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Compaq ProLiant DL320 Ultra-Dense Server Deployment in Compaq Racks

***Abstract:** This white paper is intended for use as a planning guideline to expedite concentrated deployments of several Compaq ProLiant[®] DL320 servers in a Compaq rack. Use this white paper in conjunction with documents for the ProLiant DL320 server and Compaq rack deployment products. This paper is intended for Field Systems Engineers (FSEs) and customers (IT managers, system managers, account managers, and installers).*

Executive Summary

Many of the network infrastructure and web applications that business enterprises and service providers use work best on dedicated servers, creating the need to fit a large number of smaller servers into existing server rooms and data centers. Compaq fulfills this need with the density-optimized line of ProLiant servers such as the ProLiant DL320. At a height of 1U each, up to 42 ProLiant DL320 servers can fit in a single Compaq rack. While the space-saving benefits of this server are clear, the compressed size of the ProLiant DL320 presents new challenges for rapid deployment of servers into a rack, as well as cable management and environmental considerations.

Compaq engineers have developed innovations in rapid high-volume deployment and improved cable management for large installations of ProLiant DL320 servers. This white paper introduces planning considerations, power distribution units, server and rack requirements, and installations. It also outlines the products associated with high-volume deployment in Compaq rack configurations.

IMPORTANT: This document discusses only the ProLiant DL320 server, the Compaq 7000- and 9000-series racks, and related Compaq rack options. This document does not discuss other Compaq servers or products or racks not manufactured by Compaq.

Notice

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Symbols in Text

The following symbols may be found in the text of this guide.



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



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

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

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

Symbols on Equipment

The following symbols are located on equipment in areas where hazardous conditions may exist.



This symbol in conjunction with any of the following symbols indicates the presence of a potential hazard. The potential for injury exists if warnings are not observed. Consult the documentation included with the server for specific details.



This symbol indicates the presence of hazardous energy circuits or electric shock hazards. Refer all servicing to qualified personnel.

WARNING: To reduce the risk of injury from electric shock hazards, do not open this enclosure. Refer all maintenance, upgrades, and servicing to qualified personnel.



This symbol indicates the presence of electric shock hazards. The area contains no user or field serviceable parts. Do not open for any reason.

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



This symbol on a RJ-45 receptacle indicates a Network Interface Connection.

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



This symbol indicates the presence of a hot surface or hot component. If this surface is contacted, the potential for injury exists.

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

Customer Guidelines

Adhere to the following guidelines when servicing or installing a Compaq server:



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

- Unplug the power cord from the system.
 - 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.
-



CAUTION: To properly ventilate the system, provide at least 3 inches (7.6 cm) of clearance at the front and back of the computer.



CAUTION: The system is designed to be electrically grounded. To ensure proper operation, plug the AC power cord only into a properly grounded (earthed) AC outlet.

Rack Warnings



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

- Do not attempt to move or relocate an equipment rack populated with servers. A fully populated rack can weigh as much as 1,700 pounds. The rack may become unstable and cause serious personal injury or equipment damage.
 - Before installing the servers, extend the leveling jacks to the floor, and rest the full weight of the rack on the leveling jacks. Either install the stabilizer kit or couple multiple racks together for stability.
 - Always load the heaviest item first, and load the rack from the bottom to the top. Loading in this manner makes the rack “bottom-heavy” and helps prevent the rack from becoming unstable.
 - Extend only one ProLiant DL320 server at a time. A rack may become unstable if more than one ProLiant DL320 server is fully extended for any reason.
-



CAUTION: Do not overload the AC supply branch circuit that provides power to the rack.

Note: Slide rails, power distribution units (PDUs), power cords, and cables can be preinstalled into the rack in a build room or on the data center floor before moving the rack to its final location.

Where to Find Information

This white paper is divided into sections that address important aspects of planning and installing a high-volume deployment of ProLiant DL320s in Compaq 7000-and 9000-series racks. Table 1 describes the information each section discusses and Table 2 outlines the appropriate steps to follow for high-volume server deployment.

Table 1. Where to find information

Section	Description	Where to Find
Introduction	Explains the purpose and scope of this white paper and provides a glossary of terms	Page 5
Power, Thermal, and Weight Information	Lists important information about the ProLiant DL320, Compaq racks, PDUs, and related options to help choose a rack configuration	Page 9
Power Distribution Units	Discusses specifics of PDU choices	Page 10
Console Management Systems	Discusses different options for server management	Page 14
Planning Rack Configurations	Discusses issues related to deciding on rack configurations	Page 16
Installation Procedures	Describes installation procedures	Page 28
Related Documents, Appendix A	Lists documents and Web sites that provide additional information about Compaq racks, rack options, and rack deployment of ProLiant DL320 servers	Page 36
Parts Reference, Appendix B	Lists part numbers for all the components referred to in this white paper	Page 37
Power and Thermal Budgeting, Appendix C	Explains calculating deratings	Page 41

Table 2. Steps for high-volume server deployment

Step	Description
Step 1	Choose PDUs from Table 6.
Step 2	Determine the PDUs and related options from Table 8, Table 9, and Table 10.
Step 3	Determine rack configuration. See examples on pages 21-25.
Step 4	Determine rail, console, and cable configurations. See the "Rack Management Systems" section on page 26.
Step 5	Install the ProLiant DL320 server. See the "Installation Procedures" section on page 28.

Introduction

Compaq designed the ultra-dense ProLiant DL320 server to meet the challenges associated with deploying a high concentration of servers in a single rack. Compaq suggests that customers evaluate their environments, power distribution, console, cable, and thermal management choices well in advance to ensure the efficient deployment of multiple ProLiant DL320 servers in a rack. Use this document, in conjunction with the documents listed in Appendix A, as a guideline for planning rack configurations for high-volume deployments of ProLiant DL320 servers.

The section of this paper titled "Power Distribution Units (PDUs)" outlines Compaq PDU choices best suited for building rack configurations. This section provides technical specifications for high- and low-voltage PDUs. It also describes how to allocate the correct number and type of PDUs for specific rack deployments.

The section titled “Planning Rack Configurations” provides weight information for individual rack components to help address floor support requirements. It also describes cable and console management systems.

All discussions of power requirements for ProLiant DL320 servers are based on the input power of the server. For calculation purposes, this document uses the maximum rated power supply input of 200 watts. However, derating the input power is effective for the following reasons:

- To minimize the number of PDUs required for each rack
- To match the rack current requirements with the existing circuit breaker capacity
- To match the rack cooling requirements with the existing facility cooling capability

For more information about input power derating, see Appendix C.

Note: In this document, derating the input power budget means not using the maximum rated input power values for the power supply. **Compaq strongly recommends that the derated power budget satisfies all the installation requirements, including future upgrade plans.**

Refer to the *Compaq ProLiant DL320 QuickSpecs* for detailed specifications and options for the ProLiant DL320 server.

References

Sources referenced in this paper are listed in Table 3.

Table 3. Sources of information

Topic	Where to Find
Information focal point for the Compaq ProLiant DL320 server	www.compaq.com/proliant
ProLiant DL320 server specifications, options, and a list of other Compaq products and options compatible with the ProLiant DL320 server	<i>Compaq ProLiant DL320 QuickSpecs</i>
Installation and servicing guidelines for the ProLiant DL320 server	<i>Compaq ProLiant DL320 Setup and Installation Guide</i> , P/N 203836-001 <i>Compaq ProLiant DL320 Maintenance and Service Guide</i> , P/N 203834-001
Installation of Sliding Rail option kit	Sliding Rails and Cable Management Solution Guide for ProLiant DL360 and DL320 Servers, P/N 169549-002
Installation of vertical-mount PDU brackets and Y-cables	Vertical-Mount PDU Brackets kit, P/N 191265-B21 Vertical-Mount PDU Brackets with High Voltage Cables kit, P/N 166097-B21
Installation guidelines for the ProLiant DL320 server in third-party racks	Compaq Ultra-Dense Server Deployment in Third-party Cabinet Racks, Document Number 12CU-0400A-WWEN Third-Party Rack kit, P/N 174574-B21
Installation guidelines for the ProLiant DL320 server in telecommunications (Telco) racks	Compaq Ultra-Dense Server Deployment in Telecommunications (Telco) Racks, Document number 12CZ-0400A-WWEN Telco Rack kit, P/N 174576-B21
Customer advisory on 9000-series racks casters	Customer Advisory: Caster wheels on 9000 Series Racks May Break When Moved Under Load, Document number EX991108_CW01

Table 4 lists the notations for components used in this paper:

Table 4. Notations for optional components

Notation	Description
1x, 2x, 4x	Number of components, for example, 1x128 MB means one 128-MB DIMM
800 MHz	Intel Pentium III 800- MHz Processor
933 MHz	Intel Pentium III 933-MHz Processor
128 MB	128-MB DIMM
256 MB	256-MB DIMM
512 MB	512-MB DIMM
HDD	Hard Disk Drive
9.1 GB	9.1-GB, 10,000-rpm Wide Ultra3 SCSI HDD
18.2 GB	18.2-GB, 10,000-rpm Wide Ultra3 SCSI HDD
10 GB	10-GB, 7,200-rpm ATA100 HDD
20 GB	20-GB, 7,200-rpm ATA100 HDD
SA431	Smart Array 431 Controller option (64-bit PCI card)
Remote Insight Lights-Out Edition	Remote Insight Lights-Out Edition option (32-bit PCI card)

Glossary

Note: For detailed information about the products in this glossary, visit the Compaq Web site: www.compaq.com

1U – A rack unit (1U) is 1.75 inches or 44.45 mm in vertical dimension. The height of a device, (also known as form factor), can be expressed in rack units (Us). The ProLiant DL320 server is a 1U server.

Fixed-Rail – The standard fixed server rails are factory-installed on each ProLiant DL320 server. The standard fixed rack rails shipped with the server are designed for use in Compaq 7000- and 9000-series racks.

Flat Panel Display (FPD) – The Compaq TFT5000R (15-inch) flat panel monitor provides a large image size and exceptional screen performance in a space-saving 2U size that allows the monitor to be neatly tucked away when not in use.



Figure 1. Flat Panel Monitor (TFT5000R)

High Voltage – AC line voltage of 200 V to 240 V. With higher voltage levels, a server can use a lower current and still meet its power requirements. Compaq recommends using a high-voltage source to support high-volume deployments of ProLiant DL320 servers in a rack.



In-Rack Keyboard – The 1U Rack Keyboard Drawer and the Internal Keyboard with Trackball are designed to work together to save room in space-constrained rack-mount environments. The 1U Keyboard Drawer requires only half the Compaq rack depth and provides enough space behind it to mount a Compaq Server Console Switch.

Figure 2. 1U Keyboard Drawer and Internal Keyboard with Trackball

Keyboard/Video/Mouse (KVM) – KVM refers to a keyboard cable, a video cable, a mouse cable, or a switch. Some Compaq parts lists may refer to KVM switches as Server Console Switches.

Local Console – A local console system does not use a network connection to interact with the server. A local console system incorporates a set of KVM devices and can be in-rack or off-rack. In this paper, **in-rack** local console refers to a flat panel display and a keyboard/trackball in the same rack as the servers. **Off-rack** local console refers to any combination of a display, a keyboard, and a pointing device located outside of the rack.

Low Voltage – Low voltage refers to AC line voltage of 100 V to 120 V.

N.A. – N.A. refers to North America including U.S., Canada, and Mexico.

Network Interface Controllers (NICs) – NICs are embedded on the system board of the ProLiant DL320 server.

Power Distribution Unit (PDU) – A PDU can be a high- or low-voltage device. See the section of this paper titled “Power Distribution Units ” for more details on PDUs.

Remote Console – A remote console is a server console system that uses a network connection to interact with the server. This system allows any computer with appropriate software and network access to control a server from anywhere across the globe. Compaq recommends using the remote-console system for managing a large number of servers because it eliminates the congestion of KVM cabling.

Remote Insight Lights-Out Edition – The Compaq Remote Insight Lights-Out Edition is designed to provide remote access and control of Compaq ProLiant server products from anywhere on the network with a standard web browser. Consequently, customers can deploy a ProLiant DL320 in a true “headless” fashion with a minimum of only three cables per server: one power cord for the server, one network cable for the LAN connection, and one network cable for the Remote Insight Lights-Out Edition management LAN connection. Using the Remote Insight Lights-Out Edition, customers can deploy 42 ProLiant DL320 servers in a 42U Compaq rack with significantly fewer cables than in a local console.

Server Console Switch – Compaq Server Console Switches allow multiple servers in a rack to be accessed and managed by a single keyboard, mouse, and monitor. These switches are also known as KVM switches.

Sliding Rail – The sliding rail is a rack management system designed for Compaq 7000- and 9000-series racks that supports in-rack serviceability for ProLiant DL320 servers.

UID LED and Switch – The blue Unit Identification LED identifies the ProLiant DL320 server requiring service. A UID switch toggles both the front and rear UID LEDs simultaneously.

Wake on LAN (WOL) – WOL enables a remote restart of the server.

Power, Thermal, and Weight Information

Power, thermal, and weight considerations are the most important parameters in high-volume server deployment. Table 5 provides server parameters necessary to calculate the power needs, thermal requirements, and total weight of a full rack of ProLiant DL320 servers.

Table 5. ProLiant DL320 parameters

Dimensions H x W x D	1.67 x 16.75 x 21.5 inches (4.24 x 42.55 x 54.6 cm)	
Weights	Servers:	
	Minimum configuration: 1x processor, 1x128 -MB DIMM, 1xCD/Diskette Blank, 0x HDD	19.8 lb
	Standard Configuration: 1x processor, 1x128 -MB DIMM, 1x HDD, 1x CD/Diskette Assembly	22.1 lb
	Maximum Configuration: 1x processor, 4x DIMMs, 2x HDDs, 1x SA431, 1x CD/Diskette Assembly	24.6
	Components:	
	CD/Diskette Drive Assembly	1.4 lb
	DIMM	0.1 lb
	HDD	1.3 lb
Power Ratings	Maximum Rated Input AC power (Power Supply Input)	200 W
	Maximum Rated Power Supply DC Output (200W Peak)	180 W
	Maximum Input Current Rating:	
	2 A	100 VAC
	1 A	200 VAC
Thermal Dissipation	Up to 682 BTUs per hour	
Relative Humidity (non-condensing)	Operating:	10 to 90%
	Non-operating	10 to 95%

The SA431 option and the Remote Insight Lights-Out Edition option are PCI cards available from Compaq. Any third party PCI cards used in the ProLiant DL320 server must comply with the industry-standard PCI specifications for dimension, weight, power, and thermal requirements.

Power Distribution Units

Compaq offers several PDUs designed for use in high-volume rack deployments. Compaq PDUs are equipped with circuit breakers that provide over current and surge protection for connected devices to help prevent electrical surges and external equipment malfunction. Compaq offers a variety of PDUs that support both high- and low-voltage applications. Table 6 lists PDU options.

Table 6. Compaq PDUs

Part Number	Availability	Input Voltage	Current Rating	Maximum Servers per PDU	Input Connectors and Cord	Output Connectors	Output Breakers	Dimensions	Weight
295363-001 ¹	North America	Low	24 A	12	NEMA L5-30P 12-ft. cord	12× NEMA 5-15R	2×15A	1.98 × 9.9 × 19.28 in 5.03 × 25.15 × 48.97 cm	12 lbs 5.4 kg
295363-002 ¹	North America	High	16 A	16	NEMA L6-20P 12-ft. cord	12× IEC 320-C13	2×10A	1.98 × 9.9 × 19.28 in 5.03 × 25.15 × 48.97 cm	8 lbs 3.6 kg
295363-003 ¹	North America	High	24 A	24	NEMA L6-30P 12-ft. cord	12× IEC 320-C13	4×10A	1.98 × 9.9 × 19.28 in 5.03 × 25.15 × 48.97 cm	12 lbs 5.4 kg
295363-291 ¹	Japan	Low	24 A	12	NEMA L6-30P 12-ft. cord	12× NEMA 5-15R	2×15A	1.98 × 9.9 × 19.28 in 5.03 × 25.15 × 48.97 cm	12 lbs 5.4 kg
295363-B21 ¹	International & North America	High	16 A	16	IEC 309-16P 12-ft. cord	12× IEC 320-C13	2×10A	1.98 × 9.9 × 19.28 in 5.03 × 25.15 × 48.97 cm	12 lbs 5.4 kg
295363-B32 ¹	International	High	16 A	16	NEMA L6-20P 12-ft. cord	12× IEC 320-C13	2×10A	1.98 × 9.9 × 19.28 in 5.03 × 25.15 × 48.97 cm	12 lbs 5.4 kg
207590-B21 ⁴	Worldwide	High	16 A	16	IEC 320 C-20 16A	12× IEC 320-C13	2×10A	1.62 × 8.0 × 17.00 in 4.27 × 20.32 × 43.18 cm	7 lbs 3.15kg
207590-D71 ⁴	North America & Japan	Low	24 A	12	NEMA L5-30P 12-ft. cord	12× NEMA 5-15	4×15A	1.62 × 8.0 × 17.00 in 4.27 × 20.32 × 43.18 cm	11 lbs 4.5 kg
207590-B31 ⁴	International	High	32 A	24	IEC 309-32A 12-ft. cord	12× IEC 320-C13	4×10A	1.62 × 8.0 × 17.00 in 4.27 × 20.32 × 43.18 cm	11 lbs 4.5 kg
207590-D72 ⁴	North America & Japan	High	24 A	24	NEMA L6-30P 2×12-ft. cord	12× IEC 320-C13	4×10A	1.62 × 8.0 × 17.00 in 4.27 × 20.32 × 43.18 cm	11 lbs 4.5 kg
191186-001 ²	North America	High	24 A	24	NEMA L6-30P 2×12-ft. cord	12× IEC 320-C13	4×10A	1.72 × 12.0 × 17.00 in 4.37 × 30.48 × 43.18 cm	20 lbs 9.1 kg
191186-B31 ^{2, 4}	International	High	30 A	24	IEC 309-32A 12-ft. cord	12× IEC 320-C13	4×10A	1.72 × 12.0 × 17.00 in 4.37 × 30.48 × 43.18 cm	20 lbs 9.1 kg
197617-002 ^{3, 4}	Worldwide	High	32 A	24	Field Wiring	12×IEC 320 c-13, 1×DB9 Serial, 1×RJ45	4×10A	1.70 × 17.00 × 19.70 in 4.32 × 43.18 × 50.04 cm	14 lbs 6.4 kg
Note 1: This PDU requires Compaq Vertical Mount Bracket kit (pn# 191265-B21 or 166097-B21 with high-voltage Y-cables) to vertically mount in rack side panel.									
Note 2: This PDU supports power from two different sources. If one power source fails, the PDU uses the alternate source.									
Note 3: This PDU must be hard-wired to the power source by a certified electrician.									
Note 4: This PDU is available the 1 st quarter of 2001.									

In Compaq 7000- and 9000-series racks, the 295363-xxx PDU series must be installed vertically in the rack side panels to prevent interference with the server rack rails. Compaq Vertical Mount PDU Bracket kits enable PDUs to be mounted vertically in the side compartments of 7000- and 9000-series racks. Compaq offers two Vertical Mount PDU Bracket kits:

- Compaq Vertical-Mount PDU Bracket (P/N 191265-B21): This kit includes eight brackets that support four PDUs. This kit works best with low-voltage applications that use the power cord included with the server.
- Compaq Vertical-Mount PDU Bracket with High Voltage Cables (P/N 166097-B21): This kit includes eleven Y-cables and four brackets that support two PDUs. This kit works best with high-voltage, high-current PDUs. Using the Y-cables enables each power outlet on the PDU to supply power for two servers.

Figuring Type and Number of PDUs

The type and number of PDUs required to power a full rack of servers depends on each server's power requirement, the number of servers deployed in the rack, and the available power for the servers.

Compaq PDUs support both high- and low-voltage applications. The input current rating for a ProLiant DL320 server is either 1 A at 200 to 240 volts or 2 A at 100 to 120 volts. To determine the number of servers supported by a PDU, divide the PDU's current rating by the server's total input current rating.

Example

PDU number 295363-003 is a high-voltage PDU with a current rating of 24 A. The server has a total input current rating of 1 A at 200 volts.

$$24 \text{ A (PDU current rating)} / 1 \text{ A (server total input current rating)} = 24$$

PDU number 295363-003 can support a maximum of 24 servers at full server input current ratings.

For more information refer to the "Power Distribution Unit High Voltage Models for North America and International Use, (NA CPQ # 295363-002; INT'L CPQ # 295363-B31)" Web site:

www.compaq.com/products/servers

Example

PDU number 295363-001/291 is a low-voltage PDU with a current rating of 24 A. The server has a total input current rating of 2 A at 100 volts.

$$24 \text{ A (PDU current rating)} / 2 \text{ A (server total input current rating)} = 12$$

PDU number 295363-001/291 can support a maximum of 12 servers at full server input current ratings.

For more information refer to the "Power Distribution Unit Low Voltage Models for North America and International Use" Web site:

www.compaq.com/products/servers

The ProLiant DL320 server does not support either a DC input power supply or a redundant power supply. However, the power supply for this server automatically senses input voltage level.

Selecting Server Power Cords

The server power cord depends on the cable management system installed in the rack. Generally, the sliding rail cable management system requires a power cord that is at least three feet longer than the power cord used with a fixed cable management system. The additional three feet provide enough slack for the power cord to route through the cable tension reel and the cable rack bracket, enabling the power cord to operate smoothly with the sliding rails solution.

For high-voltage applications, Compaq recommends using high-voltage Y-cables. Y-cables have a single cord section with an IEC connector that connects to the PDU, a dividing joint in the center, and a dual cord section with IEC connectors that connect to the servers. One Y-cable supplies power from the PDU for two ProLiant DL320 servers.

High-Voltage Y-Cables

The Vertical-Mount PDU Bracket with High Voltage Cables kit includes eleven Y-cables, each of which is ten feet long. The single-cord PDU section is six feet long, and the dual-cord server section is four feet long. See Table 7 for part numbers.

Table 7. Compaq high-voltage power cables

Description	Compaq Part #	Description
Vertical-Mount PDU Bracket with High Voltage Cables kit	166097-B21	This kit includes two sets of PDU brackets and eleven Y-cables. Each cable is 10 ft long with a 6-ft section on the single-side and 4-ft sections on the dual-side.
10A IEC-to-IEC cables kit	6 ft	The IEC-to-IEC cables can be used either as individual power cords for the server or to extend the length of the high voltage Y-cables. The cables are available in six-, eight-, and ten-foot lengths. The ProLiant DL320 ships with one 10-ft IEC to IEC cable, part number 142257-003.
	8 ft	
	10 ft	

Low-Voltage Power Cords

The power cord included with the North American and Japanese models of the ProLiant DL320 server can be used for low-voltage applications. Use a three- to five-foot long power cord with the fixed-rail cable management solution or a six- to eight-foot long power cord with the sliding-rails cable management solution. These lengths are optimal for PDUs installed in the rack side panels with vertical-mount brackets.

Table 8 lists PDU configurations for 42U racks, Table 9 lists PDU configurations for 36U racks, and Table 10 lists PDU configurations for 22U racks. The configurations in these tables refer to racks that are fully populated with servers. Racks fully populated with servers use either an off-rack console management system or a remote console management system. For an example configuration of a rack using an in-rack console management system, see page 23.

Table 8. PDU configurations for 42U racks

PDU	Input Voltage/ Current Rating	Vertical Mount Bracket Kits		Maximum Servers	PDUs per Rack	Populated Rack Weight	BTUs
		166097-B21 with Y-cables	191265-B21				
295363-001	Low/ 24 A		1	12	4	1,552 lb	28,644
295363-002	High/ 16 A	2		16	3	1,539 lb	28,644
295363-003	High/ 24 A	2		24	2	1,526 lb	28,644
295363-291	Low/ 24 A		1	12	4	1,552 lb	28,644
295363-B21	High/ 16 A	2		16	3	1,539 lb	28,644
295363-B32	High/ 16 A	2		16	3	1,539 lb	28,644
207590-B21	High/ 16 A	2		16	3	1,539 lb	28,644
207590-D71	Low/ 24 A			12	4	1,552 lb	28,644
207590-B31	High/ 32 A	2		24	2	1,539 lb	28,644
207590-D72	High/30 A	2		24	2	1,539 lb	28,644
191186-001	High/ 24 A	2		24	2	1,526 lb	28,644
191186-B31	High/30 A	2		24	2	1,526 lb	28,644
197617-002	High/ 32 A	2		24	2	1,526 lb	28,644

Table 9. PDU configurations for 36U racks

PDU	Input Voltage/ Current Rating	Vertical Mount Bracket Kits		Maximum Servers	PDUs per Rack	Populated Rack Weight	BTUs
		166097-B21 with Y-cables	191265-B21				
295363-001	Low/ 24 A		1	12	3	1,273 lb	24,552
295363-002	High/ 16 A	2		16	3	1,273 lb	24,552
295363-003	High/ 24 A	2		24	2	1,260 lb	24,552
295363-291	Low/ 24 A		1	12	3	1,273 lb	24,552
295363-B21	High/ 16 A	2		16	3	1,273 lb	24,552
295363-B32	High/ 16 A	2		16	3	1,273 lb	24,552
207590-B21	High/ 16 A	2		16	3	1,273 lb	24,552
207590-D71	Low/ 24 A			12	3	1,273 lb	24,552
207590-B31	High/ 32 A	2		24	2	1,273 lb	24,552
207590-D72	High/30 A	2		24	2	1,273 lb	24,552
191186-001	High/ 24 A	2		24	2	1,260 lb	24,552
191186-B31	High/30 A	2		24	2	1,260 lb	24,552
197617-002	High/ 32 A			24	2	1,260 lb	24,552

Table 10. PDU Configurations for 22U racks

PDU	Input Voltage/ Current Rating	Vertical Mount Bracket Kits		Maximum Servers	PDUs per Rack	Populated Rack Weight	BTUs
		166097-B21 with Y-cables	191265-B21				
295363-001	Low/ 24 A		1	12	2	855 lb	15,004
295363-002	High/ 16 A	1		16	2	855 lb	15,004
295363-003	High/ 24 A	1		24	1	842 lb	15,004
295363-291	Low/ 24 A		1	12	2	855 lb	15,004
295363-B21	High/ 16 A	1		16	2	855 lb	15,004
295363-B32	High/ 16 A	1		16	2	855 lb	15,004
207590-B21	High/ 16 A	1		16	2	855 lb	15,004
207590-D71	Low/ 24 A			12	2	855 lb	15,004
207590-B31	High/ 32 A	1		24	1	855 lb	15,004
207590-D72	High/30 A	1		24	1	855 lb	15,004
191186-001	High/ 24 A	1		24	1	842 lb	15,004
191186-B31	High/30 A	1		24	1	842 lb	15,004
197617-002	High/ 32 A	1		24	1	842 lb	15,004

Console Management Systems

A console management system enables a single keyboard and video console to control a full rack of servers. Install an in-rack console management system in the same rack with the servers it manages. Install an off-rack console management system in the local vicinity of the rack of servers it manages. Use a remote console management system to manage a rack of servers from any other system connected to the same network.

Table 11 lists options for configuring console management systems.

Table 11. Local console management options

Description	Compaq Part No.	Description
Server Console Switch 1x8-port (100-230VAC)	400337-001	N.A.
TFT5000R Flat Panel Monitor	120207-001	N.A.
Keyboard with Trackball	185152-406	N.A.
1U Rack Keyboard Drawer	338056-B21	A Server Console Switch can be mounted behind the keyboard drawer (0U installation)
CPU-to-Switchbox Cable	110936-B24	Use 3-ft cables for fixed rails.
CPU-to-Switchbox Cable	110936-B25	Use 6-ft cables for sliding rails.

In-Rack Local Consoles

With an in-rack local console, all equipment, servers, switchboxes, keyboards, keyboard drawers, and video displays are installed together in the same rack. One console switchbox can support up to eight pieces of equipment.

Each server deployed in a fully populated rack with an in-rack local console management system requires the following accessories for successful deployment and operation:

- Rack Rail kit (Standard Fixed Rail solution, Sliding Rail and cable management solution, or Third Party Rack Cabinet solution)
- KVM server to console cables (3-ft cables for fixed rail solutions and 6-ft cables for sliding rail solutions)
- One or two RJ45 cables for NIC 1 and NIC 2

Table 12 outlines the number of devices that fully populate a 42- or 36U rack with an in-rack local console.

Table 12. Device configuration for an in-rack local console

Device or Cable	42U Rack	36U Rack
ProLiant DL320 Servers	35	30
KVM Console Switches	5	4
Flat Panel Display	1	1
Keyboard with Trackball	1	1
Keyboard Tray	1	1
RJ45 cables	35/70	30/60
KVM server to console cables	40	30

Off-Rack Local Consoles

With an off-rack local console, certain components such as console switchboxes, keyboards, and video displays do not populate space in the rack, but are located in close vicinity to the rack. With an off-rack local console, the rack can be fully populated with servers. Cable lengths for connecting servers to an off-rack local console vary depending on the location of the console.

Each server deployed in a fully populated rack with an off-rack console management system requires the following accessories for successful deployment and operation:

- Rack Rail kit (standard fixed rail solution, Sliding Rail and Cable Management Solution, or Third-Party Rack Cabinet solution)
- KVM server to console cables
- One or two RJ45 cables for NIC 1 and NIC 2

Remote Console Management

The Compaq Remote Insight Lights-Out Edition is a PCI-based board that enables server management by remote access regardless of the state of the host server operating system or the host CPU. The Remote Insight Lights-Out Edition sends alerts and performs other functions even if the host server operating system is not responding. For installation information and features, refer to the documentation that ships with the Remote Insight Lights-Out Edition, and the *Compaq ProLiant DL320 Setup and Installation Guide*.

Each server deployed in a fully populated rack with a remote console management system requires the following accessories for successful deployment and operation:

- Rack Rail kit (standard fixed rail solution, Sliding Rail and Cable Management Solution, or Third-Party Rack Cabinet solution)
- Remote Insight Board, Lights-Out Edition
- An RJ45 cable for the Remote Insight Board
- One or two RJ45 cables for NIC 1 and NIC 2

Planning Rack Configurations

Consider several important factors when planning a rack configuration:

- The number of servers deployed in the rack
- The number of other devices such as keyboards, keyboard drawers, video displays, and console switchboxes that support the servers
- The number of PDUs and their orientation
- The type of rack
- The rack management system
- The console management system

All of these factors influence floor support requirements, future service and upgrade requirements, and installation requirements.

Use the weight and power specifications of the Compaq racks and rack option products listed in Table 13 to calculate floor support requirements. Add the weight measurements to calculate the total weight of a rack fully populated with ProLiant DL320 servers. See the following example:

1×	9142 rack	253 lb
42×	ProLiant DL320 with hard disk drives	1,078 lb
42×	Cable management system	168 lb
3×	High-Voltage PDUs with brackets	38 lb
22×	High-Voltage Y Power Cords	22 lb
42×	Keyboard/Video/Mouse cables	59 lb
	Total configured rack weight	1,618 lb

Note: Compaq recommends populating a rack with ProLiant DL320 servers and other rack option products only after the rack is in or very near its final position. Compaq does not recommend transporting a rack fully populated with ProLiant DL320 servers.

Table 13. Compaq rack and related options weight (and power if applicable)

Option	Note	Weight	Power
Compaq Rack 9142 (42U)	Without the side panels	253 lb / 114.84 kg	
Compaq Rack 9136 (36U)	Without the side panels	165 lb / 75 kg	
Compaq Rack 9122 (22U)	With the side panels	176 lb / 79.89 kg	
Compaq Rack 7142 (42U)	Without the side panels	253 lb / 114.84 kg	
Compaq Rack 7122 (22U)	With the side panels	176 lb / 79.89 kg	
Fixed Rail Assembly	2 fixed rack rails, fixed cable tray	3 lb / 1.36 kg	
Cable Management System	2 slide-rails, reel assembly, cable tray	4 lb / 1.81 kg	
High-Voltage Power Y-cable	10 ft	1 lb / 0.45 kg	
Keyboard/Video/Mouse molded cable	6 ft	1.42 lb / 0.64 kg	
High-Voltage 16 A PDU	With the vertical-mount brackets	12.64 lb / 5.73 kg	
High-Voltage 24 A PDU	With the vertical-mount brackets	12.64 lb / 5.73 kg	
Low-Voltage 24 A PDU	With the vertical-mount brackets	12.64 lb / 5.73 kg	
Keyboard/trackball	With sliding tray	16 lb / 7.26 kg	
TFT5000R Flat Panel Monitor	With sliding tray	48.5 lb / 22 kg	45 W
Server Console Switch	1x8 port (100-230 VAC)	5.25 lb / 2.38 kg	100 W

For detailed specifications or more options, refer to the Compaq Web site:

www.compaq.com.

Special Considerations for 7000- and 9000-Series Racks

Compaq recommends deploying servers in either a 7000- or 9000-series Compaq rack. The 7000- and the 9000-series Compaq racks mentioned in this section are the 7142, 7122, 9142, 9122, and 9136, racks. 4000-series racks (36U) are not recommended for 1U high-volume deployments with ProLiant DL320 servers because they are not sturdy enough to support the weight of 36 servers. This document does not discuss deploying servers in any non-Compaq rack.



WARNING: Follow these guidelines to reduce the risk of personal injury or damage to the equipment:

- Do not install a ProLiant DL320 server into a rack until the rack has been placed in its final location.
 - Slide rails, PDUs, power cords, and cables can be preinstalled into the rack in a build room or other location before moving the rack to its final location.
 - Before installing any servers, extend the leveling jacks to the floor and rest the full weight of the rack on the jacks. The casters are not designed to support the full weight of a populated rack.
 - Do not move a rack populated with servers. A fully populated rack weighs up to 1,700 pounds. Moving a populated rack can cause the rack to become unstable, resulting in serious personal injury or equipment damage.
-

Preparing a 7000-Series Rack

Before deploying ProLiant DL320 servers into a 7000-series rack, replace the front door of the rack with the High Air Flow Rack Door Insert. The High Air Flow Rack Door Insert is necessary to effectively cool ProLiant DL320 servers deployed in 7000-series racks. See Table 14 for rack-door insert part numbers.

Compaq strongly recommends using the Compaq Rack Extension Kit (P/N 154392-B21) to alleviate any space problems for cable bundles at the rear of 7000-series racks.

Preparing a 9000-Series Rack

Before deploying ProLiant DL320 servers into a 9000-series rack, it may be necessary to replace the original casters on the rack with replacement casters for 9000-series racks. These casters are available free of charge from Compaq. For more information, see *Customer Advisory: Caster Wheels on 9000 Series Racks May Break When Moved Under Load* in Appendix A -- Related Documents or visit the Compaq Web site:

www.compaq.com

Connecting Multiple Racks

Compaq offers baying or coupling kits designed to connect two or more 7000- or 9000-series racks side by side. When coupling two or more racks, only install the side panels on the outsides of the end racks. The following tables list the rack-deployment option kits for 7000- and 9000-series racks. Refer to the *Compaq ProLiant DL320 Quick Specs* for the most recent options available. Table 14 lists rack-deployment options for 7000-series racks and Table 15 lists rack-deployment options for 9000-series racks.

Table 14. Rack deployment options for 7000-series racks

7000-Series Rack Options	Compaq Part #
7000 Extension Bustle Kit The extension kit for the 7142 rack includes a steel collar that attaches to the front and/or rear of the rack, allowing additional space in the rack for large equipment or cable management.	154392-B21
Rack Side Wall Kit (42U only) This kit includes two rack side panels for the 7142 rack.	165652-001
Coupling Kit Use this kit to join two or more racks to create a multi-bay configuration. The kit supports 24-inch and 600-mm floor tile spacing. Sides of adjacent rack frames are connected, and side panels are installed on the two ends of the multi-bay configuration.	165664-001
Rack Stabilizing Feet Kit (42U only)	189907-001
High Air Flow Rack Door Insert This kit allows proper ventilation to effectively cool a high-volume deployment of ProLiant DL320 servers.	7122: 157847-B21 7142: 327281-B21 7142 6 pack: 327281-B22

Table 15. Rack deployment options for 9000-series racks

9000-Series Rack Options	Compaq Part #
Baying/Coupling Kit Use this kit to join two or more racks to create a multi-bay configuration. The kit supports 24-inch and 600-mm floor tile spacing. Sides of adjacent rack frames are connected, and side panels are installed on the two ends of the multi-bay configuration.	120669-B21
Stabilizer Kit The anti-tip stabilizer kit provides stability and support when equipment is installed, removed, or accessed within the rack. Compaq highly recommends using a stabilizer kit with a stand-alone rack.	120673-B21
Ballast Kit The ballast kit provides additional stability and support for the stabilizer kit. Use the ballast kit if heavy equipment is routinely installed, removed, or accessed within the rack. A ballast kit must be assembled with a ballast installed on each side of the rack.	120672-B21
Extension Bustle Kit The extension bustle kit attaches to the rear of the rack providing an additional 3.9 inches (8.6 cm) of space to the depth of the rack. This option allows more space for cable management or extended equipment installed in the rack.	120679-B21

continued

Table 15. Rack deployment options for 9000-series racks *(continued)*

9000-Series Rack Options	Compaq Part #
9142 Side Panels This kit includes two rack side panels for the 9142 (42U) rack.	120670-B21
9136 Side Panels This kit includes two rack side panels for the 9136 (36U) rack.	120671-B21
42U Short Rear Door The short rear doors do not fully extend to the bottom of the rack, leaving room for cables to route under the door at the bottom.	218217-B21
36U Short Rear Door	218218-B21

The following pages provide some examples of best practices for cabling and rack configurations. The configurations do not include every possible combination.

3 High-Voltage PDUs in a 42U Rack

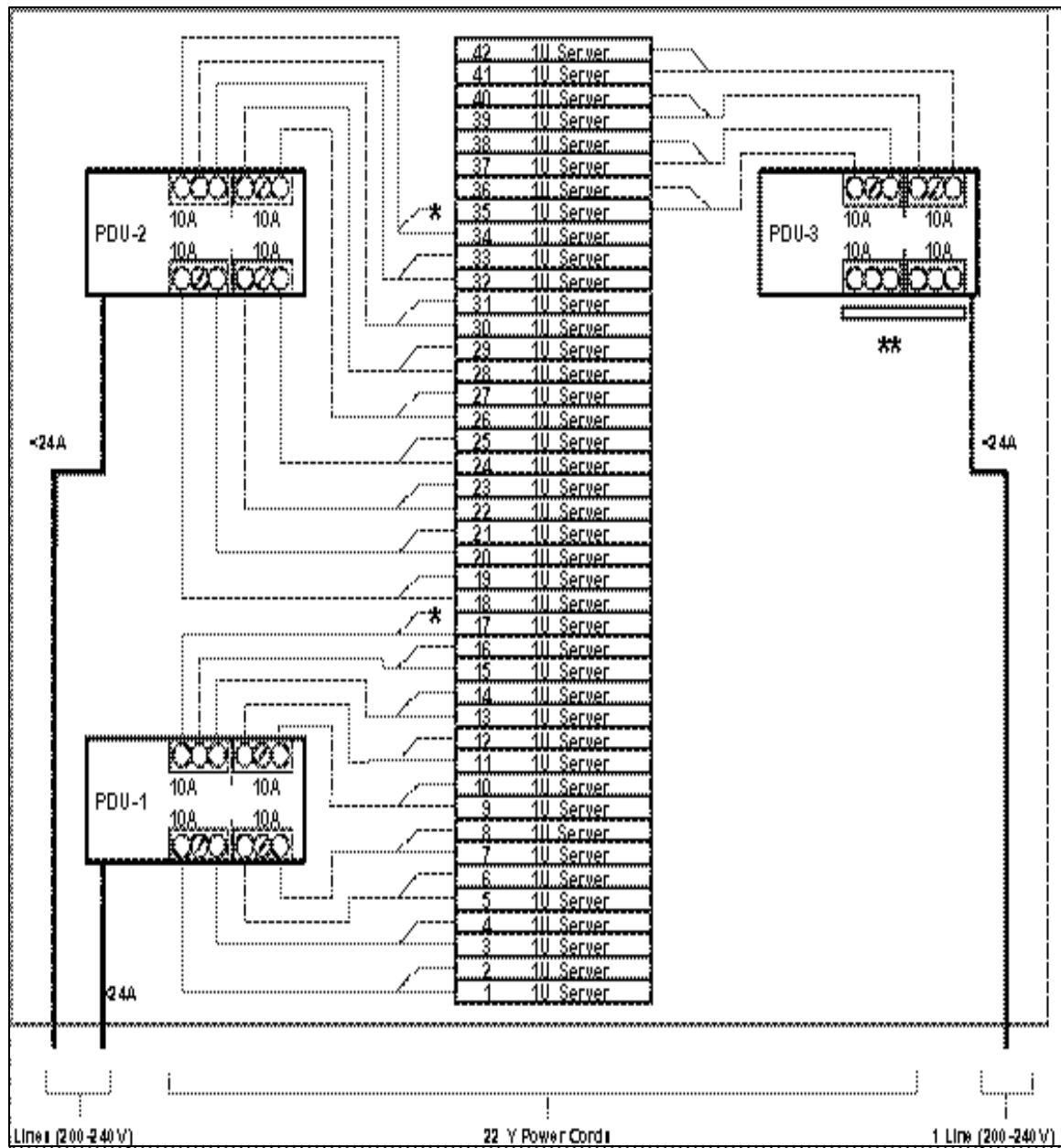


Figure 3. 3 high-voltage PDUs in a 42U rack

4 Low-Voltage PDUs with a Remote Console in a 42U Rack

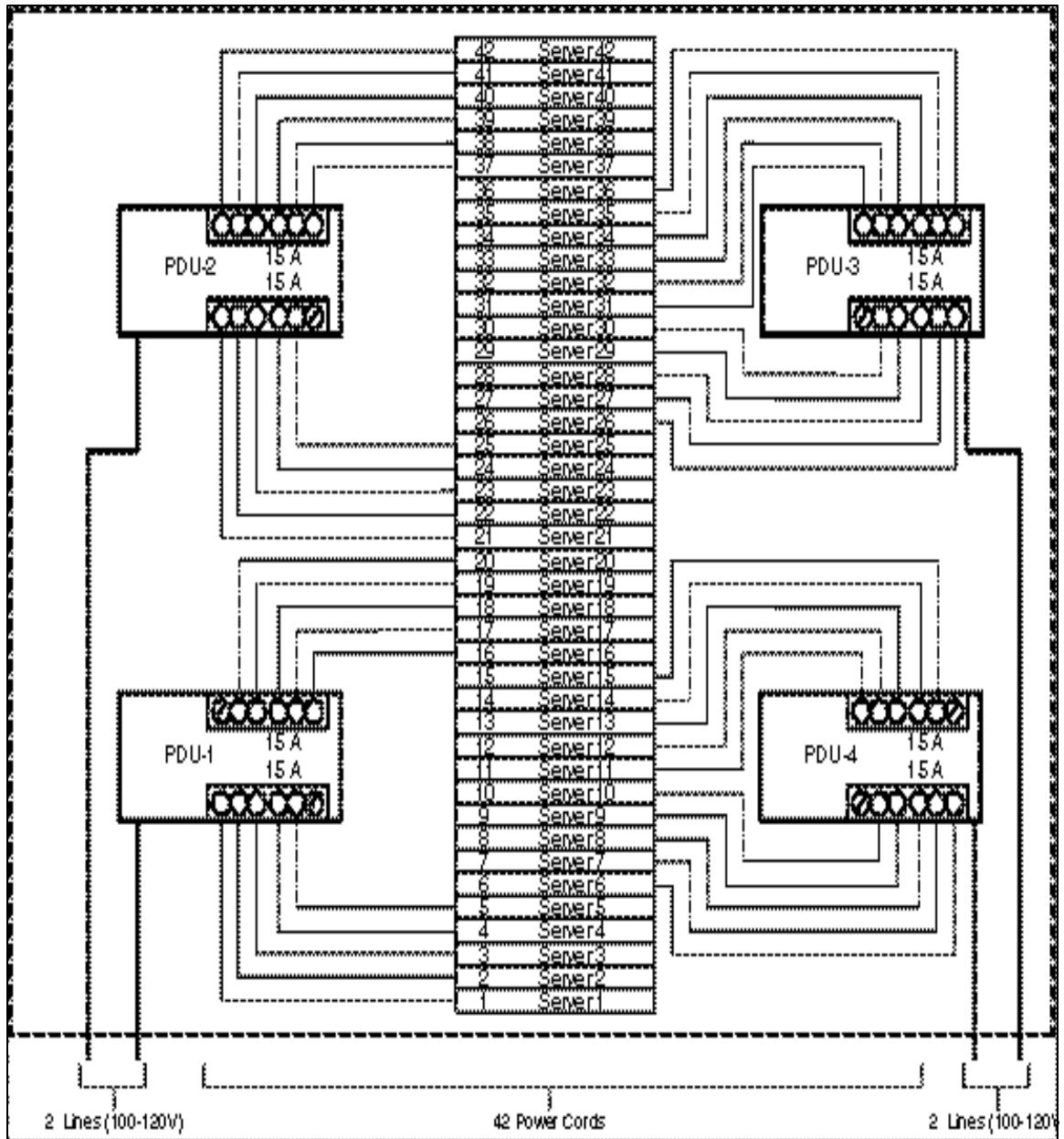


Figure 4. 4 low-voltage PDUs with a remote console in a 42U rack

3 High-Voltage PDUs with an In-Rack Local Console in a 42U Rack

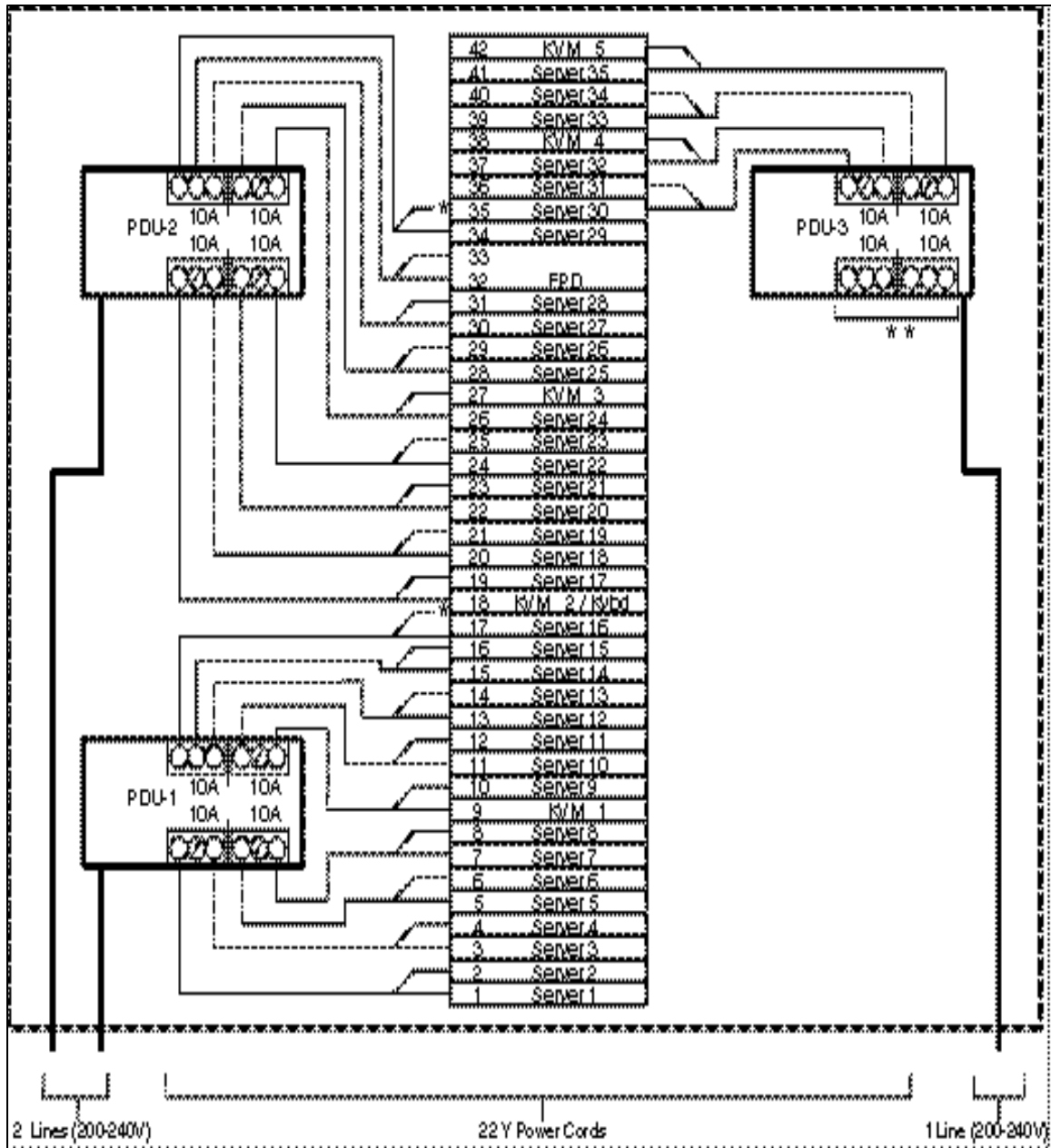


Figure 5. 3 high-voltage PDUs with an in-rack local console in a 42U rack

Note: FPD refers to a Flat Panel Monitor and KVM refers to a Keyboard Video Mouse 8-port switch.

2 High-Voltage PDUs with Y-Cables in a 36U Rack

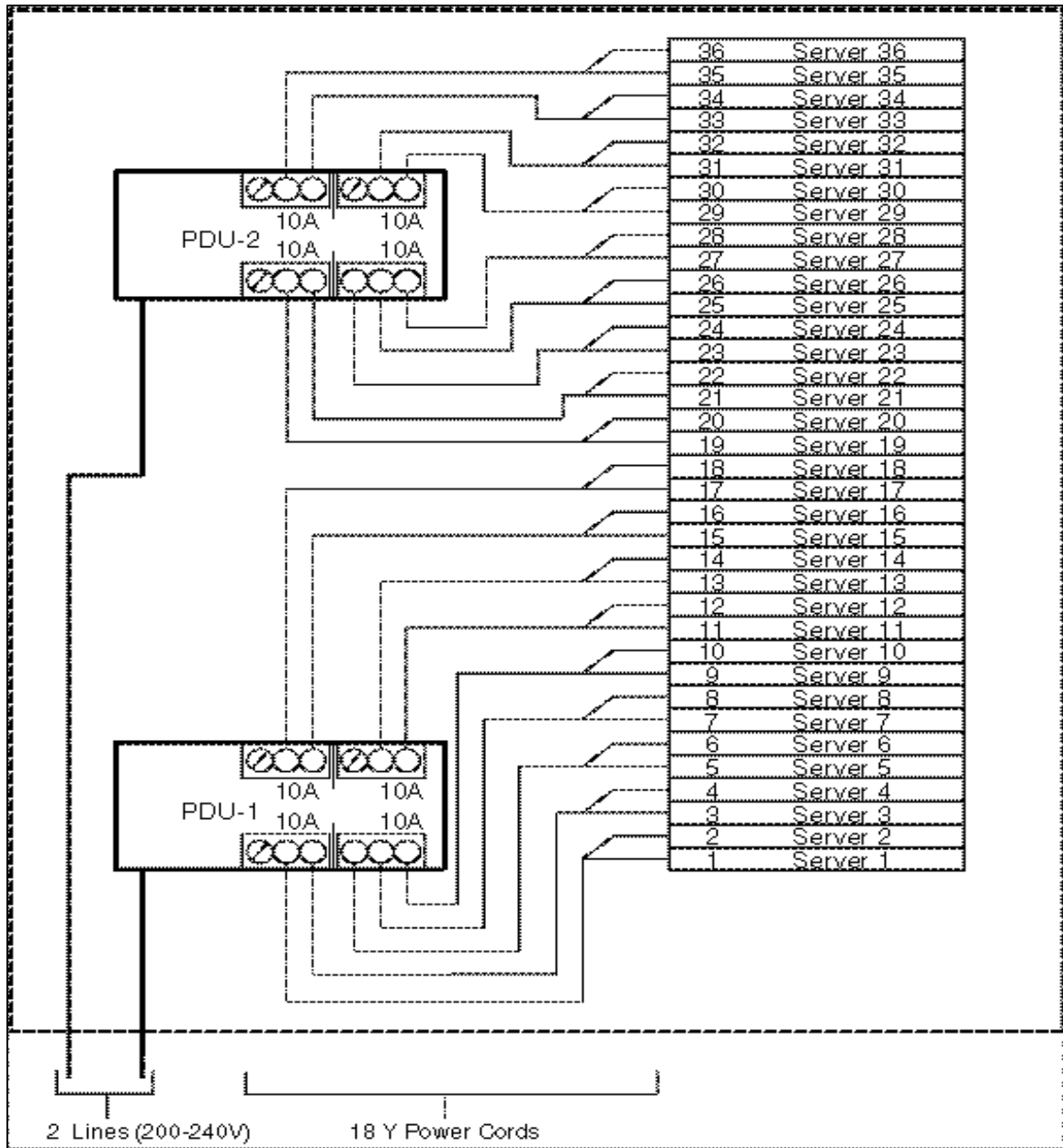


Figure 6. 2 high-voltage PDUs with Y-cables in a 36U rack

1 High-Voltage PDU with Y-Cables in a 22U Rack

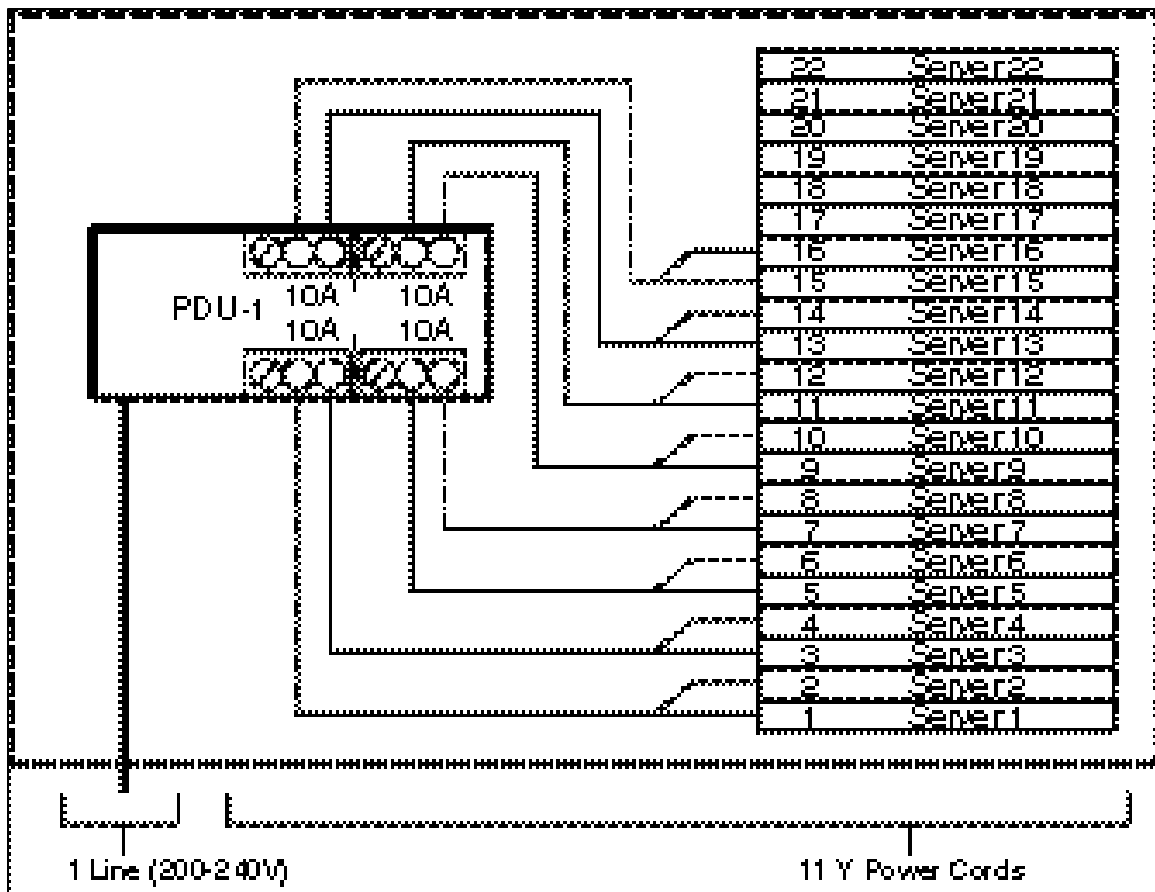


Figure 7. 1 high-voltage PDU with Y-cables in a 22U rack

Rack Management Systems

Compaq recommends using either the Standard Fixed Rail Rack Management solution or the Sliding Rail and Cable Management solution. The rack management solution installed in the rack determines the position of the PDUs installed in the rack side panels. To determine the best rack management solution, consider the service and upgrade demands of the servers deployed in the rack.

Standard Fixed Rail Rack Solution

The standard fixed rail rack solution works best in racks that require fast setup and deployment for operation with servers that require few services or upgrades. The fixed rail solution is quick and easy to install, allowing efficient deployment and setup of a full rack of servers.

The ProLiant DL320 server ships with a standard fixed rail rack kit designed for 29-inch deep square-hole racks. The server rails are pre-installed on the sides of the ProLiant DL320 server, and the rack rails are designed to snap securely in place in the rack without screws or nuts.

The ProLiant DL320 server includes a cable support bracket that works in conjunction with the fixed cable management tray included with the standard fixed rail rack kit. The cable support bracket and cable management tray route the cables to the right side of the rack (viewed from the rear) and secure them in place in the cable management tray clamp. This solution keeps the cables from sagging and tangling and allows proper air ventilation through the rack.

However, this solution does not allow in-rack servicing for any server installed in the rack. If a server requires servicing, the cables must be disconnected and the server must be removed from the rack. For detailed installation instructions for the fixed rail rack kit that ships with the server, refer to the *Compaq ProLiant DL320 Setup and Installation Guide*.

Sliding Rails and Cable Management Solution

The Sliding Rails and Cable Management Solution works best with a rack of servers that are frequently serviced or upgraded. With this solution, a server can be powered down and serviced without disconnecting the server cables or removing the server from the rack.

Like the standard fixed rail rack solution, the Sliding Rails and Cable Management Solution is designed for 29-inch deep, square-hole racks. The sliding rack rails compress and snap securely in place in the rack without screws or nuts.

The Sliding Rails and Cable Management Solution comes with a two-level cable management tray that attaches directly onto the rear of the DL320 cable support bracket. The cable management tray operates in conjunction with the cable rack bracket and tension reel. Together these components secure and route the cables along the rear of the rack. This cable management system not only prevents the cables from sagging and tangling, but it also allows proper air ventilation through the rack while allowing the servers to be fully extended without disconnecting any of the server cables.

The Sliding Rails and Cable Management Solution is conducive to in-rack servicing and provides convenient access to the server cables and connectors. Refer to the *Sliding Rails and Cable Management Solution Guide for Compaq ProLiant DL360 and DL320 Servers* included in the rack option kit for complete installation instructions.

Third-Party Rack Cabinet Solution

Recognizing that not all customers use Compaq racks, the ProLiant DL320 design supports deployment in third-party rack cabinets. Compaq offers a Third-Party Rack Cabinet kit designed to install ProLiant DL320 servers in third-party racks. This kit includes variable length rack rails that are compatible with a variety of third-party racks. The Third-Party Rack Cabinet kit can be installed in racks that are 21 inches (610 mm) to 29.13 inches (740 mm) deep. The rack rails included in this kit operate smoothly with the standard fixed server rails that are pre-installed on the ProLiant DL320 server. The fixed cable tray included with the ProLiant DL320 server is also compatible with most third-party racks.

IMPORTANT: Always install the Compaq Third Party Rack Cabinet kit when deploying a ProLiant DL320 server in a third-party rack. The kit supports the same cable management tray that the standard fixed rail rack solution uses.

Telco (Telecommunications) Rack Solution

Many data centers use telecommunications or Telco racks. The ProLiant DL320 design supports deployment in Telco racks. Compaq offers a Telco Rack kit designed to install ProLiant DL320 servers in Telco racks. This kit includes rack rails and screws that are compatible with a variety of Telco racks. The Telco rack kit includes replacement server rails designed to fit on the ProLiant DL320 server. Before deploying ProLiant DL320 servers into a Telco rack, remove the standard server rails and replace them with the Telco server rails included in the Telco Rack kit.

IMPORTANT: Always install the Compaq Telco Rack kit if when deploying a ProLiant DL320 server in a Telco rack.

Note: Read the *Compaq Ultra-Dense Server Deployment in Third-party Cabinet Racks* or the *Compaq Ultra-Dense Server Deployment in Telecommunications (Telco) Racks* before deploying ProLiant DL320 servers in a third party rack or Telco rack.

Installation Procedures

Note: See the safety guidelines at the beginning of this paper before beginning any installation procedures.

This section describes preparation and basic installation procedures common to various configurations outlined in “Planning Rack Configurations.” Compaq recommends performing the preparation and installation procedures in the order that they are presented in this section. This section discusses the following procedures:

- Preparing the ProLiant DL320 server
- Preparing the rack
 - Installing Compaq Power Distribution Units (PDUs)
 - Installing rack rail solutions
- Installing ProLiant DL320 servers into a rack
- Connecting cables
 - In-rack local consoles
 - Off-rack local consoles
 - Remote console management
- Completing the installation

Preparing the ProLiant DL320 for Rack Installation

This section briefly describes preparing the server for rack installation. Refer to the *Compaq ProLiant DL320 Setup and Installation Guide* and the rack option documentation for detailed installation instructions.

If the server is still in the shipping container, remove the server and all included components from the box. Ensure that all parts and components ordered with the server are present and undamaged. Place the server on a stable, flat surface.

With the exception of rack rail solution kits, install any optional hardware components ordered with the server. Unpack and install one option kit at a time to reduce the risk of damage to any option kit or component. The documentation included with each option kit contains detailed installation instructions for that option. Refer to the setup and installation guide included with the server for additional information on any hardware installation procedure.

The ProLiant DL320 server ships with a cable support bracket that works with the standard fixed rail cable management tray and the two-level cable management tray included with the Sliding Rails and Cable Management Solution. Attach the cable support bracket to the rear of the server before installing the server in a rack.

Fixed Rail Rack Solution

The fixed server rails are pre-installed on the ProLiant DL320 server. Install the fixed cable tray on the rack first and attach the cable support bracket to the fixed cable tray after the server is installed in the rack.

Sliding Rails and Cable Management Solution

Open the Sliding Rails and Cable Management Solution kit and unpack the cable management tray and the sliding rail assemblies. Attach the cable management tray to the rear of the cable support bracket.

Remove the server rails from the sliding rack rails. Using a Torx screwdriver, remove the standard fixed server rails from the server. Save the screws. Attach the Sliding Rails and Cable Management Solution server rails to the server. Refer to the *Sliding Rails and Cable Management Solution Guide for Compaq ProLiant DL320 Servers* included in the rack option kit for complete server rail installation instructions cable bracket and cable tray installation instructions.

Third-Party Rack Cabinet Solution

The fixed cable tray included with the ProLiant DL320 server and the fixed server rails that are pre-installed on the ProLiant DL320 server are compatible with the Third-Party Rack Cabinet kit. Install the fixed cable tray on the rack first and attach the cable support bracket to the fixed cable tray after the server is installed in the rack.

Telco (Telecommunications) Rack Solution

The Telco Rack kit includes replacement server rails designed to fit on the ProLiant DL320 server. Before deploying ProLiant DL320 servers into a Telco rack, remove the standard server rails and replace them with the Telco server rails included in the Telco Rack kit.

Installing Power Distribution Units (PDUs)

PDU installation varies depending on the rack configuration, the number of servers deployed in the rack, the selected type of PDU, and the voltage and current rating for each PDU. The 295363 series of PDUs must be mounted vertically in the side panels of the rack. See the "Power Distribution Units" section earlier in this paper for information about the Vertical-Mount PDU Bracket kits available from Compaq. The installation card in the Vertical-Mount PDU Bracket kit contains detailed instructions for installing the Vertical-Mount PDU Brackets on a PDU and in a rack.

Positioning PDUs in 22U, 36U and 42U Racks

The position of the PDUs in the rack side panels depends on the rack size, the number of servers deployed in the rack, and the cable management solution. As a general rule, install PDUs from the bottom to the top on the same side of the rack as the cable management tray (viewing the rack from the front).

The following sections explain installation positions for different PDU configurations.

Installing One PDU in a 22U Rack

Use the following guidelines to install PDUs in a 22U rack.

Sliding Rails and Cable Management Solution

In a 22U rack that uses one PDU with a sliding rails cable management system, center the PDU in the right side-panel of the rack.

Fixed Rails Cable Management Solution

In a 22U rack that uses one PDU with a fixed rails cable management system, center the PDU in the left side-panel of the rack.

Installing Two PDUs in a 22U Rack

In a 22U rack that uses two PDUs, center one PDU in each side panel of the rack. This configuration is the only one that supports installing one PDU on each side of the rack.

Installing PDUs in a 36U or 42U Rack

Before installing PDUs in a 36U or 42U rack, it may be necessary to remove the center support bracket and center it between the PDUs. Install the PDUs on the same side of the rack as the cable management tray (viewing the rack from the front). Use Figure 8 and Table 16 on the following page to determine the position of PDUs in a 36 or 42U rack.

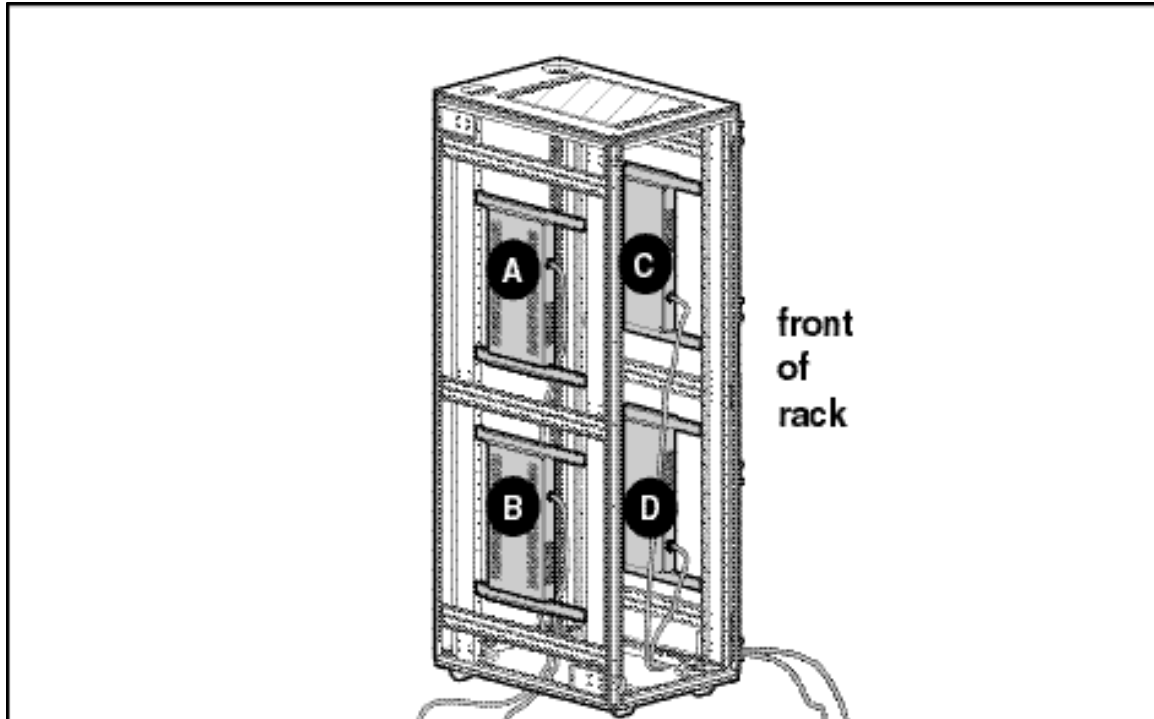


Figure 8. PDU positions in a 36U or 42U rack

Table 16. PDU configurations in a 36U or 42U rack

Rail Solution	2 PDUs		3 PDUs	
	Left	Right	Left	Right
Standard Fixed Rail Solution	A		A	C
	B		B	
Sliding Rails Solution		C	A	C
		D		D

Installing Four PDUs in a 36U or 42U Rack

In a 36 or 42U rack, install one PDU in each half side-panel.

Routing Power Cords

Use the following guidelines to route server power cords in 22U, 36U and 42U racks.

High Voltage Y-Cables

Connect the single-cord section of the Y-cable to the PDU installed on the same side as the cable management tray. Align the Y-joint with the rear rack support and center it between the rack rails of the two servers that the Y-cable supports. Use two plastic tie wraps to secure the Y-joint to the rack support. After installing the servers, connect the cables to the servers and route the slack through the cable management system with the other server cables.

Low Voltage Power Cords

Route and connect the low-voltage power cord to the PDU after the server is installed. Connect the power cord to the server first and route it through the cable management system with the other server cables. Route the power cord inside the rear rack support to the PDU.

IMPORTANT: In 7000-series racks, route the power cables from the servers to the PDUs through the gap in the rear of the rack rail.

Installing Rack Rail Solutions

Both the standard fixed rails and the sliding rails are designed to snap in place without screws or nuts.

The rack template included with the server provides an easy and reliable way to properly position the rack rails in the rack. The template is double-sided and printed with arrows that show where items are inserted, both for the rack rails and for the thumbscrews that secure the server faceplate to the front of the rack. Use the template to identify the proper square holes in the rack for inserting the rack rail tabs. Using a pencil, mark the vertical rack supports along the top and bottom edges of the template.

Align the two front tabs on the front of the rack rail with the holes identified at the front of the rack. Insert the front tabs of the rack rail into the rack. Compress the rack rail toward the front of the rack until the rear tabs align with the inner holes at the back of the rack. Insert the rear tabs into the rear holes and release the rail. The rail locks securely in place.

Note: Before installing the rack rails for the Sliding Rails and Cable Management Solution, remove the server rails from the slide rail assembly. See the “Preparing the ProLiant DL320 for Rack Installation” section earlier in this paper for more information.

Note: Install a ProLiant DL320 server in every U from the bottom to the top for maximum density.

Repeat the procedure for any subsequent rack rails.

Fixed Rail Rack Solution

Viewing the rear of the rack, insert the tabs on the right edge of the fixed cable tray into the slots on the fixed rail. Tighten the rail thumbscrew that secures the fixed cable tray to the rail.

For detailed installation instructions for the fixed rail rack kit that ships with the server, refer to *Compaq ProLiant DL320 Setup and Installation Guide*.

Sliding Rails and Cable Management Solution

After installing the sliding rack rails, install the cable tension reel and the cable rack bracket. Install one tension reel and one rack bracket for each piece of equipment installed in the rack.

Cable Tension Reel

Viewing the rear of the rack, install the cable tension reel on the right vertical rack support. Align the right side of the cable tension reel along the outside of the rack so that it is even with the installed sliding rack rail. Hook the pin on the back of the cable tension reel into the square hole on the sliding rack rail. Tighten the thumbscrew to attach the cable tension reel to the sliding rack rail.

The Cable Rack Bracket

Install the cable rack bracket on the left side of the rack. Align the left side of the cable rack bracket along the outside of the vertical rack support so that it is even with the sliding rack rail. Tighten the thumbscrew to attach the cable rack bracket to the sliding rack rail.

For detailed installation instructions for the sliding rail and cable management solution option, refer to *Sliding Rails and Cable Management Solution Guide for ProLiant DL320 Servers*.



CAUTION: Always install from the bottom of the rack to the top. Installing servers in this manner provides more stability for the rack and reduces the risk of the rack tipping over.

Installing a Server in a Rack

Install ProLiant DL320 servers in the rack from the bottom to the top. Tighten the thumbscrews on the front of each server to secure the server to the rack.

If the rack uses the fixed rail solution, attach the installed fixed cable tray to the cable support bracket. At the rear of the rack, fasten the server thumbscrew that secures the fixed cable tray to the server.



WARNING: To reduce the risk of serious personal injury, fire, or damage to the equipment:

- Extend the leveling jacks to the floor and rest the full weight of the rack on the leveling jacks.
 - Either install the stabilizer kit or couple multiple racks together for stability.
 - Load the heaviest item first and load the rack from the bottom to the top. Loading the rack in this manner makes the rack “bottom-heavy” and helps prevent the rack from becoming unstable.
 - Do not overload the AC supply branch circuit that provides power to the rack.
 - Extend only one ProLiant DL320 server at a time. A rack may become unstable if more than one ProLiant DL320 server is fully extended for any reason.
-

Installing Cables

The correct method for connecting cables and routing them to other devices depends on the type of console management and cable management solutions configured in the rack. The console management and cable management solutions determine cable lengths and cable routing. This section discusses connecting and routing cables with different cable management solutions and different console management solutions.

In-Rack Local Console

Use the following guidelines to install cables with in-rack local consoles.

Fixed Rail Rack Management Solution

Connect the cables to each device installed in the rack, working from the bottom to the top. Beginning at the bottom of the rack, connect the cables to the bottom piece of equipment. Open the cable tray clamp on the fixed cable tray. Bundle the cables and route them through the open clamp. Close the cable tray clamp. Connect the cables to the console switchbox. Connect the power cord to the PDU. Do not connect the PDU to any power source until all equipment is fully deployed in the rack.

Refer to *Compaq ProLiant DL320 Setup and Installation Guide* for the recommended order for connecting cables with the fixed cable tray.

When the cables are properly connected and routed through the cable management system, the rear door of the rack closes easily over the cables. If the rear door does not close easily, additional space may be required. Install the rack extension or the bustle kit to provide more space for the cables at the rear of the rack.

Sliding Rails and Cable Management Solution

Connect the cables to each device installed in the rack, working from the bottom to the top. Beginning at the bottom of the rack, connect the cables to the bottom piece of equipment. Connect and route the cables through the tension reel and cable rack bracket according to the instructions in *Compaq Sliding Rails and Cable Management Guide for the ProLiant DL320 Server*. Connect the cables to the console switchbox. Connect the power cord to the PDU. Do not connect the PDU to any power source until all equipment is fully deployed in the rack.

When the cables are properly connected and routed through the cable management system, the rear door of the rack closes easily over the cables. If the rear door does not close easily, additional space may be required. Install the rack extension or the bustle kit to provide more space for the cables at the rear of the rack.



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

- Unplug the power cord from the system.
 - 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.
-

IMPORTANT: In 7000-series racks, route the power cables from the servers to the PDUs through the gap in the rear of the rack rail.

Off-Rack Local Console

Use the in-rack local console procedure for the cable management system installed in the rack to connect and route cables with an off-rack local console. However, with an off-rack console, longer cables may be required to reach the console. See Table 11 earlier in this paper for information on CPU-to-switchbox cables available from Compaq.

Remote Console Management

The remote console management system uses a CAT5 cable connected to the RJ45 connector in the Remote Insight Lights-Out PCI board and the power cord. Route these cables through the cable management system according to the instructions either in the *Compaq ProLiant DL320 Setup and Installation Guide* or the *Compaq Sliding Rails and Cable Management Guide for the ProLiant DL320 Server*. Connect the power cord to the PDU and the CAT5 cable to the network data line outlet.

Completing the Installation

Perform the following steps to complete the installation.

- Install side panels on the outsides of the end racks.
- Install the front and rear doors.
- Connect the PDUs to the power source.
- Power up the servers.

Appendix A -- Related Documents

Customer Advisory: Caster Wheels on 9000 Series Racks May Break When Moved Under Load
Document number EX991108_CW01

http://www.compaq.com/support/techpubs/customer_advisories/EX991108_CW01_1.html

Compaq 9000 Series Rack Brochure

Document number 0266-0799A-NAEN

ftp://ftp.compaq.com/pub/products/storageworks/options/9000_Series_Profile.pdf

Compaq 9000 Series Universal Racks white paper

Document number ECG0145-0899-A

<ftp://ftp.compaq.com/pub/supportinformation/papers/ecg01450899a.pdf>

Compaq Rack 9000 Series Catalog

<ftp://ftp.compaq.com/pub/products/storageworks/options/CompaqRack9000Series.pdf>

Compaq Rack 7000 Series Catalog

<ftp://ftp.compaq.com/pub/products/storageworks/options/CompaqRack7000Series.pdf>

Installing Compaq Rack-Mountable Components into Third-Party Racks

<http://www.compaq.com/support/techpubs/whitepapers/3rdpartyracks.html>

Compaq Rack Options and Accessories Catalog

<ftp://ftp.compaq.com/pub/products/storageworks/options/CompaqRackAccessories.pdf>

Compaq Power Management Products Catalog

<ftp://ftp.compaq.com/pub/products/storageworks/powerprotection/PowerManagementProducts.pdf>

Compaq Power Distribution Unit Information Guide

Document number ECG045/0299

<ftp://ftp.compaq.com/pub/supportinformation/papers/ecg0450299.pdf>

Compaq Power Distribution Unit QuickSpecs

Document number DA-10253-00-002

<ftp://ftp.compaq.com/pub/products/storageworks/powerdistribution/pduqs.pdf>

Compaq Server Console Switch (KVM) Information Guide white paper

Document number ECG0155/0699-A

<ftp://ftp.compaq.com/pub/supportinformation/papers/ecg01550699a.pdf>

Compaq Server Console Switch User Guide

Document number 141555-001

ftp://ftp.compaq.com/pub/supportinformation/techpubs/user_reference_guides/141555-001.pdf

Compaq Server Console Switch Brochure

Document number 0304-0799A-NAEN

ftp://ftp.compaq.com/pub/products/storageworks/options/KVM_Profile.pdf

Compaq Flat Panel Monitor (TFT5000R) QuickSpecs

<ftp://ftp.compaq.com/pub/products/storageworks/options/15inchfpmonitor.pdf>

Compaq Internal Keyboard with Trackball and 1U Keyboard Drawer QuickSpecs

ftp://ftp.compaq.com/pub/products/storageworks/options/iukeyboard_qs.pdf

Compaq 1U Keyboard Drawer and Internal Keyboard Brochure

Document number NA020A/0499

ftp://ftp.compaq.com/pub/products/storageworks/options/iukeyboard_brochure.pdf

Appendix B -- Parts Reference

The parts referenced in this white paper are listed in this appendix. Refer to *Compaq ProLiant DL320 Quickspecs* for more option parts.

Note: In this appendix, the notation *Int'l* (or) *International* is used for a part number for the countries not explicitly listed for that part. The other notations are as follow:

APD Asia Pacific

EURO Europe

N.A. North America (including U.S., Canada, Mexico)

U.K. United Kingdom

Table 17. Power management

Power Management			
Power part		Compaq P/N	Notes
Vertical-Mount PDU Brackets Option kit		191265-B21	8 brackets
Vertical-Mount PDU Brackets Option with High Voltage Cables kit		166097-B21	4 brackets and 11 Y-power cords Each Y-power cord is 10 ft in length (6-ft single-section and 4-ft dual-sections). These cables are not available separately from this option kit.
10A IEC to IEC cable kit	6 ft / 2.0 m	142257-001	The IEC-to-IEC cables can be used either as individual power cords for the server or to extend the length of the high-voltage Y-cables. The cables are available in 6-, 8- and 10- ft lengths. The ProLiant DL320 ships with one 10-ft IEC-to-IEC cable, part number 142257-003.
	8 ft / 2.5 m	142257-002	
	12 ft / 3.0 m	142257-003	

Table 18. Console management

Console Management			
Part		Compaq P/N	Notes
TFT5000R Flat Panel Monitor	N.A.	120207-001	
	Japan	120207-291	
TFT5000R Flat Panel Monitor	International	120207-B31	
Server Console Switch 1x8-port (100-230VAC)	N.A.	400337-001	The power cord shipped with this switch is for low-voltage PDUs. High-voltage PDUs may use the Y-cables included in the Vertical-Mount Bracket kit.
	International	400337-B31	
	Japan	400337-291	

continued

Table 18. Console management *(continued)*

Console Management		
Part	Compaq P/N	Notes
CPU-to-Switchbox Cables	110936-B21	1 Cable, 12 ft
	110936-B22	1 Cable, 20 ft
	110936-B23	1 Cable, 40 ft
	110936-B24	1 Cable, 3 ft (Available 3Q00)
	110936-B25	1 Cable, 6 ft (Available 3Q00)
1U Rack Keyboard Drawer	338056-B21	A Server Console Switch may be mounted behind the keyboard drawer (0U installation).
Keyboard with Trackball	185152-406	U.S.
	185152-036	U.K., Germany, France,
	185152-046	
	185152-056	
	185152-066	Italy, Spain, Denmark
	185152-076	
	185152-086	
	185152-096	Norway, Sweden/Finland
	185152-106	
	185152-116	Swiss, Portugal, Belgium
	185152-136	
	185152-186	
185152-296	Japan, International	
185152-B36		

Table 19. Rack deployment

Rack Deployment		
Part	Compaq P/N	Notes
Sliding rails and cable management solution option	174575-B21	For DL320 server in-rack serviceability
Grounding Option Kit	120682-B21	
9000-Series Racks		
Ballast option kit	120672-B21	Extends rear part of rack to gain cabling space
Baying kit	120669-B21	
Bustle kit	120679-B21	Pallet, shock pallet, crated
Stabilizer option kit	120673-B21	
Compaq Rack 9142 (42U)	120663-B21 120663-B22 120663-B23	Pallet, shock pallet, crated
9142 Side Panel Kit	120670-B21	
Compaq Rack 9136 (36U)	120664-B21 120664-B22 120664-B23	Pallet, shock pallet, crated
9136 Side Panel kit	120671-B21	
42U Short Rear Door	218217-B21	
36U Short Rear Door	218218-B21	
Compaq Rack 9122 (22U)	120655-B21 120655-B22 120655-B23	

continued

Table 19. Rack deployment *(continued)*

Rack Deployment		
Part	Compaq P/N	Notes
7000-Series Racks		
High Air Flow Rack Door Insert for 7122	157847-B21	
High Air Flow Rack Door Insert for 7142	327281-B21	
High Air Flow Rack Door Insert for 7142 (6 pack)	327281-B22	
Stabilizing Feet (42U only)	189907-001 189907-291	Others, Japan
Compaq Rack 7142 (42U)	165753-001 165753-002 165753-003 165753-293	N.A., Air Shipment, International, Japan
Rack Sidewall kit (42U only)	165652-001	
Rack Extension Kit for 7142	154392-B21	
Coupling kit (42U only)	165664-001	
Compaq Rack 7122 (22U)	163747-001 163747-002 163747-240	N.A., International, Japan

Appendix C – Power and Thermal Budgeting

All power requirements for ProLiant DL320 servers that are discussed in this document are based on the input power of the server. Compaq recommends using the maximum rated power supply input of 200 W when planning power distribution. Derate the input power for any of the following reasons:

- To minimize the number of PDUs required for each rack
- To match the rack current requirements with the existing circuit breaker capacity
- To match the rack cooling requirements with the existing facility cooling capability

Note: In this document, derating the input power budget means not using the maximum rated input power values for the power supply. **Please verify that the derated power budget satisfies all the installation requirements including future upgrade plans.**

Use either of the following methods to determine lower input power requirement for ProLiant DL320 servers:

- Use the derated input power. Calculate this value by using the supplied worksheet at the end of this appendix.
- Use the allocated input power. Calculate this value by dividing the maximum power of a PDU by the number of servers. This calculated power must be at least 151 W (200 W peak) to support all the optional components initially released with the ProLiant DL320.

Table 20 demonstrates how calculating the derated input power of the system can significantly reduce input current and thermal dissipation.

Table 20. Derated current and thermal dissipation for reduced input power assumptions

Input Power	Derated		Fully Rated
	100 W	151 W	200 W
Input Current @110V AC	0.91 A	1.37 A	1.81 A
Input Current @208V AC	0.48 A	0.73 A	0.96 A
Thermal Dissipation	341 BTUs/hour	515 BTUs/hour	682 BTUs/hour

The derated input power values of 100 W and 151 W can be correlated with the measured input power values for the minimum and maximum configurations of ProLiant DL320 servers and optional components outlined in this paper. However, the derated input power value must be high enough to account for any future upgrades.

Carefully derating the input power may satisfy deployment needs and also reduce the number of PDUs per rack.

Input Current and Thermal Dissipation Calculations

The input power is necessary for determining the input current and thermal dissipation. For a given input power, the input current varies depending on the input voltage level.

The relationship among the current, the voltage, and the power for the power supply input is as follows:

$$\text{Input Current} = \text{Input Power} / \text{Input Voltage}$$

For example,

$$\text{Input Current} = 100 \text{ W} / 110 \text{ V} = 0.91 \text{ A}$$

$$\text{Input Current} = 100 \text{ W} / 208 \text{ V} = 0.48 \text{ A}$$

The thermal dissipation can be calculated from the input power as follows:

$$\text{Thermal Dissipation} = \text{Input Power} \times 3.41$$

For example,

$$\text{Thermal Dissipation} = 100 \times 3.41 = 341 \text{ BTUs/hour}$$

$$\text{Thermal Dissipation} = 200 \times 3.41 = 682 \text{ BTUs/hour}$$

The easiest way to calculate the thermal dissipation for the entire rack is to add the input power requirements for all the servers and other units populated in a rack and then multiply the total input power by 3.41. The total thermal dissipation helps determine cooling and environmental requirements for the populated rack.

The following section, “Measured Input Power,” further explains the effects on input power and thermal calculations from adding or removing subsystem components.

Measured Input Power

Table 21 lists the measured input power of the ProLiant DL320 with varying subsystem components to illustrate the effects of adding or removing optional components. The “peak” and “typical” input power values were measured during power-up and idle/normal operations, respectively.

Table 21. Measured input power for selected server configurations

Configuration Number	ProLiant DL320 Configuration	Power Input Typical/Peak
0	Base model with no processor, HDD, or memory (for calculation only)	46 W/51 W
1	1x800 MHz, 1x128 MB, 0xHDD (minimum configuration)	70 W/80 W
2	1x800 MHz, 1x128 MB, 1x18.2 (standard configuration)	93 W/118 W
3	1x933 MHz, 4x512 MB, 2x18.2 GB, SA431 (maximum released configuration)	135 W/189 W
4	1x933 MHz, 4x512 MB, 2x18.2 GB, 25W PCI Load Card (maximum tested configuration)	151 W/200 W

Table 21 lists the input power of each subsystem component.

Table 22. Measured input power for subsystem components

Subsystem Components	Power Input Typical/Peak
Intel Pentium III 800-MHz Processor	23 W/26 W
Intel Pentium III 933-MHz Processor	28 W/30 W
128-MB DIMM	1 W/3 W
256-MB DIMM	1 W/3 W
512-MB DIMM	1 W/4 W
9.1-GB HDD	20 W/35 W
18.2-GB HDD	24 W/38 W
Remote Insight Lights-Out Edition	9 W/11 W
SA431	9 W/16 W
SA5300	25 W/27 W

Note: DIMM and HDD input power may vary depending on the component and drive manufacturer.

Note: Compaq plans to support the SA5300 for the ProLiant DL320 in the 1st quarter of 2001.

Input Power Budget Derating

This section explains how to derate the input power budget. The maximum rated power supply input power is 200 W.

To derate the input power, start with the base configuration 0 from Table 21. Add the peak power of the components included in the desired system configuration to calculate the derated power budget. Typical and peak input powers for various components are listed in Table 22.

Example

Assume the desired server configuration is: 1×800 MHz, 2×128 MB, and 2×18.2 GB

Use Table 23 to calculate the derated power budget using the peak power from Tables 21 and 22.

Table 23. Example derating worksheet

	Maximum Rated Input Power (in watts) for the base configuration	Peak Power	51 W
1.	Add the peak power for the processor.		26 W
2.	Add the peak power for the memory.		3 W
			3 W
3.	Add the peak power for the HDD.		38 W
			38 W
4.	Add the peak power for the PCI card.		
		Peak power for the desired configuration (in watts)	159 W
5.	Calculate the thermal dissipation.		× 3.41
		Thermal dissipation for the desired configuration (in BTUs)	542 BTUs/hour

Therefore, the new power budget for this configuration is **159 W** (compared to the rated 200 W), and the thermal dissipation is approximately $(159 \times 3.41) =$ **542 BTUs/hour** (compared to the rated 682 BTUs/hour).

This derated input power budget significantly reduces the power and thermal requirements for highly populated racks, which reduces the number of PDUs for certain configurations. Fewer PDUs increases deployment time and lowers costs. Costs for the facility electrical plumbing, data center floor ventilation, and facility air conditioning installation can also be reduced.

Note: Compaq strongly recommends verifying that the derated power budget satisfies all the installation requirements, including future upgrade plans.

Input Power Budget De-rating Worksheet

Add together the input powers of the components that are included in the desired configuration. The peak and typical input powers are listed in Table 22 earlier in this appendix. Use Table 24 to calculate the derated input power.

Table 24. Derating worksheet

Maximum Rated Input Power (in watts) for the base configuration	Peak Power	51 W
1. Add the peak power for the processor.		
2. Add the peak power for the memory.		
3. Add the peak power for the HDD.		
4. Add the peak power for the PCI card.		
Peak power for the desired configuration (in watts)		
5. Calculate the thermal dissipation.		× 3.41
Thermal dissipation for the desired configuration (in BTUs)		