Abstract
This guide describes the D3600/D3700 12Gb SAS disk enclosure. Installation, cabling, configuration, and troubleshooting procedures are included.
Revision History

<table>
<thead>
<tr>
<th>Edition</th>
<th>Date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>First</td>
<td>March 2014</td>
<td>Initial release. Described server connect environments.</td>
</tr>
</tbody>
</table>
Contents

1 Hardware...........................................................................................................7
   Overview............................................................................................................7
   D3600 Large Form Factor disk enclosure chassis.............................................7
      LFF Front view................................................................................................7
      Drive bay numbering......................................................................................8
      Rear view.......................................................................................................8
   D3700 Small Form Factor disk enclosure chassis..........................................9
      SFF Front view..............................................................................................9
      Drive bay numbering....................................................................................10
      Rear view.....................................................................................................10
   Disk drives........................................................................................................11
      Disk drive LEDs...........................................................................................11
      Disk drive blanks.........................................................................................11
   Front status and UID module.........................................................................12
      Front UID module LEDs...............................................................................12
      Unit identification (UID) button...................................................................13
   Power supply module.....................................................................................13
      Power supply module LED............................................................................13
   Fan module.......................................................................................................14
      Fan module LEDs.........................................................................................14
   I/O module.......................................................................................................15
      I/O module LEDs..........................................................................................15
   Rear power and UID module.........................................................................16
      Unit identification (UID) button..................................................................16
      Powering on..................................................................................................16
   Cables...............................................................................................................16
      Cables to connect HP D3600/D3700 with any HP 6Gb SAS initiator.............16
      Cables to connect HP D3600/D3700 with any HP Smart Array 12Gb SAS initiator.16

2 Technical specifications..................................................................................17
   Physical specifications....................................................................................17
   Power and environmental specifications.......................................................17
   Acoustic noise levels.....................................................................................17

3 Deployment types..........................................................................................18

4 Installation.......................................................................................................19
   Installation overview......................................................................................19
   Required items................................................................................................19
   Preliminary tasks............................................................................................20
      Determining who will install and configure the disk enclosure..................20
      Confirming support for your hardware and software components..........20
      Signing up to automatically receive advisories, notices, and other messages.21
      Confirming warranty support and finding out about related services.......21
      Gathering and recording information.........................................................21
      Planning the storage configuration..............................................................21
      System and performance expectations.......................................................22
      Striping methods.........................................................................................22
      RAID levels..................................................................................................22
      Disk drive sizes and types..........................................................................23
      Spare disks...................................................................................................23
      Array sizing..................................................................................................24
   Preparing the site...........................................................................................25
Racking the disk enclosure................................................................. 26
Rack installation best practices...................................................... 26
Rack Installation procedures.......................................................... 26
Installing disk drives in the enclosure........................................... 29
Disk drive options........................................................................... 29
Disk drive guidelines...................................................................... 29
Installing a disk drive..................................................................... 29
Installing SAS controllers or controller enclosures...................... 31
Preparing the server....................................................................... 31
Connecting SAS cables and power cords...................................... 32
Overview......................................................................................... 32
Cabling best practices..................................................................... 32
Connecting SAS cables to the server or controller enclosure........... 33
Connecting SAS cables to cascaded disk enclosures..................... 34
Connecting power cords................................................................. 35
Powering on the disk enclosure..................................................... 36
Power on best practices.................................................................. 36
Power on procedures...................................................................... 36
Verifying the operating status of the disk enclosures..................... 37
5 Configuration................................................................................ 38
Configuration overview................................................................. 38
Supported software tools................................................................. 38
6 Operation and management........................................................... 39
Powering on disk enclosures........................................................ 39
Power on procedures...................................................................... 39
Powering off disk enclosures......................................................... 39
Updating disk enclosure firmware................................................. 39
7 Cabling examples.......................................................................... 41
Single-domain example.................................................................. 42
Dual domain example..................................................................... 43
8 Troubleshooting............................................................................ 44
If the enclosure does not initialize................................................ 44
Diagnostic steps............................................................................ 44
Is the enclosure front fault LED amber?........................................ 44
Is the enclosure rear fault LED amber?.......................................... 45
Is the System Health LED amber?.................................................. 45
Is the power supply LED amber?................................................... 45
Is the I/O module fault LED amber?.............................................. 45
Is the fan LED amber?................................................................. 46
Recognizing disk drive failure....................................................... 47
Effects of a disk drive failure......................................................... 47
Compromised fault tolerance......................................................... 47
Factors to consider before replacing disk drives............................ 47
Automatic data recovery (rebuild).................................................. 48
Time required for a rebuild............................................................. 48
Failure of another drive during rebuild........................................ 49
Handling disk drive failures.......................................................... 49
9 Replacement procedures............................................................... 50
Customer self repair (CSR)............................................................ 50
Parts-only warranty service......................................................... 50
Best practices for replacing hardware components....................... 50
Verifying component failure........................................................ 50
Identifying the spare part........................................................................................................50
Replaceable parts..................................................................................................................50
Replacing the failed component...........................................................................................51
Replacement instructions....................................................................................................51
Hardware components...........................................................................................................52

10 Support and other resources.........................................................................................54
Contacting HP....................................................................................................................54
  Before you contact HP........................................................................................................54
  HP contact information.......................................................................................................54
  Subscription service............................................................................................................54
  Documentation feedback....................................................................................................54
Related information..............................................................................................................55
  Websites.............................................................................................................................55
Document conventions and symbols..................................................................................55
Customer self repair............................................................................................................55
Rack stability.......................................................................................................................56

11 Regulatory compliance notices.....................................................................................57
Regulatory compliance identification numbers....................................................................57
Federal Communications Commission notice.........................................................................57
  FCC rating label...............................................................................................................57
  Class A equipment..........................................................................................................57
  Modifications....................................................................................................................57
  Cables...............................................................................................................................57
Battery replacement notices.................................................................................................58
RoHS material content declarations....................................................................................60
  China RoHS material content declaration....................................................................60
  India RoHS material content declaration.....................................................................60
  Turkey RoHS material content declaration..................................................................60
  Ukraine RoHS material content declaration.................................................................60
Regulatory notices..............................................................................................................60
  Canadian notice (Avis Canadien)....................................................................................60
    Class A equipment........................................................................................................60
  European Union notice....................................................................................................60
  Japanese notices..............................................................................................................61
    VCCI-A notice...............................................................................................................61
  Japanese power cord statement.....................................................................................61
  Korean notices................................................................................................................61
    Class A equipment........................................................................................................61
  Taiwanese notices..........................................................................................................61
    BSMI Class A notice....................................................................................................61
    Chinese notice.............................................................................................................61
Recycling notices................................................................................................................62
  English notice................................................................................................................62
  Bulgarian notice..............................................................................................................62
  Czech notice....................................................................................................................62
  Danish notice..................................................................................................................62
  Dutch notice....................................................................................................................62
  Estonian notice................................................................................................................63
  Finnish notice..................................................................................................................63
  French notice...................................................................................................................63
  German notice................................................................................................................63
  Greek notice....................................................................................................................63
  Hungarian notice.............................................................................................................64
  Italian notice....................................................................................................................64

Contents 5
Latvian notice....................................................................................................................64
Lithuanian notice................................................................................................................64
Polish notice.....................................................................................................................64
Portuguese notice.............................................................................................................65
Romanian notice.............................................................................................................65
Slovak notice....................................................................................................................65
Spanish notice................................................................................................................65
Swedish notice................................................................................................................65
Turkish notice................................................................................................................66

Index..............................................................................................................................67
1 Hardware

Overview

The HP 12Gb SAS disk enclosures are available in two models:

- **D3600**: supports up to 12 Large Form Factor (LFF) SAS drives for a maximum capacity of 7.2 TB with 600 GB SAS drives, 48 TB with 4 TB SAS MDL, or 4 TB SATA MDL drives.
- **D3700**: supports up to 25 Small Form Factor (SFF) SAS drives for a maximum capacity of 30 TB with 1.2 TB SAS drives, 25 TB with 1 TB SAS MDL, or 1 TB SATA MDL drives.

The D3700 also supports 12G SAS and SATA Solid State Drives (SSD).

<table>
<thead>
<tr>
<th>D3600 LFF Enclosure</th>
<th>D3700 SFF Enclosure</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.jpg" alt="D3600 LFF Enclosure" /></td>
<td><img src="image2.jpg" alt="D3700 SFF Enclosure" /></td>
</tr>
</tbody>
</table>

**NOTE:** Each enclosure is shipped with an optional digital rain bezel which customers can install as needed. The graphics in this guide are portrayed without the bezel for clarity.

**NOTE:** Depending on your disk enclosure model and controller installation environment, one or more disk enclosures can be cascaded from the disk enclosure that is connected to the controller. For more information, see the QuickSpecs for the disk enclosure, available on the D3000 website.

The enclosure and its components are detailed in the following sections:

- “D3700 Small Form Factor disk enclosure chassis” Page 9
- “D3600 Large Form Factor disk enclosure chassis” Page 7
- “Disk drives” Page 11
- “Front status and UID module” Page 12
- “Power supply module” Page 13
- “Fan module” Page 14
- “I/O module” Page 15
- “Rear power and UID module” Page 16
- “Cables” Page 16

**D3600 Large Form Factor disk enclosure chassis**

Each HP D3600 enclosure includes the following standard components:

- D3600 base enclosure with redundant power supplies and fan modules
- Two integrated 12Gb SAS I/O Modules
- Rack mounting hardware kit
- Two 0.5m SAS-HD cables
- Optional digital rain bezel
LFF Front view

<table>
<thead>
<tr>
<th>1. Disk drive in bay 1</th>
<th>2. System Health LED</th>
<th>3. UID push button</th>
</tr>
</thead>
</table>

Drive bay numbering

Disk drives mount in bays on the front of the enclosure. Bays are numbered sequentially from top to bottom and left to right. A drive-bay legend is included on the left bezel.

Rear view

**NOTE:** The I/O modules for both the HP D3600 LFF and HP D3700 SFF enclosures share the same layout.
D3700 Small Form Factor disk enclosure chassis

Each HP D3700 enclosure includes the following standard components:

- D3700 base enclosure with redundant power supplies and fan modules
- Two integrated 12Gb SAS I/O Modules
- Rack mounting hardware kit
- Two 0.5m SAS-HD cables
- Optional digital rain bezel

SFF Front view
Drive bay numbering

Disk drives mount in bays on the front of the enclosure. Bays are numbered sequentially from top to bottom and left to right.

---

Rear view

NOTE: The I/O modules for both the HP D3600 LFF and HP D3700 SFF enclosures share the same layout.

---

<table>
<thead>
<tr>
<th>1. Metal cover with fan module ID</th>
<th>4. I/O module B</th>
<th>7. Rear system health LED</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOTE: A pull tab is provided for label placement.</td>
<td>2. Fan</td>
<td>5. Fan</td>
</tr>
</tbody>
</table>

---
Disk drives

A variety of disk drive models are supported for use, including dual-ported and single-ported models. For more information, see the QuickSpecs for the disk enclosure, available on the D3000 website.

Disk drives are hot-pluggable.

Disk drive LEDs

Two LEDs indicate drive status.

<table>
<thead>
<tr>
<th>Location</th>
<th>Indicator</th>
<th>Status</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Locate</td>
<td>Solid blue</td>
<td>The drive is being identified by a host application.</td>
<td></td>
</tr>
<tr>
<td>2. Activity ring</td>
<td>Rotating green</td>
<td>Drive activity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Off</td>
<td>No drive activity</td>
<td></td>
</tr>
<tr>
<td>3. Do not remove</td>
<td>Solid white</td>
<td>Do not remove the drive. Removing the drive causes one or more of the logical drives to fail.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Off</td>
<td>Drive is safe to remove. Will not cause a logical drive to fail.</td>
<td></td>
</tr>
<tr>
<td>4. Drive status</td>
<td>Solid green</td>
<td>The drive is a member of one or more logical drives.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Flashing green</td>
<td>The drive is rebuilding or performing a RAID migration, stripe size migration, capacity expansion, or logical drive extension, or is erasing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Flashing amber/green</td>
<td>The drive is a member of one or more logical drives and predicts the drive will fail.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Flashing amber</td>
<td>The drive is not configured and predicts the drive will fail.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Solid amber</td>
<td>The drive has failed.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Off</td>
<td>The drive is not configured by a RAID controller.</td>
<td></td>
</tr>
</tbody>
</table>

Disk drive blanks

To maintain the proper enclosure air flow, a disk drive or a disk drive blank must be installed in each drive bay. The disk drive blank maintains proper airflow within the disk enclosure.
Front status and UID module

The front status and UID module includes status LEDs and a unit identification (UID) button.

Front UID module LEDs

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Startup condition</th>
<th>Operating condition</th>
<th>Fault conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. HDD in Bay 1</td>
<td>N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. System Health LED</td>
<td>Solid green</td>
<td>Solid green</td>
<td>• Flashing amber: non-critical error.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Solid amber: critical failure.</td>
</tr>
<tr>
<td>3. UID</td>
<td>The UID is a locator LED activated by pressing the rear or the front UID buttons.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Unit identification (UID) button

The unit identification (UID) button helps locate an enclosure and its components. When the UID button is activated, the UID indicators on the front and rear of the enclosure are illuminated. There is a UID button in the front panel, and another in the rear panel of the enclosure.

**NOTE:** A remote session from the management utility can also illuminate the UID.

- **To turn on the UID light,** press the UID button. The UID light on the front and the rear of the enclosure will illuminate solid blue.
- **To turn off an illuminated UID light,** press the UID button. The UID light on the front and the rear of the enclosure will turn off.

Power supply module

Two power supplies provide the necessary operating voltages to all controller enclosure components. If one power supply fails, the remaining power supply is capable of operating the enclosure. (Replace any failed component as soon as possible.)

Power supply module LED

One LED provides module status information.

<table>
<thead>
<tr>
<th>LED color</th>
<th>LED status</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Off</td>
<td>Off</td>
<td>No power</td>
</tr>
<tr>
<td>Green</td>
<td>Solid</td>
<td>Normal, no fault conditions</td>
</tr>
</tbody>
</table>
Fan module

Fan modules provide cooling necessary to maintain proper operating temperature within the controller enclosure.

If one fan fails, the system still runs, but HP recommends replacing the module. If two fans fail (either one complete module, or one fan per module) the system shuts down.

Fan module LEDs

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Startup condition</th>
<th>Operating condition</th>
<th>Fault conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Fan UID</td>
<td>Blue</td>
<td>Off</td>
<td>Off</td>
</tr>
<tr>
<td>2. Health/Status</td>
<td>Solid green</td>
<td>Solid green</td>
<td>Solid amber</td>
</tr>
<tr>
<td>3. System UID</td>
<td>Blue</td>
<td>Off</td>
<td>Off</td>
</tr>
</tbody>
</table>

One bi-color LED provides module status information.
I/O module

The I/O module provides the interface between the disk enclosure and the host. Each I/O module has two ports that can transmit and receive data for bidirectional operation.

I/O module LEDs

LEDs on the I/O module provide status information about each I/O port and the entire module.

**NOTE:** The following image illustrates LEDs on the I/O module.

The rear power and UID module includes status LEDs, a 7–segment display for status codes, and a unit identification (UID) button.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Startup condition</th>
<th>Operating condition</th>
<th>Fault conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Port Link</td>
<td></td>
<td>Blinking or solid green</td>
<td>Off</td>
</tr>
<tr>
<td>2. Port Error</td>
<td></td>
<td>Off</td>
<td>Solid amber</td>
</tr>
<tr>
<td>3. 7–segment display</td>
<td></td>
<td>A number, representing the box number, or an error/warning code.</td>
<td>Off</td>
</tr>
<tr>
<td>4. UID</td>
<td>Blue</td>
<td>Off</td>
<td>Off</td>
</tr>
<tr>
<td>5. Health</td>
<td>Blinking green</td>
<td>Solid green</td>
<td>Off</td>
</tr>
<tr>
<td>6. Fault</td>
<td></td>
<td>Off</td>
<td>Blinking or solid amber</td>
</tr>
</tbody>
</table>
Rear power and UID module

Unit identification (UID) button

The unit identification (UID) button helps locate an enclosure and its components. When the UID button is activated, the UID on the front and rear of the enclosure are illuminated.

**NOTE:** A remote session from the management utility can also illuminate the UID.

- **To turn on the UID light,** press the UID button. The UID light on the front and the rear of the enclosure will illuminate solid blue. (The UID on cascaded storage enclosures are not illuminated.)
- **To turn off an illuminated UID light,** press the UID button. The UID light on the front and the rear of the enclosure will turn off.

Powering on

Power is applied to the enclosure chassis upon plugging the unit into a live power source. There is no power on/standby button.

Cables

These disk enclosures use cables with mini-SAS connectors for connections to the host and to additional cascaded disk enclosures.

Use supported SAS cables with mini-SAS connectors. A variety of SAS cables and cable lengths are supported for use with this disk enclosure. For more information, see the QuickSpecs for the disk enclosure, available on the D3000 website.

**Cables to connect HP D3600/D3700 to any HP 6Gb SAS initiator**

<table>
<thead>
<tr>
<th>Name</th>
<th>Part number</th>
</tr>
</thead>
<tbody>
<tr>
<td>HP 0.5m External Mini SAS HD to Mini SAS Cable</td>
<td>691971-B21</td>
</tr>
<tr>
<td>HP 1.0m External Mini SAS HD to Mini SAS Cable</td>
<td>716189-B21</td>
</tr>
<tr>
<td>HP 2.0m External Mini SAS HD to Mini SAS Cable</td>
<td>716191-B21</td>
</tr>
<tr>
<td>HP 4.0m External Mini SAS HD to Mini SAS Cable</td>
<td>716193-B21</td>
</tr>
</tbody>
</table>

**NOTE:** This includes the following devices
- HP P421 and P822 controllers
- HP Smart Array H221 and H222 host bus adaptors
- HP Smart Array P721m (for Blade-attach)
- HP 6Gb SAS Switch

**Cables to connect HP D3600/D3700 with any HP Smart Array 12Gb SAS initiator**

<table>
<thead>
<tr>
<th>Name</th>
<th>Part number</th>
</tr>
</thead>
<tbody>
<tr>
<td>HP 1.0m External SAS-HD Cable</td>
<td>716195-B21</td>
</tr>
<tr>
<td>HP 2.0m External SAS-HD Cable</td>
<td>716197-B21</td>
</tr>
<tr>
<td>HP 4.0m External SAS-HD Cable</td>
<td>716199-B21</td>
</tr>
</tbody>
</table>
2 Technical specifications

Physical specifications

<table>
<thead>
<tr>
<th>Height/Width/Depth</th>
<th>HP D3600 LFF: 3.44 x 17.64 x 23.54 in (8.7 x 44.8 x 59.8 cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HP D3700 SFF: 3.44 x 17.64 x 21.48 in (8.7 x 44.8 x 54.6 cm)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Weight</th>
<th>No disk drives: 38 lb (17.2 kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HP D3700 fully populated with SFF disk drives: 54.90 lb (24.9 kg)</td>
</tr>
<tr>
<td></td>
<td>HP D3600 fully populated with LFF disk drives: 60 lb (27.2 kg)</td>
</tr>
</tbody>
</table>

Power and environmental specifications

<table>
<thead>
<tr>
<th>Temperature range (Temperature ratings shown are for sea level. An altitude rating of 1°C per 300 m (1.8°F per 1,000 ft) to 3048 m (10,000 ft) is applicable. The upper limit might be limited by the type and number of options installed.)</th>
<th>Operating 50° to 104° F (10° to 40° C)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Shipping -22° to 149° F (-30° to 65° C)</td>
</tr>
<tr>
<td></td>
<td><strong>NOTE:</strong> Rated 1°C per 1000 feet of elevation to 10,000 ft.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Relative humidity (Non-operating maximum humidity of 95% is based on a temperature of 45°C (113°F). Altitude maximum for storage corresponds to a pressure minimum of 70 KPa.)</th>
<th>Operating</th>
<th>10% to 90% relative humidity (Rh)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Non-operating</td>
<td>0% to 95% relative humidity (Rh)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Maximum wet bulb temperature (Maximum allowable altitude change rate is 457 m/min (1500 ft/min))</th>
<th>Long-term storage (operating) 82.4° F (28° C)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Short-term storage (non-operating) 101.6° F (38.7° C)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Altitude (Maximum allowable altitude change rate is 457 m/min (1500 ft/min))</th>
<th>Operating</th>
<th>3048 m (10,000 ft) This value might be limited by the type and number of options installed.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Non-operating</td>
<td>9144 m (30,000 ft)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Input power</th>
<th>Input voltage 100 to 240 VAC (Common-slot Power Supply)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Input frequency 50 to 60 Hz (Common-slot Power Supply)</td>
</tr>
<tr>
<td></td>
<td>Rated input current 120V power source: 6A</td>
</tr>
<tr>
<td></td>
<td>240V power source: 3A</td>
</tr>
<tr>
<td></td>
<td>Input power (max) 526W</td>
</tr>
</tbody>
</table>

Acoustic noise levels

Listed are the declared A-Weighted sound power levels (LWAd) and declared average bystander position A-Weighted sound pressure levels (LpAm) when the product is operating in a 23°C ambient environment. Noise emissions were measured in accordance with ISO 7779 (ECMA 74) and declared in accordance with ISO 9296 (ECMA 109). The listed sound levels apply to standard shipping configurations. Additional options may result in increased sound levels.

<table>
<thead>
<tr>
<th>Idle Acoustic Noise (sound power)</th>
<th>LWAd= 7.0 B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Idle Acoustic Noise (sound pressure)</td>
<td>LpAm - 53 dBA</td>
</tr>
<tr>
<td>Operating Acoustic Noise (sound power)</td>
<td>LWAd= 7.0 B</td>
</tr>
<tr>
<td>Operating Acoustic Noise (sound pressure)</td>
<td>LpAm - 53 dBA</td>
</tr>
</tbody>
</table>
3 Deployment types

The following types of deployments are supported:

- **Single domain**
  In a single domain deployment, one path exists from the disk enclosure to the host. In a single domain deployment, only one I/O module in the disk enclosure is used.

- **Dual domain**
  In a dual domain deployment, two paths exist from the disk enclosure to the host. In a dual domain deployment, both I/O modules in the disk enclosure are used. Because dual domain deployments provide two paths to the storage, access is ensured, even in the event of device, cable, or power failure. In dual domain environments, dual-port disk drives are required.

- **Server attached** (single or dual domain)
  In a server attached deployment, the disk enclosure is connected to a controller card installed in a server. Several models of controller cards are supported for use with this disk enclosure. For more information, see the QuickSpecs for the disk enclosure.

- **Controller enclosure attached** (single or dual domain)
  In a controller enclosure attached deployment, the disk enclosure is connected to a rack-mounted array controller enclosure. The controller enclosure is then connected to the server or network. Several models of array controller enclosures are supported for use with this disk enclosure. For more information, see the QuickSpecs for the disk enclosure.

**NOTE:** Cabling illustrations are provided elsewhere in this guide, showing a variety of example deployments. See (page 41).
4 Installation

Installation overview

Installation steps include:
1. Locating “Required items” Page 19
2. Completing “Preliminary tasks” Page 20
3. “Preparing the site” Page 25
4. “Racking the disk enclosure” Page 26
5. “Installing disk drives in the enclosure” Page 29
6. “Connecting SAS cables and power cords” Page 32
7. “Powering on the disk enclosure” Page 36

Required items

Items required for installation include the following, some of which ship with the disk enclosure:
- Rack mounting kit
- Disk enclosure
- Disk drives and drive blanks
- SAS controller or controller enclosure
- SAS cables
- Power cables
- Access to a workstation on the server
- Access to the Internet

NOTE: A variety of disk drives, SAS controllers, controller enclosures, and SAS cables are supported for use with this disk enclosure. For more information, see the QuickSpecs for the disk enclosure, available on the D3000 website.
Preliminary tasks

Planning tasks include:

- “Determining who will install and configure the disk enclosure” Page 20
- “Confirming support for your hardware and software components” Page 20
- “Signing up to automatically receive advisories, notices, and other messages” Page 21
- “Confirming warranty support and finding out about related services” Page 21
- “Gathering and recording information” Page 21
- “Planning the storage configuration” Page 21

Determining who will install and configure the disk enclosure

Storage management experience is required to successfully install and configure this product. If you are not familiar with installing and configuring storage array systems, HP can install this product for you. For more information, see the Business & IT Services website: http://www.hp.com/go/services.

Different levels of assistance are available. For example, the following services might be included:

- Site inspection
- Verification of operating system patch levels
- Customized virtual disk design
- Array hardware installation and activation of optional software
- Array initialization
- Verification that the implemented solution meets your specifications
- Availability of an HP Services Storage Specialist to answer questions during the deployment process
- Verification testing to confirm product functionality and adherence to HP installation quality standards
- On-site orientation, including highlights of basic operation and a review of documentation

Confirming support for your hardware and software components

Specific versions of hardware, firmware, software, drivers, and other components are designed to work together.

The QuickSpecs for your disk enclosure model provide an up-to-date list of supported servers, operating systems, controllers, switches, and software tools. Download and review the QuickSpecs for your disk enclosure model to confirm that the components you plan to use are supported for use with the disk enclosure.

Check the QuickSpecs before initially installing the disk enclosure and before making any changes to an existing installation. QuickSpecs are available on the D3000 disk enclosures website.
Signing up to automatically receive advisories, notices, and other messages

The Subscriber’s Choice website includes options to register for and automatically receive, by e-mail, personalized product tips, update information, driver- and support-related advisories, and other notices for this and other HP devices. Although optional, HP recommends registering all of your HP products with Subscriber’s Choice. For more information, see the Subscriber’s Choice website: http://www.hp.com/go/e-updates.

To register for and automatically receive product tips, update information, driver- and support-related advisories, see the Subscriber’s Choice website: http://www.hp.com/go/e-updates. Click Subscribe and follow the onscreen instructions to select all of the HP products for which you want to receive notices. While subscribing, indicate your delivery preference (HTML, text, or RSS) and frequency of delivery (as they become available, weekly, or monthly).

Confirming warranty support and finding out about related services

The standard warranty protects against product defects and some causes of downtime. You can extend your warranty with HP Care Pack Services. This portfolio of predefined packages is flexible, allowing you to extend coverage to the exact level of support required. You choose the support level that meets your business requirement, from basic to mission-critical.

Recommended service levels and appropriate related services for your particular disk enclosure model are listed on the QuickSpecs. For more information, see the Storage Services website: http://www8.hp.com/us/en/business-services/it-services.html?compURL=1078604.

Gathering and recording information

A brief worksheet is included on the getting started instructions that is shipped with the disk enclosure. As you gather and identify the hardware and software components for your environment, use the worksheet to record information about your components and your configuration. Some information is easily obtained before installing the disk enclosure, while some of the information is created during the configuration process.

A basic worksheet is included on the poster, but HP recommends creating and keeping more detailed records.

Information recorded on the worksheet is used during the initial system setup and configuration, and is helpful for future configuration changes and troubleshooting purposes.

NOTE: If a supplier is installing or configuring your disk enclosure, provide them with the poster, and verify that they complete the worksheet and record other important configuration and set up information.

Planning the storage configuration

Proper planning of the system storage and its subsequent performance is critical to a successful deployment of the disk enclosure. Improper planning or implementation can result in wasted storage space, degraded performance, or inability to expand the system to meet growing storage needs.
Storage planning considerations include:

- System and performance expectations
- Striping methods
- RAID levels
- Disk drive sizes and types
- Spare drives
- Array sizing (capacity)

**NOTE:** For the minimum supported configuration, and other configuration information, see the QuickSpecs for the disk enclosure.

**System and performance expectations**

To help determine the best way to configure your storage, rank the following three storage characteristics in order of importance:

- Fault tolerance (high availability)
- I/O performance
- Storage efficiency

With priorities established, you can determine which striping method and RAID level to use; some configuration methods offer greater fault tolerance, while other configuration methods offer better I/O performance or storage efficiency.

**Striping methods**

There are two methods for configuring the physical layout of the disk arrays:

- Vertical striping—the RAID array uses one physical drive from each disk enclosure.
- Horizontal striping—the RAID array uses multiple drives contained within one or more disk enclosures.

**RAID levels**

Controllers use RAID technology to group multiple disk drives together in larger logical units (LUNs). Key RAID methods include the use of data striping, data mirroring, and parity error checking. Data striping improves speed by performing virtual disk I/O with an entire group of physical disks at the same time. Mirroring provides data redundancy by storing data and a copy of the data. Parity error checking provides automatic detection and correction if corruption of a physical disk occurs.

Depending on the host environment, the following RAID levels are supported with this disk enclosure: RAID0, RAID1, RAID5 and RAID6 with ADG. Each level uses a different combination of RAID methods that impact data redundancy, the amount of physical disk space used, and I/O speed. After you create a LUN, you cannot change the RAID level.

The following table compares the different RAID levels.

<table>
<thead>
<tr>
<th>RAID</th>
<th>Summary</th>
<th>Best practices</th>
<th>Data redundancy</th>
<th>RAID method</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAID0</td>
<td>RAID0 is optimized for I/O speed and efficient use of physical disk capacity, but provides no data redundancy.</td>
<td>IMPORTANT: Do not use RAID0 for LUNs if fault tolerance is required. Consider RAID0 only for noncritical storage. RAID0 LUNs provide the best performance for applications that use random I/O.</td>
<td>None</td>
<td>Striping</td>
</tr>
<tr>
<td>RAID1</td>
<td>RAID1 is optimized for data redundancy and I/O speed,</td>
<td>In general, RAID1 virtual disks provide better performance</td>
<td>High</td>
<td>Mirroring</td>
</tr>
</tbody>
</table>
## RAID Method

<table>
<thead>
<tr>
<th>RAID Method</th>
<th>Characteristics</th>
<th>Best Practices</th>
<th>Data Redundancy</th>
<th>RAID Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAID0</td>
<td>Provides the most physical disk space. <strong>IMPORTANT</strong>: RAID0 uses about 100% more physical disk space than RAID0 and 70% more than RAID5.</td>
<td>RAID5 protects against failure of one drive (and failure of particular multiple drives). RAID 50 is a nested RAID method that uses RAID 0 striping across RAID 5 arrays.</td>
<td>RAID5 tolerates one drive failure in each spanned array without loss of data. RAID 50 requires less rebuild time than single RAID 5 arrays. RAID 50 requires a minimum of six drives.</td>
<td>Medium</td>
</tr>
<tr>
<td>RAID1</td>
<td>RAID1 uses about 100% more physical disk space than RAID0. RAID 0 provides the most physical disk space.</td>
<td>RAID5 protects against failure of one drive (and failure of particular multiple drives). RAID 50 is a nested RAID method that uses RAID 0 striping across RAID 5 arrays.</td>
<td>RAID5 tolerates one drive failure in each spanned array without loss of data. RAID 50 requires less rebuild time than single RAID 5 arrays. RAID 50 requires a minimum of six drives.</td>
<td>Medium</td>
</tr>
<tr>
<td>RAID50</td>
<td>RAID50 tolerates one drive failure in each spanned array without loss of data. RAID 50 requires less rebuild time than single RAID 5 arrays. RAID 50 requires a minimum of six drives.</td>
<td>RAID5 protects against failure of one drive (and failure of particular multiple drives). RAID 50 is a nested RAID method that uses RAID 0 striping across RAID 5 arrays.</td>
<td>RAID5 tolerates one drive failure in each spanned array without loss of data. RAID 50 requires less rebuild time than single RAID 5 arrays. RAID 50 requires a minimum of six drives.</td>
<td>Medium</td>
</tr>
<tr>
<td>RAID60</td>
<td>RAID60 tolerates one drive failure in each spanned array without loss of data. RAID 50 requires less rebuild time than single RAID 5 arrays. RAID 50 requires a minimum of six drives.</td>
<td>RAID5 protects against failure of one drive (and failure of particular multiple drives). RAID 50 is a nested RAID method that uses RAID 0 striping across RAID 5 arrays.</td>
<td>RAID5 tolerates one drive failure in each spanned array without loss of data. RAID 50 requires less rebuild time than single RAID 5 arrays. RAID 50 requires a minimum of six drives.</td>
<td>Medium</td>
</tr>
<tr>
<td>RAID6+0</td>
<td>RAID6+0 allows administrators to split the RAID 6 storage across multiple external boxes. RAID 60 requires a minimum of eight drives. RAID 6 is a nested RAID method that uses RAID 0 block-level striping across multiple RAID 6 arrays with dual distributed parity. With the inclusion of dual parity, RAID 60 will tolerate the failure of two disks in each spanned array without loss of data.</td>
<td>RAID5 protects against failure of one drive (and failure of particular multiple drives). RAID 50 is a nested RAID method that uses RAID 0 striping across RAID 5 arrays.</td>
<td>RAID5 tolerates one drive failure in each spanned array without loss of data. RAID 50 requires less rebuild time than single RAID 5 arrays. RAID 50 requires a minimum of six drives.</td>
<td>Medium</td>
</tr>
<tr>
<td>RAID6 with Advance Data Guarding (ADG)</td>
<td>RAID6 is most useful when data loss is unacceptable but cost is also an important factor. The probability that data loss will occur when an array is configured with RAID6 is less than it would be if it was configured with RAID5. However, write performance is lower than RAID5 because of the two sets of parity data.</td>
<td>RAID5 protects against failure of one drive (and failure of particular multiple drives). RAID 50 is a nested RAID method that uses RAID 0 striping across RAID 5 arrays.</td>
<td>RAID5 tolerates one drive failure in each spanned array without loss of data. RAID 50 requires less rebuild time than single RAID 5 arrays. RAID 50 requires a minimum of six drives.</td>
<td>High</td>
</tr>
</tbody>
</table>

### Disk drive sizes and types

RAID arrays should be composed of disk drives of the same size and performance capability. When drives are mixed within a disk enclosure, the usable capacity and the processing ability of the entire storage subsystem is affected. For example, when a RAID array is composed of different sized drives, the RAID array defaults to the smallest individual drive size, and capacity in the larger drives goes unused.

### Spare disks

Spare disks are disks that are not active members of any particular array, but have been configured to be used when a disk in one of the arrays fails. If a spare is present, it will immediately be used to begin rebuilding the information that was on the failed disk, using parity information from the other member disks. During the rebuilding process, the array is operating in a reduced state and, unless it is a RAID6 or RAID1+0 array, it cannot tolerate another disk failure in the same array. If another disk fails at this time, the array becomes inaccessible and information stored there must be restored from backup.
After the rebuild of the data onto the spare is completed, when a replacement drive is inserted to replace the failed drive, the system will automatically transfer the data from the spare onto the replacement drive and return the spare to an available-spare state. It is important to note that the process of rebuilding the spare or the replacement drive must not be interrupted or the process will be aborted.

Some administrators have multiple spare disks, so that multiple arrays can experience failure and successfully recover, before administrative intervention would be required to replace the spare or failed disk. When assigning a spare to an array, the administrator chooses which arrays and how many arrays are protected by that spare.

Array sizing

As a general rule, the greater the number of drives that are included in an array, the greater the performance level that can be achieved. However, performance considerations are offset by fault tolerance considerations. The greater the number of drives in an array, the higher the probability of one or more disk failures in that array. The administrator must strike a balance between performance and fault tolerance.
Preparing the site

Preparing your site includes:

- **Providing adequate structural support**
  Calculate the total weight of your equipment and verify that your site can support the weight. For HP ProLiant server environments, consider using Rack Builder, a software tool that provides a simplified method to planning and configuring racks and rack-mountable products. Rack Builder is available on the Options tab of the ProLiant Home page of the HP servers website: [http://www.hp.com/country/us/eng/prodserv/servers.html](http://www.hp.com/country/us/eng/prodserv/servers.html).

- **Providing adequate clearance space and ventilation**
  Be sure to provide adequate clearance around the front and back of the racks. Provide at least 63.5 cm (25 in) in the front of the rack to allow the doors to open fully and provide at least 76.2 cm (30 in) in the rear of the rack to allow for servicing and airflow.
  If there are unused spaces in your rack, attach blanking panels across those empty spaces to force the airflow through the components instead of through the open spaces.

- **Providing adequate and redundant sources of power**
  Make sure that you have two high-line power feeds installed near your computer. These two power sources usually come from the same external power grid, but occasionally might originate from different grids or even entirely different sources.
  For protection against a power-source failure, obtain and include two uninterruptible power supplies (UPS) in your installation. See the following URL for a list of available UPS: [http://www8.hp.com/us/en/products/ups/](http://www8.hp.com/us/en/products/ups/)
  For power consumption specifications, see the QuickSpecs for your disk enclosure model.

To ensure continuous, safe, and reliable operation of your equipment, place your system in an approved environment.

Consider using the HP Enterprise Configurator (eCO) to help plan and configure racks and rack-mountable devices. The eCO is available on the HP website: [http://h30099.www3.hp.com/configurator](http://h30099.www3.hp.com/configurator).
Racking the disk enclosure

The disk enclosure can be installed into most standard server racks. To verify that your rack is supported for use with the disk enclosure, see the QuickSpecs for the disk enclosure, available on the D3000 website.

⚠️ CAUTION: Install disk drives in the enclosures only after mounting the enclosures in the rack.
- A disk enclosure populated with disk drives is too heavy to lift safely.
- Movement of a disk enclosure during installation might damage the internal storage media of installed disk drives.

Rack installation best practices

In addition to industry-standard recommendations, consider the following:
- Locate the heaviest items, such as uninterruptible power supplies (UPS) and additional disk enclosures near the bottom of the rack.
- To make cabling easy, install the disk enclosures below the server.
- Install similar components next to each other in the rack. Because disk enclosures, switches, and servers are of differing depths, if you have more than one of a device, mount those devices adjacent to one another to accommodate working behind the rack.

⚠️ WARNING! To reduce the risk of personal injury or damage to the equipment, be sure that:
- At least two people lift the storage system during removal or installation if the weight exceeds 22.7 kg (50 lb). If the system is being loaded into the rack above chest level, a third person MUST assist with aligning the system with the rails while the other two people support the weight of the system.
- The leveling jacks on the rack are extended to the floor.
- The full weight of the rack rests on the leveling jacks.
- The stabilizing feet are attached to the rack if it is a single-rack installation.
- The racks are coupled together in multiple-rack installations.
- Only one component in a rack is extended at a time. A rack might become unstable if more than one component is extended.
- To prevent damage and to ease insertion of the device into the rack, support the weight of the device and keep it level when sliding it into the rack.

Rack Installation procedures

1. Position left and right rack rails at the desired 'U' position in the rack, adjusting the rails to fit the rack, as needed.
   Front and Rear bottom edge of the rails must align with the bottom of EIA boundary in the lowermost 'U'
   
   NOTE: Rails are marked L and R with an arrow indicating the direction in which the rail should be installed.

2. Use guide pins to align the shelf mount kit to the RETMA column holes.
   The bottom of the rail must align with the bottom of the U.

3. To engage the rear, push the rail toward the back of the rack until the spring hook (1) snaps into place.
4. To engage the front, pull the rail towards the front of the rack to engage the spring hook with the RETMA column in the same manner as the rear spring hook.

**NOTE:** Make sure that the respective guide pins for the square or round hole rack align properly into RETMA column hole spacing.

5. Secure rear of rack rail to the RETMA column with either the square- or round-hole shoulder screws, provided in the plastic accessory bag.

6. Secure front of rail to the front RETMA column using the provided flat securing screw/guide pin in the bottom screw position of the rail.

7. Slide the enclosure into position on the rails (1). Secure the chassis into the rack by tightening the captive CTO screw behind the latch on the front left and right bezel ears of the chassis (2).

⚠️ **CAUTION:** The front CTO screw must be attached at all times when racked.
8. The rear ends of the rails have a CTO bracket that must engage with the enclosure in order to secure it to the rails. Align the CTO bracket to the corresponding rear slot into the chassis. The movable bracket can be slid forward or back to correct position. The provided screw will secure the bracket and chassis to the rail.

9. When cabling the device, use holes provided in the rear rack rails, install tie wraps, and route external cable(s) as required.

**NOTE:** The provided screw must be secured tightly. HP recommends using a T25 driver.
Installing disk drives in the enclosure

Disk drive options

Depending on the enclosure model, 12 or 25 disk drives can be installed in the enclosure. A variety of disk drive models are supported for use, including dual-ported and single-ported models. For more information about supported disk drives, see the QuickSpecs for the disk enclosure, available on the D3000 website.

Disk drive guidelines

⚠️ CAUTION:

- Follow industry-standard practices when handling disk drives. Internal storage media can be damaged when drives are shaken, dropped, or roughly placed on a work surface.
- When installing a disk drive, press firmly to make sure the drive is fully seated in the drive bay and then close the latch handle.
- When removing a disk drive, press the release button and pull the drive only slightly out of the enclosure. Then, to allow time for the internal disk to stop rotating, wait approximately 10 seconds before completely removing the drive from the enclosure.
- Always populate hard drive bays starting with the lowest bay number. If only one hard drive is used, install it in the bay with the lowest device number.
- Disk drives are hot-pluggable.
- SAS and SATA disk drives may be installed in the same enclosure, but can not be included in the same RAID logical volume.

Installing a disk drive

⚠️ CAUTION: To prevent improper cooling and thermal damage, operate the enclosure only when all bays are populated with either a component or a blank.

1. Remove the drive blank.

2. Unlatch and swing out the latch handle on the drive. Then, slide the drive into the bay (1), pressing firmly on the drive to seat it. Close the latch handle (2), pressing firmly until it locks in place.
When a drive is inserted in an operational enclosure, the drive LEDs flash to indicate that the drive is seated properly and receiving power.

3. Determine the status of the hard drive.

For proper airflow and cooling, a drive blank must remain installed in all unused drive bays.
Installing SAS controllers or controller enclosures

When installing controllers or controller enclosures, be sure to do the following.

• Record information about the controller or controller enclosure that will connect to the disk enclosure.

• Depending on your deployment, do one of the following:
  ◦ For server connect deployments, install one or more Smart Array controllers in the server that will access the disk enclosure.
  ◦ For controller enclosure connect deployments, install or locate the controller enclosure to which the disk enclosure will connect.

**NOTE:** For detailed installation and configuration information about controller cards or controller enclosures, see the documentation provided with the controller card or controller enclosure.

Preparing the server

When preparing servers for the disk enclosure, be sure to do the following.

• Record information about the server and environment (server connect or controller enclosure connect) that will connect to the disk enclosure.

• Verify that the servers, controllers, operating system version, and service packs are supported for use with the disk enclosure. For more information, see the QuickSpecs for the disk enclosure, available on the D3000 website.

• Install all operating-system-specific service packs, patch kits, or other required tools.

• Install HP system management and monitoring tools, such as HP Systems Insight Manager (HP-SIM) and the Array Configuration Utility (ACU).

**NOTE:** For detailed installation and configuration information about the server or the software tools, see the documentation provided with the server or software.
Connecting SAS cables and power cords

Overview

Connecting cables includes the following steps:

1. Reading the “Cabling best practices” Page 32.
2. “Connecting SAS cables to the server or controller enclosure” Page 33.
3. “Connecting SAS cables to cascaded disk enclosures” Page 34.

IMPORTANT: The following illustrations demonstrate connecting a disk enclosure to a server with an installed controller. In your environment, the disk enclosure might connect to a controller enclosure, which then connects to the host or network. Cabling restrictions may exist for the different installation environments. For more information, see the user documents for your controller or controller enclosure.

NOTE: For additional examples of cabling scenarios, see (page 41).

Cabling best practices

- Use supported SAS cables and power cords. A variety of cables and cable lengths are supported for use with this disk enclosure. For more information, see the QuickSpecs for the disk enclosure, available on the D3000 website.

- Use the shortest possible cable between devices. Shorter cables reduce the possibility of signal degradation that might occur over longer distances. In addition, shorter cables are easier to manage and route along the back of the rack.

- Gather cables in the rear of the disk enclosure to ensure that the cabling in the back of the rack system does not interfere with system operation or maintenance. Bind cables loosely with cable ties and route the cables out of the way, along the side of the rack. When the cables are tied together and routed down the side of the rack, system components and indicators are easily visible and accessible.

- Bind and support cables in a manner that eliminates stress on connectors and tight bends of the cables. This prevents damage to the connector and cable, and ensures that the connector remains fully seated in the port.

- Attach a label near both ends of each cable to identify the device connected to that cable. Include the device, device name, port, or other useful information.

- Use colored markers to color code both ends of each cable, to help visually identify a particular cable without having to read or locate the label.

- In multipath configurations, you might want to loosely bind the matching pair of cables connecting devices.
Connecting SAS cables to the server or controller enclosure

To connect the first disk enclosure to the server or controller enclosure, use a standard mini-SAS cable.

**IMPORTANT:** When connecting this disk enclosure in a single-domain environment, only the top I/O module (I/O module A) in the disk enclosure is supported for use.

Observe the following guidelines:

- Only use supported SAS cables with mini-SAS connectors.
- Ensure that the servers or controller enclosures are powered down and power cords are disconnected before connecting SAS cables to the disk enclosure.

The following illustration demonstrates connecting a disk enclosure to a server with an installed controller. In your environment, the disk enclosure might connect to a controller enclosure, which then connects to the host or network. Regardless of environment, cabling principles from the disk enclosure to the host are the same.

Note the following when connecting cables:

- DP1 on the disk enclosure I/O module is treated as the SAS “in” port.
- DP2 on the disk enclosure I/O module is treated as the SAS “out” port.
- In single-domain configurations, one cable path is created between the host, the primary disk enclosure, and additional cascaded disk enclosures. (Shown)
- In dual-domain configurations, two cable paths are created between the host, the primary disk enclosure, and additional cascaded disk enclosures.
Connecting SAS cables to cascaded disk enclosures

To cascade additional disk enclosures from the disk enclosure that is connected to the server or controller enclosure, use standard mini-SAS cables.

As additional disk enclosures are connected to the first disk enclosure, they are assigned a box number. The assigned box number is displayed on the 7-segment display on the rear of the disk enclosure.

**IMPORTANT:**

- When connecting this disk enclosure in a single-domain environment, only the top I/O module (I/O module A) in the disk enclosure is supported for use.
- The number of supported cascaded disk enclosures varies per disk enclosure model and installation environment. For more information, see the QuickSpecs for the disk enclosure, controller, or controller enclosure, available on the HP storage website: [http://www.hp.com/go/storage](http://www.hp.com/go/storage).

Observe the following guidelines:

- Only use supported SAS cables with mini-SAS connectors.
- Use provided color clues on the disk enclosure when cabling cascaded disk enclosures; for example, connect “green” ports to “green” ports (connect I/O module A on one disk enclosure to I/O module A on the additional disk enclosure).

Note the following when connecting cables:

- DP1 on the disk enclosure I/O module is treated as the SAS “in” port.
- DP2 on the disk enclosure I/O module is treated as the SAS “out” port.
- In single-domain configurations, one cable path is created between the host, the primary disk enclosure, and additional cascaded disk enclosures. (Shown)
- In dual-domain configurations, two cable paths are created between the host, the primary disk enclosure, and additional cascaded disk enclosures.
Connecting power cords

When connecting power cords, use the cords shipped with the disk enclosure. The power cord should be approved for use in your country. The power cord must be rated for the product and for the voltage and current marked on the electrical ratings label of the product. The voltage and current rating for the cord should be greater than the voltage and current rating marked on the product. In addition, the diameter of the wire must be a minimum of 1.00 mm$^2$ or 18 AWG, your maximum length may be up to 3.66 m (12 ft).

After power is supplied to the disk enclosure, the power supply automatically senses the input voltage and the power supply LED illuminates as solid green.

To protect the system from power-failure-related downtime, each disk enclosure ships standard with a redundant power supply. Depending how you connect the power supplies to the power source, you can eliminate downtime caused by power-related failures.

<table>
<thead>
<tr>
<th>Connection Method</th>
<th>Level of Protection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connected to:</td>
<td></td>
</tr>
<tr>
<td>• One power source</td>
<td>Protects you from downtime when one of the disk enclosure power supplies fails.</td>
</tr>
<tr>
<td></td>
<td>The remaining power supply/fan module can operate the disk enclosure until you install</td>
</tr>
<tr>
<td></td>
<td>a replacement module.</td>
</tr>
<tr>
<td>Connected to:</td>
<td></td>
</tr>
<tr>
<td>• Two separate power sources</td>
<td>Protects you from downtime when one of the disk enclosure power supplies fails.</td>
</tr>
<tr>
<td></td>
<td>Protects you from data loss when one of your power sources fails, due to a pulled</td>
</tr>
<tr>
<td></td>
<td>cable or tripped breaker.</td>
</tr>
<tr>
<td></td>
<td>The remaining power source can power the disk enclosure until the failed power source</td>
</tr>
<tr>
<td></td>
<td>is restored or relocated. Depending on the cause and duration of the power outage,</td>
</tr>
<tr>
<td></td>
<td>you can use this time to properly shut down your storage subsystem.</td>
</tr>
<tr>
<td>Connected to:</td>
<td></td>
</tr>
<tr>
<td>• Two UPS</td>
<td>Protects you from downtime when one of the disk enclosure power supplies fails.</td>
</tr>
<tr>
<td>• Two separate power sources</td>
<td>Protects you from data loss when one or both of your power sources fails, due to a</td>
</tr>
<tr>
<td></td>
<td>pulled cable, tripped breaker, or local power outage.</td>
</tr>
<tr>
<td></td>
<td>The remaining power source or the UPS will power the disk enclosure until power is</td>
</tr>
<tr>
<td></td>
<td>restored to the source. Depending on the cause and duration of the power outage, you</td>
</tr>
<tr>
<td></td>
<td>can use this time to properly shut down your storage subsystem.</td>
</tr>
</tbody>
</table>

⚠️ **WARNING!** To reduce the risk of electric shock or damage to the equipment:

- Do not disable the power cord grounding plug. The grounding plug is an important safety feature.
- Plug the power cord into a grounded (earthed) electrical outlet that is easily accessible at all times.
- Route the power cord so that it is not likely to be walked on or pinched by items placed against it. Pay particular attention to the plug, electrical outlet, and the point where the cord is attached to the disk enclosure.
Powering on the disk enclosure

After disk enclosures are physically installed and cabled, apply power to the enclosure by connecting it to a live power source. Verify that they are operating properly.

Power on best practices

Observe the following best practices before powering on the enclosure for the first time:

- Complete the server, controller, or controller enclosure installation. For more information, see the server, controller, or controller enclosure user documents.
- Install the disk enclosures.
- Install disk drives in the disk enclosures so that the connected host controller can identify and configure them at power on.
- Connect the SAS cables and power cords to the enclosure.

Power on procedures

1. Apply power to each UPS, or plug the enclosure in to a live power source. The system power LED illuminates solid green.
2. Wait a few minutes for the disk enclosures to complete their startup routines.

⚠️ **CAUTION:** If power is applied to the server before the disk enclosures complete their startup routine, the server might not properly discover the storage.

3. Apply power to the controller enclosure (if included in the configuration).
4. Power on (or restart) the server with access to the disk enclosures, start the operating system, and log on as administrator.

⚠️ **CAUTION:** When you power on the server, the monitor might display a “New Hardware Found” message. Cancel out of this window to prevent the installation of unsupported software.

5. Verify that each component is operating properly.
Verifying the operating status of the disk enclosures

To verify that the disk enclosures and disk drives are operating properly, view the enclosure and disk drive LEDs and compare them with the patterns described in the following sections. If LED patterns are not as expected, check cable connections between the devices, check the availability of your power source, review the installation procedures, and remove and reinsert the module.

- “LFF Front view” (page 8)
- “SFF Front view” (page 9)
- “Fan module LEDs” (page 14)
- “Rear view” (page 10)
- “Power supply module LED” (page 13)
5 Configuration

Configuration overview

Regardless of the installation environment, operating system, or software tool used to configure the disk enclosure, the following tasks must be completed:

- Updating controller or controller enclosure firmware or drivers. Instructions are included with the controller or controller enclosure.
- Updating disk enclosure firmware. Instructions are included with the firmware. For more information, see “Updating disk enclosure firmware” Page 39.
- Configuring the disk enclosure and its storage.
  - Creating the logical storage units (LUNs).
  - Entering global controller settings, such as setting the read/write cache ratio, setting the rebuild/expand priority, and setting the redundancy level.
  - Identifying the operating system type (also called Host Mode or Profile) of the host that will access the disk enclosure. This ensures that the disk enclosure will communicate properly with that host.
  - Verifying that the configured storage is visible to the host.

Supported software tools

A variety of configuration, management, and diagnostic tools are supported for use with these disk enclosures. Which tools are supported for your installation environment is determined by the controller or controller enclosure to which the disk enclosure is connected.

For support information, see the QuickSpecs and user documents for the controller or controller enclosure.
6 Operation and management

Included topics:

- “Powering on disk enclosures” Page 39
- “Powering off disk enclosures” Page 39
- “Updating disk enclosure firmware” Page 39

Powering on disk enclosures

1. **IMPORTANT:** Always power on disk enclosures before controller enclosures and servers. This ensures that servers, during the discovery process, identify the enclosures and installed disk drives as operational devices.

Power on procedures

1. Apply power to each power supply module.
2. Once power is applied to the power supplies, the enclosure starts running.
   The power on LED turns solid green.
3. Wait a few minutes for the disk enclosures to complete their startup routines.
   - **CAUTION:** If power is applied to the server before the disk enclosures complete their startup routine, the server might not properly discover the storage.
4. Apply power to the controller enclosure (if included in the configuration).
5. Power on (or restart) the server with access to the disk enclosures, start the operating system, and log on as administrator.
   - **CAUTION:** When you power on the server, the monitor might display a “New Hardware Found” message. Cancel out of this window to prevent the installation of unsupported software.
6. Verify that each component is operating properly.

Powering off disk enclosures

1. **IMPORTANT:** Always power off disk enclosures after controller enclosures and servers.
   - **IMPORTANT:** When installing a hot-pluggable component, such as a disk drive, it is not necessary to power down the enclosure.

To power off a disk enclosure:

1. Power off any attached servers. For more information, see the server documentation.
2. Power off the controller enclosure (if included in the configuration.) For more information, see the controller enclosure documentation.
3. Power off the disk enclosures.
4. Disconnect power cords.
   The system is now without power.

Updating disk enclosure firmware

After initial installation and periodically after that, verify that all devices in the configuration have the latest available firmware installed.
To determine currently-installed firmware and software versions on system components, use management software utilities such as the HP System Management Home page, HP Systems Insight Manager (HP SIM), Storage Management Utility (SMU), or Command Line Interface (CLI).

To obtain the latest-available firmware and software, see the HP website: [http://www.hp.com/support](http://www.hp.com/support).

To perform the update, follow the procedures for your environment:

- For server connect environments, execute the downloaded Smart Component using the Firmware Maintenance CD.
- For controller enclosure connect environments, install the firmware download using the Storage Management Utility (SMU) or Command Line Interface (CLI).

**NOTE:** You can receive proactive support alerts, such as Customer Advisories, as well as updates on drivers, software, firmware, and customer replaceable components, via e-mail through HP Subscriber’s Choice. Sign up for Subscriber’s Choice at the following HP website: [http://www.hp.com/go/myadvisory](http://www.hp.com/go/myadvisory) and select the appropriate product.
7 Cabling examples

The following basic cabling examples are included:

- “Single-domain example” (page 42)
- “Dual domain example” (page 43)

**IMPORTANT:** The following illustrations demonstrate connecting disk enclosures to a generic host. Cabling restrictions may exist for server connect and controller enclosure connect environments. For more information, see the user documents for your controller or controller enclosure.
Single-domain example

This example illustrates cabling for a single-domain configuration. In this configuration, note the following:

- DP1 on the disk enclosure I/O module is treated as the SAS “in” port.
- DP2 on the disk enclosure I/O module is treated as the SAS “out” port.
- In single-domain configurations, one cable path is created between the host, the primary disk enclosure, and additional cascaded disk enclosures. (Shown)
- In dual-domain configurations, two cable paths are created between the host, the primary disk enclosure, and additional cascaded disk enclosures.
Dual domain example

This example illustrates cabling for a dual-domain configuration in a pattern that offers best possible fault tolerance. In this configuration, note the following:

- A multi-port, dual-domain controller in the host and dual-port disk drives in the disk enclosure are required for dual-domain deployments.
- Cables from each I/O module in the disk enclosure to the server or controller enclosure and to additional cascaded disk enclosures provide dual-domain connectivity.
- The reversing of the cable paths ensures access to the storage, even if the controller, cable, enclosure I/O module, or enclosure power supply fails.
- This example illustrates using a disk enclosure with one additional cascaded disk enclosure. More than one additional disk enclosure can be cascaded. For more information, see the QuickSpecs for the enclosure.
# Troubleshooting

If the enclosure does not initialize

1. **IMPORTANT:** After a power failure, the system automatically returns to the On state when A/C power is restored, except in the following cases:
   - If both power supplies are damaged.
   - If there is a single power supply in the system, and it is damaged.

   1. Ensure that power has been applied to the enclosure.
   2. Verify that the power LED is green.
   3. Verify that the power source is working:
      a. Verify that the power supplies are working by viewing the power supply LEDs. If necessary, remove and reinstall the power supplies to verify that they are seated properly.
      b. Remove and inspect AC power cords from both power supplies and reconnect them.

## Diagnostic steps

<table>
<thead>
<tr>
<th>Answer</th>
<th>Possible Reasons</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>System functioning properly.</td>
<td>No action required.</td>
</tr>
</tbody>
</table>
| Yes    | • Front Status and UID module might not be inserted properly, might have a damaged connector, or might have failed.  
        • Possible error condition exists. | • Be sure that the Front Status and UID module is undamaged and is fully seated.  
        • Check rear fault LEDs to isolate failed component.  
        • Contact an authorized service provider for assistance. |
Is the enclosure rear fault LED amber?

<table>
<thead>
<tr>
<th>Answers</th>
<th>Possible Reasons</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>Functioning properly.</td>
<td>No action required</td>
</tr>
</tbody>
</table>
| Yes     | Rear power and UID module might not be inserted properly, might have a damaged connector, or might have failed. | • Be sure that the rear power and UID module is undamaged and is fully seated.  
• Contact an authorized service provider for assistance. |

Is the System Health LED amber?

<table>
<thead>
<tr>
<th>Answer</th>
<th>Possible Reasons</th>
<th>Possible Solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>System functioning properly.</td>
<td>No action required.</td>
</tr>
</tbody>
</table>
| Yes    | • The system might have experienced a short. Controller firmware might be corrupted.  
• The system midplane might need replacement. | • Be sure that all components are fully seated.  
• Update controller firmware.  
• Contact an authorized service provider for assistance. |

Is the power supply LED amber?

<table>
<thead>
<tr>
<th>Answers</th>
<th>Possible Reasons</th>
<th>Actions</th>
</tr>
</thead>
</table>
| No      | • Power cords not connected or AC power is unavailable.  
• Power supply functioning properly. | • Remove and inspect the AC power cords from both power supplies and reconnect them.  
• No action required. |
| Yes     | Power supply might not be inserted properly, might have a damaged connector, or might have failed. | • Be sure that the power supply is undamaged and is fully seated.  
• Be sure that all pins on connectors and components are straight.  
• Contact an authorized service provider for assistance. |

Is the I/O module fault LED amber?

<table>
<thead>
<tr>
<th>Answer</th>
<th>Possible Reasons</th>
<th>Possible Solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>Functioning properly.</td>
<td>No action required.</td>
</tr>
</tbody>
</table>
| Yes    | • The I/O module is locked.  
• The I/O module has failed.  
• Other fault condition exists. | • Make sure that the I/O module is seated properly by pressing the I/O module firmly into its bay after the handle has clicked in place.  
CAUTION: Never remove an I/O module from the chassis while the status LED is green. Removing an active I/O module can result in data loss.  
• Contact an authorized service provider for assistance. |
Is the fan LED amber?

<table>
<thead>
<tr>
<th>Answers</th>
<th>Possible Reasons</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>Functioning properly.</td>
<td>No action required</td>
</tr>
</tbody>
</table>
| Yes     | Fan might not be inserted properly, might have a damaged connector, or might have failed. | • Be sure that the fan is undamaged and is fully seated.  
• Contact an authorized service provider for assistance. |
Recognizing disk drive failure

In an HP enclosure, a steadily glowing fault LED indicates that a disk drive has failed. Other indications of failed disk drives are as follows:

- ACU represents failed drives with a distinctive icon.
- HP SIM can detect failed drives remotely across a network. (For more information about HP SIM, see the documentation on the Management CD.)
- ADU lists all failed drives.
- Operating System log files

For additional information about diagnosing disk drive problems, see the HP ProLiant Servers Troubleshooting Guide.

Effects of a disk drive failure

When a disk drive fails, all logical drives that are in the same array are affected. Each logical drive in an array might be using a different fault-tolerance method, so each logical drive can be affected differently.

- RAID0 configurations cannot tolerate drive failure. If any physical drive in the array fails, all non-fault-tolerant (RAID0) logical drives in the same array also fail.
- RAID1+0 configurations can tolerate multiple drive failures as long as no failed drives are mirrored to one another (with no spares assigned).
- RAID5 configurations can tolerate one drive failure (with no spares assigned).
- RAID6 with ADG configurations can tolerate simultaneous failure of two drives (with no spares assigned).

Compromised fault tolerance

If more disk drives fail than the fault-tolerance method allows, fault tolerance is compromised, and the logical drive fails.

Factors to consider before replacing disk drives

Before replacing a degraded drive:

- Open HP SIM and inspect the Error Counter window for each physical drive in the same array to confirm that no other drives have any errors. For details, see the HP SIM documentation on the Management CD.
- Be sure that the array has a current, valid backup.
- Use replacement drives that have a capacity at least as great as that of the smallest drive in the array. The controller immediately fails drives that have insufficient capacity.
To minimize the likelihood of fatal system errors, take these precautions when removing failed drives:

- Do not remove a degraded drive if any other drive in the array is offline (the online LED is off). In this situation, no other drive in the array can be removed without data loss.

- **Exceptions:**
  - When RAID1+0 is used, drives are mirrored in pairs. Several drives can be in a failed condition simultaneously (and they can all be replaced simultaneously) without data loss, as long as no two failed drives belong to the same mirrored pair.
  - When RAID6 with ADG is used, two drives can fail simultaneously (and be replaced simultaneously) without data loss.
  - If the offline drive is a spare, the degraded drive can be replaced.

- Do not remove a second drive from an array until the first failed or missing drive has been replaced and the rebuild process is complete. (The rebuild is complete when the Online LED on the front of the drive stops blinking.)

  **Exceptions:**
  - In RAID6 with ADG configurations, any two drives in the array can be replaced simultaneously.
  - In RAID1+0 configurations, any drives that are not mirrored to other removed or failed drives can be simultaneously replaced offline without data loss.

### Automatic data recovery (rebuild)

When you replace a disk drive in an array, the controller uses the fault-tolerance information on the remaining drives in the array to reconstruct the missing data (the data that was originally on the replaced drive) and write it to the replacement drive. This process is called automatic data recovery, or rebuild. If fault tolerance is compromised, this data cannot be reconstructed and is likely to be permanently lost.

### Time required for a rebuild

- The time required for a rebuild varies considerably, depending on several factors:
  - The priority that the rebuild is given over normal I/O operations (you can change the priority setting by using ACU)
  - The amount of I/O activity during the rebuild operation
  - The rotational speed of the disk drives
  - The availability of drive cache
  - The model and age of the drives
  - The amount of unused capacity on the drives
  - The number of drives in the array (for RAID5 and RAID6 with ADG)

Allow approximately 5 minutes per gigabyte without any I/O activity during the rebuild process. This figure is conservative, and newer drive models usually require less time to rebuild.

System performance is affected during the rebuild, and the system is unprotected against further drive failure until the rebuild has finished. Therefore, replace drives during periods of low activity when possible.

⚠️ **CAUTION:** If the Online LED of the replacement drive stops blinking and the amber fault LED glows, or if other drive LEDs in the array go out, the replacement drive has failed and is producing unrecoverable disk errors. Remove and replace the failed replacement drive.
When automatic data recovery has finished, the online LED of the replacement drive stops blinking and begins to glow steadily.

**Failure of another drive during rebuild**

If a non-correctable read error occurs on another physical drive in the array during the rebuild process, the Online LED of the replacement drive stops blinking and the rebuild abnormally terminates. If this situation occurs, restart the server. The system might temporarily become operational long enough to allow recovery of unsaved data. In any case, locate the faulty drive, replace it, and restore data from backup.

**Handling disk drive failures**

If the controller was configured with hardware fault tolerance, complete the following steps after a disk drive failure:

1. Determine which physical drive failed. On hot-plug drives, an amber drive failure LED illuminates.
2. If the unit containing the failed drive does not support hot-plug drives, perform a normal shutdown.
3. Remove the failed drive and replace it with a drive that is of the same capacity. For hot-plug drives, after you secure the drive in the bay, the LEDs on the drive each flash once in an alternating pattern to indicate a successful connection. The online LED flashes, indicating that the controller recognized the drive replacement and began the recovery process.
4. Power on the server, if applicable.
5. The controller reconstructs the information on the new drive, based on information from the remaining physical drives in the logical drive. While reconstructing the data on hot-plug drives, the online LED flashes. When the drive rebuild is complete, the online LED is illuminated.
9 Replacement procedures

Customer self repair (CSR)

Information in (page 52) identifies hardware components that are customer replaceable. Using WEBES, ISEE or other diagnostic tools, a support specialist will work with you to diagnose and assess whether a replacement component is required to address a system problem. The specialist will also help you determine whether you can perform the replacement.

Parts-only warranty service

Your HP Limited Warranty might include a parts-only warranty service. Under the terms of parts-only warranty service, HP will provide replacement parts free of charge.

For parts-only warranty service, CSR part replacement is mandatory. If you request HP to replace these parts, you will be charged for travel and labor costs.

Best practices for replacing hardware components

The following information will help you replace the hardware components on your storage system successfully.

\[\text{\textbf{CAUTION:}}\] Removing a component significantly changes the air flow within the enclosure. Components or a blanking panel must be installed for the enclosure to cool properly. If a component fails, leave it in place in the enclosure until a new component is available to install.

Verifying component failure

- Consult HP technical support to verify that the hardware component has failed and that you are authorized to replace it yourself.
- Additional hardware failures can complicate component replacement. Check your management utilities to detect any additional hardware problems:
  - When you have confirmed that a component replacement is required, you might want to clear the failure message from the display. This makes it easier to identify additional hardware problems that might occur while waiting for the replacement part.
  - Before installing the replacement part, check the management utility for new hardware problems. If additional hardware problems have occurred, contact HP support before replacing the component.

Identifying the spare part

Parts have a nine-character spare part number on their label. For some spare parts, the part number might be available in the management software utility. Alternatively, the HP call center will assist in identifying the correct spare part number.

Replaceable parts

This product contains the replaceable parts illustrated in (page 52).
Parts that are available for customer self repair (CSR) are indicated as follows:

- Mandatory CSR where geography permits. Order the part directly from HP and repair the product yourself. On-site or return-to-depot repair is not provided under warranty.
- Optional CSR. You can order the part directly from HP and repair the product yourself, or you can request that HP repair the product. If you request repair from HP, you might be charged for the repair depending on the product warranty.
- No CSR. The replaceable part is not available for self repair. For assistance, contact an HP-authorized service provider

For more information about CSR, contact your local service provider or see the CSR website: [http://www.hp.com/go/selfrepair](http://www.hp.com/go/selfrepair)

To determine the warranty service provided for this product, see the warranty information website: [http://www.hp.com/go/storagewarranty](http://www.hp.com/go/storagewarranty)

To order a replacement part, contact an HP-authorized service provider or see the HP Parts Store online: [http://www.hp.com/buy/parts](http://www.hp.com/buy/parts)

### Replacing the failed component

⚠️ **CAUTION:** Components can be damaged by electrostatic discharge (ESD). Use proper anti-static protection.

- Always transport and store components in an ESD protective enclosure.
- Do not remove the components from the ESD protective enclosure until you are ready to install it.
- Always use ESD precautions, such as a wrist strap, heel straps on conductive flooring, and an ESD protective smock when handling ESD sensitive equipment.
- Avoid touching the components connector pins, leads, or circuitry.
- Do not place ESD generating material such as paper or non anti-static (pink) plastic in an ESD protective enclosure with ESD sensitive equipment.

- HP recommends waiting until periods of low storage system activity to replace a component.
- When replacing components at the rear of the rack, cabling might obstruct access to the component. Carefully move any cables out of the way to avoid loosening any connections. In particular, avoid cable damage that might be caused by:
  - Kinking or bending.
  - Disconnecting cables without capping. If uncapped, cable performance might be impaired by contact with dust, metal or other surfaces.
  - Placing removed cables on the floor or other surfaces, where they might be walked on or otherwise compressed.

### Replacement instructions

Printed instructions are shipped with the replacement part. Instructions for all replaceable components are also posted to the HP website: [http://www.hp.com/support/manuals](http://www.hp.com/support/manuals).
Hardware components
<table>
<thead>
<tr>
<th>Description</th>
<th>CSR status</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Chassis Bezel Ear</td>
<td>Not a CSR part (part of drive cage)</td>
</tr>
<tr>
<td>2. Chassis Bezel Ear</td>
<td>Not a CSR part (part of drive cage)</td>
</tr>
<tr>
<td>3. Drive Cage</td>
<td>Not a CSR part</td>
</tr>
<tr>
<td>4. Backplane</td>
<td>Mandatory</td>
</tr>
<tr>
<td>5. Fan module interconnect board</td>
<td>Mandatory</td>
</tr>
<tr>
<td>6. Voltage Regulator Module (VRM) or power module</td>
<td>Mandatory</td>
</tr>
<tr>
<td>7. Power supply</td>
<td>Mandatory</td>
</tr>
<tr>
<td>8. Enclosure</td>
<td>Not a CSR part</td>
</tr>
<tr>
<td>9. I/O module</td>
<td>Mandatory</td>
</tr>
<tr>
<td>10. Fan module</td>
<td>Mandatory</td>
</tr>
<tr>
<td>11. Rear Unit ID</td>
<td>Mandatory</td>
</tr>
<tr>
<td>12. Disk drive</td>
<td>Mandatory</td>
</tr>
</tbody>
</table>

To order a replacement part, contact an HP-authorized service provider or see the HP Parts Store online: [http://www.hp.com/buy/parts](http://www.hp.com/buy/parts)
10 Support and other resources

Contacting HP

Before you contact HP

Be sure to have the following information available before you call or contact HP:

- Technical support registration number (if applicable)
- Product serial number
- Product model name and number
- Product identification number
- Applicable error message
- Add-on boards or hardware
- Third-party hardware or software
- Operating system type and revision level

HP contact information

For the name of the nearest HP authorized reseller:

- See the Contact HP worldwide (in English) website:

For HP technical support:

- In the United States, for contact options see the Contact HP United States website:
  http://welcome.hp.com/country/us/en/contact_us.html. To contact HP by phone:
  - Call 1-800-HP-INVENT (1-800-474-6836). This service is available 24 hours a day, 7 days a week. For continuous quality improvement, calls might be recorded or monitored.
  - If you have purchased a Care Pack (service upgrade), call 1-800-633-3600. For more information about Care Packs, see the HP website:

- In other locations, see the Contact HP worldwide (in English) website:

Subscription service

HP recommends that you register your product at the Subscriber’s Choice for Business website:

After registering, you will receive email notification of product enhancements, new driver versions, firmware updates, and other product resources.

Documentation feedback

HP welcomes your feedback.

To make comments and suggestions about product documentation, please send a message to storagedocsFeedback@hp.com. All submissions become the property of HP.
Related information

Websites

- HP: http://www.hp.com
- HP storage: http://www.hp.com/go/storage
- HP support: http://www.hp.com/support
- HP manuals: http://www.hp.com/support/manuals
- HP downloads: http://www.hp.com/support/downloads

Document conventions and symbols

<table>
<thead>
<tr>
<th>Convention</th>
<th>Element</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue text: Document conventions and symbols</td>
<td>Cross-reference links and e-mail addresses</td>
</tr>
<tr>
<td>Blue, underlined text: <a href="http://www.hp.com">http://www.hp.com</a></td>
<td>Website addresses</td>
</tr>
</tbody>
</table>
| **Bold** text               | • Keys that are pressed  
                                • Text typed into a GUI element, such as a box  
                                • GUI elements that are clicked or selected, such as menu and list items, buttons, tabs, and check boxes |
| **Italic** text             | Text emphasis                                                             |
| **Monospace** text          | • File and directory names  
                                • System output  
                                • Code  
                                • Commands, their arguments, and argument values |
| **Monospace, italic** text  | • Code variables  
                                • Command variables |
| **Monospace, bold** text    | Emphasized monospace text                                                   |

⚠ **WARNING!** Indicates that failure to follow directions could result in bodily harm or death.

⚠ **CAUTION:** Indicates that failure to follow directions could result in damage to equipment or data.

⚠ **IMPORTANT:** Provides clarifying information or specific instructions.

⚠ **NOTE:** Provides additional information.

⚠ **TIP:** Provides helpful hints and shortcuts.

Customer self repair

HP customer self repair (CSR) programs allow you to repair your HP product. If a CSR part needs replacing, HP ships the part directly to you so that you can install it at your convenience. Some parts do not qualify for CSR. Your HP-authorized service provider will determine whether a repair can be accomplished by CSR.
For more information about CSR, contact your local service provider or see the CSR website: http://www.hp.com/go/selfrepair.

Rack stability

Rack stability protects personnel and equipment.

⚠️ **WARNING!** To reduce the risk of personal injury or damage to equipment:

- Extend leveling jacks to the floor.
- Ensure that the full weight of the rack rests on the leveling jacks.
- Install stabilizing feet on the rack.
- In multiple-rack installations, fasten racks together securely.
- Extend only one rack component at a time. Racks can become unstable if more than one component is extended.
11 Regulatory compliance notices

This section contains regulatory notices for the HP D3600/3700 12Gb SAS disk enclosures.

Regulatory compliance identification numbers

For the purpose of regulatory compliance certifications and identification, this product has been assigned a unique regulatory model number. The regulatory model number can be found on the product nameplate label, along with all required approval markings and information. When requesting compliance information for this product, always refer to this regulatory model number. The regulatory model number is not the marketing name or model number of the product.

Federal Communications Commission notice

Part 15 of the Federal Communications Commission (FCC) Rules and Regulations has established Radio Frequency (RF) emission limits to provide an interference-free radio frequency spectrum. Many electronic devices, including computers, generate RF energy incidental to their intended function and are, therefore, covered by these rules. These rules place computers and related peripheral devices into two classes, A and B, depending upon their intended installation. Class A devices are those that might reasonably be expected to be installed in a business or commercial environment. Class B devices are those that might reasonably be expected to be installed in a residential environment (for example, personal computers). The FCC requires devices in both classes to bear a label indicating the interference potential of the device as well as additional operating instructions for the user.

This is a class A device.

FCC rating label

The FCC rating label on the device shows the classification (A or B) of the equipment.

Class A equipment

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 instructions, might 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 personal expense.

Modifications

The FCC requires the user to be notified that any changes or modifications made to this device that are not expressly approved by Hewlett-Packard Company might void the user’s authority to operate the equipment.

Cables

When provided, connections to this device must be made with shielded cables with metallic RFI/EMI connector hoods in order to maintain compliance with FCC Rules and Regulations.
Batteries, battery packs, and accumulators should not be disposed of together with the general household waste. To forward them to recycling or proper disposal, use the public collection system or return them to HP, an authorized HP Partner, or their agents.

For more information about battery replacement or proper disposal, contact an authorized reseller or an authorized service provider.
Hinweise zu Batterien und Akkus

VORSICHT: Dieses Produkt enthält unter Umständen eine Batterie oder einen Akku.

- Versuchen Sie nicht, Batterien und Akkus außerhalb des Gerätes wieder aufzuladen.
- Schützen Sie Batterien und Akkus vor Feuchtigkeit und Temperaturen über 60°C.
- Verwenden Sie Batterien und Akkus nicht missbräuchlich, nehmen Sie sie nicht auseinander und vermeiden Sie mechanische Beschädigungen jeglicher Art.
- Vermeiden Sie Kurzschlüsse, und setzen Sie Batterien und Akkus weder Wasser noch Feuer aus.
- Entsorgen Sie Batterien und Akkus nur durch die von HP vorgesehenen Ersatzteile.

Batterien und Akkus dürfen nicht über den normalen Hausmüll entsorgt werden. Um sie der Wiederverwertung oder dem Sondermüll zuzuweisen, müssen Sie die öffentlichen Sammelstellen oder setzen Sie sich bereitwillig der Entsorgung mit einem HP Partner in Verbindung.

Weitere Informationen zum Austausch von Batterien und Akkus oder zur sachgemäßen Entsorgung erhalten Sie bei Ihrem HP Partner oder Servicepartner.

Istruzioni per la batteria

AVVERTENZA: Questo dispositivo può contenere una batteria.

- Non tentare di ricaricare la batteria se rimossa.
- Non usare la batteria anziana in un elettrodomestico con acqua o se sono esposti a temperature superiori a 60°C.
- Non smontare, schiacciare, forare o utilizzare in modo improprio la batteria.
- Non accendere i condotti esterni o gettare acqua o simili alla batteria.
- Schiaccia la batteria solo con i rami HP previsti a questo scopo.

Le batterie e gli accumulatori non devono essere smaltiti insieme ai rifiuti domestici. Per procedere al riciclaggio o al corretto smaltimento, utilizzare il sistema di raccolta pubblico dei rifiuti o rivolgersi a HP, al Partner Ufficiale o ai relativi rappresentanti.

Per ulteriori informazioni sulla sostituzione e sullo smaltimento delle batterie, contattare un Partner Ufficiale o un Centro di assistenza autorizzato.

Declaración sobre las baterías

AVERTENCIA: Este dispositivo puede contener una batería.

- No intente recargar las baterías si las extrae.
- Evite el contacto de las baterías con agua y no las exponga a temperaturas superiores a los 60°C (140°F).
- No llene incorrectamente, ni desmonte, aplaste o pinche las baterías.
- No conecte los conectores externos ni la araña al fuego o al agua.
- Sustituya las baterías solamente por otro dispositivo equivalente para HP.

Las baterías, los paquetes de baterías y los acumuladores no se deben eliminar junto con los desperdicios generales de la casa. Con el fin de tirarlos al contenedor de reciclaje adecuado, utilice los sistemas públicos de recogida de baterías o devuélvalos a HP, un distribuidor autorizado de HP o sus agentes.

Para obtener más información sobre la sustitución de la batería o su eliminación correcta, consulte con su distribuidor o servicio técnico autorizado.

バッテリに関する注意

警告: 本製品はバッテリを内蔵している場合があります。

- バッテリを取り外している場合は、充電しないでください。
- バッテリを水にさらしたり、60℃ (140°F) 以上の温度にさらさないでください。
- バッテリを処理、分解、破壊したり、穴があけたりしないでください。
- 外部端子を短絡させたり、火や水に投げしないでください。
- バッテリを交換する際は、HP指定の製品と交換してください。

バッテリ、バッテリーバッグ、蓄電池は一般的な家庭廃棄物と一緒に廃棄しないでください。
リサイクルまたは適切に廃棄するため、公共の収集システム、HP、HPパートナー、またはHPパートナーの代理店にお問い合わせください。

バッテリ交換および適切な廃棄方法についての情報は、HPのサポート窓口にお問い合わせください。
RoHS material content declarations

China RoHS material content declaration

India RoHS material content declaration
This product complies with the "India E-waste (Management and Handling) Rule 2011" and prohibits use of lead, mercury, hexavalent chromium, polybrominated biphenyls or polybrominated diphenyl ethers in concentrations exceeding 0.1 weight % and 0.01 weight % for cadmium, except for the exemptions set in Schedule 2 of the Rule.

Turkey RoHS material content declaration
Türkiye Cumhuriyeti: EEE Yönetmeliğine Uygundur

Ukraine RoHS material content declaration
Perchlorate material - special handling may apply. See http://www.dtsc.ca.gov/hazardouswaste/perchlorate
This product’s real-time clock battery or coin cell battery may contain perchlorate and may require special handling when recycled or disposed of in California.

Regulatory notices

Canadian notice (Avis Canadien)

Class A equipment
This class A digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la class A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

European Union notice
This product complies with the following EU directives:
• Low Voltage Directive 2006/95/EC
• EMC Directive 2004/108/EC

Compliance with these directives implies conformity to applicable harmonized European standards (European Norms) which are listed on the EU Declaration of Conformity issued by Hewlett-Packard for this product or product family. This compliance is indicated by the following conformity marking placed on the product:

Certificates can be obtained from http://www.hp.com/go/certificates.
Hewlett-Packard GmbH, HQ-TRE, Herrenberger Strasse 140, 71034 Boeblingen, German
Japanese notices

VCCI-A notice

Japanese power cord statement

製品には、同梱された電源コードをお使い下さい。
同梱された電源コードは、他の製品では使用出来ません。

Korean notices

Class A equipment

| A급 기기 (업무용 방송통신기기) | 이 기기는 업무용(A급)으로 전자파적합등록을 한 기기이오니 판매자 또는 사용자는 이 점을 주의하시기 바라며, 가정 외의 지역에서 사용하는 것을 목적으로 합니다。 |

 Taiwanese notices

BSMI Class A notice

警告使用者:

这是甲類的資訊產品，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。

Chinese notice

声明

此为 A级产品，在生活环境，该产品可能会造成无线电干扰。在这种情况下，可能需要用户采取可行的措施。
Recycling notices

English notice

Disposal of Waste Equipment by Users in Private Households in the European Union

This symbol means do not dispose of your product with your other household waste. Instead, you should protect human health and the environment by handing over your waste equipment to a designated collection point for the recycling of waste electrical and electronic equipment. For more information, please contact your household waste disposal service.

Bulgarian notice

Изхвърляне на отпадъчно оборудване от потребители в частни домакинства в Европейския съюз

Този символ върху продукта или опаковката му показва, че продуктът не трябва да се изхвърля заедно с другите битови отпадъци. Вместо това, трябва да предоставите човешкото здраве и околната среда, като предадете отпадъчното оборудване в предназначен за събирането му пункт за рециклиране на неизползвано електрическо и електронно оборудване. За допълнителна информация се свържете с фирмата по чистота, чиито услуги използвате.

Czech notice

Likvidace zařízení v domácnostech v Evropské unii

Tento symbol znamená, že nesmíte tento produkt likvidovat spolu s jiným domovním odpadem. Místo toho byste měli chránit lidské zdraví a životní prostředí tím, že jej předáte k tomu určené sběrné pracoviště, kde se zabývají recyklaci elektrického a elektronického vybavení. Pro více informací kontaktujte společnost zabývající se sběrem a svozem domovního odpadu.

Danish notice

Bortskaffelse af brugt udstyr hos brugere i private hjem i EU

Dette symbol betyder, at produktet ikke må bortskaffes sammen med andet husholdningsaffald. Du skal i stedet den menneskelige sundhed og miljø ved at afl evere dit brugte udstyr på et dertil beregnet indsamplingssted for af brugt, elektrisk og elektronisk udstyr. Kontakt nærmeste renovationsafdeling for yderligere oplysninger.

Dutch notice

Inzameling van afgedankte apparatuur van particuliere huishoudens in de Europese Unie

Dit symbool betekent dat het product niet mag worden gedeponeerd bij het overige huishoudelijke afval. Bescherm de gezondheid en het milieu door afgedankte apparatuur in te leveren bij een hiervoor bestemd inzamelpunt voor recycling van afgedankte elektrische en elektronische apparatuur. Neem voor meer informatie contact op met uw gemeentereinigingsdienst.
Estonian notice

Aravisatavate seadmete likvideerimine Euroopa Liidu eramajapidamistes

Finnish notice

Kotitalousjätteiden hävittäminen Euroopan unionin alueella
Tämä symboli merkitsee, että laitetta ei saa hävittää muiden kotitalousjätteiden mukana. Sen sijaan sinun on suojaattava ihmisten terveyttä ja ympäristöä toimittamalla käytöstä poistettu laite sähkö- tai elektriikkajätteen kierrätyspisteeseen. Lisätietoja saat jättehoidotyöntöihntä.

French notice

Mise au rebut d'équipement par les utilisateurs privés dans l'Union Européenne
Ce symbole indique que vous ne devez pas jeter votre produit avec les ordures ménagères. Il est de votre responsabilité de protéger la santé et l'environnement et de vous débarrasser de votre équipement en le remettant à une déchetterie effectuant le recyclage des équipements électriques et électroniques. Pour de plus amples informations, prenez contact avec votre service d'élimination des ordures ménagères.

German notice

Entsorgung von Altgeräten von Benutzern in privaten Haushalten in der EU

Greek notice

Απόρριψη άχρηστου εξοπλισμού από ιδιώτες χρήστες στην Ευρωπαϊκή Ένωση
Αυτό το σύμβολο σημαίνει ότι δεν πρέπει να απορρίπτετε το προϊόν με τα λοιπά οικιακά απορρίμματα. Αντίθετα, πρέπει να προστατεύετε την ανθρώπινη υγεία και το περιβάλλον παραδίδοντας τον άχρηστο εξοπλισμό σας σε εξουσιοδοτημένο σημείο συλλογής για την ανακύκλωση άριστου ηλεκτρικού και ηλεκτρονικού εξοπλισμού. Για περισσότερες πληροφορίες, επικοινωνήστε με την υπηρεσία απόρριψης απορριμμάτων της περιοχής σας.
Hungarian notice

A hulladék anyagok megsemmisítése az Európai Unió háztartásaiiban
Ez a szimbólum azt jelzi, hogy a készüléket nem szabad a háztartási
hulladékkal együtt kidobni. Ehelyett a
léselejteztet berendezéseknak az elektromos vagy elektronikus hulladék
átvételeire kijelölt helyen történő
beszolgáltatásával megóvja az emberi egészséget és a környezetét. További
információt a helyi közösségi
vállalattól kaphat.

Italian notice

Smaltimento di apparecchiature usate da parte di utenti privati
nell’Unione Europea
Questo simbolo avvisa di non smaltire il prodotto con i normali rifiuti
domestici. Rispettare la salute umana e l’ambiente conferendo
l’apparecchiatura dismessa a un centro di raccolta designato per il riciclo di
apparecchiature elettriche ed elettroniche. Per ulteriori informazioni, rivolgersi
al servizio per lo smaltimento dei rifiuti domestici.

Latvian notice

Eurosop Sajungos namu vartotojų įrangos atliekų šalinimas
Šis simbols nurodo, kad gaminio negalima išmesti kartu su kitomis buitinėmis
atliekomis. Kad apsaugotumėte žmonių sveikatą ir aplinką, paseniusią
nenaudojama įrangą turite nuvežti į elektrinių ir elektroninių atliekų surinkimo
punktą. Daugiau informacijos teiraukitės buitinės atliekų surinkimo tarnybos.

Lithuanian notice

Nolietauti liķušu išnicināšanas noteikumi līetotājiem Eiropas Savienības
privātās mājsaimniecībās
Šis simbolis norāda, ka ierīci nedrīkst utilizēt kopā ar citiem mājsaimniecības
atkritumiem. Jums jārotējās par cilvēku veselības un vides aizsardzību,
nododot lietu aprikojumu otroreizējai pārstrādi. Iepriekš lietu elektrisko un
elektronisko ierīci savākānas punktā. Lai iespējātu plašāku informāciju, lūdzu,
sazinieties ar savu mājsaimniecības atkritumu likvidēšanas dienestu.

Polish notice

Używana zużytego sprzętu przez użytkowników w prywatnych
gospodarstwach domowych
w krajach Unii Europejskiej
Ten symbol oznacza, że nie wolno wyrzucać produktu wraz z innymi
domowymi odpadami. Obowiązkiem użytkownika jest ochrona zdrowia
ludzkiego i środowiska przez przekazanie zużytego sprzętu do wyznaczonego
punktu zajmującego się recyklingiem odpadów powstałych ze sprzętu
elektrycznego i elektronicznego. Więcej informacji można uzyskać od lokalnej
firmy zajmującej się wywozem nieczystości.
Portuguese notice

Descarte de equipamentos usados por utilizadores domésticos na União Europeia
Este símbolo indica que não deve descartar o seu produto juntamente com os outros lixos domiciliares. Ao invés disso, deve proteger a saúde humana e o meio ambiente levando o seu equipamento para descarte em um ponto de recolha destinado à reciclagem de resíduos de equipamentos eléctricos e electrónicos. Para obter mais informações, contacte o seu serviço de tratamento de resíduos domésticos.

Romanian notice

Casarea echipamentului uzat de către utilizatorii casnici din Uniunea Europeană
Acest simbol înseamnă să nu se arunce produsul cu alte deșeuri menajere. În schimb, trebuie să protejați sănătatea umană și mediul predând echipamentul uzat la un punct de colectare desemnat pentru reciclarea echipamentelor electrice și electronice uzate. Pentru informații suplimentare, vă rugăm să contactați serviciul de eliminare a deșeurilor menajere local.

Slovak notice

Likvidácia vyradených zariadení používatelia v domácnostiach v Európskej únii
Tento symbol znamená, že tento produkt sa nemá likvidovať s ostatným domovým odpadom. Namesto toho by ste mali chrániť ľudské zdravie a životné prostredie odovzdaním odpadového zariadenia na zbiernom mieste, ktoré je určené na recykláciu odpadových elektrických a elektronických zariadení. Ďalšie informácie získate od spoločnosti zaobrazujúcej sa likvidáciou domového odpadu.

Spanish notice

Eliminación de los equipos que ya no se utilizan en entornos domésticos de la Unión Europea
Este símbolo indica que este producto no debe eliminarse con los residuos domésticos. En lugar de ello, debe evitar causar daños a la salud de las personas y al medio ambiente llevando los equipos que no utilice a un punto de recogida designado para el reciclaje de equipos eléctricos y electrónicos que ya no se utilizan. Para obtener más información, póngase en contacto con el servicio de recogida de residuos domésticos.

Swedish notice

Hantering av elektroniskt avfall för hemanvändare inom EU
Türkiye Cumhuriyeti: EEE Yönetmeliğine Uygundur
Index

B
best practices
cabling, 32
power sources, 35
powering on, 36
racking, 26

C
cables
  best practices, 32
cable management considerations, 32
connecting cascaded enclosures, 34
connecting power cords, 35
connecting to the controller, 33
SAS, 16, 32
cabling example
dual-domain, 43
single-domain, 42
cabling guidelines, 33, 34
Canadian notice, 60
cascaded disk enclosures, 34
Chinese notices, 61
clearance space, 25
components, 7
disk drive blanks, 11
disk drives, 11
fan, 14
front status and UID, 12
I/O module, 15
power supply, 13
rear power and UID, 16
SAS cables, 16
supported disk drives, 29
configuration
  initial tasks, 38
  supported software tools, 38
connecting cables to cascaded enclosures, 34
connecting cables to the controller, 33
connecting power cords, 35
controller
  preparing for use with disk enclosure, 31
conventions
documentation, 55
text symbols, 55
Customer Self Repair (CSR)
defined, 50, 55
parts list, 50
website, 55

D
diagnostic steps, 44
  if the enclosure does not initialize, 44
  if the enclosure front fault LED is amber, 44
  if the enclosure rear fault LED is amber, 46
  if the fan LED is amber, 46
  if the I/O module fault LED is amber, 45
  if the power on/standby LED is amber, 45
  if the power supply LED is amber, 45
  recognizing disk drive failure, 47
diagnostic tools, 38
disk drives
  caution, 26
defined, 11
LEDs, 11
  recognizing disk drive failure, 47
  supported, 29
disk enclosure
  available models, 7
european union notice, 60
dual domain
diagram, 7
diagram
  dual-domain, 43
diagram
  single-domain, 42
diagram
  exploded view, 52
diagram
  illustrated, 7
LFF
diagram
  component callout, 8
diagram
  drive bay numbering, 8
diagram
  front view, 8
diagram
  rear view, 8
SFF
diagram
  component callout, 9, 10
diagram
  drive bay numbering, 10
diagram
  front view, 9
diagram
  rear view, 10
document
  revision history, 2
documentation
  conventions, 55
  providing feedback, 54
dual domain
diagram, 7
example cabling, 43

E
environmental requirements, 25
European union notice, 60

F
fan failure, 14
fan module
  defined, 14
  LEDs, 14
Federal Communications Commission notice, 57
front status and UID module
  defined, 12
  LEDs, 12

G
guidelines
cabling, 33, 34

H
hard drive
options, 29
help
obtaining, 20, 54
HP
Subscriber’s Choice for Business, 21
technical support, 54
I
I/O module
defined, 15
LEDs, 15
installation
assistance, HP, 20
J
Japanese notices, 61
K
Korean notices, 61
L
LEDs
disk drives, 11
fan module, 14
front status and UID module, 12
I/O module, 15
power supply module, 13
M
models, compared, 7
P
parts
replaceable, 50
physical requirements, 25
planning
confirming support for components, 20
confirming warranty support, 21
identifying system components, 21
installation, 20
preparing the site, 25
recording information, 21
signing up for email alerts, 21
the storage configuration, 22
using the overview poster, 21
power
applying to the disk enclosure, 36
connecting power cords, 35
protection against failure, table, 35
providing redundant sources, 25
removing from the disk enclosure, 39
shutdown sequence, 39
startup sequence, 36
power cord
AC, 35
power on/standby button
defined, 16
location, 16
operation, 16
power requirements, 25
power supply module
defined, 13
LEDs, 13
powering off, 39
powering on
best practices, 36
troubleshooting, 44
preparing the controller
for disk enclosure, 31
preparing the server
for disk enclosure, 31
R
Rack Builder
website, 25
rack stability
warning, 56
racking
best practices, 26
rear power and UID module
defined, 16
redundant
power cables, 35
regulatory compliance
Canadian notice, 60
Chinese notices, 61
European Union notice, 60
identification numbers, 57
Japanese notices, 61
Korean notices, 61
Taiwanese notices, 61
revision table, 2
S
SAS cables, connecting, 32
server
preparing for use with disk enclosure, 31
shutdown
sequence, 39
single domain
example cabling, 42
software utilities, supported, 38
specifications
environmental, 17
general, 17
power, 17
startup
sequence, 36
status
disk drives, 11
fan module, 14
front status and UID module, 12
I/O module, 15
power supply module, 13
structural support, 25
Subscriber’s Choice, HP, 54
website, 21
symbols in text, 55
Taiwanese notices, 61
technical support
   HP, 54
      service locator website, 55
text symbols, 55
troubleshooting
   powering on, 44

UID button
   front, 13
   rear, 16
utilities, supported, 38

ventilation requirements, 25

warnings
   personal injury, equipment damage, 26
   power related, 35
   rack stability, 56
websites
   customer self repair, 55
   HP, 55
   HP Subscriber’s Choice for Business, 54
weight considerations, 25