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Contents

Executive Summary	1
Symbols in Text.....	3
Symbols on Equipment	3
Server Warnings.....	4
Rack Warnings	4
Where to Find Information.....	5
Introduction	6
Understanding Power, Thermal, Weight, and Console Management Considerations	7
Cabling Configurations.....	21
Installation Procedures.....	25
Appendix A: Reference Information and Glossary.....	31

HP ProLiant DL380 Generation 3 Server High-Density Deployment

Abstract: *This white paper is intended for use as a planning guide to expedite the concentrated deployment of several HP ProLiant DL380 Generation 3 servers. Use this white paper in conjunction with other documents for the server and 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. HP meets this need with the density-optimized line of ProLiant servers, such as the ProLiant DL380 Generation 3 server. At a height of 2U each, up to 21 servers can fit in a single 42U rack. While this server has clear space saving benefits, its compressed size presents new challenges for rapid server deployment, as well as cable management and environmental considerations.

HP engineers have developed innovations in rapid high-volume deployment and improved cable management for large installations of ProLiant 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 rack configurations, such as keyboard, video, and mouse infrastructure.

IMPORTANT: This document principally discusses the ProLiant DL380 Generation 3 server, HP branded or Compaq branded 7000-, 9000-, and 10000-Series racks, and related rack options. This document does not discuss other servers, products, or racks not manufactured by HP.

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Symbols in Text

The following symbols might 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 might 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 service to qualified personnel.

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

Server Warnings

Adhere to the following guidelines when servicing or installing an HP 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) electric 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 server.



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 might 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 server at a time. A rack might become unstable if more than one 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 of servers in HP branded or Compaq branded 7000-, 9000-, and 10000-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 6
Understanding Power, Thermal, Weight, and Console Management Considerations	Lists important information about the server, racks, PDUs, and related options to help choose a rack configuration. Also explains calculating deratings	Page 7
Power Distribution Units	Discusses specifics of PDU choices	Page 13
Console Management Systems	Discusses different options for server management	Page 17
Planning Rack Configurations	Discusses issues related to deciding on rack configurations	Page 19
Installation Procedures	Describes installation procedures	Page 25

Table 2. Steps for High-Volume Server Deployment

Step	Description
Step 1	Choose PDUs from Table 8
Step 2	Determine the PDUs and related options from Table 10 and Table 11.
Step 3	Determine rack configuration. See "Planning Rack Configurations" on page 19.
Step 4	Determine rail, console, and cable configurations. See "Rack Management Systems" section on page 20.
Step 5	Install the ProLiant DL380 Generation 3 server. See the "Installation Procedures" section on page 25.

Introduction

HP designed the dense ProLiant DL380 Generation 3 server to meet the challenges associated with deploying a high concentration of servers in a single rack. HP suggests that customers evaluate their environments, power distribution, console, cable, and thermal management choices well in advance to ensure efficient deployments.

All discussions of power requirements for this server are based on the input power of the server. This document uses the maximum rated power supply input for calculation purposes. However, derating the input power might be effective to help:

- 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.

IMPORTANT: In this document, derating the input power budget means using less than the maximum rated input power values for the power supply. **HP strongly recommends using the installation planner to ensure that the derated power budget will satisfy all the installation requirements, including future upgrade plans.**

Refer to the *HP ProLiant DL380 Generation 3 Server QuickSpecs* at www.hp.com/products/servers/platforms for detailed specifications and options for this server.

Understanding Power, Thermal, Weight, and Console Management Considerations

Power, thermal, and weight are the most important considerations for optimizing a hardware installation in high-volume server environments. Table 3 provides server parameters necessary to calculate the power, thermal, and weight requirements for any number of servers.

Table 3. ProLiant DL380 Generation 3 Server Parameters

Dimensions H x W x D	
8.59 x 44.45 x 65.45 cm (3.38 x 17.50 x 25.75 in)	
Server Weights	
Minimum configuration: 1 x processor, 2 x 256-MB DIMMs, 0 x hard drives, 0 x CD-ROM drive, 1 x diskette drive, 5 x fans, 1 x power supply	18.30 kg (40.35 lb)
Average configuration: 1 x processor, 4 x 512-MB DIMMs, 4 x hard drives, 1 x CD-ROM drive, 1 x diskette drive, 5 x fans, 1 x power supply	22.09 kg (48.71 lb)
Maximum configuration: 2 x processor, 6 x 2-GB DIMMs, 6 x hard drives, 1 x CD-ROM drive, 1 x diskette drive, 8 x fans, 2 x power supplies, 1 x Remote Insight Lights-Out Edition II (RiLOE II) board, Battery-Backed Write Cache Enabler	26.72 kg (58.90 lb)
Component Weights	
CD-ROM drive	0.30 kg (0.66 lb)
Diskette drive	0.33 kg (0.72 lb)
256-MB DIMM	0.02 kg (0.05 lb)
512-MB DIMM	0.02 kg (0.05 lb)
2-GB DIMM	0.04 kg (0.08 lb)
Hard drive	0.86 kg (1.9 lb)
Processor/heatsink assembly	0.46 kg (1.01 lb)
Fan	0.16 kg (0.36 lb)
Power supply	1.71 kg (3.76 lb)
Power supply blank	0.20 kg (0.43 lb)
Battery-Backed Write Cache Enabler	0.11 kg (0.24 lb)
Remote Insight Lights-Out Edition II board	0.21 kg (0.46 lb)
Server chassis without components listed above	14.74 kg (32.50 lb)
Note: Any third-party PCI cards used in the server must comply with the industry-standard PCI specifications for dimension, weight, power, and thermal requirements.	
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)

continued

Table 3. ProLiant DL380 Generation 3 Server Parameters (continued)

Power Ratings		
Maximum Power Supply Rated Input AC Power		
115 V		565 W
240 V		540 W
Maximum System Measured Input AC Power		
115 V		458 W
240 V		434 W
Maximum Power Supply Rated Input Current		
115 V		4.9 A
240 V		2.3 A
Maximum System Measured Input Current		
115 V		4.1 A
240 V		1.8 A
System Thermal Dissipation (per hour)		
115 V		1,560 BTUs
240 V		1,481 BTUs
Relative Humidity (non-condensing)		
	Operating	10 to 90%
	Non-operating	5 to 95%

Power and Thermal Budgeting

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

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

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

All power requirement discussions in this document are based on the input power of the server, since this number has direct impact in planning for the PDU selection and the facility power source. One of the following methods can be used to account for input power in the facility power distribution planning:

- Use the maximum power supply rated input AC power.
- Use the derated input power, which can be calculated by subtracting the power budgets of uninstalled optional components from the rated input power.

- Use the allocated input power, which can be calculated by dividing the maximum power of a PDU by the number of servers. This calculated power should be at least the maximum system configuration power to support all the optional components initially released with the server.

The power budgets of optional components, referred to in the following sections, were derived from the system input power of a set of selectively measured server configurations. These configurations measured range from a basic low-end configuration to a fully populated high-end configuration. Since the input power values used in an installation might vary depending on the software applications, the information provided in this section should be used as a guideline only.

The server power supply is designed to support future upgrades of processors, DIMMs, and hard drives. As such, the power supply **output power** is rated at 400 W. Assuming the power supply efficiency of 71% (including the Power Factor Correction), the power supply **input power** is rated at 565 W. This input power value may be used in planning for the power source implementation and facility cooling requirements. In some cases, the input power requirement for each server might be desired to be lower.

The input power requirement might be lowered in the following instances:

- To minimize the number of PDUs, that is, the number of facility power feed lines, required for each rack.
- To match the rack current requirements with the existing facility branch circuit breakers.
- To match the rack cooling requirements with the existing facility environment.

Table 4 demonstrates how calculating the derated input power of the system can significantly reduce input current and thermal dissipation.

Table 4. Derated Current and Thermal Dissipation for Reduced Input Power Assumptions

Input Power	Derated		Full Rating
	Minimum configuration	Maximum configuration	
Input Current at 115 VAC	1.9 A	4.1 A	4.9 A
Input Current at 240 VAC	0.9 A	1.8 A	2.3 A
Thermal Dissipation	747 BTUs/hour	1560 BTUs/hour	1927 BTUs/hour

The derated input power values of the maximum and minimum configuration wattages can be correlated with the measured input power values for the minimum and maximum configurations of the server. However, the derated input power value must be high enough to account for any future upgrades.

As stated earlier, the power supply is designed to support future processor and hard drive upgrades. When installing 21 servers, the number of PDUs to be installed will depend on the support for the input current requirement. Carefully derating the input power may very well satisfy deployment needs and also reduce the number of PDUs per rack. Reducing the number of PDUs has a direct impact on the deployment time and maintenance of an installation.

The remainder of this section explains the input power relationships to input current and thermal dissipation to aid customers in derating the input power.

Input Current and Thermal Dissipation Calculations

Input power is the key in deriving input current and thermal dissipation. For a given input power, the input current will vary 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 input power of a server depends on the operational state of the system. For example, during the initial power up, a server consumes more power due to the hard drives' spin-ups. It should be noted that in the server, the hard drives spin-up one after the other. Therefore, the peak input power requirement changes significantly when the first drive is added, but not as much when additional drives are added. After the initial power up, the input power varies depending on the operating system and the application software running on the server. During standby, only the auxiliary portion of the power supply is consuming power to support operations of a very limited part of the system, for example, the Remote Insight Lights-Out Edition II option, NICs, and so on.

Thermal dissipation can be calculated from the input power as follows:

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

For example,

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

$$\text{Thermal Dissipation} = 292 \text{ W} * 3.41 = 996 \text{ BTUs/hour}$$

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 “Measured Input Power” section explains more on how adding or removing an optional subsystem component affects the input power and thermal calculations.

Measured Input Power

Table 5 lists the measured input power of the 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 5. Measured Input Power for Selected Server Configurations

Configuration Number	ProLiant DL380 Generation 3 Server Configuration	Power Input Typical/Peak at 240 VAC
1	1 x 2.4-GHz processor, 2 x 256 MB DIMMs, 0 x hard drives (minimum/base configuration)	207 W
2	2 x 2.8-GHz processor, 6 x 1-GB DIMMs, 6 x 72-GB hard drives, 3 x 15 W PCI Load Cards (maximum tested configuration)	458 W

Table 6. Measured Input Power for Subsystem Components

Subsystem Component	Typical Power Input
Intel Pentium 2.4-GHz Xeon processor	40 W
Intel Pentium 2.8 GHz Xeon processor	47 W
256-MB DIMM	2.4 W
512-MB DIMM	2.4 W
1-GB DIMM	3 W
9.1-GB hard drive	16 W
18.2-GB hard drive	19 W
36-GB hard drive	19 W
72-GB hard drive	19 W
Remote Insight Lights-Out Edition	9 W
Note: DIMM and hard drive input power can vary depending on the component and drive manufacturer.	

Input Power Budget Derating

If a deployment plan limits future expansion beyond certain configuration options, adjustments can be made to the expected input current and thermal requirements of the servers.

To derate the input power, start with the minimum configuration 1 from Table 3. 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 5.

Example

Assuming the desired server configuration is as follows, use Table 7 to calculate the derated power budget using the typical power from Table 5.

Processors: 2 x 2.4 GHz

Memory: 4 x 512 MB

Storage: 2 x 18.2 GB

Table 7. Example Derating Worksheet

1.	Start with the maximum rated input power for the base configuration (1 processor, 2 DIMMs, 0 hard drives)	207 W (typical power)
2.	Add the typical power for the second processor.	+ 40 W
3.	Add the typical power for the additional memory.	+ 4.8 W (2.4 W per DIMM)
4.	Add the typical power for additional storage. Typical power for the desired configuration	+ 38 W (19 W per hard drive) = 290 W
5.	Calculate the thermal dissipation.	× 3.41
	Thermal dissipation for the desired configuration (in BTUs)	= 989 BTUs/hour

Therefore, the new power budget for this configuration is **290 W** (compared to the rated 565 W), and the thermal dissipation is approximately **989 BTUs/hour** (compared to the rated 1927 BTUs/hour).

The rated input power for the server power supply is 565 W. Therefore, the power budget for a maximum configuration is **565 W**, and the thermal dissipation will be approximately $565 * 3.41 = 1927 \text{ BTUs/hour}$.

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 decreases deployment time and lowers costs. Costs for the facility electrical plumbing, data center floor ventilation, and facility air conditioning installation can also be reduced.

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

Input Power Budget Allocation

This section explains how to allocate the input power budget for each server. This method can be used when a PDU supports a known number of servers. It is important to verify that the calculated power budget allocation will be sufficient to support the worst-case server configurations that are to be deployed.

The allocated input power for each server is calculated by multiplying the allocated input current for each server by the line voltage.

<i>Allocated Input Power = Allocated Input Current * Input Line Voltage</i>

Example

Assume a high-voltage PDU rated at 24 A is to support 12 servers. Each server can be allocated 2.0 A. If the line voltage is assumed to be at 240 V, then the allocated input power budget for each server will be $(2.0 \times 240) = 480$ W.

Since the input power budget of 480 W satisfies the fully configured system measured input power of 458 W (as shown in Table 5), 12 servers may be supported by a 24 A high-voltage PDU.

Power Distribution Units

HP offers a wide range of 1U/0U PDUs, supporting both low-voltage and high-voltage applications. Designed for high volume rack deployments, HP PDUs help with cable management and power distribution within the rack. These PDUs are equipped with circuit breakers to provide short circuit and over current protection.

The Modular PDUs (mPDUs), range from 16A to 40A, and provide up to 32 outlets, easy accessibility, and improved cable management. These mPDUs have a unique modular architecture, allowing increased flexibility and customization. All mounting hardware, including both the 0U and 1U mounting brackets, is included in the Modular PDU kit.

Additionally, HP offers the Dual Input PDU, a fault-tolerant solution that automatically switches to a secondary input source when the first source fails. Equipped with two input ends and a built-in AC transfer switch, this device is designed for mission critical environments where customers depend on the reliability of redundant power systems housed in their facility. The Dual Input PDUs ship with both 0U and 1U mounting brackets (no additional mounting brackets need to be purchased).

For more information, refer to Table 8 or

www.hp.com/products/ups

Table 8. HP PDUs

Part Number	Availability	Input Voltage	Current Rating	Maximum Servers per PDU	Input Connectors and Cord	Output Connectors	Output Breakers	Dimensions	Weight
Modular PDUs (Up to 32 outlets, 0U/1U mounting) <i>New!</i>									
252663-B24 ³	Worldwide	High	16A	10	Detachable input cord; IEC 320 C-20	16 X IEC320-C13	2 X 10A	17.5 x 1.62 x 5.6 in / 444.5 x 41.2 x 142.2 mm	18 lb / 8.16 kg
252663-D71 ³	North America, Japan	Low	24 A	8	NEMA L5-30P 12-ft cord	32 x NEMA 5-15R	4 x 15 A	17.5 x 1.62 x 5.6 in / 444.5 x 41.2 x 142.2 mm	18 lb / 8.16 kg
252663-D72 ³	North America, Japan	High	24 A	16	NEMA L6-30P 12-ft cord	32 x IEC 320-C13	4 x 15 A	17.5 x 1.62 x 5.6 in / 444.5 x 41.2 x 142.2 mm	18 lb / 8.16 kg
252663-B31 ³	International	High	32 A	21	NEMA L6-30P 12-ft cord	32 x IEC 320-C13	4 x 15 A	17.5 x 1.62 x 5.6 in / 444.5 x 41.2 x 142.2 mm	18 lb / 8.16 kg
252663-B21 ^{2,3}	Worldwide	High	40 A	27	Hardwired	24 x IEC 320-C13 4 x IEC 320-C19	4 x 15 A	17.5 x 1.62 x 5.6 in / 444.5 x 41.2 x 142.2 mm	18 lb / 8.16 kg
Single Input PDUs (Up to 12 outlets, 0U/1U mounting)									
207590-B21 ⁴	Worldwide	High	16A	10	Detachable input cord; IEC 320 C-20	12 X IEC320-C13	2 X 10A	17.0 x 1.65 x 8.0 in / 431.8 x 41.9 x 203.2 mm	7 lbs (3.2 kgs)
Dual Input PDUs (12 Outlets, built-In Transfer switch, 0U/1U mounting)									
191186-001 ¹	North America	High	24 A	16	x2 NEMA L6-30P 12-ft cord	12 x IEC 320-C13	4 x 10A	1.72 x 17 x 15.25 in / 4.37 x 43.18 x 38.74 cm	9.1 kg 20 lb
191186-B31 ¹	International	High	30 A	20	x2 IEC 309-32A 12-ft cord	12 x IEC 320-C13	4 x 10 A	1.72 x 17 x 15.25 in / 4.37 x 43.18 x 38.74 cm	9.1 kg 20 lb
Note 1: This PDU supports power from two different sources. If one power source fails, the PDU uses the alternate source.									
Note 2: This PDU must be hard-wired to the power source by a certified electrician.									
Note 3: This PDU is using the maximum rated power supply input and not the de-rated values.									
Note 4: This PDU will discontinue no later than June 2003.									

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.

HP PDUs support both high-voltage and low-voltage applications. The input current rating for a ProLiant DL380 Generation 3 server is either 2.3 A at 240 volts or 4.9 A at 115 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 has a current rating of 24 A. The server has a total input current rating of 2.3 A at 200 volts.

$$24 \text{ A (PDU current rating)} / 2.3 \text{ A (server total input current rating)} = 10.4$$

This PDU can support a maximum of 10 servers at full server input current ratings.

Example

One low-voltage PDU has a current rating of 24 A. The server has a total input current rating of 4.9 A at 100 volts.

$$24 \text{ A (PDU current rating)} / 4.9 \text{ A (server total input current rating)} = 4.9$$

This PDU can support a maximum of 4 servers at full server input current ratings.

Redundant Power

The 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 have a combined current rating of 48 A. The server has a total input current rating of 2.3 A at 200 volts (redundant power).

$$2 [24 \text{ A (PDU current rating)}] / 2.3 \text{ A (server total input current rating)} = 20.9$$

Together, these PDUs can support a maximum of 20 servers at full server input current ratings.

Example

Two low-voltage PDUs have a combined current rating of 48 A. The server has a total input current rating of 4.9 A at 100 volts (redundant power).

$$2 [24 \text{ A (PDU current rating)}] / 4.9 \text{ A (server total input current rating)} = 9.8$$

Together, these PDUs can support a maximum of 9 servers at full server input current ratings.

For more information on PDUs, refer to www.hp.com/products/ups.

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 1.83 m (6 ft) in length. This length provides enough slack for the power cord to route through the cable management solution.

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. Refer to Table 9 for part numbers.

Note: You do not need the vertical-mount PDU bracket to mount any of the PDUs listed in Table 9. However, the Y-cables shipped with the Vertical-Mount PDU Bracket kit may be still be used if needed.

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 servers in the standard configuration or one 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 9. HP High-Voltage Power Cables

Description	HP 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 3.0 m (10 ft) long with a 1.8-m (6-ft) section on the single-side and 1.2-m (4-ft) sections on the dual-side.
10A IEC-to-IEC Cables kit	142257-001 (1.8 m/6 ft)	The IEC-to-IEC cables can be used either as individual power cords to connect PDUs or to extend the length of the high-voltage Y-cables. The server ships with one 3.0-m (10-ft) IEC to IEC cable, part number 142263-003.
	142257-002 (2.4 m/8 ft)	
	142257-003 (3.0 m/10 ft)	
	142257-006 (1.4 m/4.5ft)	
	142257-007 (1.4 m/4.5 ft), 15 cables	

Power Cords

The server ships with an IEC-IEC power cord (PN 142263-003) used for rack mounting with high-voltage PDUs. For low-voltage, stand-alone deployments or installation without a rack, country-specific power cord options are available.

U.S. and Japanese models ship with two power cords—IEC-IEC and a country-specific cord:

- Power cord, US, IEC320-C13 to IEC320-C14, 10 A 250 V, Straight (2.5 m/10 ft) (PN 142257-002)
- Power cord, US, IEC320-C13 to NEMA 5–15P, 15 A 125 V, Straight (3 m/10 ft) (PN 103541-001)

The power cord included with the North American model of the 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 HP website:

www.hp.com/products/ups

Console Management Systems

A KVM (keyboard, video, and mouse) console management system enables a single keyboard and video console to control multiple servers. An in-rack console management system may be used to manage a single rack of servers or groups of racks. The HP IP console switch products have 16 ports that can access up to 128 servers. The HP IP Consoling Solution combines analog and digital technology to provide flexible, centralized KVM control of data center servers. This solution provides enterprise customers with a significant reduction in cable volume, secure remote access, and high-performance server KVM access. Using the IP console viewer, users can access local KVM functions from any Windows or Linux workstation by means of a 10/100 network connection. Alternatively, an off-rack console management system may also be used in the local vicinity of the servers it manages.

Table 10. Local Console Management Options

Description	HP Part No.	Description
1x1x16 IP Console Switch	262585-B21	16-port Keyboard Video Mouse switch - provides access for 2 simultaneous user sessions (1 network session and 1 local session at a rack-mounted console)
3x1x16 IP Console Switch	262586-B21	16-port Keyboard Video Mouse switch - provides access for up to 4 simultaneous user sessions (3 network sessions and 1 local session at a rack-mounted console)
Interface Adapters (8 per Pack)	262587-B21	Transitions traditional keyboard/video/mouse cabling to CAT5 - one needed for each server
Interface Adapters (Single Pack)	262588-B21	Transitions traditional keyboard/video/mouse cabling to CAT5 - one for each server
Expansion Module	262589-B21	Enables tiering of up to 8 servers per port on the IP console switch
CAT5 Cables (0.9 m/3 ft)	263474-B21	4-pack of UTP CAT5 cables with RJ45 connectors
CAT5 Cables (1.8 m/6 ft)	263474-B22	8-pack of UTP CAT5 cables with RJ45 connectors
CAT5 Cables (3.7 m/12 ft)	263474-B23	8-pack of UTP CAT5 cables with RJ45 connectors
CAT5 Cables (6.1 m/20 ft)	263474-B24	4-pack of UTP CAT5 cables with RJ45 connectors
CAT5 Cables (12.2 m/40 ft)	263474-B25	One UTP CAT5 cable with RJ45 connectors
TFT5600 Rack-Mount Keyboard and Monitor	221546-001	1U integrated keyboard and monitor.
TFT5010R Flat Panel Monitor	217248-XXX	2U rack-optimized monitor (keyboard not included).
1U Keyboard with Hot Keys and Trackball	158649-XXX	1U Form Factor

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. The HP switchboxes mount behind the keyboard drawer and don't consume extra U-space in the rack. Using the TFT5600RKM and an IP console switch will consume a total of 1U to accommodate up to 128 servers. One console switchbox can support up to 16 directly attached servers with no user blocking. Up to eight servers may be tiered or cascaded on each switch port using either a legacy Compaq KVM switch or an Expansion Module; however, only one user can access tiered switches or servers connected by Expansion Modules at any one time. Critical devices requiring frequent access should be attached directly to a switch port. Server accessibility should be assessed by the IT manager prior to deployment to determine the appropriate server density per console switch.

Table 11 outlines the number of devices that fully populate a 47U, 42U, or 36U rack with an in-rack local console.

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

Device or Cable	47U Rack	42U Rack	36U Rack
ProLiant DL380 Generation 3 Servers	23	20	17
KVM IP Console Switches	1	1	1
Interface adapters	22	20	17
UTP CAT5 cables for KVM access	22	20	17
Expansion modules	4-16	3-16	3-16
TFT5600 RKM (integrated monitor/keyboard)	1	1	1

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

- Interface adapter
- UTP CAT5 cable [1.8 m (6 ft) cables for sliding rail solutions].
- Rack Rail kit (standard rack rails and cable management arm, telco rack solution, or round-hole rack rails and cable management arm)

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 round-hole rack rails and cable management arm)
- KVM server to console cables
- One or two RJ-45 cables for NIC 1 and NIC 2

Remote Console Management

Integrated Lights-Out (iLO) is a standard component of selected ProLiant servers that provides server health and remote server manageability. The iLO subsystem includes an intelligent microprocessor, secure memory, and a dedicated network interface. This design makes iLO independent of the host server and its operating system. Integrated Lights-Out provides remote access to any authorized network client, sends alerts, and provides other server management functions. For information about iLO features, refer to the *Integrated Lights-Out User Guide* on the Documentation CD or at

www.hp.com/servers/lights-out

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 rack rails and cable management arm, telco rack solution, or round-hole rack rails and cable management arm)
- An RJ-45 cable for the iLO port
- 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
- The remote management system
- The network interface scheme

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

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

Rack Builder Online

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 HP branded or Compaq branded 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. To access Rack Builder Online, visit:

www.compaq.com/rackbuilder

Special Considerations for Racks



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

- Do not install a 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 attempt to move a rack populated with servers. A fully populated rack can weigh up to 771 kg (1700 lb) pounds. Moving a populated rack can cause the rack to become unstable, resulting in serious personal injury or equipment damage.

9000 and 10000 Series racks provide proper server cooling from flow-through perforations in the front and rear doors that provide 64 percent open area for ventilation.

To effectively cool the 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.

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

Rack Management Systems

HP recommends using the standard rack rails 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 Square-Hole Rack Rails

The server ships with a standard fast deployment fixed rack rail kit designed for 24- to 36-inch deep square-hole racks. The sliding rails and cable management solution allows the server to be extended fully from the rack and temporarily locked in place for servicing, without removing the cables from the server. This solution also provides better access to the rear cabling connections.

For detailed instructions on installing standard rack rails, refer to the *HP ProLiant DL380 Generation 3 Server User Guide* and to the *HP ProLiant DL380 Generation 3 Quick Setup Poster*.

Round-Hole Rack Cabinet Solution

The server design supports deployment in round-hole rack cabinets. This Round-Hole Rack Rail kit includes variable length rack rails that are compatible with round-hole racks 610 mm (21 inches) to 740 mm (29.13 inches) deep.

Telco Rack Solution

The server design supports deployment in telco racks. If you are installing the server into a telco rack, order the appropriate option kit at

www.racksolutions.com/hp

Cabling Configurations

Figures 1 through 3 show three possible cabling configurations. The configurations shown do not include every possible combination.

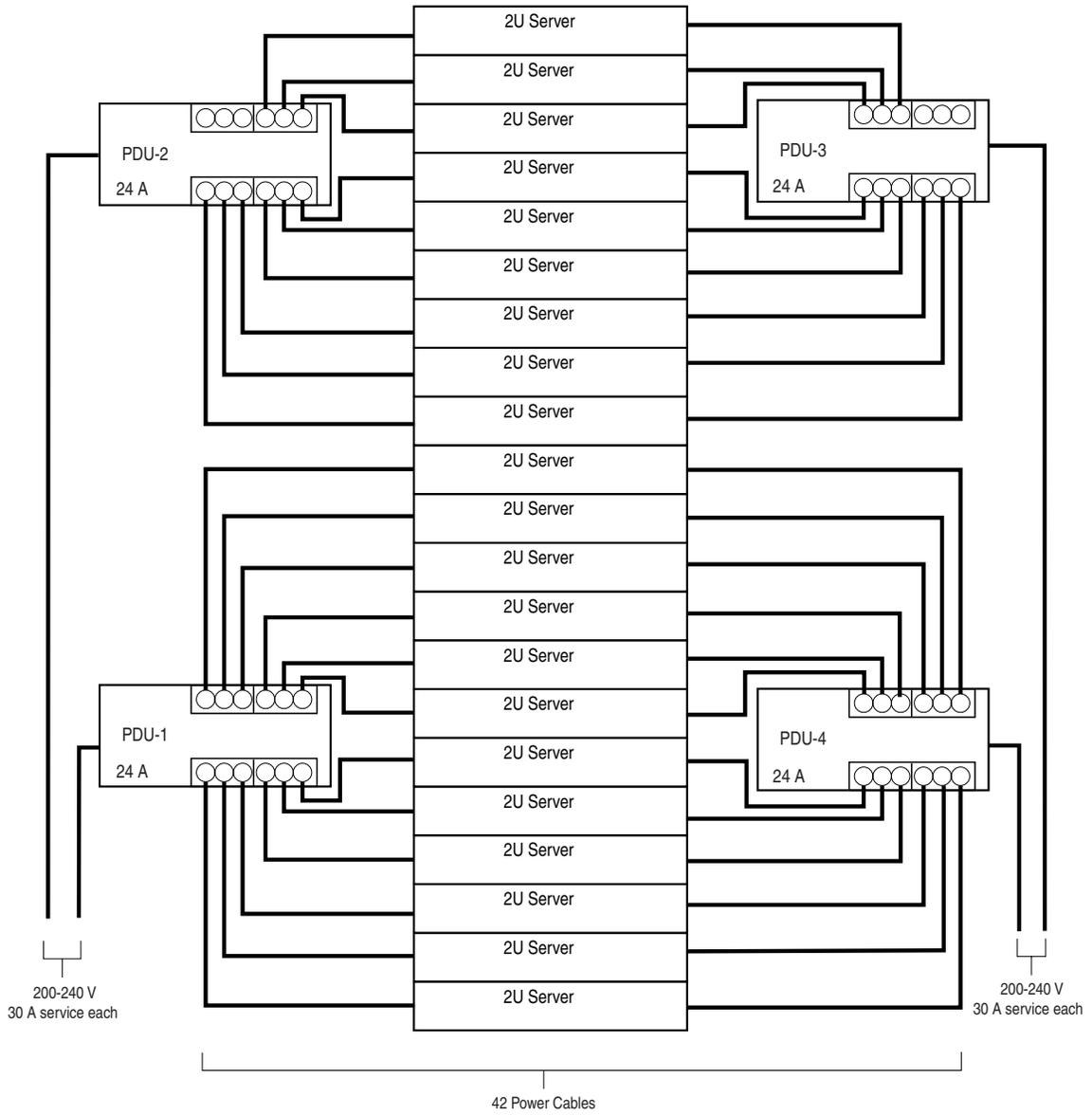


Figure 1. Four high-voltage PDUs (24A)

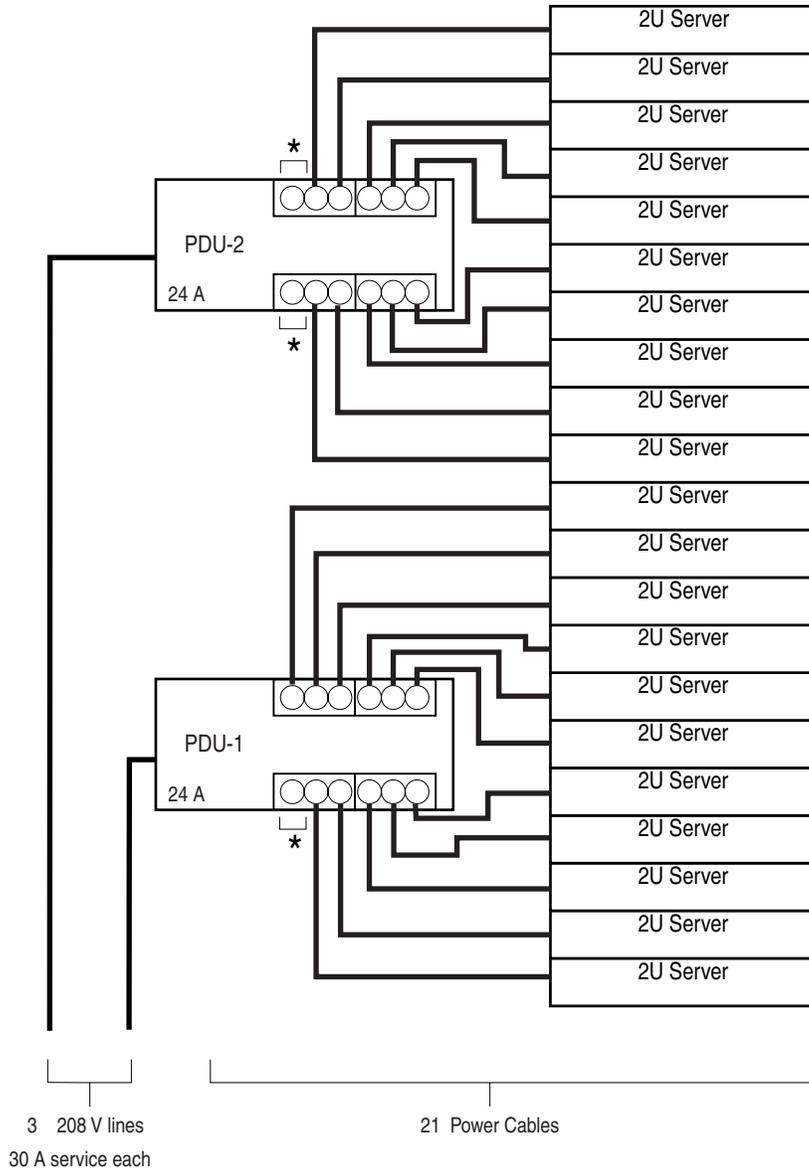


Figure 2. Two high-voltage PDUs (24A)

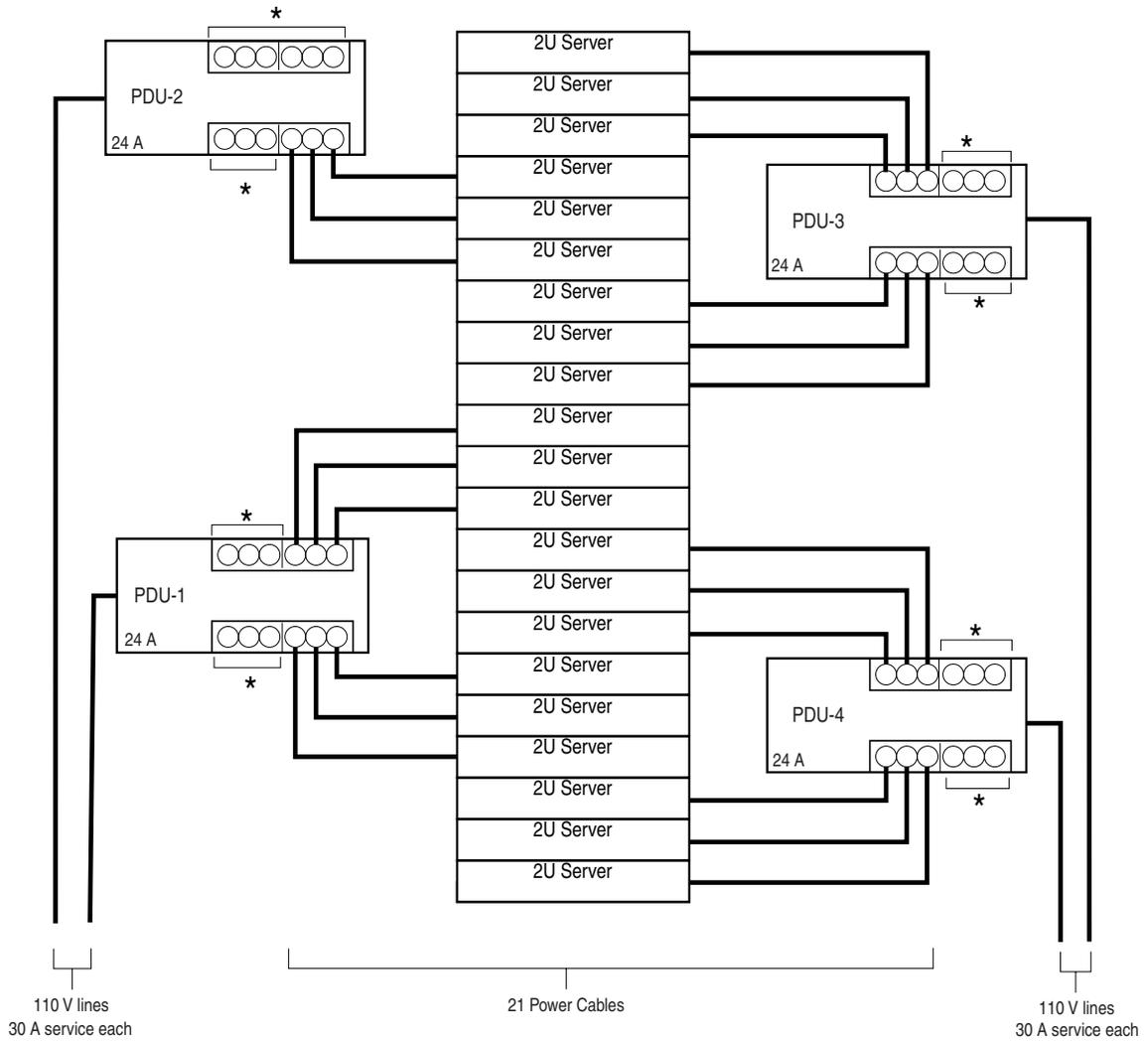


Figure 3. Four low-voltage PDUs (24A)

Installation Procedures

This section describes preparation and basic installation procedures common to various configurations outlined in “Planning Rack Configurations.” This section discusses the following procedures:

- Server Preparation
- Rack Preparation
- Installing PDUs in 36U, 42U, and 47U Racks
- Routing Power Cords
- Installing the Rack Rails
- Installing the Server in a Rack
- Connecting Cables
- Completing the Installation

Refer to the safety guidelines at the beginning of this document before beginning any installation procedures.

HP recommends that you execute these steps in order, especially when multiple racks are connected together or when a rack is populated in a separate room and relocated to its final position.

Server Preparation

Before installing the server in a rack, install any optional hardware components. Refer to the server documentation for details.

Rack Preparation

Rack selection criteria and recommendations are beyond the scope of this document.

For complete details on rack installation, refer to the documentation shipped with the rack.

A bustle or an extension kit may be required if the installation will end up with several cables for all the servers, for example, KVM cables.

Installing PDUs in 36U, 42U, and 47U Racks

PDU installation varies depending on the rack configuration: the number of servers deployed in the rack, the type of PDU, as well as the voltage and current rating for each PDU. As a rule, install PDUs from the bottom to the top on the same side of the rack as the cable management solution (viewing the rack from the front).

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.

Before installing PDUs in a 36U, 42U, or 47U rack, remove the center support bracket and center it between the PDUs.

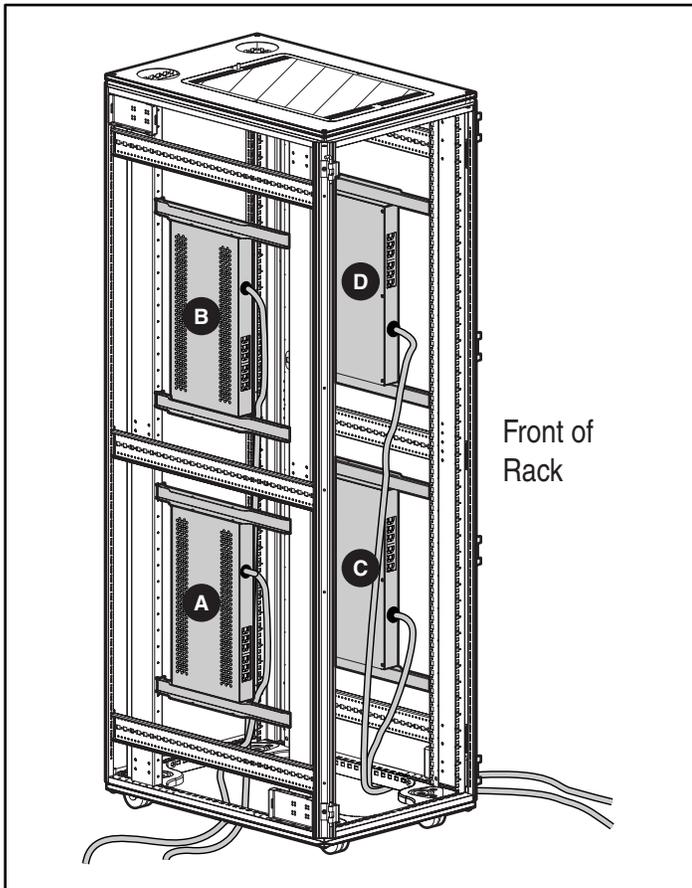


Figure 4. PDU positions in a 36U, 42U, or 47U rack

Table 12. PDU Configurations in a 36U, 42U, or 47U Rack

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

Routing Power Cords

Use the following general procedures to route server power cords in rack.

IMPORTANT: When connecting server power cords to the PDUs, be sure the load is balanced between the output circuit breakers.

High-Voltage or Low-Voltage Power Cords

To route and connect high-voltage or low-voltage power cords:

IMPORTANT: Route and connect the 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.

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

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 that the cable management solution is mounted.
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.

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 onto the chassis.
4. Insert the server into the rack.
5. Install the cable management solution.
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 *HP ProLiant DL380 Generation 3 Server User Guide* and to the *HP ProLiant DL380 Generation 3 Quick Setup Poster*.

Installing the Server in a Rack



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

- Extend the leveling jacks to the floor and rest the full weight of the rack on the leveling jacks.
 - Install either 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 server at a time. A rack might become unstable if more than one server is fully extended for any reason.
-

To properly install servers:

1. Install servers in the rack from the bottom to the top for maximum density.
2. Tighten the thumbscrews on the front of each server to secure the server to the rack.
3. Attach the cable management solution to the rear of the server and to the rear of the rack.

For detailed instructions on server installation, refer to the *HP ProLiant DL380 Generation 3 Server User Guide* and to the *HP ProLiant DL380 Generation 3 Quick Setup Poster*.

Connecting Cables

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



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) electric 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, electric 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.

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 solution.
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.

When the cables are properly connected and routed through the cable management solution, 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 kit (P/N 154392-B21) or bustle kit to provide more space for the cables at the rear of the rack.

Remote Console Management

The remote console management system uses a CAT5 cable connected to the RJ-45 connector in the RILOE II PCI board, as well as the power cord.

1. Route the CAT5 cable and the power cord through the cable management system according to the instructions either in the server documentation.
2. Connect the power cord to the PDU
3. Connect the CAT5 cable to the network data line outlet.

Completing the Installation

To complete the installation:

1. Install side panels on the outside 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: Reference Information and Glossary

References

Sources referenced in this paper are listed in Table 13.

Table 13. Sources of Information

Topic	Where to Find
Information focal point for the server	www.hp.com/products/servers/platforms
Specifications, options, and a list of other HP products and options compatible with the server	<i>ProLiant DL380 Generation 3 QuickSpecs</i> at www.hp.com/products/servers/platforms
Installation and service guidelines for the server	<i>HP ProLiant DL380 Generation 3 User Guide</i> , P/N 303130-001 <i>HP ProLiant DL380 Generation 3 Maintenance and Service Guide</i> , P/N 291916-001 www.hp.com/products/servers/platforms

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 (U). The ProLiant DL380 Generation 3 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) – An HP 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. HP recommends using a high-voltage source to support high-volume deployments of ProLiant DL380 Generation 3 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 rack depth and provides enough space behind it to mount an HP Server Console switch.

Integrated Lights-Out (iLO) – a standard component of selected ProLiant servers that provides server health and remote server manageability. The iLO subsystem includes an intelligent microprocessor, secure memory, and a dedicated network interface. This design makes iLO independent of the host server and its operating system. Integrated Lights-Out provides remote access to any authorized network client, sends alerts, and provides other server management functions.

Keyboard/Video/Mouse (KVM) – KVM refers to a keyboard cable, a video cable, a mouse cable, or a switch. Some HP parts lists might 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 3 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. HP 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 II (RILOE II) – The Remote Insight Lights-Out Edition II is designed to provide remote access and control of ProLiant server products from anywhere on the network with a standard Web browser. Consequently, customers can deploy a 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 RILOE management LAN connection. Using the RILOE II, customers can deploy 42 ProLiant DL380 Generation 3 servers in a 42U 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 tool-free rack management system designed for in-rack serviceability.

UID LED and Switch – The blue Unit Identification (UID) LED identifies that the ProLiant DL380 Generation 3 server requires 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, refer to:

www.hp.com