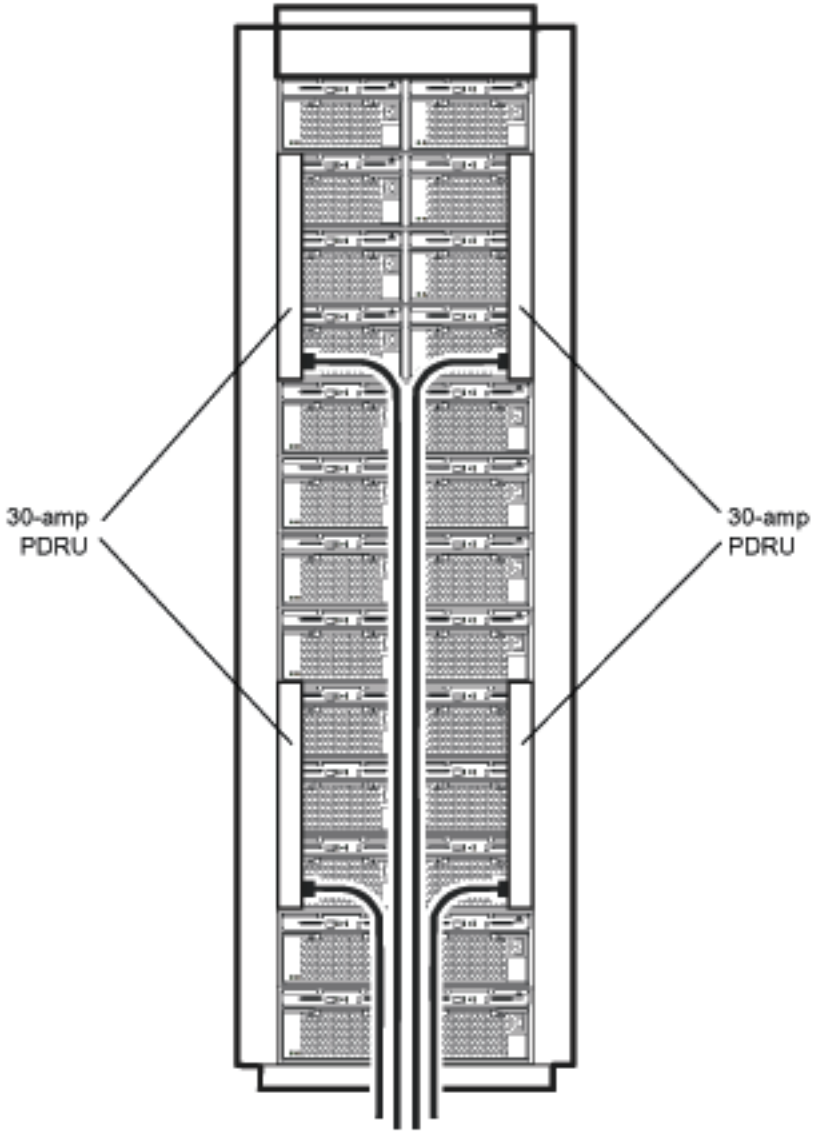


Figure 11. PDRU Placement in a 2.0-Meter Rack



Software Requirements

Ensure that the minimum revisions of HP-UX extension software and online diagnostics are installed. These release packages enable STM and EMS for the disk system.

1. At the host console, enter `swlist | grep XSW` and look for the following extension software according to the installed HP-UX revision:
   - HP-UX 11.00 with HWE 0302 (March 2002 Patch bundles)
   - HP-UX 11.11 with HWE 0302 (March 2002 Patch bundles)
2. Enter `swlist | grep Online` and look for the following online diagnostics according to the installed HP-UX revision:
   - `OnlineDiags B.11.00.20.09`, or greater, on HP-UX 11.00
   - `OnlineDiags B.11.11.06.09`, or greater, on HP-UX 11.11

   If swlist does not report the specified releases, install them from the latest CD-ROM in any of the following products:
   - For HP-UX 11.00:
     - o B3920EA HP-UX OE Media for Servers
     - o B6261AA HP-UX 11.00 Extension Upgrade Media Kit
   - For HP-UX 11.11:
     - o B3920EA HP-UX OE Media for Servers
     - o B6191AA HP 9000 Support Plus Media
     - o B6821AA HP-UX TCOE Media
     - o B6845AA HP-UX 11.11 Minimal Technical OE Media
     - o B7993AA HP-UX Enterprise OE Server Media
     - o B7994AA HP-UX Mission Critical OE Comm. Media

The external IT Resource Center web site is:
http://us-support3.external.hp.com/

Step 1: Gather Tools

Once the electrical, software, and special V-class preparations are complete, collect the tools you need to install the disk system hardware:

- Torx T25 screwdriver
- Torx T15 screwdriver
- Small flat-blade screwdriver

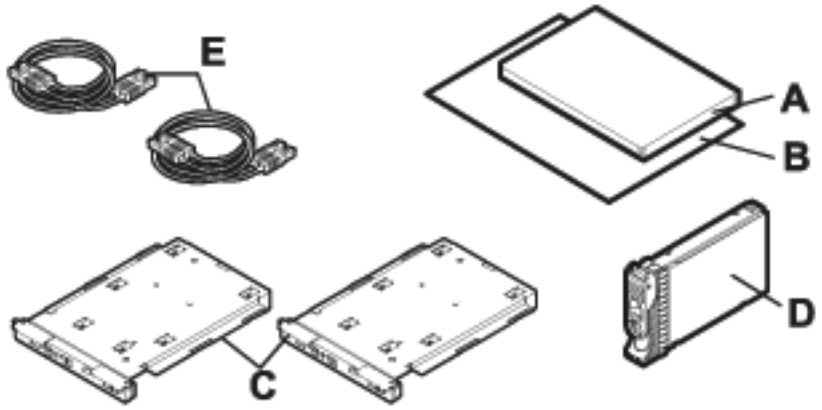
Step 2: Unpack the Product

1 Lift off the overcarton and verify the contents of the accessories (top) box. See Table 5 and Figure 12.

Table 5. Disk System Accessories

Figure Label	Part (part number)
A	User guide (A6250-96010)
B	Quick installation guide (A6490-96003)
C	LCCs (A6255-60001)
D	Disk Modules and/or Filler Panels
E	Fibre Channel cable(s)
–	Rail Kits (not shown)

Figure 12. Disk System Accessories

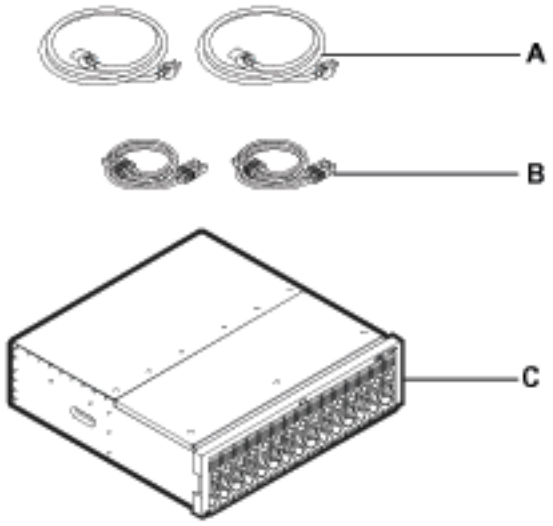


2 Lift off the accessories box and the top of the under box, and verify the contents shown in Table 6 and Figure 13.

Table 6. Disk System Contents

Figure Label	Part (part number)
A	Two power cords (8120-6514)
B	FC Cables (Ordered separately)
C	Disk system chassis with previously installed disk modules, link control cards, and power supply/fan modules

Figure 13. Disk System Contents



3 If a part is missing, contact an HP sales representative.

Step 3: Install the device

Follow the procedures in this section to install your storage device in one of the following rack systems:

- HP Rack System/E
- HP Computer Cabinet
- Rittal-Style Rack

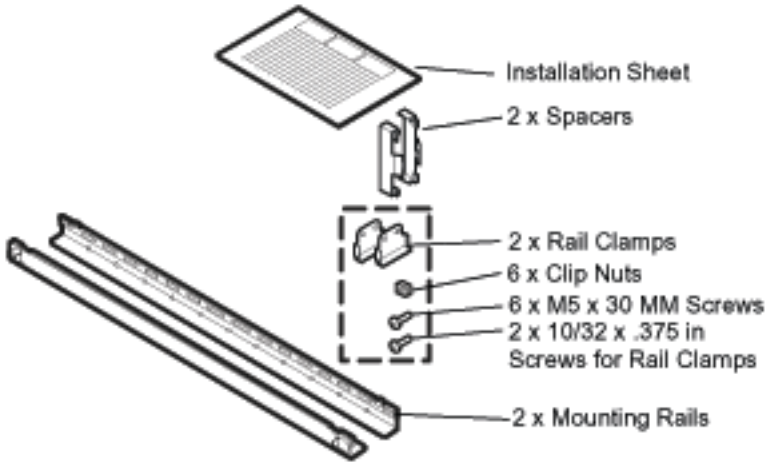
Installing the Storage Device into a Rack System/E

Your storage device can be installed into any of these HP Rack System/E Products:

- A4900A HP Rack System/E25 (1.25 M; 25U)
- A4901A HP Rack System/E33 (1.60 M; 33U)
- A4902A HP Rack System/E41 (2.00 M; 41U)

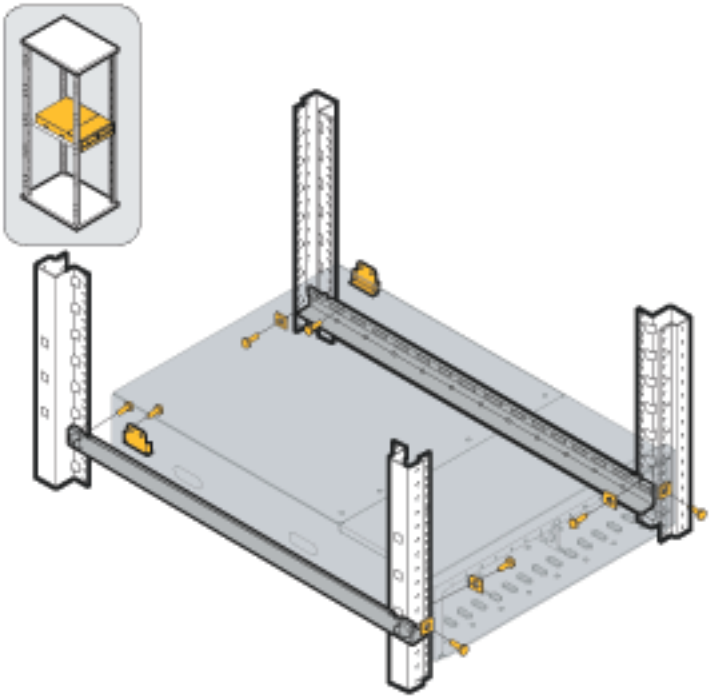
1 Check the rail kit contents (see Figure 14). If any parts are missing, call your nearest HP sales office.

Figure 14. HP Rack System/E Rail Kit Contents



2 Study the installation overview (see Figure 15).

Figure 15. HP Rack System/E Installation Overview



The following tools are required for the installation of the storage device:

- Flat-blade screwdriver
- T25 nut driver

WARNING To ensure cabinet or rack stability, and avoid possible injury, always install the storage devices in the rack or cabinet from the bottom up.

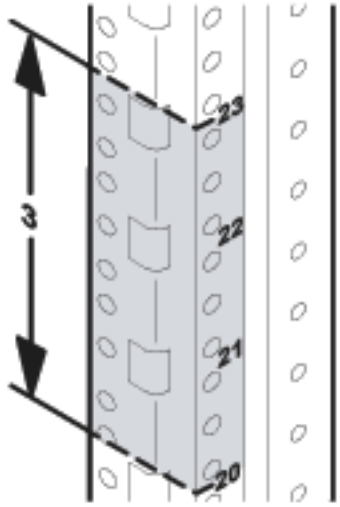
3 Locate a place on the rack columns with the available space required for the installation of the storage device. The storage device and the rail kit require 3 EIA units of space.

Use the following table as a guide for placement of the rails in a Rack System/E where multiple disk systems will be installed. You can rack multiple disk systems without gaps by installing rails every three EIA units. For example, starting at the bottom of a 2-meter rack, set rails at the following unit/hole locations:

Table 7. Rail Positions for Sequential Disk Systems

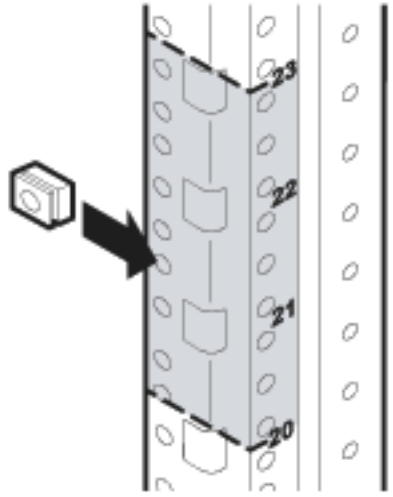
Disk Systems	Hole from Rack Bottom
One	1
Two	4
Three	7
Four	10
Five	13
Six	16
Seven	19
Eight	22
Nine	25
Ten	28
Eleven	31

Figure 16. Locating the site for the device installation in a System/E rack



4 Install clipnuts in all four columns as shown in Figure 17.

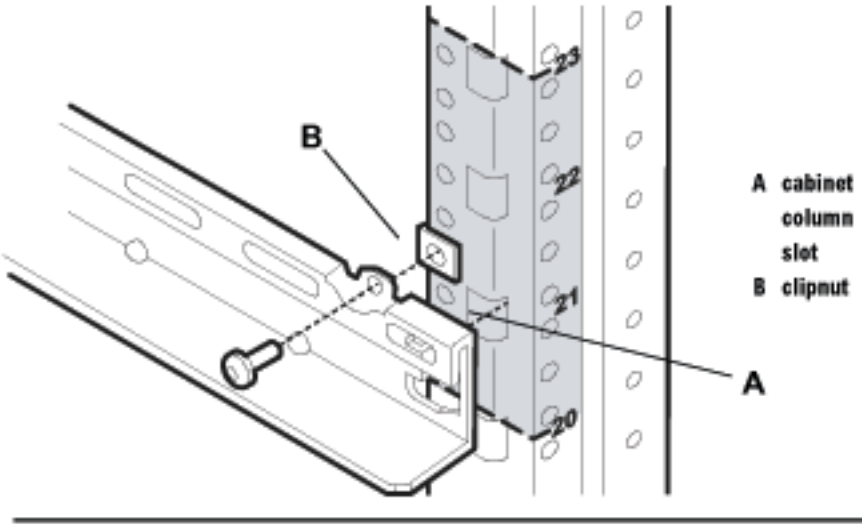
Figure 17. Installing clipnuts for an HP Rack System/E



Note Be sure to use the same tab—upper or lower—on opposing rails. Also, hole patterns vary at opposite ends of the rails.

5 Insert the rail tabs into the appropriate column holes (see A in Figure 18).

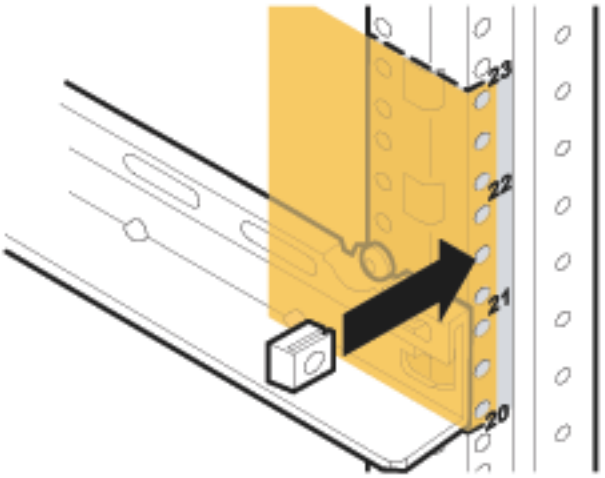
Figure 18. Installing rails in an HP Rack System/E



6 Secure the rail ends with one M5 screw each.

7 Install clipnuts on the front columns of the cabinet (see Figure 19). These are used for the retention bracket screws.

Figure 19. Installing the enclosure clipnut in an HP Rack System/E

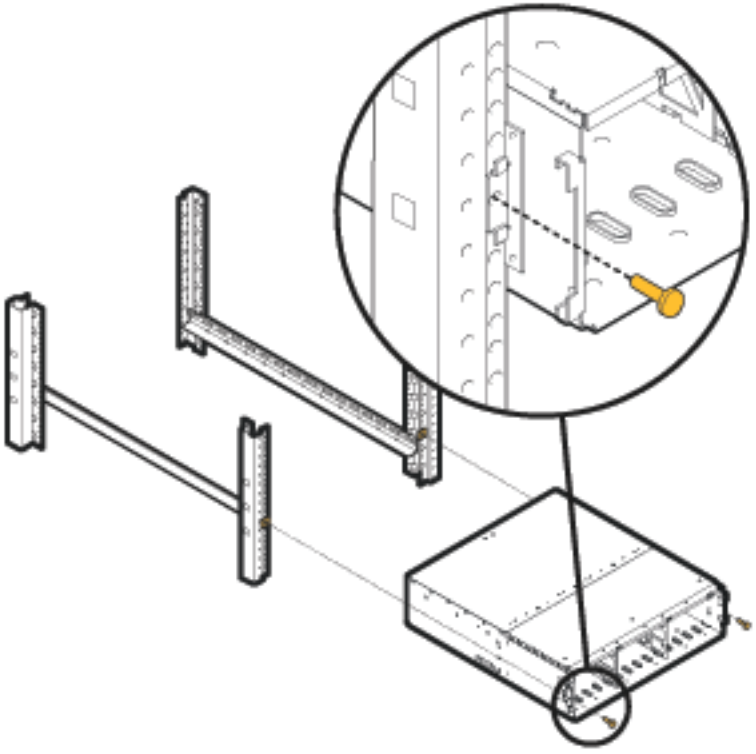


8 Place the storage device on the rails and slide into the cabinet until the retention bracket comes into contact with the rack column (see Figure 20).

WARNING An empty disk system weighs approximately 54 pounds (24.5 kg). To avoid personal injury, it is recommended that two people install the storage device in the rack.

9 Insert and tighten the storage device retention (M5) screws through the retention bracket (see Figure 20).

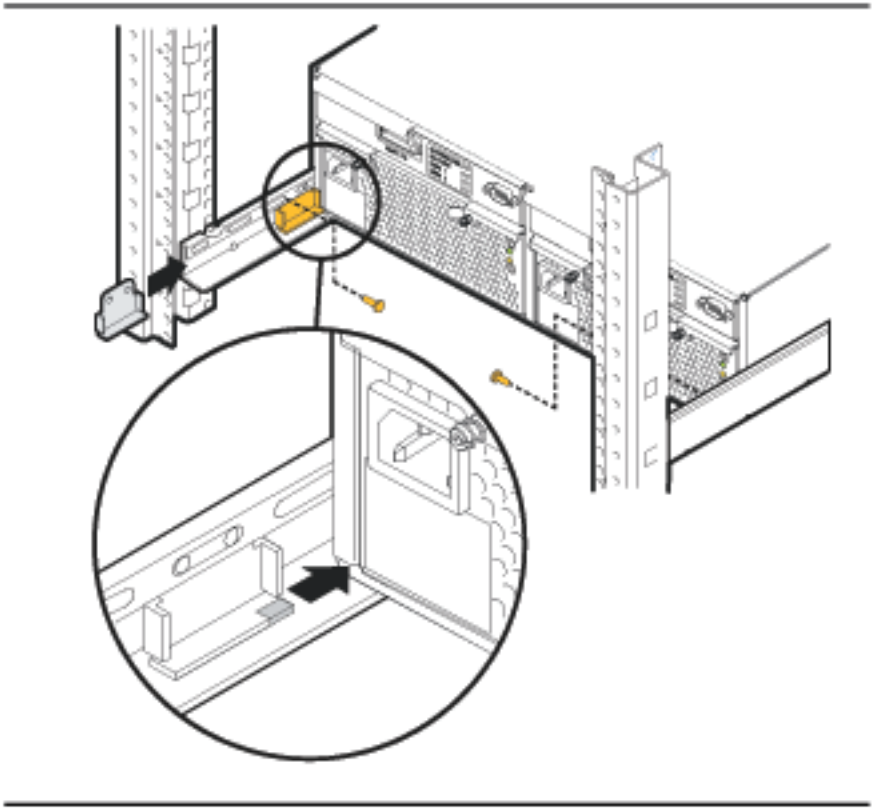
Figure 20. Installing the storage device in the Rack System/E



10 Place a rail clamp on each rail and slide them to each bottom rear corner of the storage device (see Figure 21).

11 Secure the clamps to the rails. Use one 10-32 screw for each rail clamp.

Figure 21. Installing enclosure rail clamps in an HP Rack System/E



Installing the storage device into an HP Computer Cabinet

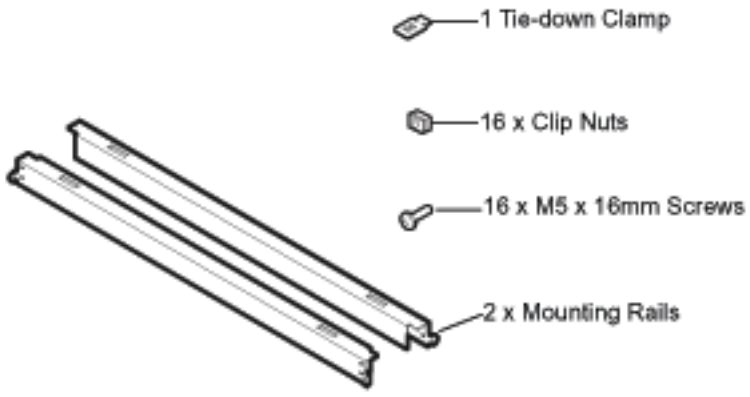
Your storage device can be installed into the following Computer Cabinets:

- C2785A Computer Cabinet (1.10M; 21U)
- C2786A Computer Cabinet (1.60M; 32U)
- C2787A Computer Cabinet (1.96M; 41U)

Caution To ensure proper installation, only use the instructions in this manual for installing the storage device in the HP Computer Cabinet. Do not use the instructions enclosed in the rail kit box.

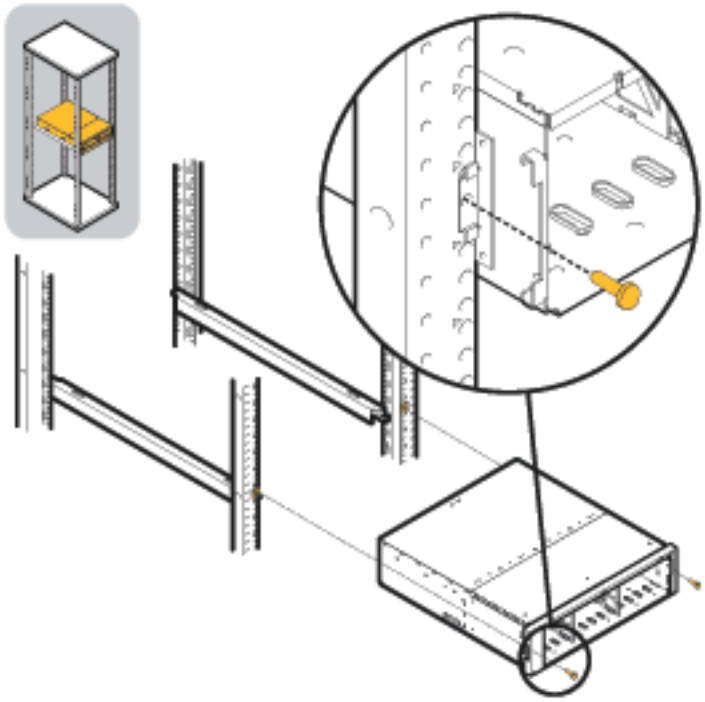
1 Check the rail kit contents (see Figure 22). If any parts are missing, call your nearest HP sales office. The tie-down clamp is not used and may be discarded.

Figure 22. HP Computer Cabinet Rail Kit Contents



2 Study the installation overview (see Figure 23).

Figure 23. HP Computer Cabinet Installation Overview



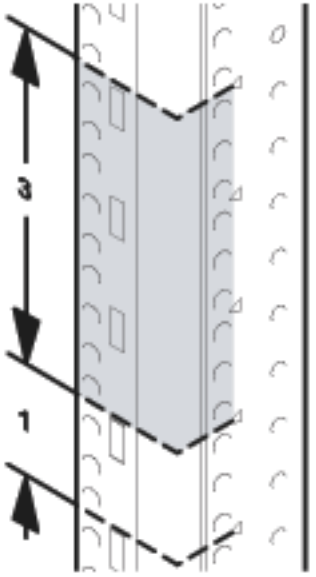
The following tools are required for the installation of the storage device:

- Flat-blade screwdriver
- T25 nut driver

WARNING To ensure cabinet or rack stability and avoid possible injury, always install the storage devices in the rack or cabinet from the bottom up.

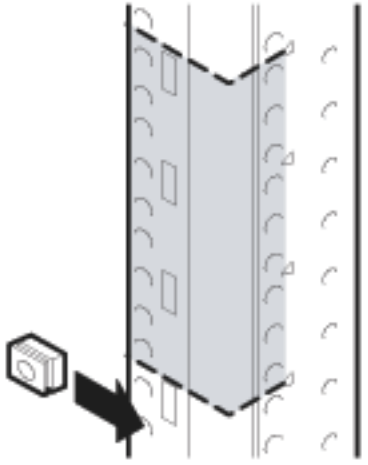
3 Locate a place on the rack columns with the available space required for the installation of the storage device. The storage device and the rail kit require 4 EIA units of space, three units for the storage device and one unit for the rails (see Figure 24).

Figure 24. Locating the site for the device installation in an HP Computer Cabinet



4 Install clipnuts as shown in Figure 25.

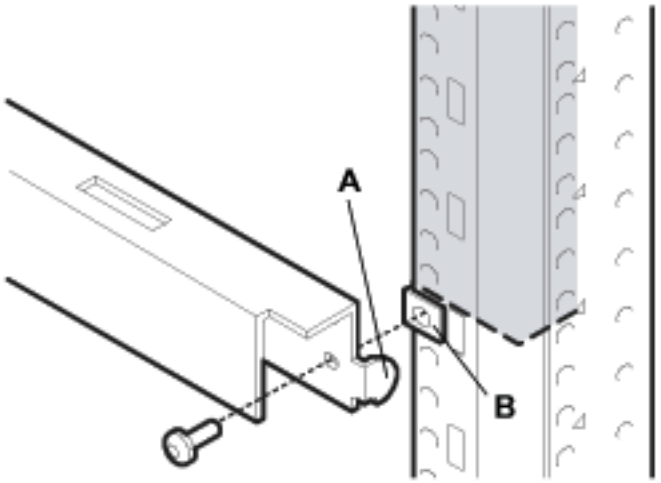
Figure 25. Installing rail clip nuts in the HP Computer Cabinet



5 Insert the rail tabs into the appropriate holes on the HP Computer Cabinet columns (see A in Figure 26).

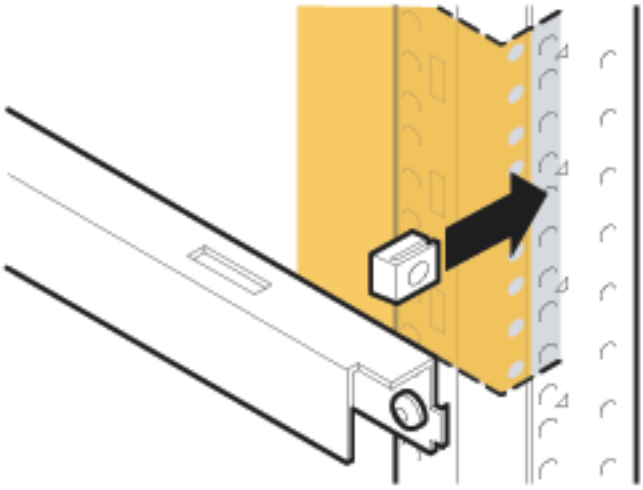
6 Secure the rail ends with one M5 screw each.

Figure 26. Installing rails in the HP Computer Cabinet



7 Install clipnuts on the front columns of the cabinet (see Figure 27). These are used for the device retention screws.

Figure 27. Installing enclosure retention clipnuts in an HP Computer Cabinet

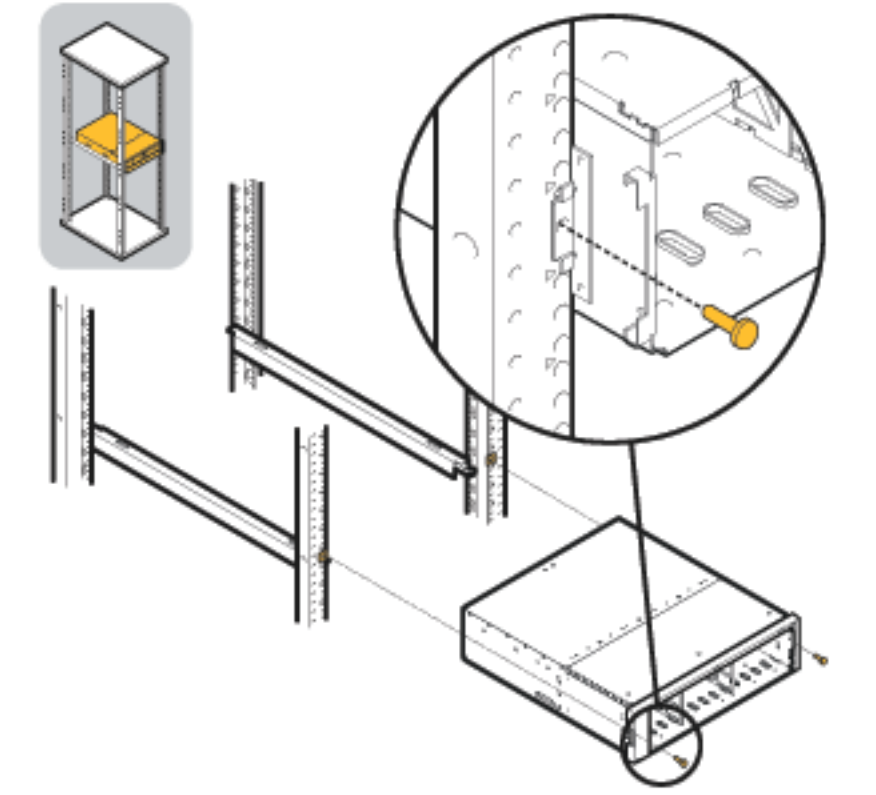


8 Place the storage device on the rails and slide it into the cabinet until the retention bracket comes in contact with the rack column (see Figure 28).

WARNING An empty disk system weighs approximately 54 pounds (24.5 kg). To avoid personal injury, it is recommended that two people install the storage device in the rack.

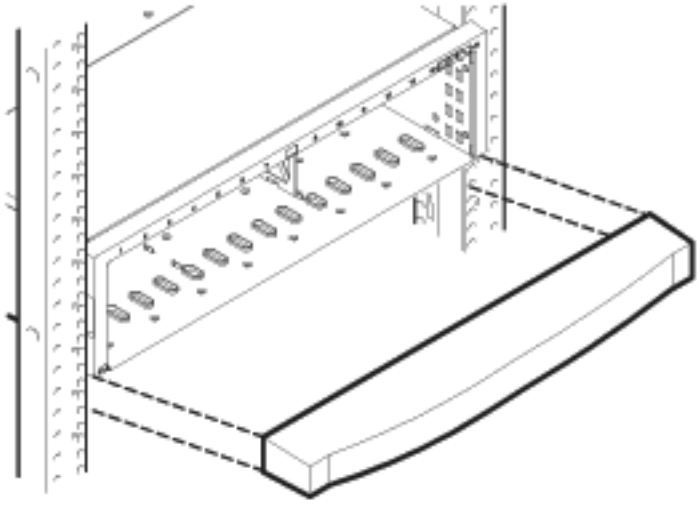
9 Tighten the storage device retention (M5) screws through the retention bracket (see Figure 28).

Figure 28. Installing the storage device in an HP Computer Cabinet



10 Install a filler panel in the space below the storage device.

Figure 29. Installing a filler panel in an HP Computer Cabinet

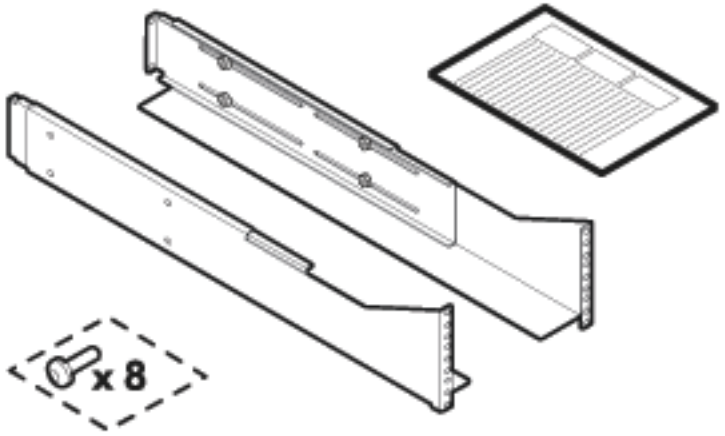


Installing the Storage Device into a Rittal-Style Rack

Your storage device can be installed into the Rittal-Style Rack by doing the following steps:

1 Inspect the contents of the rail kit. If any parts are missing, call your nearest HP sales office (see Figure 30).

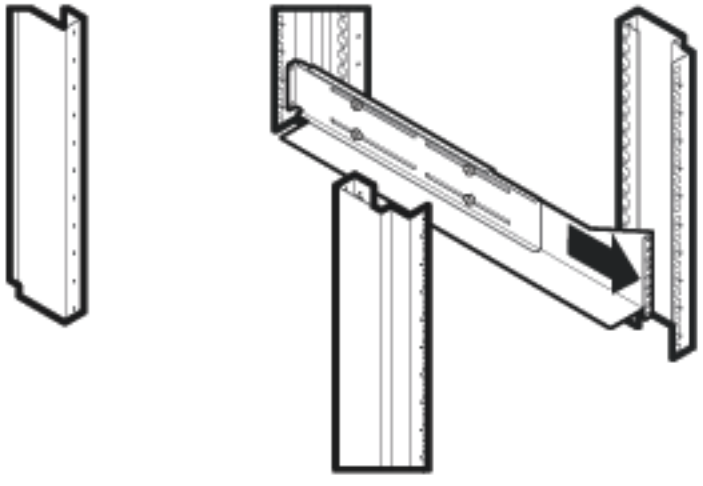
Figure 30. Rittal-Style Rail Kit Contents



2 Align the front of rails to the inside of the front cabinet column.

Carefully observe the alignment of the groups of holes on the columns so the holes in the rails align properly (see Figure 31).

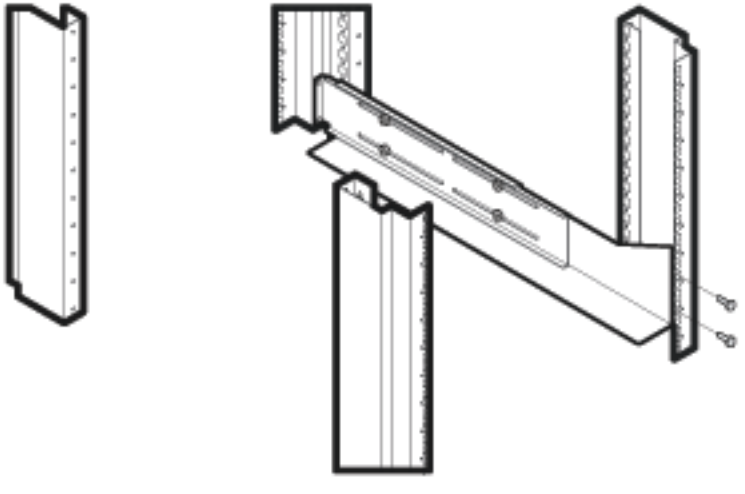
Figure 31. Rail Alignment



3 Insert and finger tighten the rail mounting screws.

Use the third and seventh holes (from the top of rail) to mount the rail to the front column of the cabinet (see Figure 32).

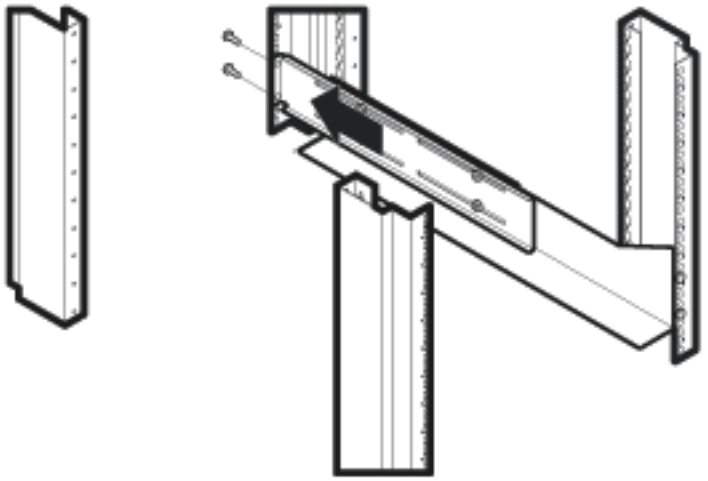
Figure 32. Front Screw Installation



4 Extend the adjustable slide to the back column of the cabinet.

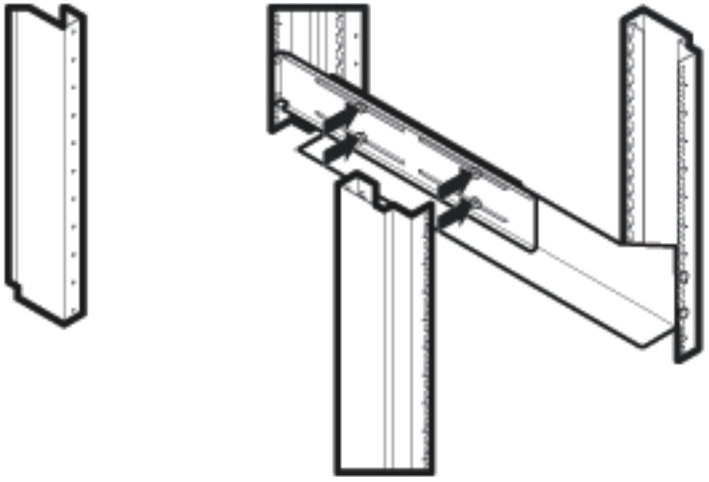
5 Insert the mounting screws and finger tighten them through the rear column of the cabinet (see Figure 33).

Figure 33. Rear Slide Extension



6 Tighten the center nuts to finger tightness (see Figure 34).

Figure 34. Center Nut Tightening



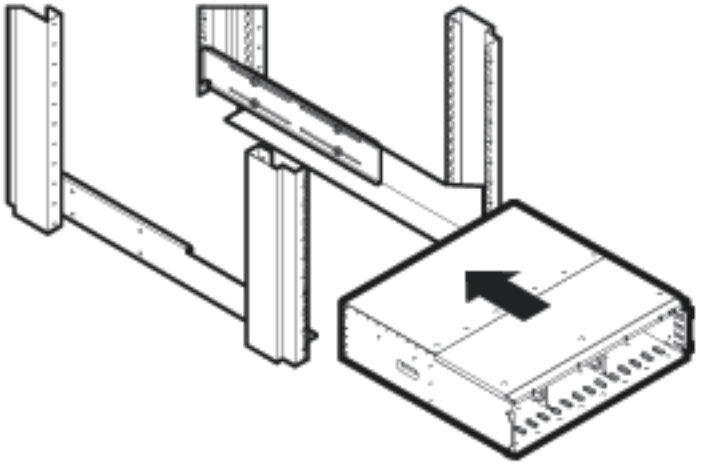
7 Tighten all screws to their final tightness using a driver.

Tighten the screws that hold the rail to the columns first, *before* tightening the center slide nuts to their final tightness.

8 Repeat the procedure above for the other rail.

9 Insert the disk system (with disk modules and power supplies removed) onto the rails (see Figure 35).

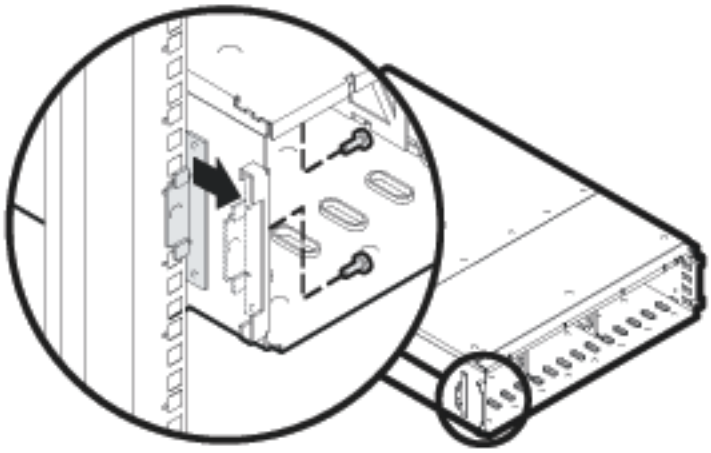
Figure 35. Installing a Disk System into the Rittal-Style Rack



10 Move the disk system retention brackets to the frontmost set of mounting holes.

This allows the disk system to install further back into the cabinet; and allows the cabinet doors (if present) to close properly (see Figure 36).

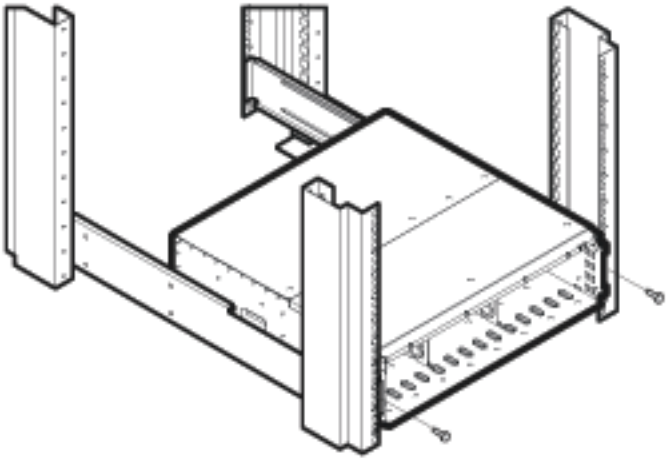
Figure 36. Moving a Disk System Retention Bracket



11 Push the disk system back into the rack until the disk system retaining bracket is flush against the front column of the rack.

12 Bolt the disk system to the front column. Use the fifth hole from the top of the front of the rail (see Figure 37).

Figure 37. Bolting the Disk System to the Front Column of the Rack



Install the Disk System

1. Remove the power supply/fan modules to prepare the disk system for lifting:
   a. Loosen the screws in the extractor handles of each power supply/fan module with the chassis still in the box.
   b. Pull the extractor handles out from the center of the power supply to disengage it from the midplane. Pull each power supply/fan module out of the chassis. Support the far end of the power supply/fan module with your free hand as it clears the chassis.
   c. Set the power supply/fan modules aside, on an antistatic pad, to be reinstalled later.

WARNING An empty disk system weighs approximately 54 pounds (24.5 kg). To avoid personal injury, it is recommended that two people install the storage device in the rack.

2. Remove the disk modules from the disk system. Place them aside on the pink antistatic foam pad supplied with your disk system.
3. Carry the disk system to the front of the rack and slide the back end onto the rails (Figure 35) with the help of another person or using a lifting device. Push the disk system into the rack as far as it will go.

Step 4: Configure LCCs

The disk system comes with two LCCs installed.

If you are connecting this disk system to an HP StorageWorks Virtual Array 7400 or to a 1 Gb/s hub, the link speed switch must be set to 1 Gb/s.

1 Attach your ESD strap to ground.

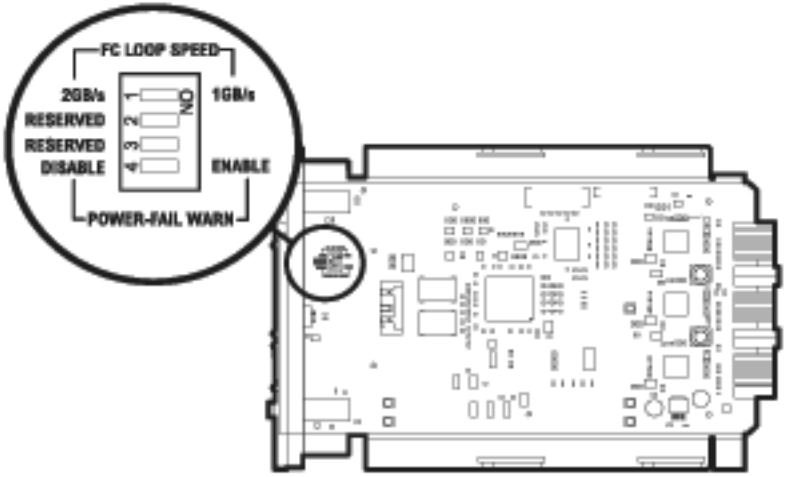
2 Remove the LCC from the disk system chassis.

Caution Do not touch the pins on the back of the LCC.

3 Set internal configuration dip switch to appropriate link speed.

Be sure to set the internal LCC data transmission speed switch to 1 Gb/s or 2 Gb/s as appropriate for your configuration. See Figure 2.29 for more detailed information.

Figure 38. LCC Internal Configuration Switch



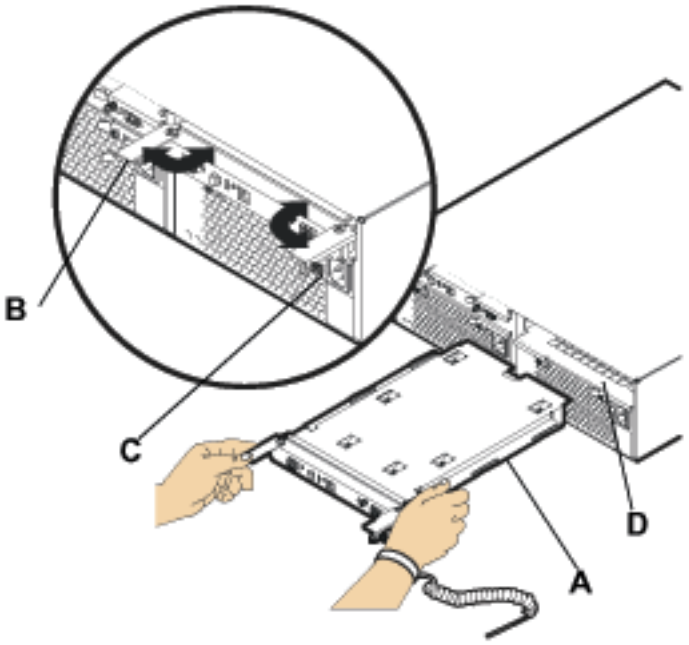
4 Open the LCC cam latches (B in Figure 39) by pulling them away from the center.

5 Align the LCC with the slot (D in Figure 39), and insert the LCC into the slot at the back of the disk system. Stop pushing when the LCC meets the midplane.

6 Press the cam latches inward and flat against the center. The cam action draws the LCC completely into the slot and seats the connector pins on the midplane.

7 Tighten the locking thumbscrews (C).

Figure 39. LCC Installation



A LCC
B cam latch
C locking screw
D LCC slot

8 Repeat steps 2 through 7, installing the second LCC in the remaining empty slot.

Step 5: Set LCC Switches

1 Set the FC address switches on the disk system.

Front-end fiber-optic cable connections depend on the type of connectors used by the controller and the type of HBA to which the controller is connected. The Virtual Array products use integrated LC (small form factor) connectors. They support HBAs with either SC (large form factor) or LC connectors. See Figure 40 through Figure 45.

Figure 40. Fiber Optic Cabling and Address Switch Settings with 1 Disk System

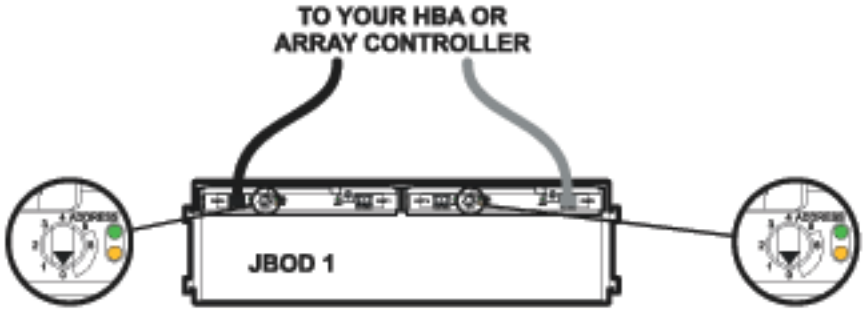


Figure 41. Fiber Optic Cabling and Address Switch Settings with 2 Disk Systems

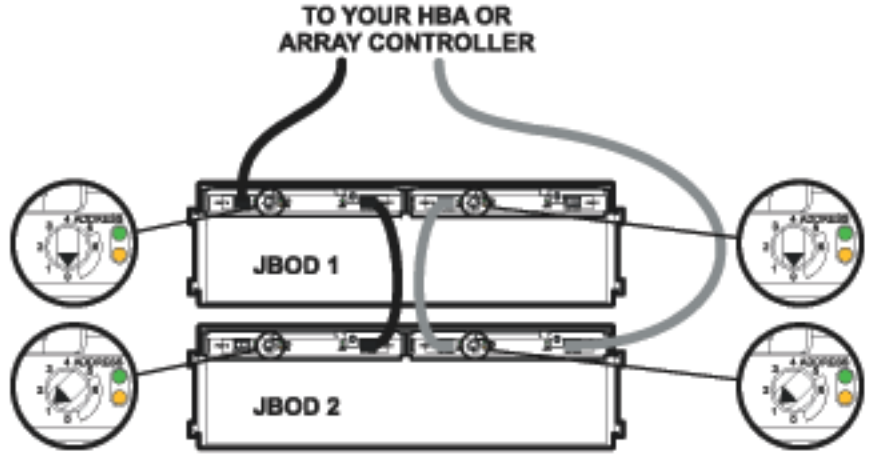


Figure 42. Fiber Optic Cabling and Address Switch Settings with 3 Disk Systems

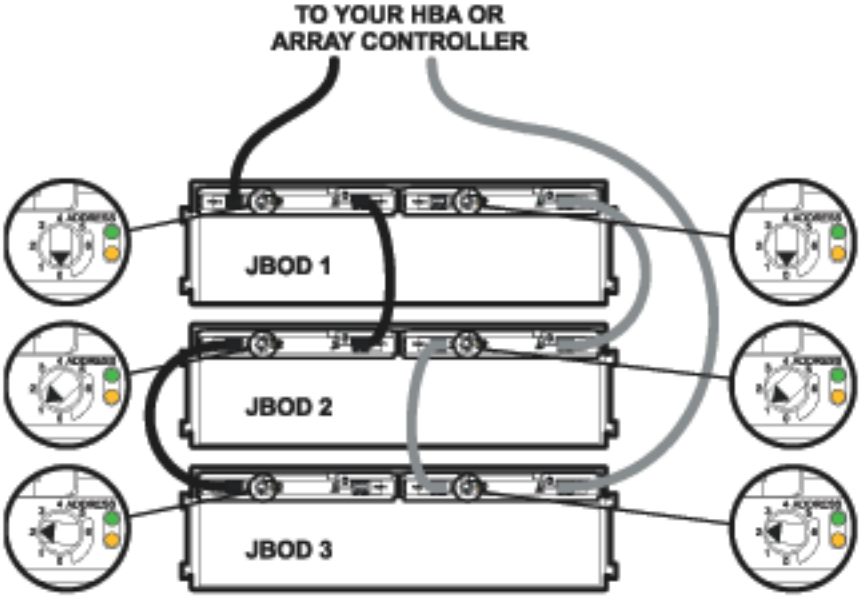


Figure 43. Fiber Optic Cabling and Address Switch Settings with 4 Disk Systems

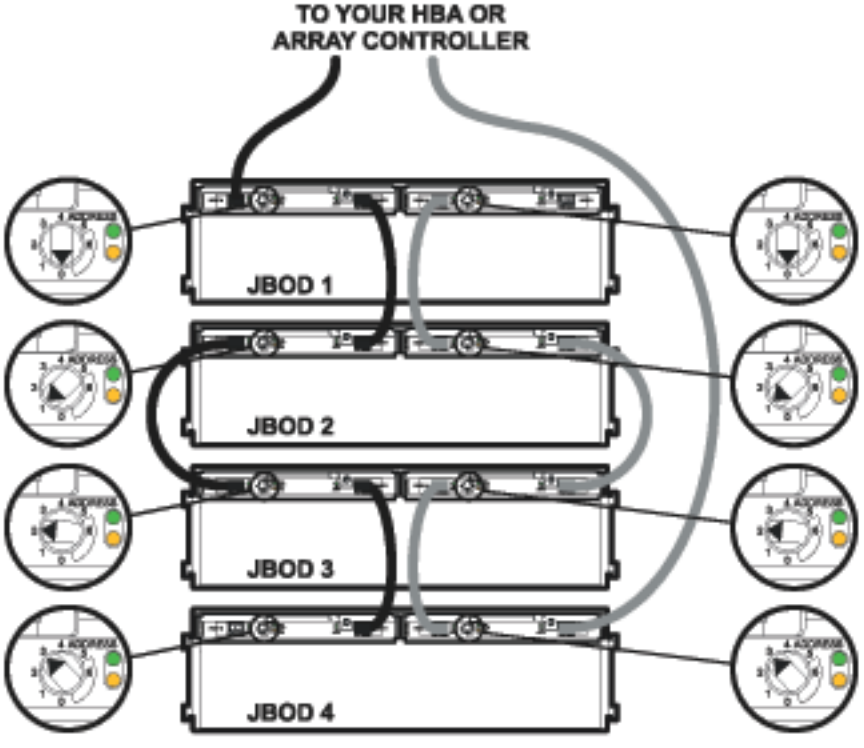


Figure 44. Fiber Optic Cabling and Address Switch Settings with 5 Disk Systems

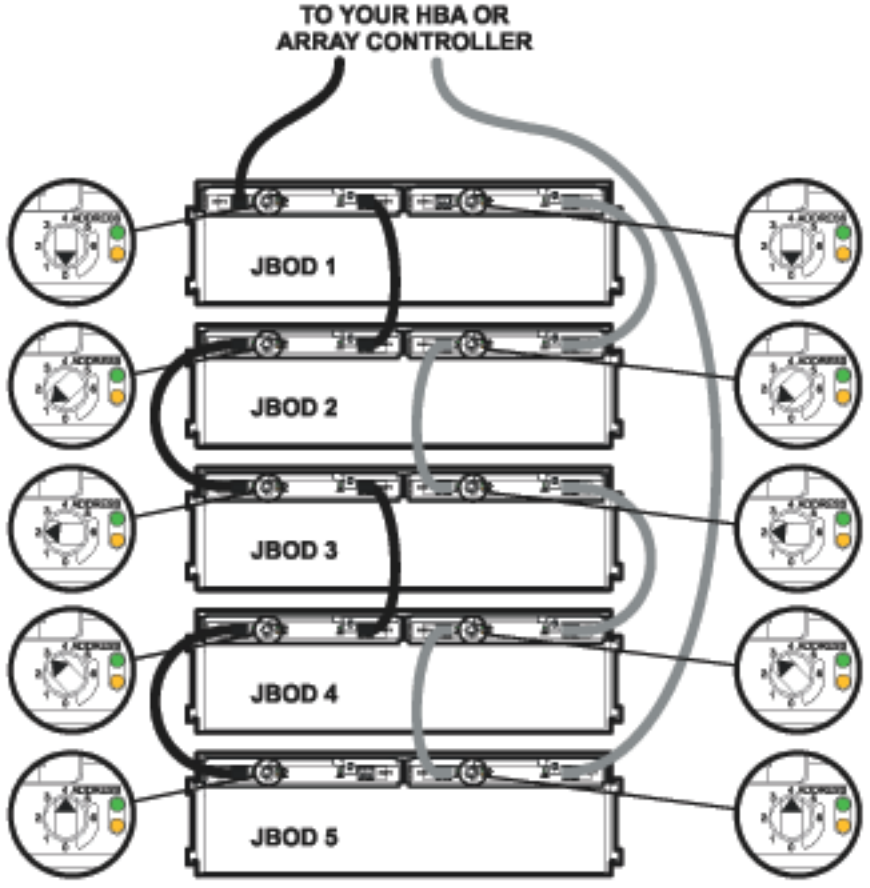
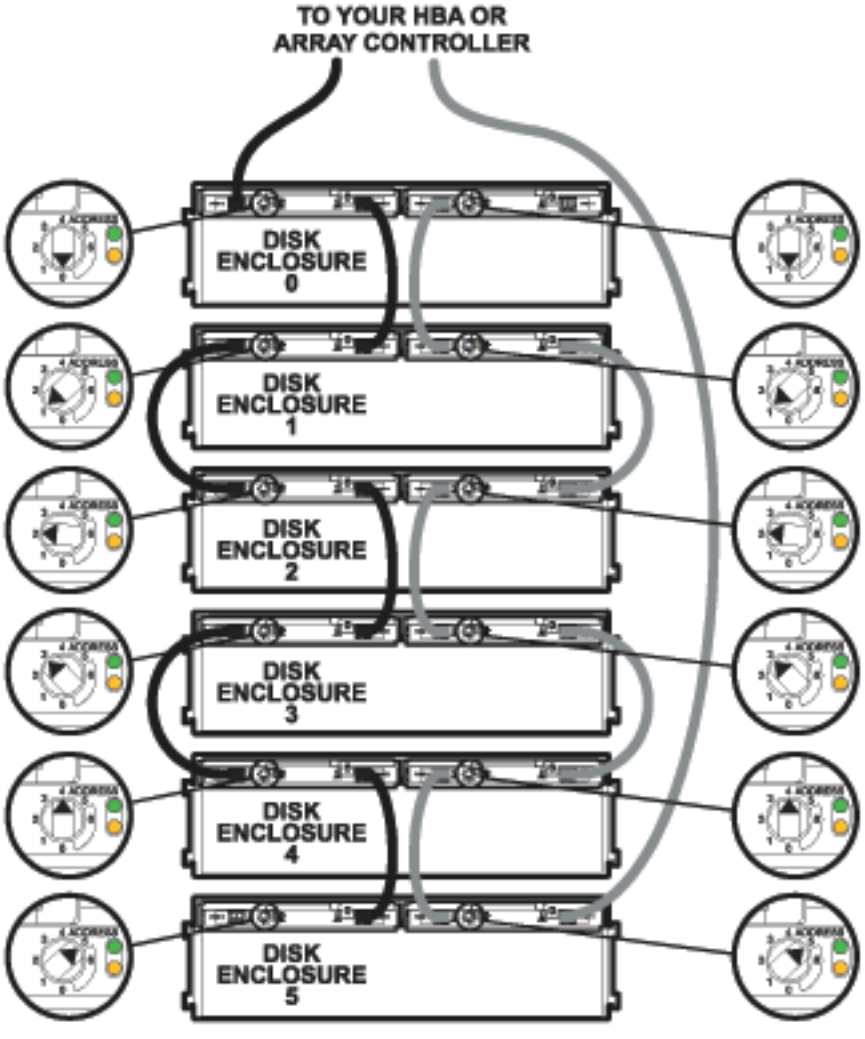


Figure 45. Fiber Optic Cabling and Address Switch Settings with 6 Disk Systems



Step 6: Connect FC and Power Cables

1. Connect the front-end fiber-optic cables.

   Front-end fiber-optic cable connections depend on the type of connectors used by the controller and the type of HBA to which the controller is connected. The Virtual Array Products use integrated LC (small form factor) connectors. They support HBAs with either SC (large form factor) or LC connectors. See Figure 40 through Figure 45.

2. Connect power cords to the power receptacle on the power supply/fan module(s).
3. Attach the other end of each power cord to a preinstalled PDU/PDRU. Choose outlets according to the following guidelines:

   — Redundancy. To extend the redundancy of the product, attach each cord to a different PDU. This is represented in Figure 46 and Figure 47.

   — Reliability. To avoid cascading faults for a group of disk systems that are plugged into the same PDU, distribute redundant power cords to as many different combinations of PDUs as possible. See Figure 46 and Figure 47. Cascading faults occur when a backup PDU is overloaded with power surges after the primary PDU fails.

   — Serviceability. Choose PDU locations that prevent power cords from interfering with the removal and replacement of serviceable components. Also leave a 6-inch service loop to allow for the rotation of PDRUs.

The letters in Figures 46 and 47 represent independent PDUs or PDU banks. The absence of duplicate letters in individual disk systems indicates the products are using redundant PDUs. The minimal number of duplicate letter pairs indicates the disk systems are protected against cascading faults.

Figure 46. Wiring Scheme for 1.6-Meter Rack

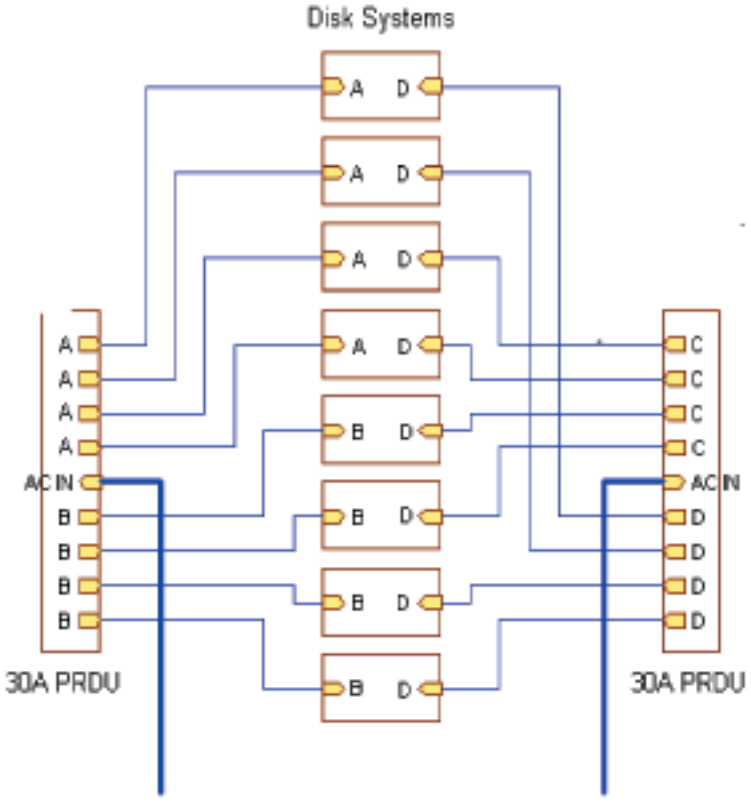
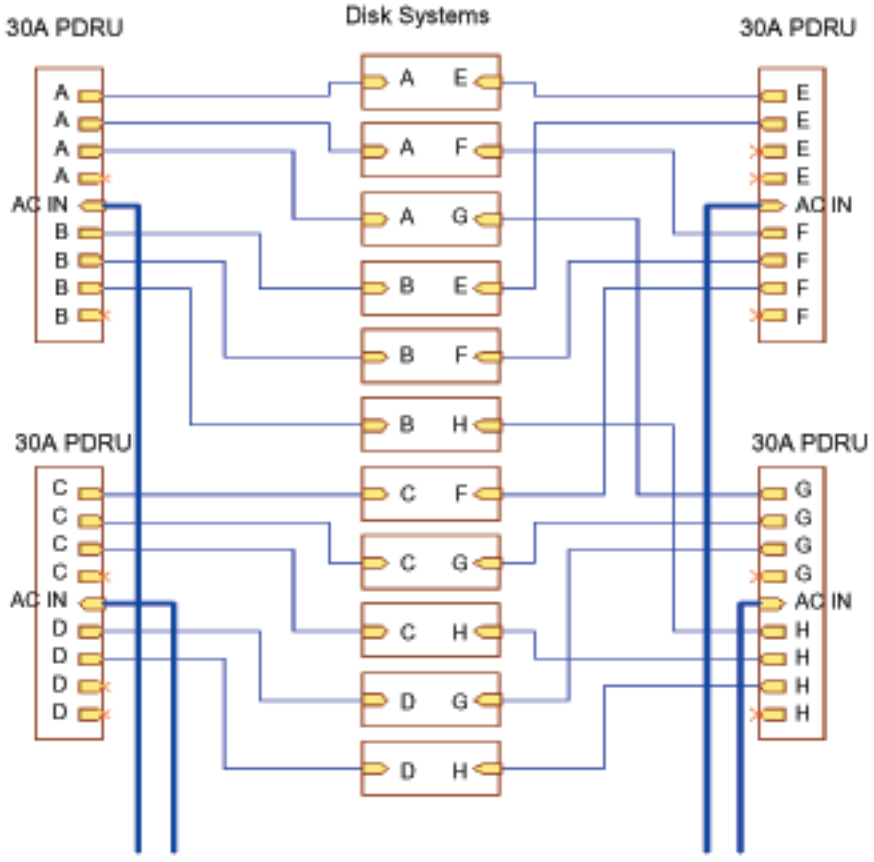


Figure 47. Wiring Scheme for 2.0-Meter Rack

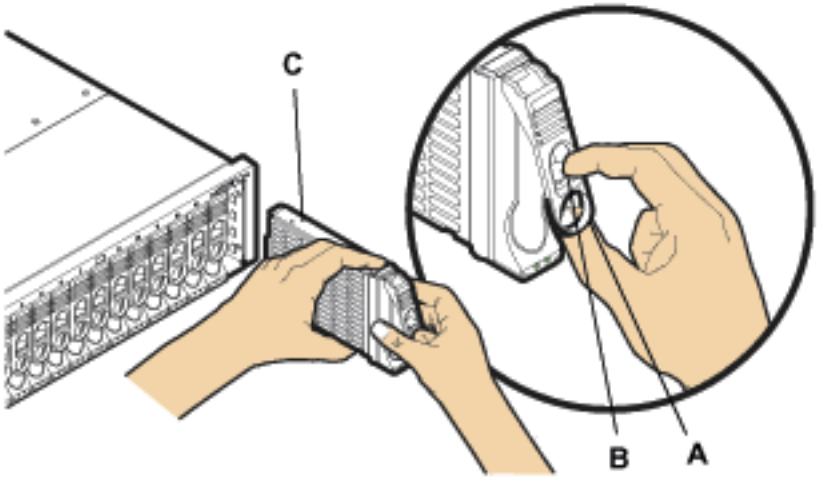


Step 7: Install Disk Modules

Caution Touching exposed areas on the disk can cause electrical discharge and disable the disk. Be sure you are grounded and be careful not to touch exposed circuits.

Disk modules are fragile and ESD sensitive. Dropping one end of the disk just two inches is enough to cause permanent damage. In addition, static electricity can destroy the magnetic properties of recording surfaces. Grip disks only by their handles (A in Figure 48) and carriers (C), and follow strict ESD procedures.

Figure 48. Disk Module Installation



A disk handle
B cam latch
C disk carrier

1 Determine which slots, 1 through 15, will contain disk modules and which will contain fillers.

   At least two slots must contain disk modules.

2 Put on the ESD strap and attach the other end of the strap appropriately.

Caution Disk modules are fragile. Handle carefully. Be careful to grasp the disk module by its handle and avoid touching exposed circuitry.

3 Remove a disk module from the disk pack and its ESD bag.

4 Open the disk module cam latch (C) by pulling the tab toward you.

5 Push the disk module as far as it will go into the selected slot.

6 Close the cam latch by pushing the latch toward the disk until it clicks. The cam action draws the disk module completely into the slot and seats the connecting pins on the midplane.

7 Repeat steps 4 through 6 to install additional disk modules.

8 Install disk fillers in the remaining slots.

Caution Every slot must contain either a disk module or filler.

Step 8: Turn on the Disk System

Caution When starting up the disk system, do not override automatic spin-up of the drives. Doing so could cause an overcurrent fault, requiring a power cycle to recover.

Press in the power/standby switch with the retracted tip of a pen or pencil to power-on the disk system (see Figure 49). Allow 2 minutes for the disk drives and controllers to complete their self-tests.

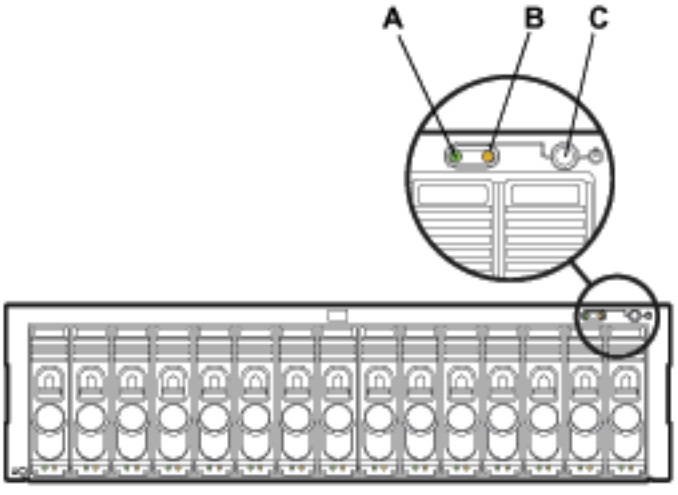
1 Press the power/standby switch (C in Figure 49) to turn on the disk system.

2 Watch the system LEDs for confirmation that the disk system is operational. The system power LED (A) should be green, and the fault LED (B) should be off.

   If the LEDs indicate a problem, refer to chapter 4, Troubleshooting.

Note An amber light that is on briefly when a component turns on is normal. If this light remains on more than a couple seconds, a fault has been detected.

Figure 49. Power/Standby Switch and System LEDs



A system power LED
B system fault LED
C power/standby switch

Step 9: Verify Devices on the Host

On the host system run IOSCAN (ioscan -f) and verify that the disks and LCC(s) are listed in IOSCAN output. If the displayed “S/W State” is not “claimed,” begin troubleshooting (see chapter 4).

Sample IOSCAN

Each LCC (`ctl`) or disk appears as a separate target in IOSCAN output.

```
Class     I   H/W Path              Driver    S/W State   H/W Type   Description
================================================================================================
fc        0   0/4/0/0               fcT1      CLAIMED   INTERFACE  HP Fibre Channel Mass Storage
                                                                    Adapter
lan       1   0/4/0/0.5             fcT1_cntl CLAIMED   INTERFACE  HP Fibre Channel Mass Storage
                                                                    Cntl
fcp       0   0/4/0/0.8             fcp       CLAIMED   INTERFACE  FCP Protocol Adapter
ba        4   0/5                   lba       CLAIMED   BUS_NEXUS  Local PCI Bus Adapter (782)
lan       2   0/5/0/0               btlan5    CLAIMED   INTERFACE  PCI Ethernet (10110019)
ba        5   0/8                   lba       CLAIMED   BUS_NEXUS  Local PCI Bus Adapter (782)
fc        4   0/8/0/0               td        CLAIMED   INTERFACE  HP Tachyon TL/TS Fibre Channel
                                                                    Mass Storage Adapter
fcp       4   0/8/0/0.8             fcp       CLAIMED   INTERFACE  FCP Protocol Adapter
ext_bus  10   0/8/0/0.8.0.255.0      fcpdev    CLAIMED   INTERFACE  FCP Device Interface
target    5   0/8/0/0.8.0.255.0.0    tgt       CLAIMED   DEVICE
disk    140   0/8/0/0.8.0.255.0.0.0  sdisk     CLAIMED   DEVICE     HP 18.2GST318451FC
target    6   0/8/0/0.8.0.255.0.1    tgt       CLAIMED   DEVICE
disk    141   0/8/0/0.8.0.255.0.1.0  sdisk     CLAIMED   DEVICE     HP 18.2GST318451FC
target    7   0/8/0/0.8.0.255.0.2    tgt       CLAIMED   DEVICE
disk     64   0/8/0/0.8.0.255.0.2.0  sdisk     CLAIMED   DEVICE     HP 18.2GST318451FC
target    8   0/8/0/0.8.0.255.0.3    tgt       CLAIMED   DEVICE
disk     65   0/8/0/0.8.0.255.0.3.0  sdisk     CLAIMED   DEVICE     HP 18.2GST318451FC
target    9   0/8/0/0.8.0.255.0.4    tgt       CLAIMED   DEVICE
disk    142   0/8/0/0.8.0.255.0.4.0  sdisk     CLAIMED   DEVICE     HP 36.4GST336704FC
target   10   0/8/0/0.8.0.255.0.5    tgt       CLAIMED   DEVICE
disk    143   0/8/0/0.8.0.255.0.5.0  sdisk     CLAIMED   DEVICE     HP 36.4GST336704FC
target   11   0/8/0/0.8.0.255.0.6    tgt       CLAIMED   DEVICE
disk    144   0/8/0/0.8.0.255.0.6.0  sdisk     CLAIMED   DEVICE     HP 36.4GST336704FC
target   12   0/8/0/0.8.0.255.0.7    tgt       CLAIMED   DEVICE
```

```
disk    145   0/8/0/0.8.0.255.0.7.0  sdisk     CLAIMED   DEVICE     HP 36.4GST336704FC
target   13   0/8/0/0.8.0.255.0.8    tgt       CLAIMED   DEVICE
disk    146   0/8/0/0.8.0.255.0.8.0  sdisk     CLAIMED   DEVICE     HP 36.4GST336704FC
```

The “descriptions” in this example represent some of the valid disk modules. Valid disk descriptions include:

- ST336704FC36-Gbyte 10K rpm FC disk module ST336605FC
- ST373405FC73-Gbyte 10K rpm FC disk module
- ST318451FC18-Gbyte 15K rpm FC disk module ST318452FC
- ST336752FC36-Gbyte 15K rpm FC disk module

Where do you go from here?

For operating system and application configuration information, refer to the documentation for your particular server’s operating system.

Configuration

3

Viewing a Disk System in IOSCAN

An IOSCAN (example below) shows each LCC (0/8/0/0.8) and disk in the system.

Sample IOSCAN

Type the command: `ioscan -fn`

```
Class     I    H/W Path            Driver         S/W State   H/W Type      Description
=============================================================================================
fcp         4  0/8/0/0.8               fcp       CLAIMED     INTERFACE    FCP Protocol Adapter
ext_bus    10  0/8/0/0.8.0.255.0       fcpdev    CLAIMED     INTERFACE    FCP Device Interface
target      5  0/8/0/0.8.0.255.0.0     tgt       CLAIMED     DEVICE
disk      140  0/8/0/0.8.0.255.0.0.0   sdisk     CLAIMED     DEVICE       HP 18.2GST318451FC
                                      /dev/dsk/c10t0d0   /dev/rdsk/c10t0d0
target      6  0/8/0/0.8.0.255.0.1     tgt       CLAIMED     DEVICE
disk      141  0/8/0/0.8.0.255.0.1.0   sdisk     CLAIMED     DEVICE       HP 18.2GST318451FC
                                      /dev/dsk/c10t1d0   /dev/rdsk/c10t1d0
target      7  0/8/0/0.8.0.255.0.2     tgt       CLAIMED     DEVICE
disk       64  0/8/0/0.8.0.255.0.2.0   sdisk     CLAIMED     DEVICE       HP 18.2GST318451FC
                                      /dev/dsk/c10t2d0   /dev/rdsk/c10t2d0
target      8  0/8/0/0.8.0.255.0.3     tgt       CLAIMED     DEVICE
disk       65  0/8/0/0.8.0.255.0.3.0   sdisk     CLAIMED     DEVICE       HP 18.2GST318451FC
                                      /dev/dsk/c10t3d0   /dev/rdsk/c10t3d0
target      9  0/8/0/0.8.0.255.0.4     tgt       CLAIMED     DEVICE
disk      142  0/8/0/0.8.0.255.0.4.0   sdisk     CLAIMED     DEVICE       HP 36.4GST336704FC
                                      /dev/dsk/c10t4d0   /dev/rdsk/c10t4d0
target     10  0/8/0/0.8.0.255.0.5     tgt       CLAIMED     DEVICE
disk      143  0/8/0/0.8.0.255.0.5.0   sdisk     CLAIMED     DEVICE       HP 36.4GST336704FC
```

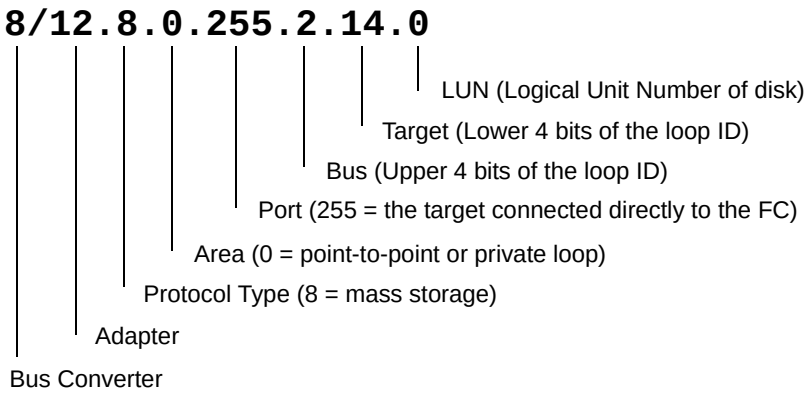
```
                                  /dev/dsk/c10t5d0   /dev/rdsk/c10t5d0
target     11  0/8/0/0.8.0.255.0.6      tgt       CLAIMED     DEVICE
disk      144  0/8/0/0.8.0.255.0.6.0    sdisk     CLAIMED     DEVICE       HP 36.4GST336704FC
                                  /dev/dsk/c10t6d0   /dev/rdsk/c10t6d0
target     12  0/8/0/0.8.0.255.0.7      tgt       CLAIMED     DEVICE
disk      145  0/8/0/0.8.0.255.0.7.0    sdisk     CLAIMED     DEVICE       HP 36.4GST336704FC
                                  /dev/dsk/c10t7d0   /dev/rdsk/c10t7d0
target     13  0/8/0/0.8.0.255.0.8      tgt       CLAIMED     DEVICE
disk      146  0/8/0/0.8.0.255.0.8.0    sdisk     CLAIMED     DEVICE       HP 36.4GST336704FC
                                  /dev/dsk/c10t8d0   /dev/rdsk/c10t8d0
target     14  0/8/0/0.8.0.255.0.9      tgt       CLAIMED     DEVICE
disk      147  0/8/0/0.8.0.255.0.9.0    sdisk     CLAIMED     DEVICE       HP 36.4GST336704FC
                                  /dev/dsk/c10t9d0   /dev/rdsk/c10t9d0
target     15  0/8/0/0.8.0.255.0.10     tgt       CLAIMED     DEVICE
disk      148  0/8/0/0.8.0.255.0.10.0   sdisk     CLAIMED     DEVICE       HP 36.4GST336704FC
                                  /dev/dsk/c10t10d0   /dev/rdsk/c10t10d0
target     16  0/8/0/0.8.0.255.0.11     tgt       CLAIMED     DEVICE
disk      149  0/8/0/0.8.0.255.0.11.0   sdisk     CLAIMED     DEVICE       HP 36.4GST336704FC
                                  /dev/dsk/c10t11d0   /dev/rdsk/c10t11d0
target     17  0/8/0/0.8.0.255.0.12     tgt       CLAIMED     DEVICE
disk      150  0/8/0/0.8.0.255.0.12.0   sdisk     CLAIMED     DEVICE       HP 36.4GST336704FC
                                  /dev/dsk/c10t12d0   /dev/rdsk/c10t12d0
target     18  0/8/0/0.8.0.255.0.13     tgt       CLAIMED     DEVICE
disk      151  0/8/0/0.8.0.255.0.13.0   sdisk     CLAIMED     DEVICE       HP 36.4GST336704FC
                                  /dev/dsk/c10t13d0   /dev/rdsk/c10t13d0
target     19  0/8/0/0.8.0.255.0.14     tgt       CLAIMED     DEVICE
disk      185  0/8/0/0.8.0.255.0.14.0   sdisk     CLAIMED     DEVICE       HP 36.4GST336704FC
                                  /dev/dsk/c10t14d0   /dev/rdsk/c10t14d0
target     20  0/8/0/0.8.0.255.0.15     tgt       CLAIMED     DEVICE
ctl         7  0/8/0/0.8.0.255.0.15.0   sctl      CLAIMED     DEVICE       HP      A6255A
                                  /dev/rscsi/c10t15d0
```

The disks shown in the previous sample ioscan -fn are the ST318451FC (used in the A6191A disk module) and the ST336704FC (used in the A6192A disk module). The full descriptions of the supported disk modules are:

- ST336605FC 36 Gbyte 10K rpm disk FC disk module (A6192A) ST336704FC
- ST373405FC 73 Gbyte 10K rpm disk FC disk module (A6194A)
- ST318451FC 18 Gbyte 15K rpm disk FC disk module (A6191A) ST318452FC
- ST336752FC 36 Gbyte 15K rpm disk FC disk module (A6193A)

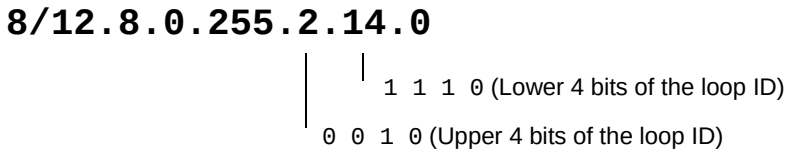
Interpreting the Hardware Path

The elements of the Fibre Channel hardware path are interpreted as follows:



The loop ID, broken out in upper and lower bits in the example above, is 46. To derive the loop ID from the Bus and Target values of the hardware path:

1 Convert the Bus and Target fields (the upper and lower bits of the loop ID) to binary:



2 Combine the two binary fields into 8 bits and convert back to decimal:

```
Upper bit  Lower bit
0 0 1 0 1 1 1 0
    |     | | |
   32   + 8+4+2    = 46
```

Loop IDs and Hardware Paths by Enclosure ID

The rotary switch on the LCC set the Fibre-Channel Address range for the enclosure. Both LCCs should be set identically for proper redundancy. Multiple enclosures need to have unique settings to avoid address conflicts. If devices are physically present and are not reported as found, suspect address conflicts with other devices. The following tables helps understand what addressing is being used:

Table 8. Loop IDs and Hardware Paths by Slot Number and Enclosure ID 0 - 2

Encl. ID	0				1				2			
Disk Slot # (dec)	Loop ID (dec)	Bus (dec)	Tgt (dec)	ALPA (hex)	Loop ID (dec)	Bus (dec)	Tgt (dec)	ALPA (hex)	Loop ID (dec)	Bus (dec)	Tgt (dec)	ALPA (hex)
1	0	0	0	EF	16	1	0	CD	32	2	0	B2
2	1	0	1	E8	17	1	1	CC	33	2	1	B1
3	2	0	0	E4	18	1	2	CB	34	2	2	AE
4	3	0	3	E2	19	1	3	CA	35	2	3	AD
5	4	0	4	E1	20	1	4	C9	36	2	4	AC
6	5	0	5	E0	21	1	5	C7	37	2	5	AB
7	6	0	6	DC	22	1	6	C6	38	2	6	AA
8	7	0	7	DA	23	1	7	C5	39	2	7	A9
9	8	0	8	D9	24	1	8	C3	40	2	8	A7
10	9	0	9	D6	25	1	9	BC	41	2	9	A6

Table 8. Loop IDs and Hardware Paths by Slot Number and Enclosure ID 0 - 2

Encl. ID	0				1				2			
Disk Slot # (dec)	Loop ID (dec)	Bus (dec)	Tgt (dec)	ALPA (hex)	Loop ID (dec)	Bus (dec)	Tgt (dec)	ALPA (hex)	Loop ID (dec)	Bus (dec)	Tgt (dec)	ALPA (hex)
11	10	0	10	D5	26	1	10	BA	42	2	10	A5
12	11	0	11	D4	27	1	11	B9	43	2	11	A3
13	12	0	12	D3	28	1	12	B6	44		12	9F
14	13	0	13	d2	29	1	13	B5	45	2	13	9E
15	14	0	14	D1	30	1	14	B4	46	2	14	B4
SES	15	0	15	CE	31	1	15	B3	63	3	15	73

Table 9. Loop IDs and Hardware Paths by Slot Number and Enclosure ID 3 - 4

Encl. ID	3				4			
Disk Slot # (dec)	Loop ID (dec)	Bus (dec)	Tgt (dec)	ALPA (hex)	Loop ID (dec)	Bus (dec)	Tgt (dec)	ALPA (hex)
1	48	3	0	98	64	4	0	72
2	49	3	1	97	65	4	1	71
3	50	3	2	90	66	4	2	6E
4	51	3	3	8F	67	4	3	6D
5	52	3	4	88	68	4	4	6C
6	53	3	5	84	69	4	5	6B
7	54	3	6	82	70	4	6	6A
8	55	3	7	81	71	4	7	69

Table 9. Loop IDs and Hardware Paths by Slot Number and Enclosure ID 3 - 4

Encl. ID	3				4			
Disk Slot # (dec)	Loop ID (dec)	Bus (dec)	Tgt (dec)	ALPA (hex)	Loop ID (dec)	Bus (dec)	Tgt (dec)	ALPA (hex)
9	56	3	8	80	80	4	8	67
10	57	3	9	7C	73	4	9	66
11	58	3	10	7A	74	4	10	65
12	59	3	11	79	75	4	11	63
13	60	3	12	76	76	4	12	5C
14	61	3	13	75	77	4	13	5A
15	62	3	14	74	78	4	14	59
SES	79	4	15	56	79	4	15	56

Table 10. Loop IDs and Hardware Paths by Slot Number and Enclosure ID 5- 6

Encl. ID	5				6			
Disk Slot # (dec)	Loop ID (dec)	Bus (dec)	Tgt (dec)	ALPA (hex)	Loop ID (dec)	Bus (dec)	Tgt (dec)	ALPA (hex)
1	80	5	0	55	96	6	0	3A
2	81	5	1	54	97	6	1	39
3	82	5	2	53	98	6	2	36
4	83	5	3	52	99	6	3	35
5	84	5	4	51	100	6	4	34
6	85	5	5	4E	101	6	5	33

Table 10. Loop IDs and Hardware Paths by Slot Number and Enclosure ID 5- 6

Encl. ID	5				6			
Disk Slot # (dec)	Loop ID (dec)	Bus (dec)	Tgt (dec)	ALPA (hex)	Loop ID (dec)	Bus (dec)	Tgt (dec)	ALPA (hex)
7	86	5	6	4D	102	6	6	32
8	87	5	7	4C	103	6	7	31
9	88	5	8	4B	104	6	8	2E
10	89	5	9	4A	105	6	9	2D
11	90	5	10	49	106	6	10	2C
12	91	5	11	47	107	6	11	2B
13	92	5	12	46	108	6	12	2A
14	93	5	13	45	109	6	13	29
15	94	5	14	43	110	6	14	27
SES	95	5	15	3C	111	6	15	26

In the above tables, columns 0-6 correspond to possible switch settings. Rows 1-15 indicate the disk slot positions. SES refers the address reserved for the enclosure controller. The intersection of a row and a column contains the loop ID the device will take. The loop ID is translated to a Fibre Channel address (AL-PA) by firmware according to the table in the FC-AL2 standard.

Enclosure IDs (0 through 6) are set with a dial on the LCC. This setting determines the FC-AL IDs of the disks and LCCs in the disk system. See Table 8 and Table 10 for the FC-AL IDs and corresponding hardware paths for each slot and LCC based on the Enclosure ID.

Caution The Enclosure IDs on both LCCs in the same disk system must be identical.

For redundancy, each LCC is connected to a different Fibre Channel loop (that is, a different host bus adapter).

Setting Up the Hardware Event Monitor

Separate monitors watch over the disks and the disk system. You need to install and configure the Disk Monitor (disk_em) and the High Availability Storage System Monitor (dm_ses_enclosure) for complete event notification.

To install and configure the required monitors, refer to the *EMS Hardware Monitors User's Guide*, which is included in Adobe Acrobat format on the IPR Support Media. You can download a copy of Acrobat Reader without charge from http://www.adobe.com/prodindex/acrobat/readstep.html.

Aliasing Devices (HP-Qualified Only)

Using host-based software, you can "label" each disk system with any information that would be useful for the site. You might use this feature to assign an inventory number or to indicate the location of the product. The maximum length of the annotation is 256 characters.

Using SAM

To define a text string using SAM, select the desired LCC or disk from the Disk Devices list; then select Annotate Device from the Actions menu. Type the comment that you want in the Annotation field and select OK.

You can view the annotation through the Annotate Device option in the Actions menu or by displaying the Annotation column in the Disk Devices list. To include the Annotation column in the Disk Devices window, select Columns from the View menu and choose Annotation.

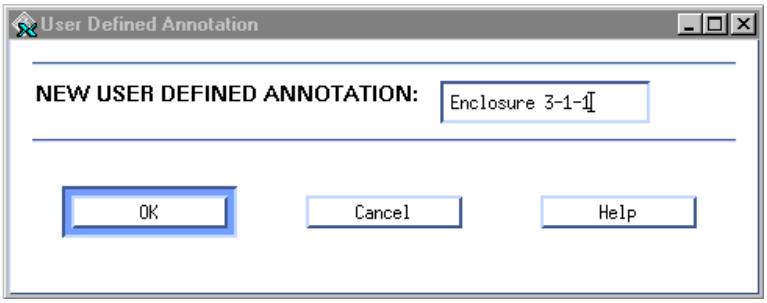
Using STM (HP-Qualified Only)

Annotating devices is a password-protected function of STM (Support Tools Manager). Use the System menu License option to install the HP-Only license before you select the annotate function.

1. Run STM and install the HP-Only license.
2. Select the desired LCC.
3. Select Expert Tool > Run from the Tools menu. An Expert Tool window opens.

4 Select Write Label from the Info menu. The User Defined Annotation window, similar to the screen shown below, displays the existing label in an edit field.

Figure 50. Annotate Device Using STM



5 Type the desired text in the New User Defined Annotation field. Click OK. The new label will replace the existing label.

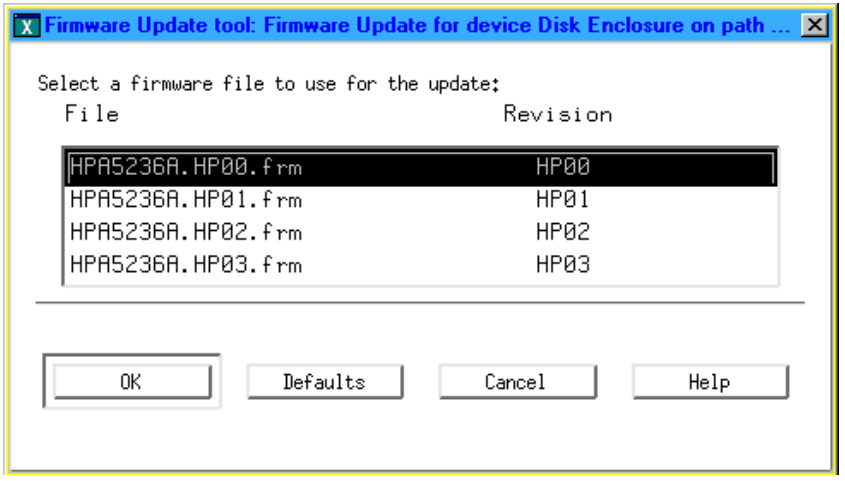
To view the annotation of a selected disk system, select Read Label from the Expert Tool Info menu. The label is displayed in the Expert Tool window.

Updating Firmware (HP-Qualified Only)

Obtain the latest disk system firmware release from the support web site before traveling to the customer site. When you arrive at the site:

1. Save the firmware file on the customer's system, preferably in the default firmware directory: /var/tmp
2. If you want to run STM in graphic mode, make sure DISPLAY is exported.
3. Start STM by typing `xstm&` on the HP-UX command line. This command starts the graphic version of STM and keeps the X window open when you quit STM.
4. Select License from the System menu and install the password-protected HP-Only license.
5. Select Firmware Update > Run from the Tools menu. A tool window opens, displaying the current firmware version and instructions for updating. A second window lists the available firmware files in the var/tmp directory. That second window is similar to the one shown below.

Figure 51. Firmware File Selection Window

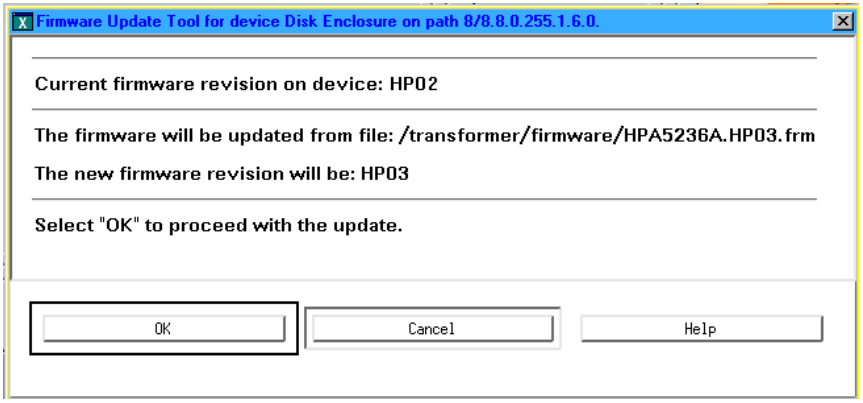


If there are no firmware files in the default directory, a pop-up window instructs you to select an optional path and STM displays a list of directories. Enter the directory path you used to save the firmware file (in step 1) and click OK.

6 Select the firmware file from the list of files displayed in the default or specified directory. Click OK.

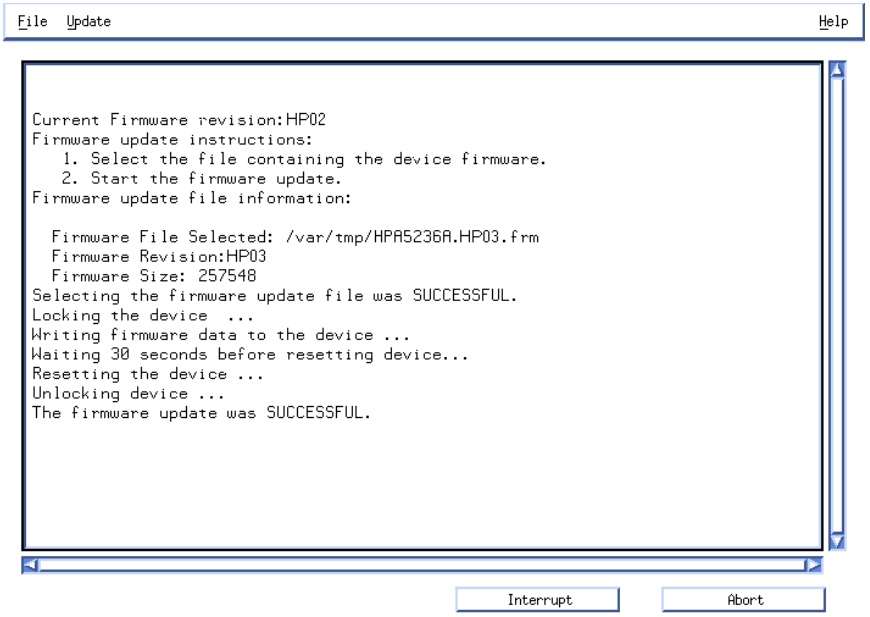
7 Select Start Update... from the Update menu. STM prompts you to confirm or cancel the firmware update. A window is similar to the one shown below.

Figure 52. Firmware Download Confirmation Window



The results of your action appear in the Tool window. The screen that appears is similar to the illustration shown below.

Figure 53. Firmware Tool Window



Troubleshooting

4

Overview

The following steps will help you identify and resolve disk system failures:

8 Gather information from all sources:

- Event notifications (page 93)
- Disk system LED status (page 96)
- Online information tools (page 98)

9 Isolate the cause of the problem (page 104).

10 Correct the problem (chapter 5, Removal and Replacement).

11 Verify operational status with IOSCAN or other host utilities.

Event Notification

The EMS hardware event monitor polls environmental services on the LCC and reports any changes in the status of monitored components. Depending on how the monitor is set up, you can receive messages at the console, in e-mail, in a log file, or through third-party applications. These messages are likely to be the first indication of a problem with a disk system.

Events are reported for changes in temperature, voltage, and the status of replaceable components.

Messages identify five levels of severity:

Critical	An event that causes data loss, host system downtime, or other loss of service. Host system operation will be affected if the disk system continues to be used without correction. Immediate action is required.
Serious	An event that may cause data loss, host system downtime, or other loss of service if left uncorrected. Host system and hardware operation may be adversely affected. The problem needs repair as soon as possible.
Major Warning	An event that could escalate to a serious condition if not corrected. Host system operation should not be affected and normal use of the disk system can continue. Repair is needed but at a convenient time.
Minor Warning	An event that will not likely escalate to a severe condition if left uncorrected. Host system operation will not be interrupted and normal use of the disk system can continue. The problem can be repaired when convenient.
Information	An event that is expected as part of the normal operation of the hardware. No action is required.

Event messages (see Figure 54) contain the following:

- Message Data – Date and time the message was sent, the source and destination of the message, and the severity level
- Event Data – Date and time of the event, the host, event ID, name of the monitor, event number, event class, severity level, hardware path, associated OS error log entry ID
- Error Description – Narrative information indicating the component that experienced the event and the nature of the event
- Probable Cause/Recommended Action – The cause of the event and suggested steps toward a solution. This information should be the first step in troubleshooting.
- Annotation – The user-defined annotation associated with the specific disk system

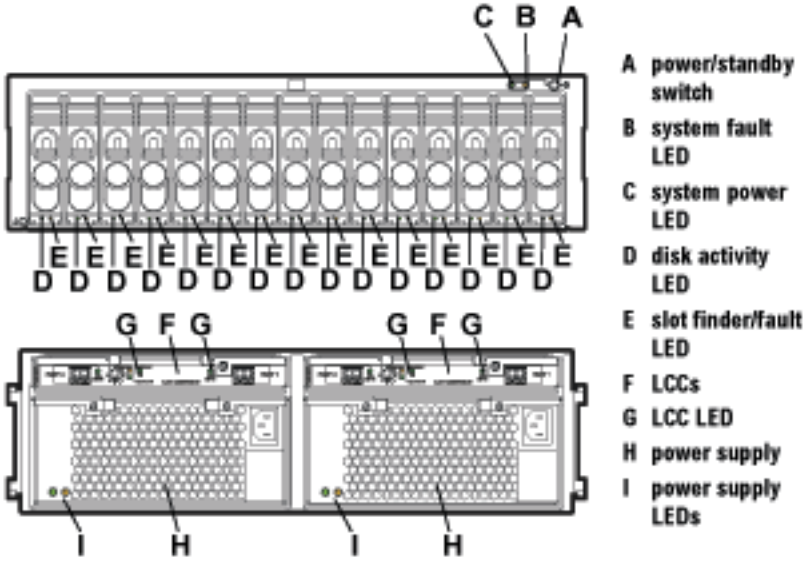
Figure 54. Sample Hardware Event Notification

```
Notification Time:  Wed Feb 3 11:27:15 1999

yourserver sent Event Monitor notification information:

/storage/events/enclosures/ses_enclosure/8_0_1_0.15.0 is >=1.
Its current value is MAJORWARNING(3)

Event data from monitor:

Event Time: Wed Feb 3 11:27:15 1999
Hostname: yourserver.rose.hp.com      IP Address : 15.43.213.13
Event ID: 0x0036b8a313000000002       Monitor    : dm_ses_enclosure
Event # : 402                         Event Class: I/O
Severity : MAJOR WARNING

Enclosure at hardware path 8/0/1/0.15.0: Hardware failure
Associated OS error log entry id(s): None

Description of Error:

     The enclosure services controllers have different versions of
     firmware.

Probable Cause / Recommended Action:

     The enclosure services controller cards have different versions of
     firmware. Update the controllers to the same version of firmware.

User Defined Annotation: Enclosure 37 LCC A.
```

Status LEDs

LEDs indicate the status of the disk system itself and each of its components (see Table 11). Green and amber system LEDs are visible on the front of the disk system. They show that power is on (green) and a fault has occurred (amber). Disk activity (green) LEDs are on the front of the disk drives at the bottom. Other LEDs are on individual components in the back of the disk system.

Figure 55. LED Status Indicators



LED states are described in Table 11:

Table 11. LED Functions

LED	State	Indication
System Power	Green	Power is on.
	OFF	Power is off.

Table 11. LED Functions

LED	State	Indication
System Fault	Amber	Self-test[1] / Problem.[2]
	OFF	Normal operation.
	Flashing	LCC A & B DIP switch settings do not match.
LCC Fault	Amber	Self-test[1] / Fault.
	OFF	Normal operation.
	Flashing	Peer LCC DIP switch settings do not match.
Link Active	Green	Port is in use.
	OFF	Port is disabled (bypassed).
2G	ON	Disk system is configured for 2.125 Gb/s operation.
	OFF	Disk system is configured for 1.0625 Gb/s operation.
Power Supply	Amber	Start-up[1] / Fault.
	Green	Operating.
	OFF	Power is off.
Disk Activity[3]	ON	Installed and spinning up. If the LED is still on 3 minutes after power is engaged, the disk may be faulty.
	Flashing	There is input/output activity to the disk.
	OFF	Not installed or not operating.

1.Start-up and self-tests occur briefly when the unit is powered on.
2.A component has failed; temperature or voltage is out of normal range. See Isolating Causes on page 104.
3.When a disk is installed with power on, its activity LED stays on until the disk has spun up. When the disk is ready, the LED turns off. Thereafter, it flashes when there is I/O to the disk.

Note

An amber light that is on briefly when a component first comes on is normal. If this light remains on more than a couple of seconds, a fault has been detected.

Online Status Information

Software applications that run on HP-UX hosts display status and descriptive information about the disk system and its components. SAM is the system administrator's interface to specific HP-UX functions. STM is the service engineer's tool for information, diagnostics, firmware updates, and more.

Viewing Component Status in SAM

SAM displays the status of disk system components on the host console. Follow the instructions below to use SAM:

1. Select Disks and File Systems from the main window.
2. Select Disk Devices. SAM displays the hardware paths of all disks, disk systems, and arrays on the host.
3. Select the path that represents the LCC of the desired disk system. You can recognize the LCC by the description "HP Disk System 2405 Controller."
4. Select View More Info from the Actions menu. A window displays header information and a graphical representation of the front of the disk system.

The header provides the following information:

- LCC Hardware path - the path chosen from the Disk Devices list
- Peer LCC Hardware path - the path to the other LCC in the same unit
- Controller's ID Switch Setting - Enclosure ID, set by the dial on the LCC bulkhead
- Enclosure's logical ID - the enclosure's World Wide Name, a unique identifier in the Fibre Channel network

5. For a view of the back of the selected disk system, click the "Back" tab.
6. To view component information, click the button representing the component. SAM displays the following information about specific components:

Button	Displays
Disk	Disk Slot, hardware path, status
LCC	Hardware path, status, firmware revision
Power Supply	Name, status

Status values are OK, critical error, noncritical, not installed, unknown, and status not available. See Interpreting Status Values on page 100 for the meanings of these terms.

Viewing the STM Information Log

STM generates Information and Activity logs for a selected disk system. Execute STM in an X window and run the Information tool as follows.

1. At the system prompt, type `xstm&`.
2. Select the desired disk system (HP A6250A).
3. Select Information from the Tools menu.
4. To generate a current log, select Run.
5. To view log output, select Information from the Tools menu.
6. Select Information Log.
7. Select Done when you have finished viewing the information.

The contents of the STM Information Log are as follows:

Log creation time	The date and time the Information Tool was last run for the selected disk system.
Hardware path	The physical path from the host to the reporting LCC; for example, 8/12.8.0.255.2.14.0.
Product ID	A6250A, the HP product number of the disk system.
FC Loop ID	The FC-AL ID of the reporting LCC, a decimal value between 0 and 125.
LCC A Status	The reported status of LCC A in the selected disk system. Possible values are OK, critical, noncritical, not installed, or not available.
LCC B Status	The reported status of LCC B in the selected disk system. Possible values are OK, critical, noncritical, not installed, or not available.
Reporting LCC	LCC A or LCC B, whichever LCC corresponds to the selected hardware path.

Enclosure ID	The unique manufacturer number that distinguishes the reporting LCC from all other LCCs.
WW Name (node)	The World Wide Name assigned to this disk system. In normal operation, this value is the same as the World Wide Name (port) for LCC A.
WW Name (port)	The World Wide Name of the reporting LCC.
Firmware Rev.	The current firmware version on the reporting LCC.
Power Supply Status	The status of the left (Supply A) and right (Supply B) power supplies in the selected disk system. Possible values are OK, critical, not installed, or not available.
Voltage Sensors Voltage and Status	The voltage detected and status of three voltage sensors—3.3V, 5.0V, and 12V—on each LCC. Possible status values are OK, critical, noncritical, not installed, unknown, and not available.
Temp Sensors Temperature and Status	The temperature detected and status of four sensors. Possible status values are OK, critical, noncritical, not installed, unknown, or not available.

Interpreting Status Values

SAM and STM report status in common terms, which are defined as follows:

Table 12. Status Indications

Reported Status	Applicable Component	Indication
OK	All replaceable components and sensors	Component is installed and no error conditions are known.

Table 12. Status Indications

Reported Status	Applicable Component	Indication
Critical	Replaceable components	Hardware has failed.
	Sensors	Voltage/temperature exceeds critical limit.
Noncritical	LCC	LCC A and LCC B have different firmware versions.
	Sensors	Voltage/temperature exceeds warning limit.
Not Installed	All replaceable components and sensors	Component is not installed.
Unknown	Sensors	Sensor has failed or status is not available.
Not Available	All replaceable components and sensors	Component is installed without known errors, but has not turned on or set into operation.

Checking the Fibre Channel Link

At power up, the disk system and the host Fibre Channel I/O adapters default to Fibre Channel Arbitrated Loop (FC-AL) Use the HP-UX FCMSUTIL on the host to verify that the loop is operating correctly. Then check the Fibre Channel cables and connectors.

To create the device files, first run the IOSCAN command against the Fibre Channel driver to find the minor numbers. For example:

1 ioscan -fnd fcT1_cnt1

Output similar to the following will appear

```
Class I  H/W Path  Driver    S/W State    H/W Type  Description
============================================================================
lan   0  8/8.5fcT1_cntl CLAIMED    INTERFACE HP Fibre Channel Mass Stora
              /dev/fcms0
lan   1  8/12.5 fcT1_cntl CLAIMED  INTERFACE HP Fibre Channel Mass Stora
              /dev/fcms1
```

2 Next, run the LSDEV command to find the major number of the Fibre Channel driver:

```
lsdev | grep fcT1_cntl
```

Output similar to the following will display. The major number is the first item in the output line.

```
78   -1   fcT1_cntl   lan
```

3 Next, run the MKNOD command to create the device files using the major and minor numbers from the LSDEV and IOSCAN output. The minor numbers are under the “I” column.

```
mknod   /dev/fcms1   c   78   0x000000
mknod   /dev/fcms1   c   78   0x010000
```

FCMSUTIL uses the device file of the Fibre Channel I/O adapters. If the device files do not exist, they must be created.

4 After the device files have been created, issue the FCMSUTIL command on the device files. For example:

```
/opt/fcms/bin/fcmsutil  /dev/fcms0
```

The output should appear similar to the following:

```
                Local N_Port_ID is = 0x000001
     N_Port Node World Wide Name = 0x10000060B03E22CB
          N_Port World Wide Name = 0x10000060B03E22CB
                        Topology = IN_LOOP
                           Speed = 1062500000 (bps)
                     HPA of card = 0xFBF48000
                     EIM of card = 0xFFFA000A
                    Driver state = Ready
          Number of EDB's in use = 0
          Number of OIB's in use = 0
Number of Active Outbound Exchanges = 1
    Number of Active Login Sessions = 5
```

A driver state of Ready indicates that the driver is in the correct operating state. IN_LOOP topology indicates that the host has detected an FC-AL.

5 Check Fibre Channel cables for loose connections.

6 Check the Enclosure ID switches for conflicting loop IDs. Make sure both LCCs have the same ID setting.

Isolating Causes

Table 13 lists the probable causes and solutions for problems you may detect on the disk system. When more than one problem applies to your situation, investigate the first description that applies. The table lists the most basic problems first and excludes them from subsequent problem descriptions.

Table 13. Troubleshooting Table

Problem Description	HW Event Category	LED State	STM Status	Probable Cause/Solution
Installed product does not power on	none	System power LED off	none	■ Neither power cord is plugged in. ■ The power switch is not pressed. ■ AC breaker is tripped. ■ AC power source has failed. ■ The PDU/PDRU is defective. ■ Power switch is defective. ■ A faulty component is causing power supplies to turn off. Remove all components and reinsert one at a time until the faulty component is isolated.
System fault LED is on	none	Power supply LED off	Power supply Not Available	■ The power supply is not plugged in. ■ The PDU/PDRU or primary power source has failed.
	Critical	Part fault LED on	Critical	A component has failed. See problem descriptions below.
Audio alarm when LCC installed	none	LCC Fault flashing	Disk Not Available	LCC DIP switch settings do not match peer LCC switch settings. Reset switches.
LCC Fault LED is on	Critical	LCC Fault on	Critical	LCC hardware is faulty. Replace the LCC.
Fan LED is amber	Critical	Amber	Critical	Fan has slowed or stopped. Replace the fan.

Table 13. Troubleshooting Table

Problem Description	HW Event Category	LED State	STM Status	Probable Cause/Solution
Power supply LED is amber	Critical	Amber	Critical	■ An incompatible or defective component caused a temporary fault. ■ Power supply hardware is faulty. Unplug the power cord and wait for the LED to turn off. Reinsert the power cord. If fault persists, replace the power supply.
IOSCAN lists LCC and disks as NO_HW	Critical	All normal	none	■ Cable is unplugged or loose at either end. ■ Cable is damaged. Replace with another cable to test. ■ Prior unit in the daisy chain is powered off. ■ HBA is faulty. Check status and correct any problem.
		All off	none	Disk system is powered off.
IOSCAN lists disk as NO_HW	none	On or off	(See STM Disk Tool)	■ Use the fcmsutil replace_dsk operation when replacing the disk drive. ■ Use insf -e to create the appropriate device files for the newly installed disk drive. ■ Reboot host. If after reboot, ioscan does not report the newly installed disk drive, then the disk drive is faulty. ■ Replace the drive.

Table 13. Troubleshooting Table

Problem Description	HW Event Category	LED State	STM Status	Probable Cause/Solution
Temperature is over limit	Critical	none	Critical Temp is >54.5º C (130.1º F)	■ A fan is faulty. Check status and correct. ■ Airflow is obstructed; vents are blocked. ■ One or more slots are empty. ■ Power supply is faulty. Check status and correct. ■ Room temperature is too high. If ambient temperature cannot be reduced in a reasonable time, turn off product to prevent shortened life. ■ Temperature sensor is faulty. Compare temperature reported by peer LCC.
	Major Warning	none	Non-critical Temp is >36º C (96.8º F)	
Temperature sensors are on the LCC and are independent of power supplies. Investigate temperature warnings immediately, before power supplies sense critical temperature and turn off.				
Temperature is under limit	Critical	none	Critical Temps <9.5º C (49.1º F)	■ Room temperature is too low. ■ Temperature sensor is faulty. Compare temperature reported by peer LCC.
	Major Warning	none	Non-critical Temps <15.5º C (59.9º F)	
Voltage is over limit	Critical	none	Critical	Power supply is faulty. Check status and correct.
	Major Warning	none	Non-critical	
Voltage is under limit	Critical	none	Critical	Either power supply is faulty. Check status and correct.
	Major Warning	none	Non-critical	

Table 13. Troubleshooting Table

Problem Description	HW Event Category	LED State	STM Status	Probable Cause/Solution
Peer LCC status, temperature and voltage are Not Available	Major Warning	none	Both LCCs: Non-critical	Firmware on LCC A and LCC B are different versions.
		none	Not Available	Internal bus is faulty. Contact HP technical support to replace midplane.

Removal and Replacement

Caution Do not remove hot-pluggable components until you have the replacement parts and are ready to install them. An empty slot will cause uneven cooling and eventual overheating.

Caution Do not move the disk system with disks installed and power on. Even a one-inch drop of the disk system can damage spinning disks.

Figure 56. Disk System Field Replaceable Units (FRUs)

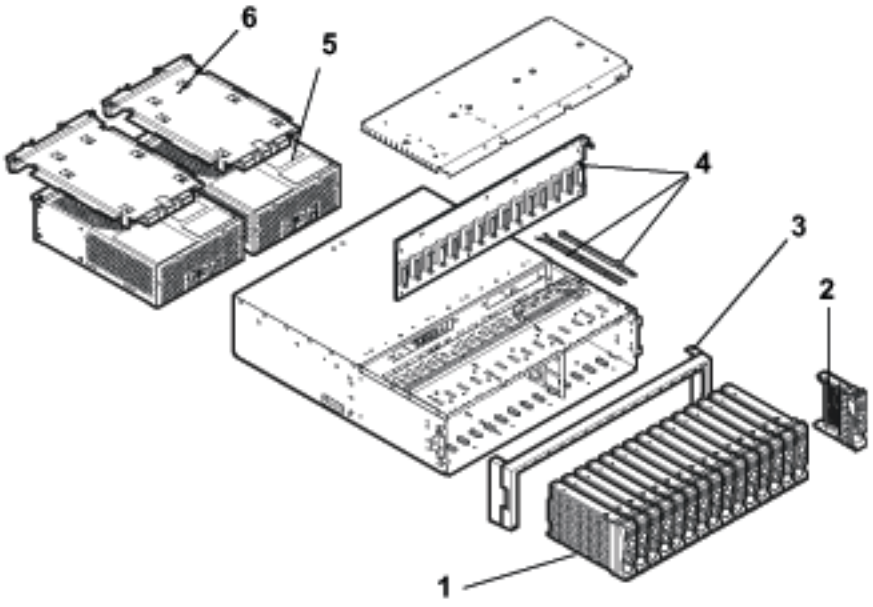


Table 14. Disk System Field Replaceable Units

Fig. 38 Item	Part No.	FRU Description	Qty Per Encl.	Exch/ Repl. Part	FRU Type
1	A6191-69001	Disk Drive, 18GB, 15k rpm, 512 bytes/sector	2-15	E	CRU
1	A6192-69001	Disk Drive, 36GB, 10k rpm, 512 bytes/sector	2-15	E	CRU
1	A6193-69001	Disk Drive, 36GB, 15k rpm, 512 bytes/sector	2-15	E	CRU
1	A6194-69001	Disk Drive, 73GB, 10k rpm, 512 bytes/sector	2-15		CRU
2	A6198-69002	Disk Drive Filler Panel	0-13	R	CRU
3	A6250-67003	Enclosure Bezel	1	R	HP
4	A6250-97005	Midplane Assembly (includes: midplane PCA, T-15 driver, ESD kit, 8 x T-15 x 6/32 x 7/16” long screws, 3 x T-10 x 6mm long screws, 1 x power/ standby switch shaft, 1 x lightpipe)	1	R	HP
5	A6250-69001	Power Supply/Fan Module	2	E	CRU
6	A6255-69001	Link Controller Card	2	E	CRU

CRU = Customer Replaceable Unit
HP = Hewlett-Packard Replaceable Only Unit

Disk Module

Add or replace disks to increase storage capacity or eliminate faults. (See chapter 4 for troubleshooting procedures.) Disks must be Fibre Channel (FC) and 3.5 inches wide but can vary in capacity. For current information about supported disks, consult an HP sales representative.

You do not need to turn off the disk system to replace a disk or filler.

Preparation

Removing or replacing a disk has consequences for the file systems and logical volumes located on the disk. Before removing or replacing a disk, complete the appropriate system administration for your environment and configuration. Instructions for determining physical volume status and reducing and recreating mirrored extents follow. For additional information, refer to your HP-UX guide, *How HP-UX Works: Concepts for the System Administrator.*

The LVM commands in the following instructions assume the following:

- All of the extents of the disk in use belong to mirrored logical volumes created with the strict (-s) option.
- The replacement disk is of the same or greater capacity as the disk being replaced.

The correct set of instructions depends on whether the mirrored volume is active and attached, or unattached. First, follow the instructions to determine the volume status; then follow the instructions to replace the volume depending on whether the volume is attached or unattached.

To Determine If a Volume Group or Physical Volume Group Is Active

At the host console, enter:

```
# vgdisplay <VG name>
```

For example:

```
#vgdisplay /dev/vg00
```

If the volume group is not active, the host will display:

```
# vgdisplay: volume group not activated.
# vgdisplay: cannot display volume group  /dev/vg00
```

The following messages will appear if the disk is defective:

```
VGDISPLAY: WARNING: COULDN’T QUERY PHYSICAL VOLUME
“/dev/dsk/c2t4d0”

THE SPECIFIED PATH DOES NOT CORRESPOND TO PHYSICAL
VOLUME ATTACHED TO THE VOLUME GROUP

VGDISPLAY: WARNING: COULDN’T QUERY ALL OF THE
PHYSICAL VOLUMES
```

If either of the above messages appears, follow the replacement instructions for unattached physical volumes (page 114).

Otherwise, follow the instructions to determine if the physical volume is attached.

To Determine If the Physical Volume Is Attached

Enter the `vgchange` command to activate the volume group.

The physical volume is unattached if a message similar to the following appears:

```
VGCHANGE: WARNING: COULDN’T ATTACH TO THE VOLUME
GROUP PHYSICAL VOLUME “/dev/dsk/c2t4d0”

THE PATH OF THE PHYSICAL VOLUME REFERS TO A DEVICE
THAT DOES NOT EXIST, OR IS NOT CONFIGURED INTO THE
KERNEL.
```

Continue with the appropriate replacement instructions as follows:

- If the physical volume is unattached, follow the instructions for replacing unattached physical volumes (page 114).
- If the physical volume is attached, follow the instructions for replacing attached physical volumes (page 112).

To Replace Attached Physical Volumes

Use the following commands to reduce any logical volumes that have mirror copies on the faulty disk and to recreate the mirror extents once the disk has been replaced. Commands to recover from a host failure are included with most steps.

Note — The way that mirrors span several disks may not be duplicated exactly. For cases where the original mirror layout must be preserved, consider deactivating the volume group with the vgchange command and using the procedure for replacing unattached physical volumes.

1 Enter the following command to reduce the mirror:

lvreduce -m <*mirror_copies*> -A n <LV name> <physical volume path>

For example, to reduce a two-way mirror:

```
# lvreduce -m 0 -A n /dev/vg00/lvol4  /dev/dsk/c2t4d0
```

or, for a three-way mirror:

```
# lvreduce -m 1 -A n /dev/vg00/lvol5  /dev/dsk/c2t4d0
```

If this step fails, execute an lvdisplay command to determine if the lvreduce command succeeded. If the command did not succeed, execute the command again. Perform any other lvreduce commands that were not executed before the system failed. Then proceed.

Note An important effect of the lvreduce command is that the LVM configuration backup file used by the vgcfgrestore command is updated. If this replacement procedure is being performed now on another host system and there is no need to execute any lvreduce commands, then the configuration file is not updated. The LVM configuration is correct on the physical volumes, however, so the configuration file can be updated with the vgcfbackup command.

2 Replace the disk module (see “Procedure” on page 115).

3 Execute ioscan to verify that the new disk drive is accessible and a proper replacement.

4 Enter the following command to restore the LVM configuration/headers to the replaced disks from the backup of the LVM configuration:

vgcfgrestore -n <volume group name> <physical volume path>

For example:

```
# vgcfgrestore -n /dev/vg00  /dev/rdsk/c2t4d0
```

If this step fails, repeat it to ensure all configuration data is written to the new disk.

Note If this replacement procedure is being performed now on another host system and there is no need to execute any lvreduce commands, then the configuration file can be updated with the vgcfbackup command.

5 Enter the following command to attach the replaced disk to the active volume group:

vgchange -a y <volume group name>

For example:

```
# vgchange -a y  /dev/vg00
```

6 Enter the `lvextend` command to transfer the mirrors onto the replaced disk. It will take time to copy all of the original data to the mirrored extents. The logical volumes are accessible to users' applications for two-way mirroring during this command.

lvextend -m <*mirror_copies*> <LV name> physical volume path

For example, for two-way mirroring:

```
# lvextend -m 1  /dev/vg00/lvol4  /dev/dsk/c2t4d0
```

For three-way mirroring:

```
# lvextend -m 2 /dev/vg00/lvol5  /dev/dsk/c2t4d0
```

If there is a failure during step 6, execute an lvdisplay command to determine if the lvextend command was successful. If the command did not successfully execute, reissue the command. Perform any other lvextend commands that were not executed before the system failed.

At this point, the system should be fully functioning.

To Replace Unattached Physical Volumes

Follow these instructions if the volume group is not active or if the physical volume is unattached.

1 Replace the disk (see page 115).

2 Execute ioscan to verify that the replaced disk is accessible and a proper replacement.

3 Enter the `vgcfgrestore` command to restore the LVM configuration/ headers to the replaced disk from the backup of the LVM configuration.

vgcfgrestore -n <volume group name> character device file

For example:

```
# vgcfgrestore -n  /dev/vg00  /dev/rdsk/c2t4d0
```

If the host fails, repeat the step to ensure that all configuration data is written to the new disk.

4 Enter the `vgchange` command to attach the new disk to the active volume group:

vgchange -a y <volume group name>

For example:

```
# vgchange -a y /dev/vg00
```

Tools

- ESD wrist strap (no hand tools are required to perform this procedure). Whenever possible, follow ESD procedures.

Procedure

Caution Whenever possible, follow standard ESD procedures and avoid touching exposed circuitry.

Do not remove a disk or filler from an operating product until you have the replacement part and are ready to install it. An empty slot will cause uneven cooling and overheating.

1 Release the disk module from the slot by squeezing the latch tab (see Figure 57) and pulling the disk module toward you.

Caution Spinning disks generate heat and gyroscopic force.

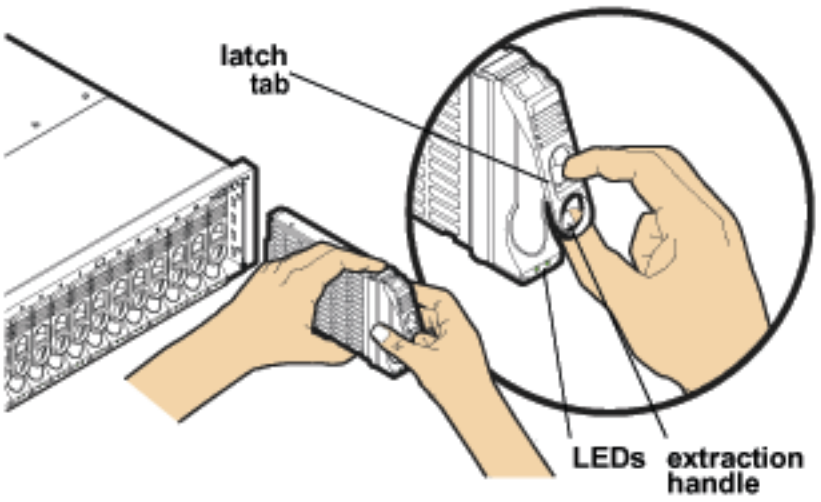
Wait for a spinning disk to slow down and cool off before removing it from the product.

WARNING High current available. Avoid touching the midplane or adjacent drive electronics when removing and inserting disk modules.

2 Pull the disk out of the slot using the extraction handle. Support the disk module with your other hand around the enclosed side. See Figure 57.

Note Removing disk modules and fillers from right to left improves access to successive disk modules.

Figure 57. Disk Module Removal



Caution Replace the disk module or filler immediately (see next step).

Caution Touching the disk circuit board can cause high energy discharge and permanently damage the disk.

Disk modules are fragile. Handle carefully.

3 Remove the replacement disk module from its ESD bag, being careful to grasp the disk module by its extraction handle (see Figure 57). (Fillers are not in ESD bags.)

4 Press the cam latch toward the end of the extraction handle to loosen the extraction handle.
When you are installing a disk module filler, align the disk filler guides with the chassis rails and insert the filler. Push the filler in until it stops. When it is fully inserted, it will be flush with the rest of the disk modules/disk module fillers.

5 Slide the disk module, capacity label up, into the empty slot.

6 Press the extraction handle to seat the disk module firmly on the midplane. An audible click indicates the disk module is fully seated.

If you are installing a disk module (as opposed to a filler), monitor the LEDs. It should be on while the disk spins up and then turn off. The LED will blink

with I/O activity to the disk. If you observe different results, refer to chapter 4, Troubleshooting, for probable causes and solutions.

7 Run IOSCAN on the host and verify that the replacement disk module is "claimed."

8 Restore file systems and data as needed (see Preparation on page 111).

LCC

Replace an LCC when troubleshooting shows that the card is faulty (see "Isolating Causes" in chapter 4).

There is no need to turn off the disk system to remove and replace an LCC. However, the host must be notified that all disks on the affected loop will be unavailable for I/O. Refer to Preparation on page 111.

Caution Touching the LCC pins can cause high energy discharge and permanently damage the LCC.

Tools

- ESD wrist strap (no hand tools are required to perform this procedure). Whenever possible, follow ESD procedures.

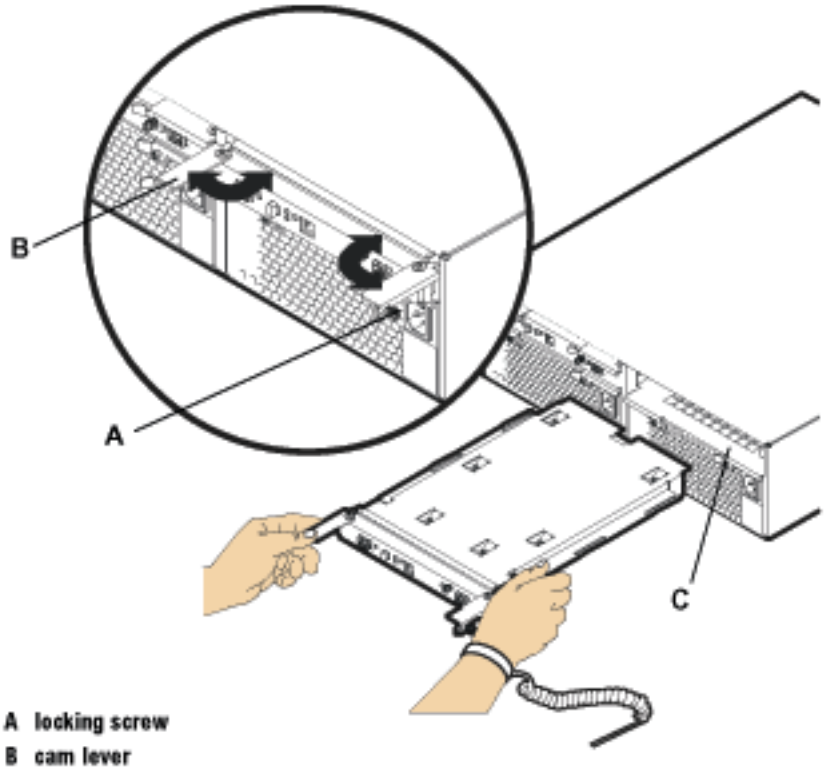
Procedure

Caution Do not remove a LCC from an operating product until you have the replacement LCC and are ready to install it. An empty slot will cause uneven cooling and eventual overheating.

1 Remove the cables and/or terminators from the failed LCC.

2 Loosen the locking thumbscrew (A in Figure 58) until it clears the LCC bulkhead. The screw stays in the ejector handle.

Figure 58. LCC Removal and Replacement



A locking screw
B cam lever
C LCC slot

3 Open the cam levers (B) by pulling them away from the center of the card. This disconnects the LCC pins from the midplane.

4 Pull the LCC out of the slot (C).

Replace the LCC immediately if the product is in use (see next step).

5 Attach the clip end of your ESD wrist strap to the ground stud at the top of the rack.

Caution Touching the LCC pins can cause high energy discharge and permanently damage the LCC.

6 Remove the replacement LCC from its ESD bag.

7 Set address switches on the new LCC to match settings on the peer LCC.

Caution The address switches must have the same settings on both LCCs.

8 Open the cam levers (see Figure 58) by pulling them away from the center of the card.

9 Insert the LCC in the empty slot.

10 Push the cam levers flat against the center of the card to seat the LCC pins firmly on the midplane.

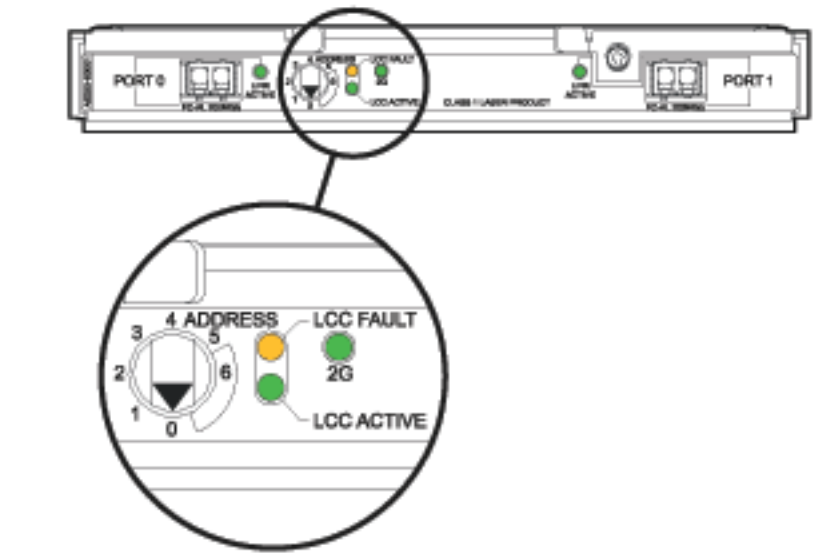
11 Watch the LCC Fault LED (see Figure 59). It should come on briefly and then turn off. If the LED stays on and a buzzer sounds, the switch settings do not match the settings on the peer LCC. For other solutions to a LCC fault, see "Isolating Causes" in chapter 4.

12 Tighten the locking screws (A in Figure 58).

13 Reattach the FC cables.

Caution The LCC must be replaced or a filler panel installed in the open slot to ensure proper cooling for the disk system.

Figure 59. LCC Address Switches and LEDs



Power Supply

Replace a power supply as soon as possible when troubleshooting indicates a power supply failure (see “Isolating Causes” in Chapter 4). If a power supply fails, the remaining power supply provides proper voltage to the disk system. However, if the remaining power supply fails before the first power supply is replaced, the disk system will turn off.

The power supply fan may continue to operate even when a power supply fails.

You do not need to turn off the disk system to replace a power supply.

Follow ESD procedures whenever possible.

Tools

ESD wrist strap (no hand tools are required to perform this procedure). Whenever possible, follow ESD procedures.

Procedure

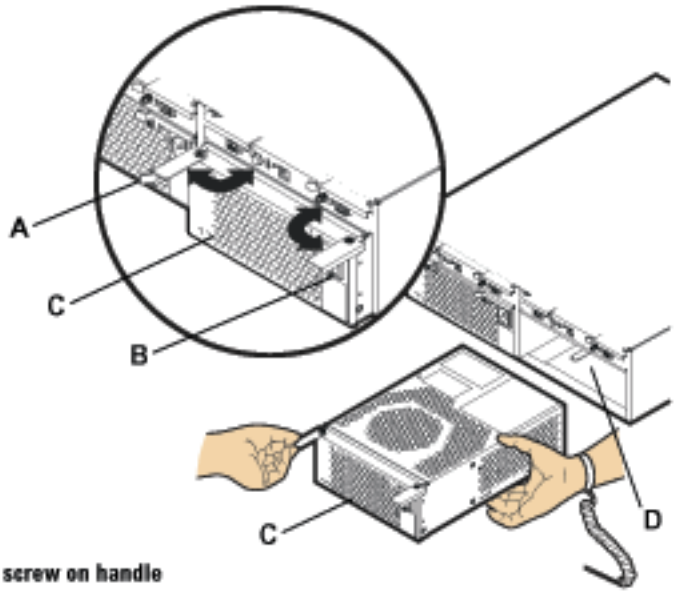
Caution — Do not remove a power supply from an operating product until you have the replacement and are ready to install it. An empty slot will cause uneven cooling and eventual overheating.

The power supply may be hot to touch. 

1. Disconnect the power cord from the power supply.
2. Loosen the thumbscrews on the power supply handles (A and B in Figure 60).
3. Rotate the handles out to disengage the power supply from the midplane.
4. Pull the power supply out of the chassis. Support the far end of the supply with your free hand as it clears the chassis.

   Replace the power supply immediately if the product is in use (see next step).

Figure 60. Power Supply Removal and Replacement



A locking screw on handle
B locking screw on handle
C power supplies
D power supply slot

5 Slide the replacement power supply into the empty slot (D in Figure 60). The power supply begins to engage the midplane with 3/8 inch (8mm) still exposed.

6 Rotate the handles back toward the center of the power supply module to draw the power supply the last 3/8 inch into the chassis and firmly seat the power supply on the midplane. The power supply should be flush with the edge of the chassis.

7 Tighten the thumbscrews on the power supply handles (A and B). It is recommended that you use a screwdriver to ensure proper seating.

8 Plug the power cord into the power supply and electrical source.

9 Monitor the power supply LED. It should turn green. If the LED is dark or stays amber, see Chapter 4, Troubleshooting.

Disk System

Use this procedure if you need to move or remove and replace the disk system in the rack. For example, you must remove the disk system from the rack in order to replace the midplane or power switch assembly. Twenty four inches of vertical space is required in the rack if the midplane or power switch assembly are to be replaced without removing the disk system from the rack.

The disk system will be turned off in this procedure.

Caution Do not move the disk system with disks installed and power on. Even a one-inch drop of the disk system can damage spinning disks.

Tools

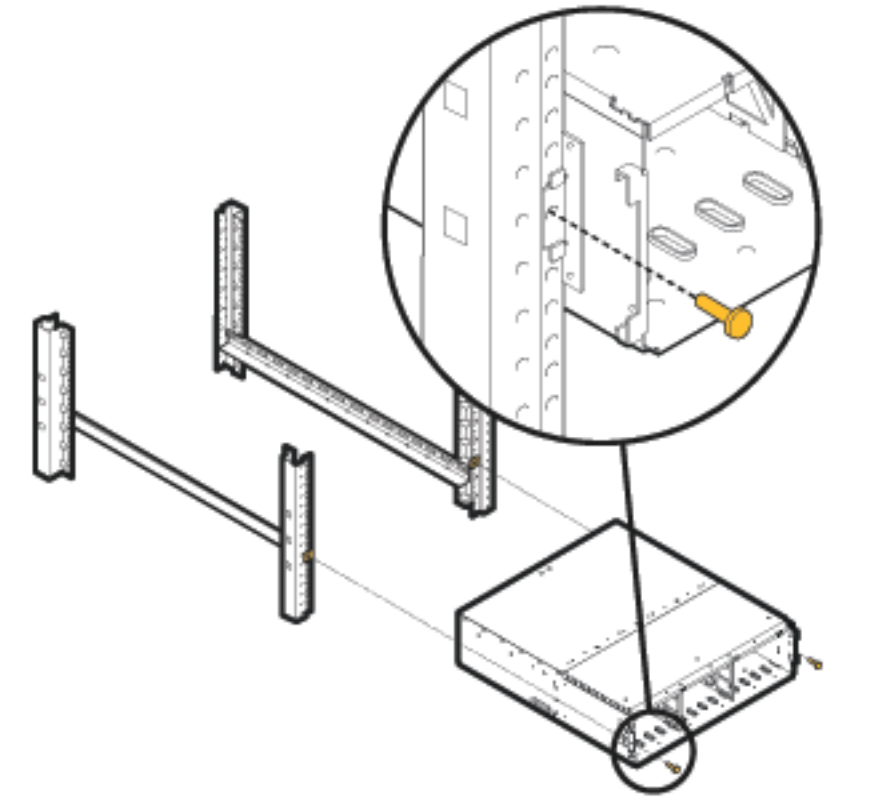
- ESD wrist strap (no hand tools are required to perform this procedure). Whenever possible, follow ESD procedures.

Procedure

1. Determine the file systems that will be inaccessible for I/O operations while the disk system is turned off, and perform necessary system administration. (See the HP-UX guide, *How HP-UX Works: Concepts for the System Administrator.)*
2. Push and release the power button to turn off the disk system.
3. Remove the disk modules from the chassis and set them aside on an anti-static surface. Label the disk modules so they can be reinstalled in the same disk slots.
4. Remove the power supply/fan modules and set them aside on an anti-static surface.
5. Remove screws from the mounting ears (see Figure 61).
6. Disconnect power and Fibre Channel cables from the back of the disk system.

WARNING Product is heavy (~54 lbs. without disks). If you choose to remove the disk system from the rack, use two people or a lift device.

Figure 61. Disk System Removal and Replacement



7 Push the disconnected disk system forward or lift it completely out of the rack, as needed.

8 When you are ready to replace the disk system, push the chassis back into the rack.

9 Insert and tighten the front mounting screws.

10 Reinstall the power supply/fan module(s).

11 Reinstall the disk modules in the slots from which they were removed.

12 Reconnect Fibre Channel cables and power cords.

13 Push the power/standby button in to turn on the disk system.

14 Perform necessary system administration to return file systems to service.

Top Cover (HP-Qualified Only)

The following procedure is for HP-qualified personnel only.

The top cover, which is not an orderable part, will need to be removed and replaced to service the light pipes, the power switch extension arm, or the midplane.

You will need to turn the power off to perform this procedure.

Tools

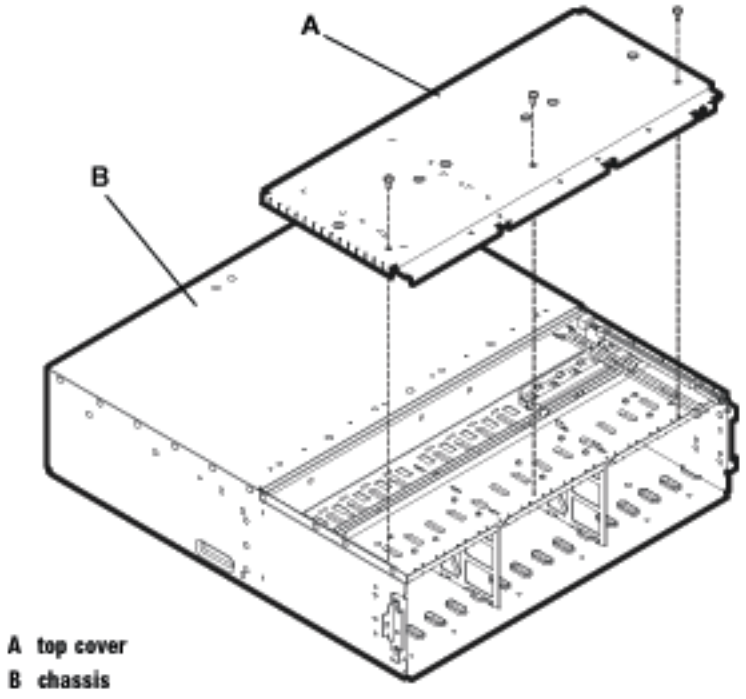
- Small flat-blade screwdriver
- Torx T25 screwdriver
- Torx T10 screwdriver

Procedure

Caution Disk slots must be empty before removing the top cover.

1. Perform all appropriate system administration tasks before doing the following tasks.
2. Remove disk modules and fillers and place them on an appropriate anti-static surface. See page 111.
3. Disconnect all power and fibre channel cables. See Figure 2 on page 14.
4. Remove the power supply/fan modules. See page 120.
5. Remove the disk system retention screws. See page 123.
6. Remove the disk system from the rack and place it on an appropriate anti-static surface.
7. Remove the three flathead screws from the back and side edges of the cover plate (A in Figure 62).
8. Rotate the cover upward; then lift it away from the disk system.

Figure 62. Top Cover Assembly



9 Slide the cover toward the middle of the chassis.

10 Insert the three flathead screws through the holes as shown in Figure 62 and tighten.

11 Reconnect the disk system. See page 120.

12 Reinstall disks. See page 111.

Midplane (HP-Qualified Only)

The midplane board is replaceable by HP-qualified personnel only.

Replace the midplane based on troubleshooting results (see “Isolating Causes” in chapter 4). Disks, LCCs, and power supply/fan modules connect to the midplane.

The power must be OFF and the top cover removed in order to remove and replace the midplane board.

Caution Turning off a disk system isolates the enclosed disks from the host. Perform recommended system administration to prevent loss of pending I/Os to the disks.

Tools

- Small flat-blade screwdriver
- Torx T25 screwdriver
- Torx T15 screwdriver
- Torx T10 screwdriver
- ESD strap

Procedure

1. Remove the top cover. See page 124.
2. Put on your ESD strap and attach the free end to the disk system.

Caution Static discharge can destroy functional components on the midplane.

3. To remove the midplane:
   a. Loosen the cam handle locking screws and pull power supplies free of the midplane (see page 120).
   b. Loosen the cam handle locking screws and pull the LCCs free of the midplane.
   c. Remove the disk modules from the chassis.
   d. Remove the light pipes (see Figure 63 on page 128).
   e. Remove the power switch extender arm.

f Remove the eight Torx T15 screws along the top and bottom edges of the midplane (see Figure 63).

g Pull the midplane forward to clear alignment pins and lift it up and out of the disk system.

4 To replace the midplane:

a Stand the new midplane inside the chassis and push it over the alignment pins. Connectors automatically align with floating fan connectors inside the chassis.

b Insert and tighten eight screws into the midplane and chassis.

c Replace the light pipes.

d Replace the power switch extender arm.

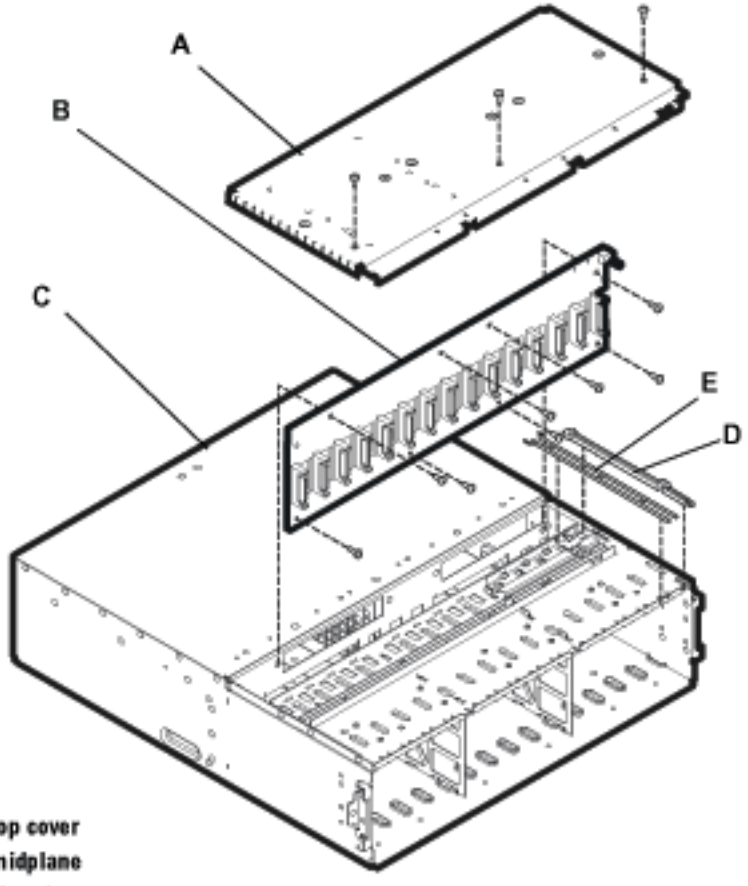
5 Replace the top cover. See page 124.

6 Reseat and secure the LCCs (see page 117).

7 Reseat and secure the power supplies (see page 120).

8 Reinstall the disk modules.

Figure 63. Midplane Assembly



A top cover
B midplane
C chassis
D power switch extender arm
E light pipes

Reference

6

Product Models and Options

Three models of the disk system are available:

- A6250A field-racked disk system
- A6250AZ factory-racked disk system
- A6250AE empty field-racked disk system

Upgrade Products

Order the following parts to expand or reconfigure your original purchase:

Table 15. Upgrade Products

Order No.	Description
A6192A	36-Gbyte 10K rpm FC disk module
A6194A	73-Gbyte 10K rpm FC disk module
A6191A	18-Gbyte 15K rpm FC disk module
A6193A	36-Gbyte 15K rpm FC disk module
C7524A	2-meter LC duplex M/M FC cable
C7525A	16-meter LC duplex M/M FC cable
C7526A	50-meter LC duplex M/M FC cable
C7527A	200-meter LC duplex M/M FC cable
C7529A	2-meter LC/SC duplex 50/125 M/M Fiber Optic Cable
C7530A	16-meter LC/SC duplex 50/125 M/M Fiber Optic Cable
C7534A	Fiber Optic Coupler SC F/F
C7540A	Fiber Optic Adapter Kit - Optical
A6244A	Rail kit for HP C2785A, C2786A, C2787A, A1896A, and A1897A
A6209A	Rail kit for HP Rack Systems/E
A6496A	Rittal Rack Rail Kit
A6498A	2-Post Rail Kit

PDU/PDRU Products

Table 16. PDU/PDRU Products

Order No.	Description
E7676A	19-inch, 100-240 V, 16 Amp, 1 C20 inlet, 10 C13 outlets
E7671A	19-inch, 100-240 V, 16 Amp, 1 C20 inlet, 2 C19 & 6 C13 outlets
E7674A	19-inch, 100-240 V, 16 Amp, 1 C20 inlet, 1 C19 & 7 C13 outlets
E7679A	19-inch, 100-127 V, 16 Amp, 2 C20 inlets, 2 C19 outlets, switch accessory
E7680A	19-inch, 200-240 V, 16 Amp, 2 C20 inlets, 2 C19 outlets, switch accessory
E7681A	19-inch, 200-240 V, 30 Amp, L6-30P, 2 C19 & 8 C13 outlets, switch accessory
E7682A	19-inch, 200-240 V, 30 Amp, IEC-309, 2 C19 & 8 C13 outlets, switch accessory
E4452A	36-inch, 200-240 V, 16 Amp, L6-20P plug, 6 IEC-320 outlets
E4453A	36-inch, 200-240 V, 16 Amp, L6-20P plug, 6 IEC outlets
E5933A	36-inch, 110-240 V, 16 Amp, UPS, IEC-320, 6 IEC-320 outlets
E4456A/B	60-inch, 220 V, 16 Amp, power cord w/IEC-320 plug, 6 IEC outlets
E4457A/B	60-inch, 200-240 V, 16 Amp, L6-20P plug, 10 IEC-320 outlets
E5930A	60-inch, 110-220 V, 16 Amp, UPS, IEC-320, 10 C-13 outlets
E5931A	60-inch, 220 V, 16 Amp, UPS, LP-30P, 10 C-13 outlets
E5932A	60-inch, 220 V, 16 Amp, UPS, no plug, 10 C-13 outlets
E7677A	Switch panel accessory for PRU
E7678A	Switch control jumper cord for PRU

Replaceable Parts

Table 17. Replacement and Exchange Part Numbers

Replacement Part Order No.	Exchange Part Order No.	Part Description
8120-6514		Power cord
A6250-67001	A6250-69001	Power supply/fan module
A6250-67005		Midplane PCA
A6255-67001	A6255-69001	Link Control Card (LCC)
A6198-60009		Disk filler
A6192-67001	A6192-69001	36-GB 10K rpm FC disk module
A6194-67001	A6194-69001	73-GB 10K rpm FC disk module
A6191-67001	A6191-69001	18-GB 15K rpm FC disk module
A6193-67001	A6193-69001	36-GB 15K rpm FC disk module

Specifications

Dimensions

The maximum dimensions of the disk system are:

- Height: 12.9 cm (5.10 in.)
- Width: 44.7 cm (17.60 in.)
- Depth: 50.5 cm (19.90 in.)

Weight

A fully loaded disk system weighs approximately 78 pounds. Component weights are shown in Table 18.

Table 18. Product Weights

Component	Weight of Each (lbs)	Quantity	Subtotal (lbs)
Disk Module (half height disk drives)	1.6	15	24
Power Supply/Fan Module	9.5	2	19
LCC	3	2	6
Midplane	6	1	6
Chassis	23	1	23
		Approx. Total	78 lbs

AC Power Input

The disk system operates at 100-127 and 200-240 V AC, 50-60 Hz, single phase, power factor corrected. Maximum current is 6.5 amps over the low voltage range and 3.2 amps over the high voltage range. Average power consumption with medium load (15 disks running idle) is 340 watts.

DC Power Output

- Disk: +5 V and +12 V from power supply
- LCC: +5 V and +3.3 V from power supply

Heat Output

- 1600 BTU/hr.

Environment

The following environmental specifications were type-tested under controlled conditions. Hewlett-Packard maintains an active program of auditing production products to make sure these specifications remain true when products are retested under the same conditions. However, the limits of these specifications do not represent the optimum for long, trouble-free operation and specifically are not recommended for maximum satisfaction. The recommended conditions are stated when appropriate.

- Operating temperature: 5º C to 40º C (50º F to 104º F)
  Recommended: 20º C to 25.5º C (68º F to 78º F)
- Maximum gradient: 20º C per hour (36º F per hour)
- Relative humidity: 20% to 80% noncondensing, max. wetbulb at 26º C
  Recommended: 30% to 50% noncondensing
- Altitude: 3000 m (10,000 ft.)

Note — For continuous, trouble-free operation, the disk system should NOT be operated at its maximum environmental limits for extended periods of time. Operating within the recommended operating range, a less stressful operating environment, ensures maximum reliability.

The environmental limits in a nonoperating state (shipping and storage) are wider:

- Temperature: -40º C to 70º C (-40º F to 158º F)
- Maximum gradient: 24º C per hour (43.2º F per hour)
- Relative humidity: 15% to 90% noncondensing
- Altitude: 4600 m (15,000 ft.)

Acoustics

- Sound power: 7.3 Bels
- Sound pressure at operator's position: 56.3 dB(A)

Safety Certifications

UL listed, UL 1950:1995 – 3rd Edition

CSA certified, C22.2 No. 950:1989

TUV certified with GS mark, EN 60950:1992 + A1:1993, A2:1993, A3:1995, A4:1997

CE mark (see Declaration of Conformity on page 139)

EMC Compliance

Australia: AS/NZS 3548, Class A

Canada: ICES-003, Class A

China: CB9254-88

European Union: EN55022 Class A, EN50082-1

Japan: VCCI Class A

Taiwan: CNS 13438, Class A

US: 47 CFR Parts 2 & 15, Class A

Regulatory Statements

A. FCC Statement (For U.S.A. Only)

The Federal Communications Commission (in 47 CFR 15.105) has specified that the following notice be brought to the attention of the users of this product.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense. The end user of this product should be aware that any changes or modifications made to this equipment without the approval of Hewlett-Packard could result in the product not meeting the Class A limits, in which case the FCC could void the user's authority to operate the equipment.

B. IEC Statement (Worldwide)

This is a Class A product. In a domestic environment this product may cause radio interference, in which case the user may be required to take adequate measures.

C. Spécification ATI Classe A (France)

DECLARATION D'INSTALLATION ET DE MISE EN EXPLOITATION d'un matériel de traitement de l'information (ATI), classé A en fonction des niveaux de perturbations radioélectriques émis, définis dans la norme européenne EN 55022 concernant la Compatibilité Electromagnétique.

Cher Client,

Conformément à la Réglementation Française en vigueur l'installation ou le transfert d'installation, et l'exploitation de cet appareil de classe A, doivent faire l'objet d'une déclaration (en deux exemplaires) simultanément auprès des services suivants:

Comité de Coordination des Télécommunications 20, avenue de Ségur - 75700 PARIS

Préfecture du département du lieu d'exploitation

Le formulaire à utiliser est disponible auprès des préfectures.

La déclaration doit être faite dans les 30 jours suivant la mise en exploitation.

Le non respect de cette obligation peut être sanctionné par les peines prévues au code des Postes et Télécommunications et celles indiquées dans la loi du 31 mai 1993 susvisée.

Arrêté du 27 Mars 1993, publié au J.O. du 28 Mars - ATI

D. Product Noise Declaration (Germany)

Schalldruckpegel Lp = 56.3 dB(A)

Am Arbeitsplatz (operator position)

Normaler Betrieb (normal operation)

Nach ISO 7779:1988 / EN 27779:1991 (Typprufung)

E. VCCI Statement (Japan)

この装置は、情報処理装置等電波障害自主規制協議会（ＶＣＣＩ）の基準に基づくクラスＡ情報技術装置です。この装置を家庭環境で使用すると電波妨害を引き起こすことがあります。この場合には使用者が適切な対策を講ずるよう要求されることがあります。

Harmonics Conformance (Japan)

高調波ガイドライン適合品

F. BSMI EMC Statement (Taiwan)

警告使用者：這是甲類的資訊產品，在居住的環境中使用時，可能會造成射頻干擾，在這種情況下，使用者會被要求採取某些適當的對策。

檢磁XXXXYXXX

G. Declaration of Conformity

DECLARATION OF CONFORMITY
according to ISO/IEC Guide 22 and EN 45014

Manufacturer's Name: Hewlett-Packard Company

Manufacturer's Address: 8000 Foothills Blvd.
Roseville, CA 95747
USA

declares, that the product

Product Name: Disk System 2405

Product Number(s): A6250A, A6250AV, A6250AE, and A6250AZ

Regulatory Model: RSVLB-0101

Product Options: All

conforms to the following Product Specifications[1]:

Safety: IEC 60950:1991 + A1, A2, A3, A4 / EN 60950:1992 + A1, A2, A3, A4, A11
GB 4943-1995

EMC: CISPR 22:1997 / EN 55022:1998 Class A[2]
GB 9254-1988
CISPR 24:1997 / EN 55024:1998
IEC 61000-3-2:1995 / EN 61000-3-2:1995 + A14
IEC 61000-3-3:1994 / EN 61000-3-3:1995

Supplementary Information:

1) The product herewith complies with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC and carries the CE marking accordingly.

2) The Product was tested in a typical configuration with a Hewlett-Packard computer system and peripherals.

Roseville, January 18th, 2002

George E. Barrett, Regulatory Mgr.

European Contact: Your local Hewlett-Packard Sales and Service Office or Hewlett-Packard GmbH, Department HQ-TRE, Herrenberger Straße 130, D-71034 Böblingen (FAX: + 49-7031-14-3143)

Product Web Site

This guide is available in Adobe® Acrobat® format on the HP Customer Care web site for enterprise storage (*http://www.hp.com/support/storage*). Choose HP Disks and Disk Arrays and then HP disk systems. The HP StorageWorks Disk System 2405 is one of the disk system selections.

Related Documents

The following manuals explain how to use the system software interfaces to the HP StorageWorks Disk System 2405.

- *EMS Hardware Monitors User's Guide*, available at *http://docs.hp.com/hpux/hw/*
- *Online Diagnostics (for HP 9000): Support Tools Manager Overview*
- *HP-UX System Administration Tasks Manual*

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