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Compaq ProLiant DL380 Generation 2 Server High-Density Deployment in Compaq Racks

***Abstract:** This white paper is intended for use as a planning guide to expedite concentrated deployments of several Compaq ProLiant™ DL380 Generation 2 servers in a Compaq rack. Use this white paper in conjunction with documents for the ProLiant DL380 Generation 2 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 business enterprises and service providers use network infrastructure and web applications that work best on dedicated servers. This creates the need to fit a large number of smaller servers into existing server rooms and data centers. Compaq meets this need with the density-optimized line of ProLiant servers such as the ProLiant DL380 Generation 2 server. At a height of 2U each, up to 21 ProLiant DL380 Generation 2 servers can fit in a single Compaq 42U rack. While the ProLiant DL380 Generation 2 server has clear space saving benefits, its compressed size presents new challenges for rapid server deployment, 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 DL380 Generation 2 servers. This white paper introduces planning, power and thermal considerations, server and rack requirements, and installation configurations. It also outlines the products associated with high-volume deployment in Compaq rack configurations.

IMPORTANT: This document discusses only the ProLiant DL380 Generation 2 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 electrical shock hazards. Refer all service to qualified personnel.

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



This symbol indicates the presence of electrical 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 electrical 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 electrical 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.

Server Warnings

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



WARNING: To reduce the risk of electrical 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 7.6 cm (3 inches) 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 771 kg (1,700 lb). 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 DL380 Generation 2 server at a time. A rack may become unstable if more than one ProLiant DL380 Generation 2 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

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 DL380 Generation 2 server, Compaq racks, PDUs, and related options to help choose a rack configuration	Page 10
Power Distribution Units and Power Cords	Discusses specific PDU and power cord choices	Page 11
Console Management Systems	Discusses server management options	Page 16
Planning Rack Configurations	Discusses rack configuration issues	Page 19
Installation Procedures	Describes installation procedures	Page 26
Related Documents, Appendix A	Lists documents and websites that provide additional information about Compaq racks, rack options, and rack deployment of ProLiant DL380 Generation 2 servers	Page 34
Parts Reference, Appendix B	Lists part numbers for all the components referred to in this white paper	Page 35
Power and Thermal Budgeting, Appendix C	Explains calculating power deratings	Page 38
Connecting Multiple Racks, Appendix D	Discusses connecting multiple racks and lists rack deployment options for 7000- and 9000-series racks.	Page 43

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 12.
Step 3	Determine rack configuration. See examples on pages 22-24.
Step 4	Determine rail, console, and cable configurations. See the "Rack Management Systems" section on page 25.
Step 5	Install the ProLiant DL380 Generation 2 server. See the "Installation Procedures" section on page 26.

Introduction

Compaq designed the dense ProLiant DL380 Generation 2 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 DL380 Generation 2 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 DL380 Generation 2 servers.

The “Power Distribution Units” section 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 “Planning Rack Configurations” section provides weight information for individual rack components to help address floor support requirements. It also describes cable systems.

The “Console Management Systems” section provides information on server management options.

All discussions of power requirements for ProLiant DL380 Generation 2 servers are based on the input power of the server. This document uses the maximum rated power supply input of 575 W for calculation purposes. However, derating the input power may be effective to:

- Minimize the number of PDUs required for each rack.
- Match the rack current requirements with the existing circuit breaker capacity.
- Match the rack cooling requirements with the existing facility cooling capability.

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

IMPORTANT: In this document, derating the input power budget means using less than the maximum rated input power values for the power supply. To derate the input power, see Appendix C. **Compaq strongly recommends that the derated power budget satisfies all the installation requirements, including future upgrade plans.**

Refer to the *Compaq ProLiant DL380 Generation 2 Server QuickSpecs* for detailed specifications and options for the ProLiant DL380 Generation 2 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 DL380 Generation 2 server	www.compaq.com/proliant
Specifications, options, and a list of other Compaq products and options compatible with the ProLiant DL380 Generation 2 server	<i>Compaq ProLiant DL380 Generation 2 QuickSpecs</i>
Installation and service guidelines for the ProLiant DL380 Generation 2 server	<i>Compaq ProLiant DL380 Generation 2 Setup and Installation Guide</i> , P/N 203844-001 <i>Compaq ProLiant DL380 Generation 2 Maintenance and Service Guide</i> , P/N 203840-002
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 DL360 Generation 2 server in third-party racks. (Contains information that applies to the ProLiant DL380 G2 server.)	Compaq Ultra-Dense Server Deployment in Third-Party Cabinet Racks, Document Number 12CU-0400A-WWEN Third-Party Rack Cabinet kit, P/N 228894-B21
Installation guidelines for the ProLiant DL360 Generation 2 server in telecommunications (Telco) racks. (Contains information that applies to the ProLiant DL380 G2 server.)	Compaq Ultra-Dense Server Deployment in Telecommunications (Telco) Racks, Document number 12CZ-0400A-WWEN Telco Rack kit, P/N 228892-B21

Table 4. Notations for Optional Components

Notation	Description
1x, 2x, 4x	Number of components, for example, 1 x 128 MB means one 128-MB DIMM
1.13 GHz	Intel Pentium III 1.13-GHz processor
1.266 GHz	Intel Pentium III 1.266-GHz processor (when available)
128 MB	128-MB DIMM
256 MB	256-MB DIMM
512 MB	512-MB DIMM
HDD	Hard disk drive
	36-GB HDD
	72-GB HDD (when available)
	Hot-plug fan
	Hot-plug power supply
	Tape drive
SA5300	Smart Array 5300 Controller option (64-bit PCI card)
Remote Insight Lights-Out Edition	Remote Insight Lights-Out Edition option (32-bit PCI card)

Glossary

1U – A rack unit (1U) is 4.45 cm or 1.75 inches in vertical dimension. The height of a device, (also known as form factor), can be expressed in rack units (Us). The ProLiant DL380 Generation 2 server is a 2U server.

1U Integrated Keyboard/Mouse/TFT – The TFT5600 RKM (rack-mount keyboard and monitor) is a 1U integrated keyboard and monitor. Its full 15-inch TFT active matrix display provides flicker-free, quality display at viewing angles up to 120 degrees horizontally and 105 degrees vertically.

Flat Panel Display (FPD) – A Compaq TFT5010R (15-inch) flat panel monitor provides a large image size and exceptional screen performance in a space-saving 2U size that enables the monitor to be neatly tucked away when not in use.

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 DL380 Generation 2 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.

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 interacts with a server using 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. A local console system does not use a network connection to interact with the server.

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

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

Network Interface Controllers (NICs) – Controllers that are embedded on the system board of the ProLiant DL380 Generation 2 server.

Power Distribution Unit (PDU) – A PDU is a high-voltage or low-voltage device that is equipped with circuit breakers that help prevent electrical surges and external equipment malfunction by providing over current and surge protection for connected devices. See the “Power Distribution Units” section of this paper.

Remote Console – A remote console is a server console system that uses a network connection to interact with the server. This system enables 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 DL380 Generation 2 server 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 21 ProLiant DL380 Generation 2 servers in a 42U Compaq rack with significantly fewer cables than in a local console.

Server Console Switch – A device that enables 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 – A toolless rack management system designed for Compaq 7000- and 9000-series racks that supports in-rack serviceability for ProLiant DL380 Generation 2 servers.

UID LED and Switch – The blue Unit Identification LED identifies the ProLiant DL380 Generation 2 server requiring service. A UID switch toggles both the front and rear UID LEDs simultaneously.

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

For detailed information about the products in this glossary visit the Compaq website:

www.compaq.com

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 DL380 Generation 2 servers.

Table 5. ProLiant DL380 Generation 2 Server Parameters

Dimensions H x W x D		
8.64 x 65.45 x 44.45 cm (3.38 x 25.75 x 17.50 inches)		
Server Weights		
Minimum configuration: 1 x processor, 2 x 128-MB DIMM, 0 x CD-ROM drive, 1 x diskette assembly, 0 x HDD, 5 x fans, 1 x power supply		16.7 kg (37 lb)
Average configuration: 1 x processor, 4 x 256-MB DIMM, 4 x HDD, 1 x CD-ROM drive, 1 x diskette assembly, 5 x fans, 1 x power supply, 1 x Remote Insight Lights-Out Edition		21.2 kg (47 lb)
Maximum configuration: 2 x processor, 6x DIMMs, 6 x HDDs, 2 x SA5300, 1 x CD-ROM drive, 1 x diskette assembly, 8 x fans, 2x power supplies, 1 x Remote Insight Lights-Out Edition		27 kg (60 lb)
Component Weights		
CD/diskette drive assembly		0.34 kg (0.75 lb)
DIMM		0.04 kg (0.1 lb)
HDD		0.86 kg (1.9 lb)
Remote Insight Lights-Out Edition		0.86 kg (1.2 lb)
SA5300		0.45 kg (1.0 lb)
Rack Rails and Hardware Weights		
Cable arm		0.81 kg (1.8 lb)
Slide (2)		2.07 kg (4.6 lb)
Rail (2)		1.8 kg (4.0 lb)
Total Weight:		4.7 kg (10.4 lb)
Power Ratings		
Maximum power supply rated input AC power		
	115 V	575 W
	240 V	545 W
Maximum system measured input AC power (per power calculator)		
	115 V	457 W
	240 V	400 W
Maximum power supply rated input current		
	115 V	6.4 A
	240 V	3.2 A
Maximum system measured input current (per power calculator)		
	115 V	3.8 A
	240 V	1.7 A

continued

Table 5. ProLiant DL380 Generation 2 Server Parameters (continued)

System Thermal Dissipation (per hour)		
	115 V	1,435 BTUs
	240 V	1,363 BTUs
Relative Humidity (non-condensing)		
	Operating	10 to 90%
	Non-operating	5 to 95%

The SA5300 option and the Remote Insight Lights-Out Edition option are PCI cards available from Compaq. Any third-party PCI cards used in the ProLiant DL380 Generation 2 server must comply with the industry-standard PCI specifications for dimension, weight, power, and thermal requirements.

Power Distribution Units and Power Cords

Power Distribution Units

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

Table 6. Compaq PDUs

Part Number	Availability	Input Voltage	Current Rating	Maximum Servers per PDU ¹	Input Connectors and Cord	Output Connectors	Output Breakers	Dimensions	Weight
207590-B21	Worldwide	High	16 A	5	IEC 320 C-20	12 × IEC 320-C13	2 × 10 A	4.27 × 20.32 × 43.18 cm 1.62 × 8.0 × 17.00 in	3.15 kg 7 lb
207590-D71	North America & Japan	Low	24 A	3	NEMA L5-30P 12-ft cord	12 × NEMA 5-15	4 × 15 A	4.27 × 20.32 × 43.18 cm 1.62 × 8.0 × 17.00 in	4.5 kg 11 lb
207590-B31	International	High	32 A	10	IEC 309-32A 12-ft cord	12 × IEC 320-C13	4 × 10 A	4.27 × 20.32 × 43.18 cm 1.62 × 8.0 × 17.00 in	4.5 kg 11 lb
207590-D72	North America & Japan	High	24 A	7	NEMA L6-30P 2 × 12-ft cord	12 × IEC 320-C13	4 × 10 A	4.27 × 20.32 × 43.18 cm 1.62 × 8.0 × 17.00 in	4.5 kg 11 lb
207590-B23	North America	High	40 A	12	Field wiring	12 × IEC 320-C13	2 × 10 A; 3 × 15 A	4.27 × 20.32 × 43.18 cm 1.62 × 8.0 × 17.00 in	6.4 kg 14 lb

continued

Table 6. Compaq PDUs (continued)

Part Number	Availability	Input Voltage	Current Rating	Maximum Servers per PDU ¹	Input Connectors and Cord	Output Connectors	Output Breakers	Dimensions	Weight
191186-001 ²	North America	High	24 A	7	NEMA L6-30P 2 × 12-ft cord	12 × IEC 320-C13	4 × 10 A	4.37 × 30.48 × 43.18 cm 1.72 × 12.0 × 17.00 in	9.1 kg 20 lb
191186-B31 ²	International	High	30 A	9	IEC 309-32A 12-ft cord	12 × IEC 320-C13	4 × 10 A	4.37 × 30.48 × 43.18 cm 1.72 × 12.0 × 17.00 in	9.1 kg 20 lb
197616-B22 ³	Worldwide	High	40 A	12	Field wiring	12 × IEC 320-C13 1 × DB9 Serial 1 × RJ-45	4 × 10 A	4.32 × 43.18 × 50.04 cm 1.70 × 17.00 × 19.70 in	6.4 kg 14 lb
295363-001 ^{4,5}	North America	Low	24 A	3	NEMA L5-30P 12-ft cord	12 × NEMA 5- 15R	2 × 15 A	5.03 × 25.15 × 48.97 cm 1.98 × 9.9 × 19.28 in	5.4 kg 12 lb
295363-002 ^{4,5}	North America	High	16 A	5	NEMA L6-20P 12-ft cord	12 × IEC 320-C13	2 × 10 A	5.03 × 25.15 × 48.97 cm 1.98 × 9.9 × 19.28 in	3.6 kg 8 lb
295363-003 ^{4,5}	North America	High	24 A	3	NEMA L6-30P 12-ft cord	12 × IEC 320-C13	4 × 10 A	5.03 × 25.15 × 48.97 cm 1.98 × 9.9 × 19.28 in	5.4 kg 12 lb
295363-291 ^{4,5}	Japan	Low	24 A	3	NEMA L6-30P 12-ft cord	12 × NEMA 5- 15R	2 × 15 A	5.03 × 25.15 × 48.97 cm 1.98 × 9.9 × 19.28 in	5.4 kg 12 lb
295363-B21 ^{4,5}	Worldwide	High	16 A	5	IEC 320 C-20	12 × IEC 320-C13	2 × 10 A	5.03 × 25.15 × 48.97 cm 1.98 × 9.9 × 19.28 in	5.4 kg 12 lb
295363-B32 ^{4,5}	International	High	16 A	5	NEMA 309-16A	12 × IEC 320-C13	2 × 10 A	5.03 × 25.15 × 48.97 cm 1.98 × 9.9 × 19.28 in	5.4 kg 12 lb
Note 1: These numbers are determined using a single power source (non-redundant).									
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 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 5: This PDU is no longer being shipped by Compaq.									

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 11 Y-cables and 4 brackets that support 2 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 2 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-voltage and low-voltage applications. The input current rating for a ProLiant DL380 Generation 2 server is either 3.2 A at 200 to 240 volts or 6.4 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.

IMPORTANT: The examples shown in the following sections use the maximum rating of the power supply. They are for reference only.

Non-Redundant Power

The following examples illustrate how to calculate the number of servers per PDU when using non-redundant power.

Example

One high-voltage PDU (P/N 207590-D72) has a current rating of 24 A. The server has a total input current rating of 3.2 A at 200 volts.

$$24 \text{ A (PDU current rating)} / 3.2 \text{ A (server total input current rating)} = 7$$

This PDU can support a maximum of 7 servers at full server input current ratings.

Example

One low-voltage PDU (P/N 207590-D71) has a current rating of 24 A. The server has a total input current rating of 6 A at 100 volts.

$$24 \text{ A (PDU current rating)} / 6.4 \text{ A (server total input current rating)} = 3$$

This PDU can support a maximum of 3 servers at full server input current ratings.

Redundant Power

The ProLiant DL380 Generation 2 server supports a redundant power supply. The power supply for this server automatically senses input voltage level.

When using redundant power, it is necessary to use two PDUs per server. The following examples illustrate how to calculate the number of servers per pair of PDUs when using redundant power.

Example

Two high-voltage PDUs (P/N 207590-D72) have a combined current rating of 48 A. The server has a total input current rating of 3 A at 200 volts (redundant power).

$$2 [24 \text{ A (PDU current rating)}] / 3.2 \text{ A (server total input current rating)} = 7$$

These PDUs can support a maximum of 7 servers at full server input current ratings.

Example

Two low-voltage PDUs (P/N 207590-D71) have a current rating of 48 A. The server has a total input current rating of 6 A at 100 volts (redundant power).

$$2 \text{ [24 A (PDU current rating) / 6.4 A (server total input current rating)]} = 3$$

These PDUs can support a maximum of 3 servers at full server input current ratings.

For more information on high-voltage PDUs, refer to the “Power Distribution Unit High-Voltage Models for North America and International Use, (NA CPQ # 295363-002; INT’L CPQ # 295363-B31)” website:

www.compaq.com/products/servers

For more information on low-voltage PDUs, refer to the “Power Distribution Unit Low-Voltage Models for North America and International Use” website:

www.compaq.com/products/servers

Selecting Server Power Cords

The appropriate server power cord to use depends on the cable management system installed in the rack. Generally, the sliding rail cable management system requires a power cord that is 1.8288 m (6 ft) in length. This length provides enough slack for the power cord to route through the cable management arm.

High-Voltage Y-Cables

The Vertical-Mount PDU Bracket with High-Voltage Cables kit includes 11 Y-cables, each of which is 3.0 m (10 ft) long. The single-cord PDU section is 1.8 m (6 ft) long, and the dual-cord server section is 1.3 m (4 ft) long. See Table 7 for part numbers.

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 to two ProLiant DL380 Generation 2 servers in the standard configuration or one ProLiant DL380 Generation 2 server in the maximum configuration.



CAUTION: When installing server power cords into the PDUs, ensure that the load is balanced among the output circuit breakers. Do not exceed the ratings of the circuit breakers.

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 11 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	142257-001 (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 DL380 Generation 2 Server ships with one 10-ft IEC to IEC cable, part number 142257-003.
	142257-002 (8 ft)	
	142257-003(10 ft)	

Power Cords

The power cord included with the North American model of the ProLiant DL380 Generation 2 server can be used for low-voltage applications. Use a 1.8-m (6-ft) to 2.4-m (8-ft) long power cord with the standard rack rails and cable management arm.

For information on obtaining high-voltage power cords, visit the Compaq website:

www.compaq.com

Table 8 lists PDU configurations for 42U racks and Table 9 lists PDU configurations for 36U 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 Figure 3.

Table 8. PDU Configurations for 42U Racks

Part Number	Input Voltage/ Current Rating	Vertical Mount Bracket Kits		Maximum Servers	PDUs per Rack	Populated Rack Weight (lb)	BTUs
		166097-B21 with Y-cables	191265-B21				
207590-B21	High/16 A	2		5	4	1,813	29,400
207590-D71	Low/24 A			3	4	1,813	29,400
207590-B31	High/32 A	2		10	3	1,800	29,400
207590-D72	High/30 A	2		7	3	1,800	29,400
191186-001	High/24 A	2		7	3	1,800	29,400
191186-B31	High/30 A	2		9	3	1,800	29,400
197616-B22	High/32 A	2		12	2	1,787	29,400
295363-001	Low/24 A		1	3	4	1,813	29,400
295363-002	High/16 A	2		5	4	1,813	29,400
295363-003	High/24 A	2		7	3	1,800	29,400
295363-291	Low 24 A		1	3	4	1,813	29,400
295363-B21	High/16 A	2		5	4	1,813	29,400
295363-B32	High/16 A	2		5	4	1,813	29,400

Table 9. PDU Configurations for 36U Racks

Part Number	Input Voltage/ Current Rating	Vertical Mount Bracket Kits		Maximum Servers	PDUs per Rack	Populated Rack Weight (lb)	BTUs
		166097-B21 with Y-cables	191265-B21				
207590-B21	High/16 A	2		5	4	1,510	24,534
207590-D71	Low/24 A			3	4	1,510	24,534
207590-B31	High/32 A	2		10	2	1,484	24,534
207590-D72	High/30 A	2		7	3	1,497	24,534
191186-001	High/24 A	2		7	3	1,497	24,534
191186-B31	High/30 A	2		9	2	1,484	24,534
197616-B22	High/32 A	2		12	2	1,484	24,534
295363-001	Low/24 A		1	3	4	1,510	24,534
295363-002	High/16 A	2		5	4	1,510	24,534
295363-003	High/24 A	2		7	3	1,497	24,534
295363-291	Low/24 A		1	3	4	1,510	24,534
295363-B21	High/16 A	2		5	4	1,510	24,534
295363-B32	High/16 A	2		5	4	1,510	24,534

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 10 lists options for configuring console management systems.

Table 10. Local Console Management Options

Description	Compaq Part No.	Description
TFT5600 Rack-Mount Keyboard and Monitor	221546-001	A 1U integrated keyboard and monitor; N.A.
Server Console Switch 1 x 8-port (100-230VAC)	400337-001	N.A.
TFT5010R Flat Panel Monitor	104741-001	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-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 rack rails and cable management arm, Telco rack solution, or third-party rack cabinet and cable management arm)
- KVM server to console cables [1.8 m (6 ft) cables for sliding rail solutions]
- One or two RJ-45 cables for NIC 1 and NIC 2

Table 11 outlines the number of devices that fully populate a 42U or 36U rack with an in-rack local console.

Table 11. Device Configuration for an In-Rack Local Console

Device or Cable	42U Rack	36U Rack
ProLiant DL380 Generation 2 servers	19	16
KVM console switches	3	2
Flat panel display	1	1
Keyboard with trackball	1	1
Keyboard tray	1	1
RJ-45 cables	19/36	16/30
KVM server to console cables	21	17

Off-Rack Local Consoles

When an off-rack local console is used, certain components such as console switchboxes, keyboards, and video displays do not populate space in the rack, but are located in close proximity to the rack. Because of this, the rack can be fully populated with servers. Cable lengths for connecting servers to an off-rack local console vary in length 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 rack rails and cable management arm, Telco rack solution, or third-party rack cabinet and cable management solution)
- KVM server to console cables
- One or two RJ-45 cables for NIC 1 and NIC 2

Remote Console Management

The Compaq Remote Insight Lights-Out Edition board 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 board 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 board and the *Compaq ProLiant DL380 Generation 2 Server 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:

- A Rack Rail kit (standard sliding rail and cable management arm, Telco rack solution, or third-party pack cabinet and cable management arm)
- A Remote Insight board
- An RJ-45 cable for the Remote Insight board
- One or two RJ-45 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.

Table 12 lists the weight and power specifications for Compaq racks and rack option products. To calculate floor support requirements for a particular rack configuration, add the weight measurements to calculate the total weight of a rack fully populated with ProLiant DL380 Generation 2 servers. See the following example:

1 ×	9142 rack	114 kg (253 lb)
21 ×	ProLiant DL380 Generation 2 server with hard disk drives	567 kg (1,260 lb)
21 ×	Cable management system	76 kg (168 lb)
3 ×	High-voltage PDUs with brackets	17 kg (38 lb)
22 ×	High-voltage Y-cables	9 kg (21 lb)
21 ×	Keyboard/Video/Mouse cables	27 kg (59 lb)
	Total configured rack weight	<u>810 kg (1,800 lb)</u>

IMPORTANT: Compaq recommends populating a rack with ProLiant DL380 Generation 2 servers and other rack option products only after the rack is in or very near its final position. Compaq does not recommend transporting a fully populated rack.

Table 12. Compaq Rack and Related Options Weight (and power if applicable)

Option	Note	Weight	Power
Compaq Rack 9142 (42U)	Without the side panels	114.84 kg/253 lb	
Compaq Rack 9136 (36U)	Without the side panels	75 kg/165 lb	
Compaq Rack 7142 (42U)	Without the side panels	114.84 kg/253 lb	
High-voltage Power Y-cable	10 ft	0.45 kg/1 lb	
Keyboard/Video/Mouse molded cable	6 ft	0.64 kg/1.42 lb	
High-voltage 16 A PDU		4.99 kg/11 lb	
High-voltage 24 A PDU		4.99 kg/11 lb	
Low-voltage 24 A PDU		4.99 kg 11 lb	
Keyboard/trackball	With sliding tray	7.26 kg/16 lb	
TFT5010R Flat Panel Monitor	With sliding tray	22 kg/48.5 lb	45 W
TFT5600 Rack-mount keyboard and monitor		6.25 kg/13.75 lb	
Server Console Switch	1 x 8 port (100-230 VAC)	2.38 kg/5.25 lb	100 W

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

www.compaq.com.

Compaq Rack Builder Online

Compaq Rack Builder Online is a tool that assists in planning and configuring new racks. It provides users with a powerful web-based tool for configuring one or many racks with Compaq components. Using either a simple guided interface or a “build it yourself” mode for advanced users, rack configurations are created using a complete and current database that includes all Compaq rack-mountable products. To access Compaq Rack Builder Online, visit the Compaq website:

www.compaq.com/rackbuilder

Special Considerations for 7000-Series Racks

Compaq recommends deploying servers in either a 7000- or 9000-series Compaq rack. 4000-series racks (36U) are not recommended for 2U high-volume deployments with ProLiant DL380 Generation 2 servers because they are not sturdy enough to support the weight of 18 servers. The 7000- and the 9000-series Compaq racks mentioned in this section are the 7142, 9142, and 9136, racks. This document does not discuss deploying servers in any rack not manufactured by Compaq.



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

- Do not install a ProLiant DL380 Generation 2 server into a rack until the rack has been placed in its final location.
- Pre-install slide rails, PDUs, power cords, and cables into the rack in a build room or other location before moving the rack to its final location.
- Extend the leveling jacks to the floor and rest the full weight of the rack on the jacks before installing any servers. 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 can weigh up to 1,800 pounds. Moving a populated rack can cause the rack to become unstable, resulting in serious personal injury or equipment damage.

To effectively cool the ProLiant DL380 Generation 2 servers in a 7000-series rack, replace the front door of the rack with the High Air Flow Rack-Door Insert before deploying the servers in the rack. See Table 13 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.

Cabling and Rack Configurations

The figures on the following pages show three possible cabling and rack configurations. The configurations do not include every possible combination.

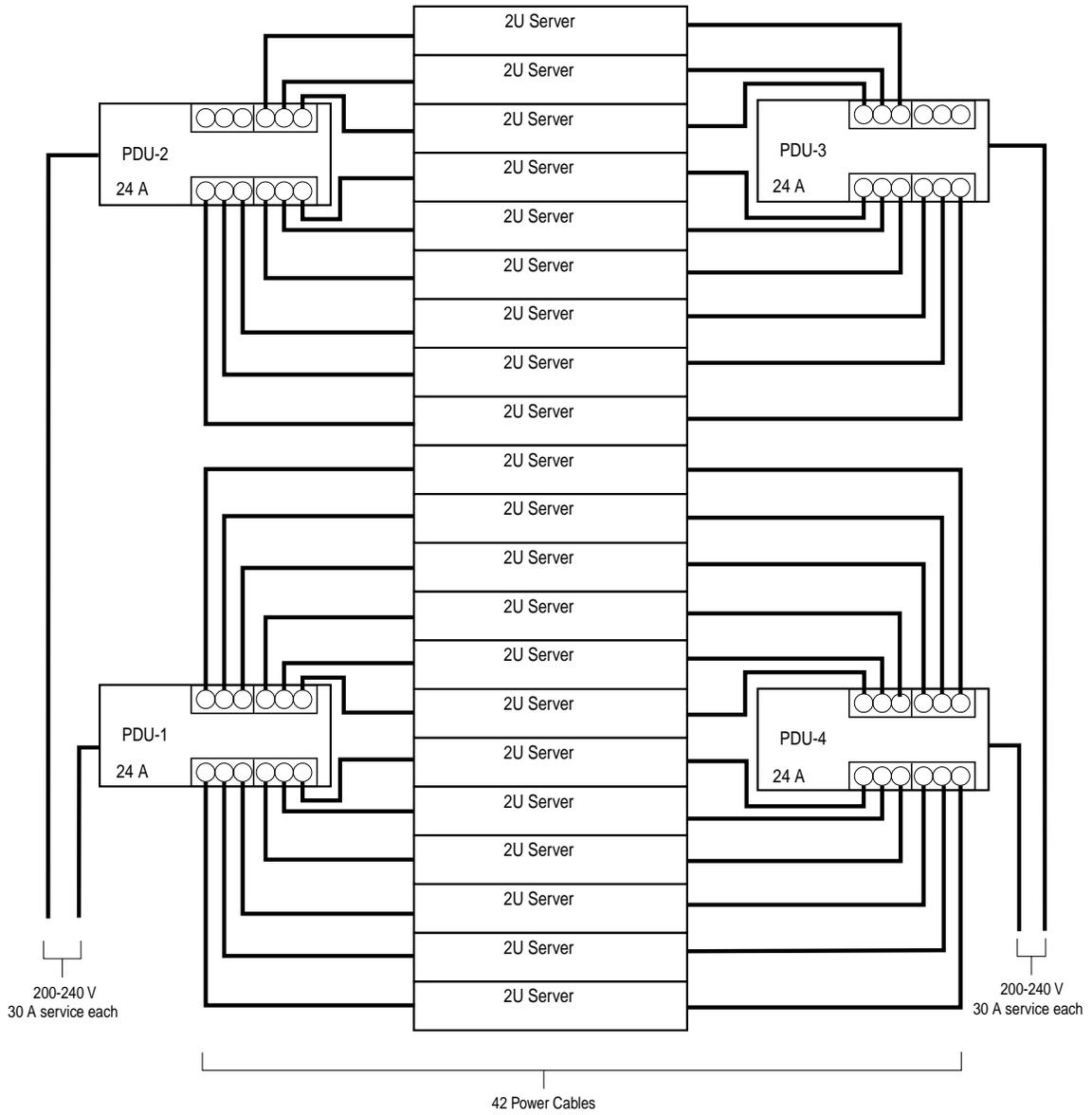


Figure 1. Four high-voltage PDUs (24A)

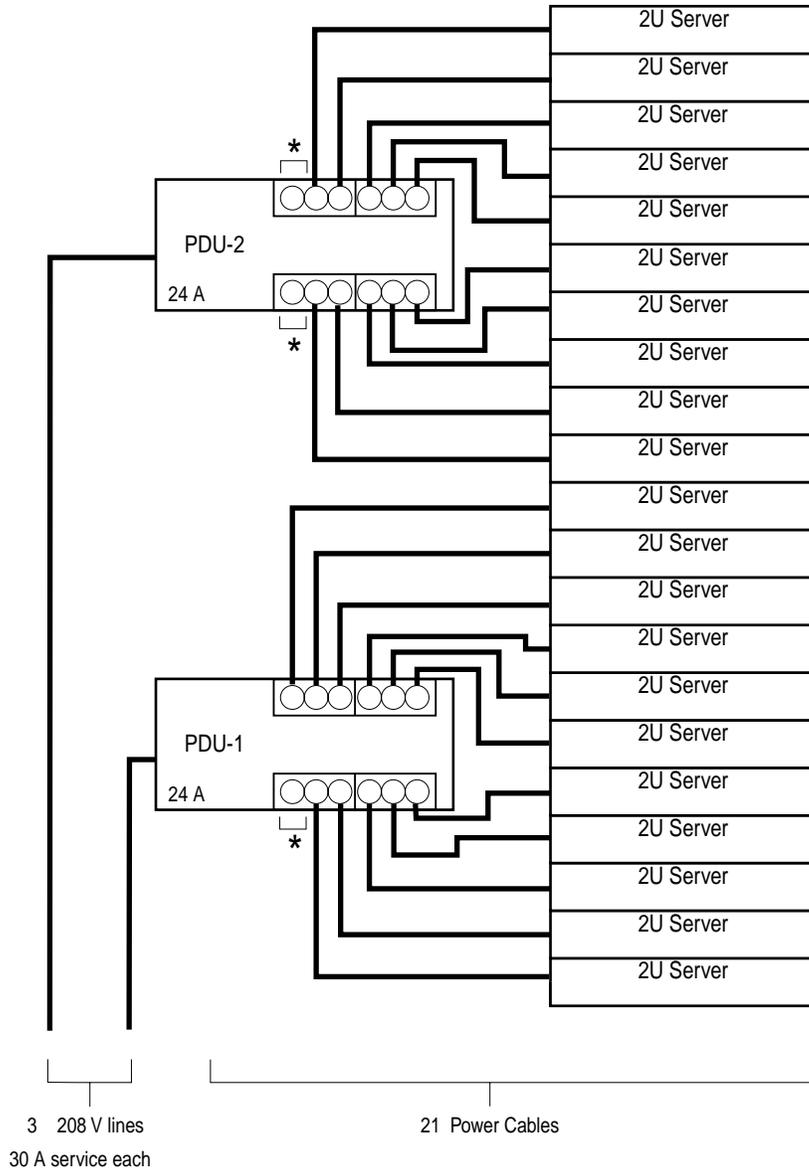


Figure 2. Two high-voltage PDUs (24A)

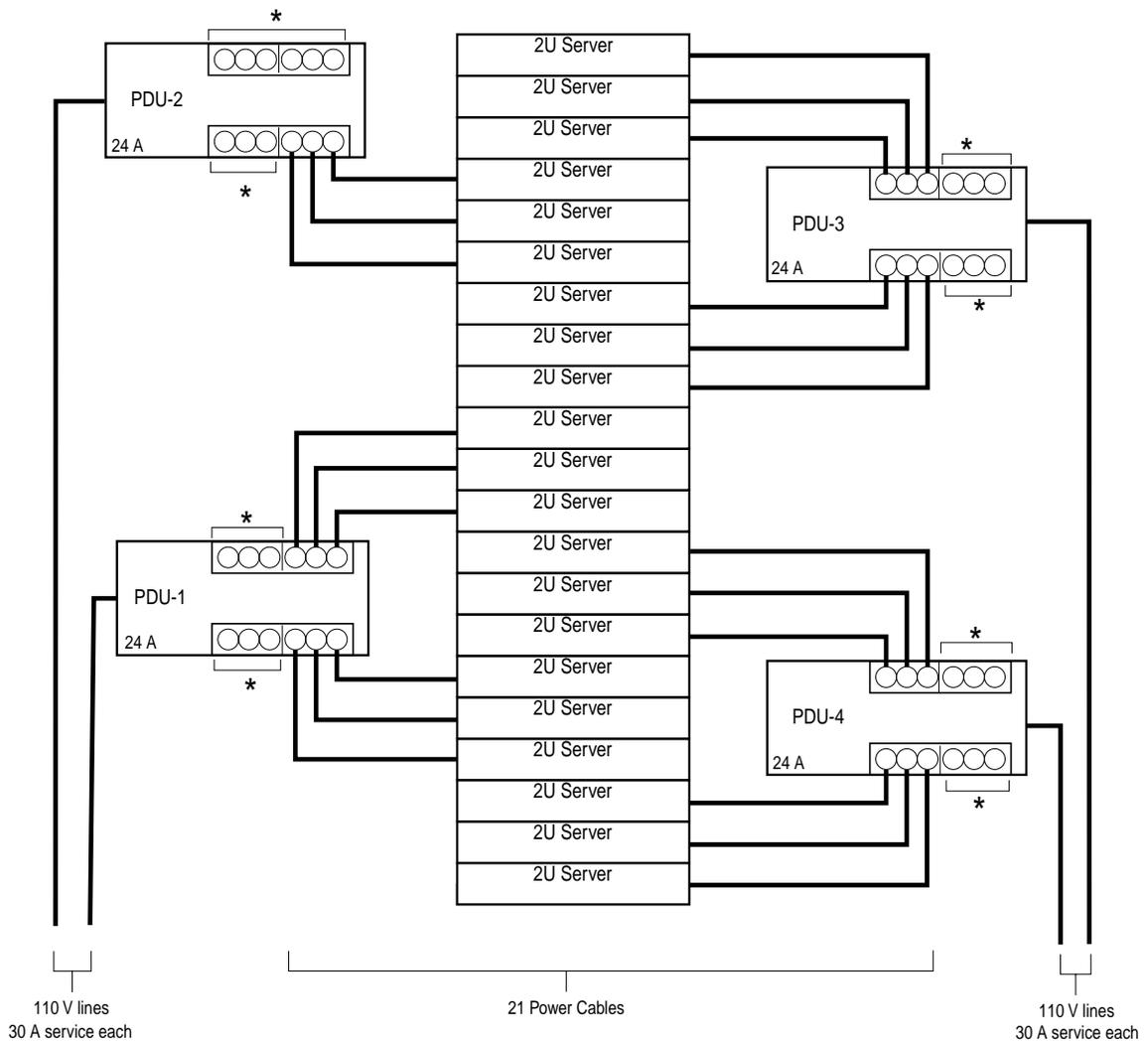


Figure 3. Four low-voltage PDUs (24A)

Rack Management Systems

Compaq recommends using the standard rack rails and cable management arm. 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.

IMPORTANT: Read the *Compaq Ultra-Dense Server Deployment in Third-party Cabinet Racks* or the *Compaq Ultra-Dense Server Deployment in Telco Racks* before deploying ProLiant DL380 Generation 2 servers in a third-party rack or Telco rack.

Standard Rack Rails

The standard rack rails and cable management arm work 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.

The standard rack rails and cable management arm are 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 cable management arm attaches directly onto the rear of the server and the rear of the rack. It secures and routes the cables along the rear of the rack. This not only prevents the cables from sagging and tangling, but it also enables proper air ventilation through the rack while enabling the servers to be fully extended without disconnecting any of the server cables.

The standard rack rails and cable management arm are conducive to in-rack servicing and provide convenient access to the server cables and connectors. Refer to the *Compaq ProLiant DL380 Generation 2 Setup and Installation Guide* for complete installation instructions.

Third-Party Rack Cabinet Solution

Because not all customers use Compaq racks, the ProLiant DL380 Generation 2 server design supports deployment in third-party rack cabinets. Compaq offers a Third-Party Rack Cabinet kit to use in installing ProLiant DL380 Generation 2 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 610 mm (21 inches) to 740 mm (29.13 inches) deep.

IMPORTANT: Always install the Compaq Third-Party Rack Cabinet kit when deploying a ProLiant DL380 Generation 2 server in a third-party rack. The kit supports the same cable management arm that the standard fixed rack rail solution uses.

Telco Rack Solution

Many data centers use Telco racks. The ProLiant DL380 Generation 2 server design supports deployment in Telco racks. Compaq offers a Telco Rack kit designed to install ProLiant DL380 Generation 2 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 DL380 Generation 2 server. Before deploying ProLiant DL380 Generation 2 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 when deploying a ProLiant DL380 Generation 2 server in a Telco rack.

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 DL380 Generation 2 server
- Installing Power Distribution Units (PDUs)
- Routing the Power Cords
- Installing the Rack Rails
- Installing a Server in a Rack
- Connecting Cables
- Completing the Installation

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

Preparing the ProLiant DL380 Generation 2 Server for Rack Installation

This section briefly describes preparing the server for rack installation.

Standard Rack Rails and Cable Management Arm

1. 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.
2. 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.
3. 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.

4. The ProLiant DL380 Generation 2 server ships with rack rails and a cable management arm. Remove the server rails from the standard rack rails and attach them to the server. Attach the cable management arm to the rear of the server before installing the server in a rack.

Refer to the *Compaq ProLiant DL380 Generation 2 Server Setup and Installation Guide* and the rack option documentation for detailed installation instructions.

Third-Party Rack Cabinet Solution and Cable Management Arm

The standard rack rails and cable management arm that are included with the ProLiant DL380 Generation 2 server are required for the third-party Rack Cabinet option kit. Before deploying ProLiant DL380 Generation 2 servers into a third-party rack, install the slide rail assembly on the third-party rack rail. For detailed instructions on deploying ProLiant DL380 Generation 2 servers into a third-party rack, refer to the documentation that ships with the third-party rack-mounting kit (P/N 228894-B21).

IMPORTANT: Read the *Compaq Ultra-Dense Server Deployment in Third-Party Cabinet Racks* before deploying ProLiant DL380 Generation 2 servers in a third-party rack.

Telco Rack Solution

The Telco Rack kit includes replacement server rails designed to fit on the ProLiant DL380 Generation 2 server. Before deploying ProLiant DL380 Generation 2 servers into a Telco rack, remove the standard server rails and replace them with the Telco server rails included in the Telco Rack kit. For detailed instructions on deploying ProLiant DL380 Generation 2 servers into a Telco rack, refer to the documentation that ships with the Telco rack-mounting kit (P/N 228892-B21).

IMPORTANT: Read *Compaq Ultra-Dense Server Deployment in Third-party Cabinet Racks* or *Compaq Ultra-Dense Server Deployment in Telco Racks* before deploying ProLiant DL380 Generation 2 servers in a third-party rack or Telco rack.

Installing Power Distribution Units

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-xxx series of PDUs must be mounted vertically in the side panels of the rack. See the “Power Distribution Units” section 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 36U and 42U Racks

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

Installing PDUs in a 36U or 42U Rack

Before installing PDUs in a 36U or 42U rack, you may need 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 arm (viewing the rack from the front). Use Figure 4 and Table 13 to determine the position of PDUs in a 36U or 42U rack.

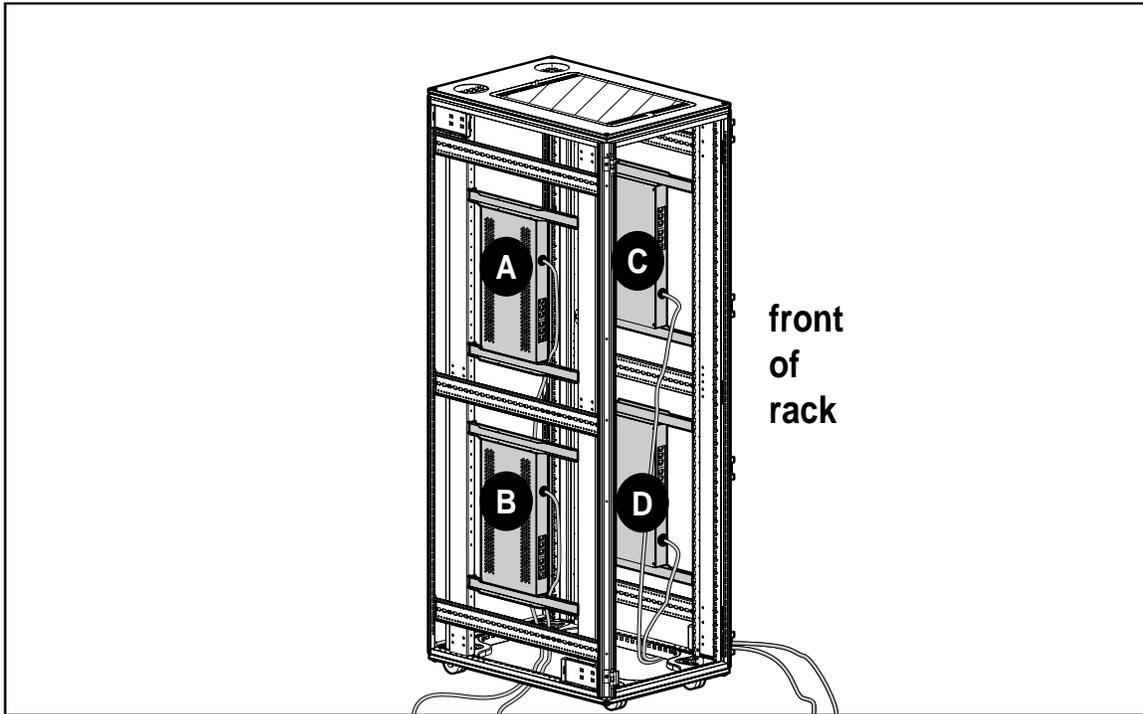


Figure 4. PDU positions in a 36U or 42U rack

Table 13. PDU Configurations in a 36U or 42U Rack

2 PDUs		3 PDUs	
Left	Right	Left	Right
	C	A	C
	D		D

Routing Power Cords

Use the following general procedures to route server power cords in 36U and 42U racks.

IMPORTANT: When installing server power cords into the PDUs, ensure that the load is balanced among the output circuit breakers.

High-Voltage Power Cords

To route and connect low-voltage power cords:

IMPORTANT: Route and connect the high-voltage power cord to the PDU after the server is installed.

1. Connect the power cord to the server and route it through the cable management system with the other server cables.
2. Route the power cord inside the rear rack support to the PDU.

High-Voltage Y-Cables

To route high-voltage Y-cables:

1. Connect the single-cord section of the Y-cable to the PDU installed on the same side as the cable management tray.
2. 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.
3. Use two plastic tie wraps to secure the Y-joint to the rack support.
4. After installing the servers, connect the cables to the servers and route them through the cable management system with the other server cables.

Low-Voltage Power Cords

To route and connect low-voltage power cords:

IMPORTANT: Route and connect the low-voltage power cord to the PDU after the server is installed.

1. Connect the power cord to the server first and route it through the cable management system with the other server cables.
2. 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 the Rack Rails

The following procedure describes how to install the standard rack rails onto the rack. The rails are designed to snap in place without screws or nuts.

1. Remove the server rails from the left and right standard rails.
2. Insert the rails into the rack holes.
3. Install the server rails on the chassis.
4. Insert the server into the rack.
5. Install the cable management arm.
6. Cable and power up the server.

Repeat the procedure for any subsequent rack rails. For detailed instructions on installing standard rack rails, refer to the *Compaq ProLiant DL380 Generation 2 Server Setup and Installation Guide* and to the *Compaq ProLiant DL380 Generation 2 Hardware Configuration and Installation Poster*.



CAUTION: Always install servers 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.

IMPORTANT: Before installing the rack rails for the standard rack rails and cable management arm, remove the server rails from the slide rail assembly. See the “Preparing the ProLiant DL380 Generation 2 for Rack Installation” section in this paper for more information.

IMPORTANT: Install a ProLiant DL380 Generation 2 server in every U-space from the bottom to the top for maximum density.

Installing a Server in a Rack

Install ProLiant DL380 Generation 2 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. Attach the cable management arm to the rear of the server and to the rear of the rack.



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 DL380 Generation 2 server at a time. A rack may become unstable if more than one ProLiant DL380 Generation 2 server is fully extended for any reason.
-

Connecting Cables

This section discusses connecting and routing cables with different cable management solutions and different console management solutions.

In-Rack Local Console

To install cables with in-rack local consoles:

1. Connect the cables to each device installed in the rack, working from the bottom to the top.
2. Connect the cables to the bottom piece of equipment.
3. Bundle the cables and route them through the cable management arm.
4. Connect the cables to the console switchbox.
5. 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 DL380 Generation 2 Server Setup and Installation Guide* for the recommended order for connecting cables.

When the cables are properly connected and routed through the cable management arm, 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 electrical 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.
 - Do not route the power cord where it can be walked on or pinched by items placed against it. Pay particular attention to the plug, electrical outlet, and the point where the cord extends from the server.
-

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 arm installed in the rack to connect and route cables with an off-rack local console. Longer cables may be required to reach an off-rack console. See Table 11 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 RJ-45 connector in the Remote Insight Lights-Out Edition PCI board and the power cord. Route these cables through the cable management arm according to the instructions in the *Compaq ProLiant DL380 Generation 2 Server Setup and Installation Guide*. Connect the power cord to the PDU and the CAT5 cable to the network data line outlet.

Completing the Installation

To complete the installation:

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

Appendix A – Related Documents

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

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

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

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 IU Keyboard Drawer QuickSpecs

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

Compaq IU 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 DL380 Generation 2 Server 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 follows:

APD Asia Pacific

EURO Europe

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

U.K. United Kingdom

Table 14. Power Management

Part	Compaq P/N	Notes
Vertical-Mount PDU Brackets 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	2.0 m / 6 ft 2.5 m / 8 ft 3.0 m / 12 ft	142257-001 142257-002 142257-003
		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 DL380 Generation 2 server ships with one 10-ft IEC-to-IEC cable, part number 142257-003.

Table 15. Console management

Part	Availability	Compaq P/N	Notes
TFT 5010R Flat Panel Monitor	N.A., International	104741-001 104741-B24	
TFT5000R Flat Panel Monitor	N.A, Japan	120207-001 120207-291	
TFT5000R Flat Panel Monitor	International	120207-B31	
Server Console Switch 1 x 8-port (100-230VAC).	N.A., International, Japan	400337-001 400337-B31 400337-291	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.

continued

Table 15. Console management *(continued)*

Part	Availability	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
		110936-B25	1 Cable, 6 ft
1U Rack Keyboard Drawer		338056-B21	A Server Console Switch may be mounted behind the keyboard drawer (0U installation).
Keyboard with Trackball	U.S.	185152-406	
	U.K., Germany, France	185152-036	
		185152-046	
		185152-056	
	Italy, Spain, Denmark	185152-066	
		185152-076	
		185152-086	
	Norway, Sweden/Finland	185152-096	
		185152-106	
	Swiss, Portugal, Belgium	185152-116	
		185152-136	
		185152-186	
	Japan, International	185152-296	
		185152-B36	

Table 16. Rack Deployment

Part	Compaq P/N	Notes
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	
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	

Appendix C – Power and Thermal Budgeting

This appendix provides the information and worksheets necessary to calculate power and thermal budgeting for your system. However, for the most accurate, updated power and thermal budgeting calculations for your particular configuration, Compaq recommends using the online power calculator. To use the calculator, visit the Compaq Active Answers website:

activeanswers.compaq.com/aaconfiguratorcode/configurationUi.asp?HTMLFilename=Country

Note: In this document, derating the input power budget means using less than the maximum rated input power values for the power supply. **Verify that the derated power budget satisfies all the installation requirements including future upgrade plans.**

Use either of the following methods to determine the lower input power requirement for ProLiant DL380 Generation 2 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 421 W to support all the optional components initially released with the ProLiant DL380 Generation 2 server.

Table 17 demonstrates how calculating the derated input power of the system can significantly reduce input current and thermal dissipation.

Table 17. Derated Current and Thermal Dissipation for Reduced Input Power Assumptions

Input Power	Derated		Fully Rated
	226 W	421 W	575 W
Input Current @115 VAC	2.0 A	3.8 A	6.4 A
Input Current @220 VAC	1.0 A	1.9 A	3.2 A
Thermal Dissipation	770 BTUs/hour	1435 BTUs/hour	1961 BTUs/hour

The derated input power values of 226 W and 421 W can be correlated with the measured input power values for the minimum and maximum configurations of ProLiant DL380 Generation 2 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 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 18 lists the measured input power of the ProLiant DL380 Generation 2 server with varying subsystem components to illustrate the effects of adding or removing optional components. The “typical” input power values were measured during idle/normal operations.

Table 18. Measured Input Power for Selected Server Configurations

Configuration Number	ProLiant DL380 Generation 2 Server Configuration	Typical Power Input
1	1x1.13-GHz, 2 x 128 MB, 0x HDD (minimum/base configuration)	226 W
2	2 x 1.26-GHz, 6 x 1-GB, 6 x 36-GB, 3 x 10 W PCI Load Cards (maximum tested configuration)	421 W

Table 19 lists the input power of each subsystem component.

Table 19. Measured Input Power for Subsystem Components

Subsystem Components	Typical Power Input
Intel Pentium III 1.13-GHz processor	27 W
Intel Pentium III 1.26 GHz processor (when available)	30 W
128-MB DIMM	2 W
256-MB DIMM	2.4 W
512-MB DIMM	2.4 W
1-GB DIMM	3 W
9.1-GB HDD	10 W
18.2-GB HDD	10 W
36-GB HDD	10 W
Remote Insight Lights-Out Edition	9 W
SA5300	17 W

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

Input Power Budget Derating

This section explains how to derate the input power budget. The maximum rated power supply input power is 575 W.

To derate the input power, start with the minimum configuration 0 from Table 18. Add the typical power of the components included in the desired system configuration to calculate the derated power budget. Typical input powers for various components are listed in Table 19.

Example

Assume the desired server configuration is: 2 × 1.13 GHz, 4 × 128 MB, and 2 × 18.2 GB.

Use Table 20 to calculate the derated power budget using the typical power from Tables 18 and 19.

Table 20. Example Derating Worksheet

	Maximum Rated Input Power (in watts) for the base configuration	Typical Power	226 W
1.	Add the typical power for the processor.		27 W
2.	Add the typical power for the memory.		2 W
			2 W
3.	Add the typical power for the HDD.		10 W
			10 W
4.	Add the typical power for the PCI card.		
	Typical power for the desired configuration (in watts)		278 W
5.	Calculate the thermal dissipation.		× 3.41
	Thermal dissipation for the desired configuration (in BTUs)		947 BTUs/hour

Therefore, the new power budget for this configuration is **278 W** (compared to the rated 575 W), and the thermal dissipation is approximately **947 BTUs/hour** (compared to the rated 1961 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 be reduced.

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

Input Power Budget Derating Worksheet

Add together the input powers of the components that are included in the desired configuration. The typical and typical input powers are listed in Table 19 earlier in this appendix. Use Table 21 to calculate the derated input power.

Table 21. Derating Worksheet

Maximum Rated Input Power (in watts) for the base configuration	Typical Power	226 W
1. Add the typical power for the processor.		
2. Add the typical power for the memory.		
3. Add the typical power for the HDD.		
4. Add the typical power for the PCI card.		
Typical power for the desired configuration (in watts)		
5. Calculate the thermal dissipation.		× 3.41
Thermal dissipation for the desired configuration (in BTUs)		

Appendix D – 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 DL380 Generation 2 Quick Specs* for the most recent options available. Table 22 lists rack-deployment options for 7000-series racks. Table 23 lists rack-deployment options for 9000-series racks.

Table 22. 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, enabling 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 enables 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 23. 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 8.6 cm (3.9 in) of space to the depth of the rack. This option enables more space for cable management or extended equipment installed in the rack.	120679-B21

continued

Table 23. 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