

# Guidelines and Best Practices

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## Contents

EXECUTIVE SUMMARY .....	1
SAFETY GUIDELINES .....	5
HOW TO USE THIS DOCUMENT	8
1 INTRODUCTION .....	9
2 POWER, THERMAL, AND WEIGHT INFORMATION .....	12
3 CONFIGURATION CHOICES .....	25
4 INSTALLATION PROCEDURES .....	55
APPENDIX A -- RELATED DOCUMENTS .....	82
APPENDIX B -- PARTS REFERENCE .....	83

# Compaq Ultra-Dense Server Deployment in Compaq Racks

**Abstract:** *This white paper is intended for use as a planning guideline to expedite concentrated deployment of many Compaq™ ProLiant™ DL360 servers in a Compaq rack. This white paper should be used in conjunction with documents for the ProLiant DL360 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

Today's Internet world drives the need for unprecedented levels of server based computing. Enterprises and Service Providers have found that many of their network infrastructure and web applications work best on dedicated servers. This has driven the need to fit more and smaller servers into existing server rooms and data centers. Compaq fulfills this need with the density-optimized line of ProLiant servers. The ProLiant DL360, just 1U high, supports up to 42 servers in a single rack. While the space-saving benefits are clear, the server also presents new challenges such as the need for rapid deployment of servers into a rack, as well as environmental and cable management.

Development of the ProLiant DL360 server is the result of close customer collaboration and the long Compaq tenure in developing servers for space constrained rack environments. Compaq engineers have produced innovations in rapid volume deployment and improved cable management for large installations of ProLiant DL360 servers. This white paper outlines the products needed for specific Compaq rack deployment configurations, including diagrams and parts lists for ease of planning.

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**Note:** This document covers only the ProLiant DL360 server, the Compaq 9000- and 7000-series racks, and related Compaq rack options. This document does not cover other Compaq servers or products, and racks not manufactured by Compaq.

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**IMPORTANT:** You may find it helpful to use the hyperlinks to locate sections in this white paper that apply to specific environments and print the applicable pages. For best visual quality, use a printer that optimizes the appearance of the graphics.

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Guidelines and Best Practices prepared by Industry Standard Servers Division

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## Detailed Table of Contents

<b>EXECUTIVE SUMMARY .....</b>	<b>1</b>
<b>SAFETY GUIDELINES .....</b>	<b>5</b>
CUSTOMER GUIDELINES .....	5
SYMBOLS ON EQUIPMENT.....	6
RACK WARNINGS .....	7
<b>HOW TO USE THIS DOCUMENT .....</b>	<b>8</b>
<b>1 INTRODUCTION .....</b>	<b>9</b>
1.1 REFERENCES .....	9
1.2 GLOSSARY .....	10
<b>2 POWER, THERMAL, AND WEIGHT INFORMATION.....</b>	<b>12</b>
2.1 PROLIANT DL360 SERVER PARAMETERS .....	13
2.2 PROLIANT DL360 POWER AND THERMAL BUDGETING.....	14
2.2.1 <i>Input Current and Thermal Dissipation Calculations</i> .....	15
2.2.2 <i>Measured Input Power</i> .....	16
2.2.3 <i>Input Power Budget De-rating</i> .....	17
2.2.4 <i>Input Power Budget Allocation</i> .....	18
2.3 PDU CHOICES.....	19
2.3.1 <i>High Voltage 24A PDU (P/N 295363-003)</i> .....	20
2.3.2 <i>High Voltage 16A PDU (P/N 295363-002 or 295363-B32)</i> .....	21
2.3.3 <i>Low Voltage 24A PDU (P/N 295363-001 or 295363-291)</i> .....	22
2.4 PDU REQUIREMENTS .....	23
2.5 WEIGHT AND POWER OF RACKS AND RELATED OPTIONS .....	24
<b>3 CONFIGURATION CHOICES .....</b>	<b>25</b>
3.1 CONFIGURATION-A: 42 DE-RATED SERVERS, HIGH VOLTAGE.....	27
3.2 CONFIGURATION-B: 42 SERVERS, 24A HIGH VOLTAGE PDU.....	29
3.3 CONFIGURATION-C: 42 SERVERS, 16A HIGH VOLTAGE PDU.....	31
3.4 CONFIGURATION-D: 42 DE-RATED SERVERS, LOW VOLTAGE.....	33
3.5 CONFIGURATION-E: 36 FULL-RATED SERVERS, LOW VOLTAGE.....	35
3.6 CONFIGURATION-F: 42 SERVERS, OFF-RACK LOCAL CONSOLE, HIGH VOLTAGE .....	37
3.7 CONFIGURATION-G: 35 SERVERS, STAND-ALONE RACK, 24A HIGH VOLTAGE PDU.....	39
3.8 CONFIGURATION-H: 35 DE-RATED SERVERS, STAND-ALONE RACK, 24A HIGH VOLTAGE PDU.....	41
3.9 CONFIGURATION-I: 35 SERVERS, STAND-ALONE RACK, LOW VOLTAGE .....	43
3.10 CONFIGURATION-J: 36U RACK, 36 DE-RATED SERVERS, HIGH VOLTAGE.....	45
3.11 CONFIGURATION-K: 36U RACK, 36 SERVERS, 24A HIGH VOLTAGE PDU.....	47
3.12 CONFIGURATION-L: 36U RACK, 36 SERVERS, LOW VOLTAGE .....	49
3.13 CONFIGURATION-M: 22U RACK, 22 SERVERS, HIGH VOLTAGE.....	51
3.14 CONFIGURATION-N: 22U RACK, LOW VOLTAGE PDU .....	53
<b>4 INSTALLATION PROCEDURES .....</b>	<b>55</b>
4.1 PROLIANT DL360 PREPARATION .....	55
4.2 RACK PREPARATION.....	56
4.2.1 <i>9000-Series Rack Preparation</i> .....	56
4.2.2 <i>7000-Series Rack Preparation</i> .....	56
4.2.3 <i>Attaching Multiple Racks</i> .....	57
4.3 PDU INSTALLATION.....	58
4.3.1 <i>Vertically Orienting the PDUs</i> .....	58
4.3.2 <i>Installing Multiple PDUs in a Rack</i> .....	59
4.3.2.1 <i>Mounting 2 PDUs on One-Side</i> .....	59
4.3.2.2 <i>Mounting 1 PDU on Each Side</i> .....	59

4.3.2.3.	Mounting 3 PDUs.....	59
4.3.2.4.	Mounting 4 PDUs.....	60
4.3.3.	<i>PDU Cord Set Choices</i> .....	60
4.3.3.1.	High Voltage Power Cords.....	60
4.3.3.2.	Low Voltage Power Cords.....	61
4.3.4.	<i>Power Cord Routing</i> .....	61
4.3.5.	<i>PDU Cabling Diagrams</i> .....	61
4.3.5.1.	High Voltage 2-PDU Cabling Diagram (42U Rack).....	62
4.3.5.2.	High Voltage 3-PDU Cabling Diagram (42U Rack).....	63
4.3.5.3.	High Voltage 3-PDU Cabling Diagram for In-Rack Local Console (42U Rack).....	64
4.3.5.4.	High Voltage 4-PDU Cabling Diagram (42U Rack).....	65
4.3.5.5.	Low Voltage 4-PDU Cabling Diagram for In-Rack Local Console (42U Rack).....	66
4.3.5.6.	Low Voltage 4-PDU Cabling Diagram for Remote Console (36 servers in a 42U Rack).....	67
4.3.5.7.	Low Voltage 4-PDU Cabling Diagram for Remote Console (42 servers in a 42U Rack).....	68
4.3.5.8.	High Voltage 2-PDU Cabling Diagram with Y-Cables (36U Rack).....	69
4.3.5.9.	High Voltage 3-PDU Cabling Diagram with Y-Cables (36U Rack).....	70
4.3.5.10.	Low Voltage 4-PDU Cabling Diagram with Single Cables (36U Rack).....	71
4.3.5.11.	High Voltage 2-PDU Cabling Diagram with Y-Cables (22U Rack).....	72
4.3.5.12.	Low Voltage 2-PDU Cabling Diagram (18 servers in a 22U Rack).....	73
4.4	RACK RAILS INSTALLATION.....	74
4.5	SERVER INSTALLATIONS IN A RACK.....	75
4.6	CABLE INSTALLATION.....	76
4.6.1.	<i>Power Cord Connection</i> .....	76
4.6.2.	<i>Console Management Choices</i> .....	76
4.6.2.1.	Remote Console Management Cables.....	76
4.6.2.2.	Off-Rack Local Console Cabling.....	77
4.6.2.3.	In-Rack Local Console Cabling Using Server Console Switches.....	77
4.6.3.	<i>Cable Management Procedure</i> .....	79
4.6.3.1.	Fixed-Rail Cable Management.....	79
4.6.3.2.	Sliding-Rail Cable Management.....	80
4.7	COMPLETING THE INSTALLATION.....	81
<b>APPENDIX A -- RELATED DOCUMENTS.....</b>		<b>82</b>
<b>APPENDIX B -- PARTS REFERENCE.....</b>		<b>83</b>

## Safety Guidelines

A set of cautionary statements provided here shall be followed to reduce certain risks associated in deploying ProLiant DL360 servers, especially when concentrating these servers in a single rack.

### Customer Guidelines

The following guidelines should be adhered to when servicing or installing a Compaq server:



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

- ◆ Unplug the power cord from the system.
  - ◆ Do not disable the power cord grounding plug. The grounding plug is an important safety feature.
  - ◆ Plug the power cord into a grounded (earthed) electrical outlet that is easily accessible at all times.
- 



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

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

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## Symbols on Equipment

These symbols may be 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 your documentation for specific details.

---



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

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

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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.

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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.

---

## Rack Warnings



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

- Do not attempt to move or relocate an equipment rack populated with servers. A fully populated rack can weigh as much as 1,800 pounds. The rack may become unstable and cause serious personal injury or damage to the equipment.
  - Do not install the ProLiant DL360 Servers into the rack until the rack has been located in its final location.
  - Slide rails, PDUs, power cords and cables can be pre-installed into the rack in a build-room or on the data center floor prior to moving it to the final location.
  - Prior to installing the servers, ensure that the leveling jacks are extended to the floor and that the full weight of the rack rests on the leveling jacks. The casters are not designed to support the full weight of a populated rack.
  - Prior to installing the servers, ensure that the stabilizing kit has been installed on stand-alone racks, or that multiple racks are coupled together.
- 

**IMPORTANT:** Because the rack allows you to stack computer components on a vertical rather than horizontal plane, you must take precautions to provide for rack stability and safety and to protect both personnel and property. Heed all cautions and warnings in the installation instructions that came with the server.

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

- Before beginning work on the rack, be sure that the leveling jacks are extended to the floor, that the full weight of the rack rests on the leveling jacks, and that either the stabilizer kit is installed or multiple racks are coupled together for stability.
  - Always load the heaviest item first, and load the rack from the bottom up. This 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.
  - The bottom stabilizers on the equipment must be fully installed. Be sure that the equipment is properly supported/braced when installing options and cards.
  - A rack may become unstable if more than one ProLiant DL360 servers are fully extended for any reason. Fully extend only one ProLiant DL360 server at a time.
-

## How to Use This Document

This section provides some suggestions for the use of this document. The sections in this white paper are organized in an order that parallels the beginning-to-end sequence of multiple server deployment procedures. One way to read this paper is to start from the first page and go through all the sections sequentially. Another way is to read from Section 1 through the beginning of Section 3, and selectively read Section 4, for the information pertaining to your predefined set of requirements.

To help you choose a rack configuration that will closely satisfy your application needs, Section 3 provides the Configuration Selection Table as well as the Configuration Selection Tree.

**Table-1. Where to find information**

<b>Section</b>	<b>Description</b>	<b>Where to Find</b>
<i>Introduction</i>	This section explains the purpose of this white paper and its scope. It also lists some of the terms used in this document.	<b>Section 1</b> (Page 9)
<i>Power, Thermal and Weight Information</i>	This section lists the important information about the ProLiant DL360, Compaq racks, and related options to aid in choosing a rack configuration.	<b>Section 2</b> (Page 12)
<i>Configuration Choices</i>	This section describes selected rack configurations depending on the choices including rack size, power source, PDU type, and console management.	<b>Section 3</b> (Page 25)
<i>Installation Procedures</i>	This section describes the installation procedures, which are referred to from Section 3. The document is structured this way, because many of the procedures are common to several of the configurations.	<b>Section 4</b> (Page 55)
<i>Related Documents</i>	This section lists other documents and web sites related to Compaq racks and rack options used in this white paper. In addition, it lists other white papers related to rack deployment of ProLiant DL360 servers.	<b>Appendix A</b> (Page 82)
<i>Parts Reference</i>	This section lists part numbers for all the components referred to in this white paper.	<b>Appendix B</b> (Page 83)



# 1 Introduction

Compaq designed its new ultra-dense server, the ProLiant DL360, to face the strict challenges associated with a concentration of servers within a rack, including power distribution, and console, cable, and thermal management. In an effort to support the efficient deployment of multiple 1U servers in racks, Compaq suggests that customers evaluate their environments well in advance.

This paper describes selected rack configurations and installation procedures, including a complete list of required parts for selected configurations. Use this document as a guideline in conjunction with other documents listed in Appendix A.

## 1.1 References

**Table 1-1. Information referenced in this white paper.**

Topic	Where to Find
Information focal point for the Compaq ProLiant DL360	<a href="http://www.compaq.com/proliant/ultrathin">http://www.compaq.com/proliant/ultrathin</a>
ProLiant DL360 server specifications, options, and a list of other Compaq products and options compatible with the ProLiant DL360	<i>Compaq ProLiant DL360 QuickSpecs</i>
Installation and servicing guidelines for the ProLiant DL360	<i>Compaq ProLiant DL360 Setup and Installation Guide, P/N 169545-001</i> <i>Compaq ProLiant DL360 Maintenance and Service Guide, P/N 169616-00</i>
Installation of Sliding Rail Option Kit	<i>Sliding Rails and Cable Management Solutions for ProLiant DL360 Servers Guide, P/N 169549-001</i>
Installation of Vertical-Mount PDU Brackets and Y-Cables	<i>Vertical-Mount PDU Brackets Option Kit, P/N 191265-B21</i> <i>Vertical-Mount PDU Brackets Option with High Voltage Cables Kit, P/N 166097-B21</i>
Installation guidelines for the ProLiant DL360 in third-party racks	<i>Compaq Ultra-Dense Server Deployment in Third-party Cabinet Racks, Document Number 12CU-0400A-WWEN</i> <i>Third-Party Rack Option Kit, P/N 174574-B21</i> <i>[Installation Card for ProLiant DL360 Server]</i>
Installation guidelines for the ProLiant DL360 in telecommunications (Telco) racks	<i>Compaq Ultra-Dense Server Deployment in Telecommunications (Telco) Racks, Document number 12CZ-0400A-WWEN</i> <i>Telco Rack Option Kit, P/N 174576-B21</i> <i>[Installation Card for ProLiant DL360 Server]</i>
Customer Advisory on 9000-Series Casters	<i>Customer Advisory: Caster wheels on 9000 Series Racks May Break When Moved Under Load,</i> <i>Document number EX991108_CW01</i>

## 1.2 Glossary

**Note:** For more detailed information about the products in this glossary, log on to the Internet at

[www.compaq.com](http://www.compaq.com)

**1U** – One rack unit (1U) is 1.75 inches or 44.45 mm in vertical dimension. The height of a device, or form-factor, can be expressed in rack units (Us), for example 1U, 3U, 7U. The actual height of a device is somewhat less. For example, while the ProLiant DL360 server is considered to be a 1U server, its actual height is 1.65 inches. This slight reduction in height prevents mechanical interference between two servers that are mounted in adjacent places in a rack.

**Fixed-Rail** – The fixed server rails are factory-installed in each ProLiant DL360 server. The matching fixed rack rails shipped with the server are to be installed on Compaq 9000- and 7000-series racks. The fixed rack rails are spring-loaded so that they can be installed easily by one person. When using fixed rails, servicing of a ProLiant DL360 server requires disconnecting all cables from the server and removing the server from the rack.



**Flat Panel Display (FPD)** – The Compaq TFT5000R (15-inch) Flat Panel Monitor provides large viewable image size and exceptional screen performance in a space saving 2U-form factor for rack usage, allowing the monitor to be neatly tucked away when not in use.

**Figure 1-1. Flat Panel Monitor (TFT5000R)**

**High Voltage** – AC line voltage of 200V to 240V. Higher voltage level means lower current for the same amount of power requirement for a server. Compaq recommends a high voltage source to support high volume deployments of ProLiant DL360 servers in a rack.



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

**Figure 1-2. 1U keyboard drawer and internal keyboard with trackball**

**Keyboard/Video Mouse (KVM)** – This abbreviation is used to refer to Keyboard/Video/Mouse cable or switch. KVM switches also are referred to as Server Console Switches in Compaq parts lists.

**Local Console** – A server console system incorporates a set of KVM (keyboard, video and mouse) devices. The word “local” in this context describes the relatively close proximity of the console from the server, and how the console function is accomplished without the use of a network connection. The console can be attached either directly to the server or indirectly via a KVM switch. Local-console implementations are limited to controlling one or a few servers per console. Additionally, KVM cables have the disadvantage of being very bulky to route especially from a rack to a number of KVM switches located off-rack. A local-console can be in-rack or off-rack. In this paper, **in-rack**

local-console means a flat panel display on rails, and a keyboard/trackball on a sliding tray in the same rack as the servers. **Off-rack** local-console means any combination of a display, a keyboard, and a pointing-device located outside of the rack.

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

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

**NICs** – Network Interface Controllers embedded on the ProLiant DL360 system board.

**Power Distribution Unit (PDU)** – A Power Distribution Unit can be a high voltage or a low voltage version. See Section 2.3 for more details on PDU.

**Remote Console** – A server console system incorporating a network as the vehicle for interacting with the server. This means that any computer with appropriate software and privileges can control a server from anywhere across the globe provided that they have access to the same network. The remote-console method eliminates the congestion of KVM cabling and is a recommended practice for managing large number of servers. For the ProLiant DL360 server, remote console function is recommended by using the Compaq Remote Insight Lights-Out Edition.

**Remote Insight Lights-Out Edition** – The optional Compaq Remote Insight Lights-Out is designed to provide remote access and control of Compaq ProLiant server products from anywhere on the network using a standard web browser. Remote Insight Lights-Out Edition provides easy access to Compaq servers through a seamless, hardware-based, OS-independent graphical remote console. Since it is hardware-based, the Remote Insight Lights-Out Edition does not require any additional software or use any host server CPU cycles. The on-board graphical remote console capability turns any client browser into a virtual desktop with full keyboard and mouse support, no matter what operating system the host server is running or what state it is in. The Remote Insight Lights-Out Edition also includes many other powerful and exciting features, such as a virtual power button, virtual floppy drive, DNS/DHCP IP auto-configuration, and ROM-based configuration. In the ProLiant DL360, an internal connection has been designed so that the external keyboard/mouse cable and the external AC adapter are not necessary. As a result, customers can deploy a ProLiant DL360 in a true “headless” fashion with minimum of only three cables per server – one power cord for the server, one network cable for the LAN connection, and one network cable for the Remote Insight Lights-Out Edition management LAN connection. Using the Remote Insight Lights-Out Edition, customers can deploy 42 ProLiant DL360 servers in a Compaq 42U rack with significantly reduced cabling complexity.

**Server Console Switch** – Compaq Server Console Switches allow multiple servers in a rack to be accessed and managed by one keyboard, mouse, and monitor. These switches are also known as KVM switches. Five models are available from Compaq, including a 2-port, a 4-port, and three 8-port switches. Two of the three 8-port switches provide dual-user functionality, that is, to control a server from two separate consoles.

**Sliding Rail** – A set of option rails to fit within Compaq 9000- and 7000-series racks to support in-rack serviceability for ProLiant DL360 servers. That is, the server can be extended from the rack without removing the cables. The sliding-rails and cable management solution option kit designed for the ProLiant DL360 also comes with the optional server rails (to be attached to the server), the ball-bearing slide-rail assemblies (to be mounted on a rack), cable tension reel/bracket, a server cable tray and a few other parts to neatly manage the cables when the server is either extended or retracted.

**UID LED and Switch** – The Unit Identification LED can be used to indicate which ProLiant DL360 server is being upgraded or serviced. A UID switch, either from the front or the rear of the server, toggles both front and rear UID LEDs at the same time. The UID LEDs are in blue for easy identification.

**WOL** – Wake on LAN permits remote restart of the server.

## 2 Power, Thermal, and Weight Information

After the type and the number of servers have been determined, the next most important parameters in deployment planning are on power, thermal and weight. This section enables customers to calculate the necessary power, thermal and weight for the rack configurations unique to their environment.

Effective planning begins with recognizing environmental and server basics such as the power dedicated to each rack and how much power each server draws. After understanding these requirements, the electrical power lines can be planned.

Section 2.1 lists individual weight, power rating and thermal dissipation specific to the ProLiant DL360 server itself. The power consumption of the servers has direct relationship with the thermal dissipation, which will determine the cooling system requirements as well as how the ventilation system should be constructed around the racks.

Section 2.2 provides more tools to render input power budgets, and to derive input current and thermal dissipation from the input power.

Following this, Section 2.3 outlines Compaq PDU choices best suited for building rack configurations. This section describes technical specifications for two high voltage PDUs and one low voltage PDU. It also distinguishes the outlet plug connector types and internal circuit breakers associated with each PDU.

Section 2.4 bridges the server power ratings and the PDU power rating with a quick analysis and guideline, for allocating the correct number and type of PDU for a particular rack deployment.

Lastly, Section 2.5 explores important requirements for weight capacity planning by summarizing the weights of individual rack components and providing an example of how a typically configured rack of 42 ProLiant DL360 servers can easily weigh as much as 1,700 lb without the cables. Understanding the weight of a fully populated rack will enable the server deployment planning, such as where to build the servers and where to populate the racks. In addition, the floor support requirements can be derived from the weight information of all the servers and other equipment installed in the racks.

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**Note:** This Section 2 can be read selectively. Section 2.2.2 (*Measured Input Power*) and Section 2.2.3 (*Input Power Budget De-rating*) may be skipped, if full input power ratings will be used for the power and thermal calculations, however these sections are highly recommended for customers to gain insight into the configurations listed in Section 3 or planning a custom configuration. The remainder of Section 2 should be understood for proper deployment planning and installation.

---

Refer to the *Compaq ProLiant DL360 QuickSpecs* for detailed specifications on the ProLiant DL360 server and options.

The following notation for the optional components will be used throughout this section:

- |      |                                   |   |
|------|-----------------------------------|---|
| (1)  | 1x, 2x, 4x                        | : number of components, for example, 1x128MB means one 128MB DIMM |
| (2)  | 550MHz                            | : Intel Pentium III 550-MHz Processor                             |
| (3)  | 800MHz                            | : Intel Pentium III 800-MHz Processor                             |
| (4)  | 128MB                             | : 128MB DIMM  |
| (5)  | 256MB                             | : 256MB DIMM  |
| (6)  | 512MB                             | : 512MB DIMM  |
| (7)  | 1GB                               | : 1GB DIMM  |
| (8)  | HDD                               | : Hard Disk Drive   |
| (9)  | 9.2GB                             | : 9.2GB 10,000rpm Wide Ultra2 SCSI HDD                            |
| (10) | 18.4GB                            | : 18.4GB 10,000rpm Wide Ultra2 SCSI HDD                           |
| (11) | SA4200                            | : Smart Array 4200 Controller option (64-bit PCI card)            |
| (12) | Remote Insight Lights-Out Edition | : Remote Insight Lights-Out Edition option (32-bit PCI card)      |

## 2.1 ProLiant DL360 Server Parameters

This section describes the abbreviated measured and specification values for ProLiant DL360 parameters. Most parameters listed in Table 2-1 will be used as a reference in discussing power budgets and in calculating total rack configuration weight. The SA4200 option and the Remote Insight Lights-Out Edition option are PCI cards from Compaq. Make sure that all the third-party PCI cards used in the ProLiant DL360 server are compliant with the industry-standard PCI specifications for dimension, weight, power and thermal requirements.

**Table 2-1. ProLiant DL360 parameters**

<b>Dimensions HxWxD</b>	1.65 x 16.75 x 25 in (4.19 x 42.55 x 63.5 cm)
<b>Weight</b>	<p><b>24 lb</b> as shipped (1xprocessor, 1x128MB DIMM, 2xHDD blanks)</p> <p><b>29.3 lb</b> fully-configured (2xprocessors, 4xDIMMs, 2xHDDs, 1xSA4200, 1x Remote Insight Lights-Out Edition)</p> <ul style="list-style-type: none"> <li>• Processor: 0.2 lb (with the heat sink and clip)</li> <li>• DIMM: 0.1 lb</li> <li>• HDD: 1.9 lb (with the carrier)</li> <li>• Remote Insight Lights-Out Edition: 0.5 lb</li> <li>• SA4200: 1.0 lb</li> </ul>
<b>Power Rating</b>	<p>Max. Output DC power is rated at <b>190W</b></p> <p>Power Supply Efficiency (including Power Factor Correction) is rated at <b>65%</b></p> <p>Max. Input AC power is rated at <b>292W</b> [<i>Input Power = Output Power / Efficiency</i>]</p> <p>Max. input current rating depends on the line voltage. For example,</p> <p style="padding-left: 40px;"><b>2.66A @110V</b> AC (low voltage)</p> <p style="padding-left: 40px;"><b>1.41A @208V</b> AC (high voltage)</p>
<b>Thermal Dissipation</b>	Up to <b>1000 BTUs/hour</b>
<b>Temperature Rise</b>	<b>Up to 25°C T-rise</b> between front and rear
<b>Relative Humidity (non-condensing)</b>	<p>Operating: 8% to 90%</p> <p>Non-operating: 5% to 95%</p>

## 2.2 ProLiant DL360 Power and Thermal Budgeting

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

All ProLiant DL360 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 the ProLiant DL360 input power in the facility power distribution planning:

1. Use the maximum rated input power of 292W.
2. Use the de-rated input power, which can be calculated by subtracting the power budgets of uninstalled optional components from the rated input power.
3. 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 200W, to support all the optional components initially released with the ProLiant DL360.

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 fully populated high-end configuration. Since the input power values for a ProLiant DL360 server in an installation might vary depending on the software applications, the information provided in this section should be use as a guideline only.

The ProLiant DL360 server power supply is designed to support future upgrades of processors, DIMMs, and hard disk drives. As such, the power supply output power is rated at 190W. Considering the power supply efficiency of 65% (including the Power Factor Correction), the power supply input power is rated at 292W. 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 ProLiant DL360 server may be desired to be lower than 292W. For example,

- 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 2-2 demonstrates how significant reduction in input current and thermal dissipation can be realized, if a deployment plan can limit each ProLiant DL360 configuration over the useful lifetime of a rack configuration.

**Table 2-2. De-rated current and thermal dissipation for reduced input power assumptions**

Input Power	De-Rated		Fully Rated
	100W	200W	292W
Input Current @110V AC	0.91A	1.82A	2.66A
Input Current @208V AC	0.48A	0.96	1.41A
Thermal Dissipation	341 BTUs/hour	682 BTUs/hour	996 BTUs/hour

The de-rated input power values of 100W and 200W can be correlated with the measured input power values for the minimum and maximum configurations for ProLiant DL360, respectively, considering the optional components currently offered as illustrated in Section 2.2.2. However, the de-rated input power value must be high enough to account for any future upgrades for a deployment plan.

As stated earlier, the power supply is designed to support future processor and hard drive upgrades. When installing 42 servers, the number of PDUs to be installed will depend on the support for the input current requirement. Carefully de-rating 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 de-rating the input power.

### 2.2.1. Input Current and Thermal Dissipation Calculations

The input power is the key in deriving the 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 disk drives spin-ups. It should be noted that in ProLiant DL360, the two hard disk 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 the second drive is added. After the 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 option, NICs, and so on.

The 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.

Section 2.2.3 explains more on how adding or removing of an optional subsystem component affects the input power and thermal calculations.

## 2.2.2. Measured Input Power

Table 2-3 lists the measured input power of ProLiant DL360 with varying subsystem components, to illustrate the effects of adding or removing optional components. Table 2-4 lists each subsystem component's input power derived from Table 2-3. A few test programs were run to exercise various parts of the system, and the current and power were measured on the input side of the power supply. The “peak” and “typical” input power values were measured during power up and idle/normal operations, respectively.

**Table 2-3. Measured input power for selected server configurations**

Configuration Number	ProLiant DL360 Configuration	Power Input Typical / Peak
1	1x550MHz, 1x128MB, 1x18.4GB (base-line)	90W / 110W
2	1x550MHz, 2x128MB, 2x9.2GB, Remote Insight Lights-Out Edition	102W / 131W
3	1x800MHz, 1x128MB, 1x18.4GB (base-line)	100W / 115W
4	2x800MHz, 1x1GB, 2x18.4GB, Remote Insight Lights-Out Edition	134W / 156W
5	2x800MHz, 4x1GB, 2x18.4GB, SA4200, Remote Insight Lights-Out Edition	170W / 185W

**Note:** Peak power of a fully configured ProLiant DL360 (Configuration 5) was measured to be only about 67% of its rated peak input power. This power may be higher if the Remote Insight Lights-Out Edition option is replaced by a RAID storage controller.

**Table 2-4. Measured input power for optional subsystem components**

Sub-system Components	Power Input Typical / Peak
Intel Pentium® III 800-MHz Processor	23W / 26W
128MB DIMM	1W / 3W
256MB DIMM	1W / 3W
512MB DIMM	1W / 4W
1GB DIMM	2W / 5W
9.2GB HDD	13W / 35W
18.4GB HDD	16W / 38W
Remote Insight Lights-Out Edition	9W / 11W
SA4200	9W / 16W

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



### 2.2.3. Input Power Budget De-rating

If a deployment plan limits the future expansion beyond certain configurations, then adjustments may be made to the input current and thermal requirements based on the worst-case configuration for a specific site deployment.

This section explains how to de-rate the input power budget. Assume that the power supply rated input power of 292W is for the “maximum” configuration. For initial availability of ProLiant DL360, the maximum configuration (with remote console management) can be assumed to be as follows:

2x800MHz, 4x1GB, 2x18.4GB, SA4200, Remote Insight Lights-Out Edition

The peak input power of a subsystem/component is added to or subtracted from the rated (peak) input power when the subsystem is added or removed, respectively. When a subsystem is added to a configuration, either the typical or the peak input power of the subsystem will be added depending on whether the server input power budget or the thermal dissipation is to be calculated. Following are some rules of thumb for calculating the power budget and the thermal dissipation for both methods when a subsystem is added:

1. To calculate the power budget, the peak power should be added.
2. To calculate thermal dissipation, the typical power should be added for the hard disk drives and peak power should be added for all other components.
3. To calculate either the power budget or the thermal dissipation, only the typical input power should be added when the 2<sup>nd</sup> drive is added. Typical input power is listed in Table 2-4. The reasons for this suggestion are:
  - The peak input power for each drive is for the beginning of the spin-up duration, which is relatively short, for example, 10 seconds. During normal operation, that is, while an application is running, the power consumption of a disk drive varies.
  - The drives are spinning up at different times. Therefore, only one drive will consume “peak” power at a time within a server. Note that the only time that up to 42 drives can be spinning up simultaneously in a 42U rack is if all the servers regain power simultaneously, after having lost power. Then all of them will restart automatically and almost simultaneously.
  - There is almost no activity in the processors or memory DIMMs when the drives are spinning up.

#### Example

Assuming the desired server configuration is: 1x550MHz, 2x128MB, 2x18.4GB

The rated input power for the ProLiant DL360 power supply is 292W. Therefore, the power budget for a maximum configuration is **292W**, and the thermal dissipation will be approximately  $(292 * 3.41 =)$  **996 BTUs/hour**.

After removing the 4x1GB DIMMs, 1x800MHz processors, the SA4200 and the Remote Insight Lights-Out Edition from the maximum configuration:

The peak input power of the server will be  $(292 - (4 * 5) - (1 * 26) - 11 - 16) = 219W$ . Since we used the 800MHz processor’s input power instead of the 550MHz processor’s, the 219W is a more conservative number.

Adding back 2x128MB DIMM:

The peak input power of the server will be  $(219 + (2 * 3)) = 225W$ . Therefore, the new power budget for this configuration is **225W** (compared to the rated 292W), and the thermal dissipation will be approximately  $(225 * 3.41 =)$  **765 BTUs/hour** (compared to the rated 996 BTUs/hour).

This de-rated input power budget significantly reduces the power and thermal requirements for highly populated racks. This can mean reduced number of PDUs for certain configurations illustrated in Section 3. Fewer PDUs translates to faster deployment time and lower cost. This can also mean reduced costs for the facility electrical plumbing, data center floor ventilation, and facility air conditioning installation. However, care must be taken in de-rating the input power budget.

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**Note:** Compaq strongly recommends the installation planner to ensure that the de-rated power budget will satisfy all the installation requirements, including future upgrade plans.

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When a subsystem is removed, the typical or the peak power will be subtracted depending on whether the server input power budget or the thermal dissipation is to be calculated.

#### 2.2.4. 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 is to support a known number of ProLiant DL360 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 with the line voltage.

$$\text{Allocated Input Power} = \text{Allocated Input Current} * \text{Input Line Voltage}$$

##### **Example**

Assume a high voltage PDU rated at 24A is to support 21 servers. Each server can be allocated 1.143A. If the line voltage is assumed to be at 208V then the allocated input power budget for each server will be  $(1.143 * 208) = 238\text{W}$ .

Since the input power budget of 238W satisfies the fully configured system measured input power of 185W (as shown in Table 2-3), 21 ProLiant DL360 servers may be supported by a 24A high-voltage PDU. That means, only two of these PDUs are needed to support 42 servers in a 42U rack. This example configuration is further explained in Section 3.1.

## 2.3 PDU Choices

This section details the three Compaq PDUs currently available in deploying maximum number of ProLiant DL360 servers in Compaq racks. Table 2-5 shows a list of important parameters of these PDUs.

**Table 2-5. Compaq PDU choices used for ProLiant DL360 high-volume deployment configurations**

	High Voltage 24A	Low Voltage 24A	High Voltage 16A
<b>Compaq P/N</b>			
North America (N.A.)	<b>295363-003</b>	<b>295363-001</b>	<b>295363-002</b>
EMEA/APD	Not Available	Not Available	<b>295363-B32</b>
Japan	Not Available	<b>295363-291</b>	Not Available
<b>AC Voltage Input</b>	200V-240V	100V-127V	200V-240V
<b>AC Voltage Output</b>	200V-240V	100V-127V	200V-240V
<b>Frequency</b>	50/60 Hz		
<b>Current (Maximum)</b>	24A	24A	16A
<b>Circuit Breaker</b>	4ea. 2-pole 10A	2ea. 2-pole 15A	2ea. 2-pole 10A
<b>Power cord – AWG x Length &amp; Plug Type</b>	#10 x 12 ft NEMA L6-30P	#10 x 12 ft NEMA L5-30P	#10 x 12 ft NEMA L6-20P (for -002) IEC 309-16P (for -B32)
<b>Output Receptacles</b>	IEC 320-C13	NEMA 5-15R	IEC 320-C13
<b>Number of Output Receptacles</b>	12		
<b>Surge Suppression Clamping Level</b>	275V-320V RMS		
<b>Surge Current</b>	50,000A per unit		
<b>Spike Protection</b>	500 joules 10 x 10,000 µsec		
<b>Weight</b>	12 lb / 5.4 kg		
<b>Dimensions (WxHxD)</b>	19.28 x 1.98 x 9.9 in. / 48.97 x 5.03 x 25.15 cm		
<b>Kit Contents</b>	PDU, Documentation, Two IEC320 to IEC320 Coupler cables, and Two power cord retention brackets and tie-wraps.		
<b>Conformance Standards</b>	<b>24A models:</b> UL, CSA, NOM <b>16A N.A. model:</b> UL, CSA, NOM <b>16A EMEA/APD model:</b> CE, TUV, NEMKO, SEMKO, DEMKO, FEMKO		

Compaq PDUs include over-current and surge protection for both low and high voltage equipment requirements and are equipped with circuit breakers to protect any connected system devices from damage in the event of an incoming electrical surge or external equipment malfunction.

All of these PDUs have 12 outlets, with six outlets on each side of the PDU. As listed in Table 2-5, the connector types used in the High Voltage and the Low Voltage PDUs are different. These PDUs were in production before the availability of ProLiant DL360, and the installation procedures of these PDUs need to be modified when they are used to support ProLiant DL360 servers.

The Vertical-Mount PDU Bracket Kit is required for all these PDUs for the rack configurations listed in Section 3. There are two PDU bracket option kits available:

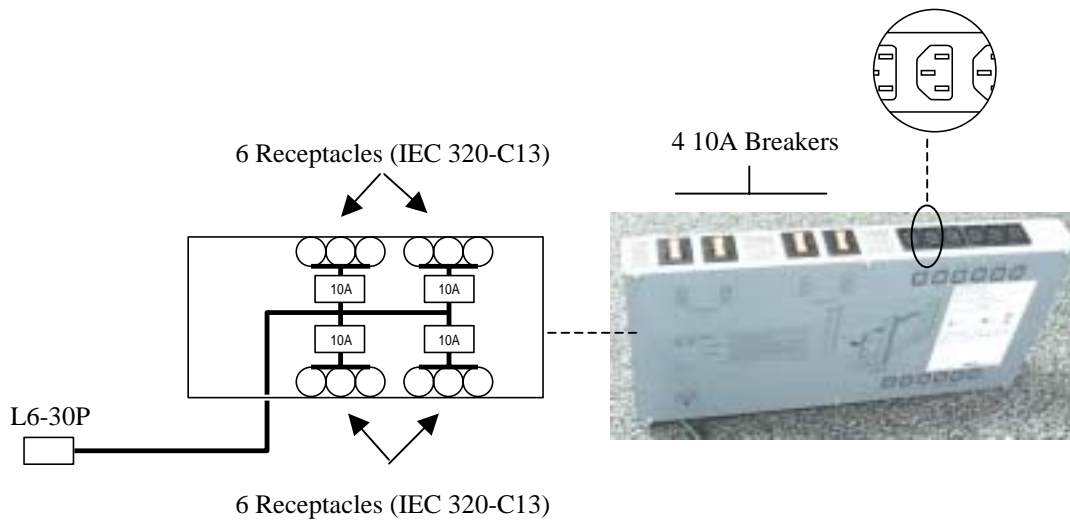
- [P/N 166097-B21](#) is intended to be used with up to two High Voltage PDUs and includes the High Voltage cables. Two of these kits (with cables) are needed to fully populate a 36U or a 42U rack with ProLiant DL360 servers in a high voltage facility.
- [P/N 191265-B21](#) is intended to be used with up to four Low Voltage PDUs and does not include any cable. One kit (without cables) is needed to fully populate a 36U or a 42U rack with ProLiant DL360 servers in a low voltage facility. The 12-ft long power cords that come with each ProLiant DL360 server can be used with the Low Voltage PDUs.

Section 4.3 details the recommended procedures on how these PDUs and associated power cords are installed in Compaq 9000- and 7000-series racks when deploying a fully populated rack.

### 2.3.1 High Voltage 24A PDU (P/N 295363-003)

The 12 outlets on this PDU are grouped into four sections. Each section is protected with a 10A circuit breaker. The total load for this PDU cannot exceed 24A. Each section of the PDU has three outlets. The total current available for each section is 10A. The loads should be balanced amongst the four sections such that the total per section does not exceed 10A or a total of 24A for the PDU. Figure 2-1 identifies the outlets and the circuit breakers.

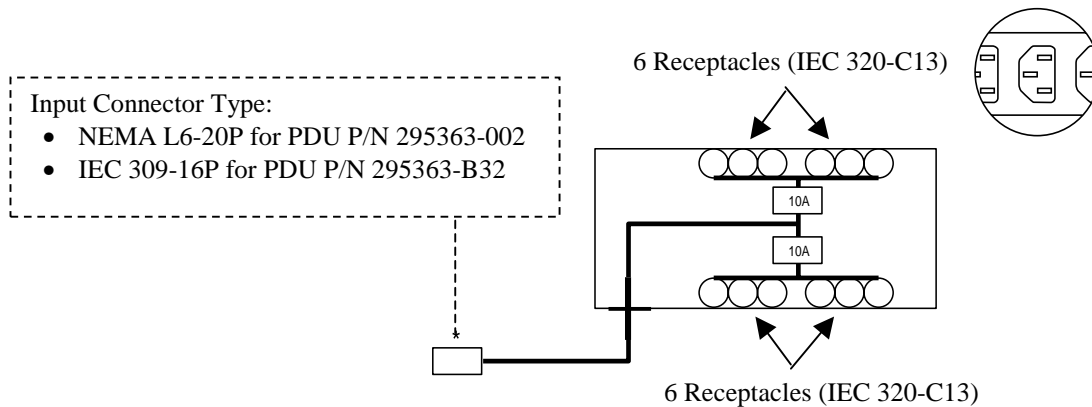
**Figure 2-1. High Voltage 24A PDU**



### 2.3.2 High Voltage 16A PDU (P/N 295363-002 or 295363-B32)

The 12 outlets on this PDU are grouped into two sections, and each section is protected with a 10A circuit breaker. The total load for this PDU cannot exceed 16A. Each section of the PDU has six outlets. The total current available for each section is 10A. The loads should be balanced amongst the two sections such that the total per section does not exceed 10A or a total of 16A for the PDU. Figure 2-2 illustrates the outlets and the circuit breakers.

**Figure 2-2. High Voltage 16A PDU**



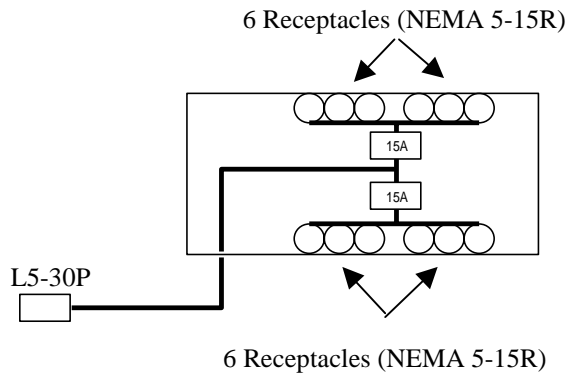
For more information see the following reference:

- "Power Distribution Unit High Voltage Models for North America and International Use, (NA CPQ # 295363-002; INT'L CPQ # 295363-B31)," at <http://www.compaq.com/products/servers/options/ups-high.html>, a web page describing the PDU features and listing the cable part numbers.

### 2.3.3 Low Voltage 24A PDU (P/N 295363-001 or 295363-291)

The 12 outlets on this Low Voltage PDU are grouped into two sections, and each section is protected with a 15A circuit breaker. The total load for this PDU cannot exceed 24A. Each section of the PDU has six outlets. The total current available for each section is 15A. The loads should be balanced amongst the two sections such that the total per section does not exceed 15A or a total of 24A for the PDU. Figure 2-3 illustrates the outlets and the circuit breakers.

Figure 2-3. Low Voltage 24A PDU.



For more information see the following references:

- "Power Distribution Unit Low Voltage Models for North America and International Use," <ftp://ftp.compaq.com/pub/products/servers/Cords-powerdist-low.pdf>, a document with an illustration of the Low Voltage PDU front and rear panels.

## 2.4 PDU Requirements

This section describes the Compaq PDU types available, and explains the number of PDUs needed. After reading this section, customers can plan for the necessary facility power lines and circuit breakers to support a maximum number of ProLiant DL360 servers in a 42U rack.

We have described the power ratings of ProLiant DL360 and Compaq PDU choices in Section 2.1 and 2.3 respectively. The type and number of PDUs required for a rack will depend on the power requirements for each ProLiant DL360 server, the power source available for a rack, the console management method, and the number of servers to be deployed in a rack.

The input current requirement (at an input line voltage level) for a ProLiant DL360 server is one of the most important numbers in planning for a rack configuration. Considering the full rating for each ProLiant DL360 server, the input current for each server will be 1.41A @208V, or 2.66A @110V. The number of servers supported by a PDU is calculated by dividing the PDU rated current (at an input voltage level) by the input current:

$$\text{Number of Servers to be supported by a PDU} = \text{PDU rated current} / \text{Server rated input current}$$

For example, for the input current rated to be

- 1.41A at 208V input voltage and using a High Voltage 24A PDU (P/N 295363-003),

$$\text{Number of Servers to be supported by a PDU} = 24A / 1.41A = 17.02$$

Therefore, up to 17 servers can be supported by a 24A High Voltage PDU. That means, 3 PDUs will be needed to support 42 servers (at full server rating).

- 2.66A at 110V input voltage and using a Low Voltage 24A PDU (P/N 295363-001),

$$\text{Number of Servers to be supported by a PDU} = 24A / 2.66A = 9.02$$

Therefore, up to 9 servers can be supported by a 24A Low Voltage PDU. That means, 5 PDUs will be needed to support 42 servers (at full server rating). However, since a Compaq 42U rack can accommodate up to 4 PDUs in the side panel compartments, only 36 servers can be supported at the input voltage level. The PDU installation in a Compaq 42U rack are described in Section 4.3.

The number of PDUs necessary or installable for a populated 42U rack with maximum number of ProLiant DL360 servers will be as follows:

**Table 2-6. PDUs/rack and Servers/PDU**

Input Voltage	PDU Current Rating	Input Current Rating per ProLiant DL360	Max. # Servers /PDU	# PDUs needed or installable	Max. # Servers in a 42U Rack
208V	24A	1.41A	17	3	42
230V	16A	1.27A	12	4	42
220V	16A	1.33A	12	4	42
208V	16A	1.41A	11	4	42
110V	24A	2.66A	9	4	36
100V	24A	2.92A	8	4	32

The ProLiant DL360 power supply supports both low voltage (100V-120V) and high voltage (200V-240V). The power supply automatically senses input voltage level.

**Note:** There is neither a DC-input power supply nor a redundant power supply for the ProLiant DL360.

## 2.5 Weight and Power of Racks and Related Options

**Note:** Compaq recommends populating a rack with ProLiant DL360 servers and other rack option products after the rack is in or very near its final position. Transporting a 42U rack fully populated with ProLiant DL360 servers is not recommended.

Table 2-7 lists the weight (and power if applicable) of the Compaq racks and rack option products that can be used for installation planning, for example, calculating floor support requirements. These weight measurements can be added to calculate the total weight of a rack fully populated with ProLiant DL360 servers.

For example,

1x	9142 rack	253 lb
42x	ProLiant DL360 with hard disk drives	1,201 lb
42x	Cable management system	168 lb
3x	High Voltage PDUs with brackets	38 lb
22x	High Voltage Y Power Cords	18 lb
		-----
	Total configured rack weight	1,678 lb
		-----

In addition, the weight for the network cables and the KVM cables (if applicable) should be added to the total configured rack weight, if they are not suspended above the rack or if they are resting on any attachment on the rack.

**Table 2-7. Compaq rack and related options weight (and power if applicable)**

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

For more detailed specifications or more options, refer to the Compaq web site at [www.compaq.com](http://www.compaq.com).



### 3 Configuration Choices

A rack can be configured with servers, storage devices, KVM switches, PDUs, and so on. In this paper, several rack configurations will be discussed. We will address full-rack configurations that can hold as many ProLiant DL360 servers as possible, while depending on the rack size, power source, PDU current rating, and console management choices.

The 9000- and the 7000-series Compaq racks mentioned in this section are 9142, 9136, 9122, 7142 and 7122. The 4000-series racks (36U) are not recommended for full-rack configurations because they are not sturdy enough to hold 36 ProLiant DL360 servers.

The configurations are listed in alphabetical order (A to N) in Section 3.1 to Section 3.14. Table 3-1 can be used as a guideline for finding the section and page number to locate a configuration. The worst-case thermal dissipation and weight (with fixed rails) information for each configuration are also shown here for a quick reference.

**Table 3-1. Rack Configuration Selection Table**

Config	Rack	Number of Servers	PDU		Console Management	Section [page]	Thermal (BTUs/hr)	Weight (lb)
			Input Voltage	Qty.x Rating				
*A	42U	42 de-rated	High	2x 24A	Remote	3.1 [27]	34,100	1,665
B	42U	42	High	3x 24A	Remote	3.2 [29]	41,820	1,678
C	42U	42	High	4x 16A	Remote	3.3[31]	41,820	1,690
D	42U	42 de-rated	Low	4x 24A	Remote	3.4 [33]	34,520	1,690
E	42U	36	Low	4x 24A	Remote	3.5 [35]	35,850	1,518
F	42U	42	High	3x 24A	Local / Off-Rack	3.6[37]	41,820	1,678
G	42U	35	High	3x 24A	Local / In-Rack	3.7 [39]	35,000	1,567
H	42U	35 de-rated	High	2x 24A	Local / In-Rack	3.8 [41]	33,560	1,555
I	42U	35	Low	4x 24A	Local / In-Rack	3.9[43]	35,000	1,579
*J	36U	36 de-rated	High	2x 24A	Remote	3.10 [45]	34,270	1,406
K	36U	36	High	3x 24A	Remote	3.11 [47]	35,850	1,418
L	36U	36	Low	4x 24A	Remote	3.12[49]	35,850	1,430
*M	22U	22	High	2x 24A	Remote	3.13[51]	25,900	940
N	22U	18	Low	2x 24A	Remote	3.14[53]	18,000	825

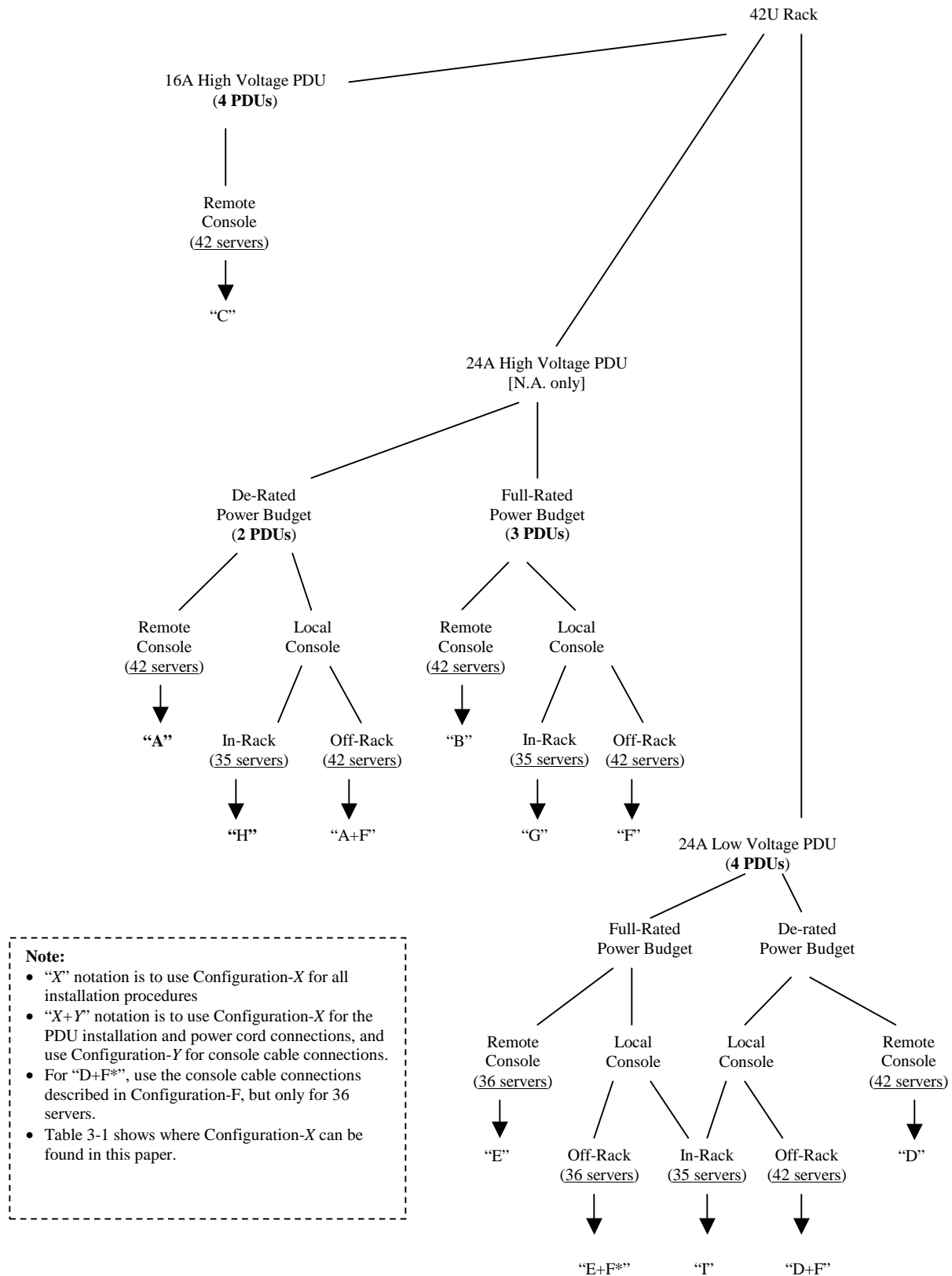
**Note:** \*These configurations are Best Practices.

Each configuration section includes the parts lists for one rack deployment. For multiple racks, multiply the parts lists contents by the number of racks. See section 4.2.3 for multiple rack deployment tips.

Figure 3-1 on the next page shows the Configuration Selection Tree for an at-a-glance view of the number of servers that can be deployed in a 42U rack based on the AC power source, PDU type, server configuration (to allow for de-rated power), and console management. The 36U and 22U cases are simple enough that neither the selection table nor the tree is provided in this paper.

Sections 3.1 through 3.14 describe individual rack configuration, each with the rack U-space layout, the rack contents, the parts lists, and the installation procedures. The rack U-space is numbered from the bottom to the top for references purposes. Compaq racks have tick marks for every 1U space.

Figure 3-1. Rack Configuration Selection Tree (Table 3-1 shows pages for letter definitions)





### 3.1 Configuration-A: 42 De-rated Servers, High Voltage

This configuration shows a “best practice” for a 42U rack with 42 servers in a high voltage facility (North America only) where a deployment plan can accommodate the de-rating of each ProLiant DL360 server. Section 2.2 explains power budgeting methods and measured power for different base-line configurations and subsystem components. The following calculation verifies supporting 42 servers with 24A High Voltage PDUs:

Since there are 2 PDUs to support 42 servers, each PDU needs to support 21 servers. A 24A High Voltage PDU supporting 21 servers can allocate each server with maximum current of  $(24/21=)$  1.143A @ 208V. Therefore, the allocated maximum input power for each server will be

$$1.143A * 208V = \underline{238W}$$

The maximum thermal dissipation per server will be

$$238W * 3.41 = 812 \text{ BTUs/hour}$$

For 42 servers, the total thermal dissipation will be  $(812*42=)$  34,104 BTUs/hour.

In Section 2.2, a fully configured system was measured to consume lower than 200W (Table 2-3, Server Configuration-5). Hence, if each de-rated server configuration input power is lower than 238W then 42 servers can be supported via this configuration summary.

Configuration-A Summary	
<b><u>Rack Contents</u></b>	
<b>Units</b>	
42 servers with all fixed or all sliding rails with cable trays	
2 High Voltage 24A PDUs vertically mounted in the side panel compartments	
<b>Internal Cables</b>	
22 Y-power cords going to 2 PDUs in the side panels	
<b><u>Cables External to Rack</u></b>	
42 (management) network cables from the optional Remote Insight Lights-Out Edition RJ45 connectors to external switches	
42 (data) network cables from on-board RJ-45 to external switches, assuming use of only one LAN connection per server	
2 input power cords from the rack to external power outlets	
<b><u>Site Utility Requirements (worst-case)</u></b>	
<b>Power:</b> 2 dedicated 200V-240V 30A branch circuits.	
<b>Thermal:</b> up to 34,100 BTUs/hour [This number is a worst-case. The actual BTUs/hour will depend on the OS/application software running and the server hardware configurations.]	
<b>Weight:</b> up to 1,665 lb (with sliding-rails) [The network cables are not accounted for since most implementations route the network cables to the ceiling-hung cable rails outside of the rack.]	

42	Server 42
41	Server 41
40	Server 40
39	Server 39
38	Server 38
37	Server 37
36	Server 36
35	Server 35
34	Server 34
33	Server 33
32	Server 32
31	Server 31
30	Server 30
29	Server 29
28	Server 28
27	Server 27
26	Server 26
25	Server 25
24	Server 24
23	Server 23
22	Server 22
21	Server 21
20	Server 20
19	Server 19
18	Server 18
17	Server 17
16	Server 16
15	Server 15
14	Server 14
13	Server 13
12	Server 12
11	Server 11
10	Server 10
9	Server 9
8	Server 8
7	Server 7
6	Server 6
5	Server 5
4	Server 4
3	Server 3
2	Server 2
1	Server 1

The optional Compaq Remote Insight Lights-Out Edition is recommended for remote console management in this configuration. The network cables originating from each ProLiant DL360 server connect to network switches outside this rack enclosure. This configuration still accommodates a “walk-up” local console, whereby a person can walk up to the rear of the rack and plug in a set of keyboard/video/mouse (KVM) cables to any server rear panel in the rack.

<b>Configuration-A Parts List</b>			
<b>Description</b>	<b>Compaq P/N</b>	<b>Qty.</b>	<b>Notes</b>
Sliding rails and cable management solution option	174575-B21	42	Optional for in-rack servicing
Remote Insight Lights-Out Edition option	157866-001	42	N.A. [See Note(a)]
High Voltage 24A PDU option	295363-001	2	N.A. [See Note(b)]
Vertical-Mount PDU Bracket Kit with High Voltage Cables	166097-B21	2	Contains 4 PDU brackets and 11 Y-power cords

**Note:**

This list does not include the rack, the ProLiant DL360 servers, and the network cables.

- (a) Part numbers for the regions outside N.A. are listed in Appendix B on page 83.
- (b) At this time, only one model of the high current (24A) High Voltage PDU is available. This configuration can be used in regions where NEMA electrical standards are followed. See Section 2.3.1 for more details on the high current High Voltage PDU.

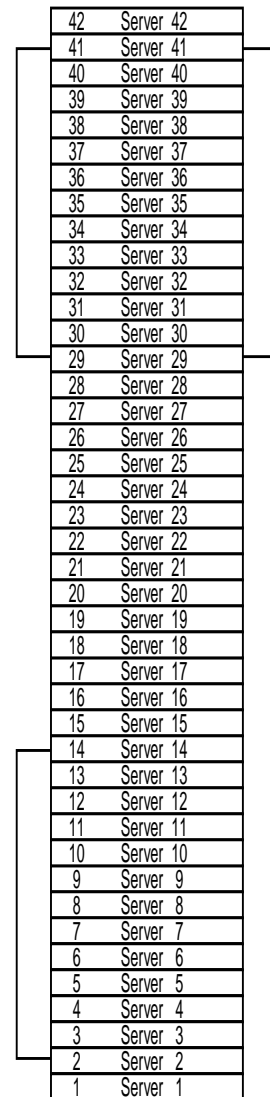
<b>Configuration-A Installation Procedure</b>		
<b>Procedure</b>		<b>Section [page]</b>
ProLiant DL360 Preparation		4.1 [55]
Rack Preparation		4.2 [56]
PDU Installation	Mechanical unit	4.3.2 [59]
	Power cord wiring	4.3.5.1 [62]
Rack Rails Installation		4.4 [74]
Rack Population		4.5 [75]
Cable Dressing	Power cord connections	4.6.1 [76]
	Console cable connections	4.6.2.1 [76]
	Cable management procedure	4.6.3 [79]
Completing the Installation		4.7 [81]

### 3.2 Configuration-B: 42 Servers, 24A High Voltage PDU

This configuration shows how to deploy a 42U rack with 42 servers in a high voltage facility. Three PDUs will be required to support 42 fully-rated servers as explained in Section 2.4.

The optional Compaq Remote Insight Lights-Out Edition is recommended for remote console management in this configuration. The network cables originating from each ProLiant DL360 server connect to network switches outside this rack enclosure. This configuration still accommodates a “walk-up” local console, whereby a person can walk up to the rear of the rack and plug in a set of keyboard/video/mouse (KVM) cables to any server rear panel in the rack.

Configuration-B Summary	
<b><u>Rack Contents</u></b>	
<b>Units</b>	
42 servers with all fixed or all sliding rails with cable trays	
3 High Voltage 24A PDUs vertically mounted in the side panel compartments	
<b>Internal Cables</b>	
22 Y-power cords connecting from 3 PDUs in the side panels to 42 servers	
<b><u>Cables External to Rack</u></b>	
42 (management) network cables from the optional Remote Insight Lights-Out Edition RJ-45 connector to external switches	
42 (data) network cables from on-board RJ-45 to external switches, assuming use of only one LAN connection per server	
3 input power cords from the rack to external power outlets	
<b><u>Site Utility Requirements (worst-case)</u></b>	
<b>Power:</b> 3 dedicated 200V-240V 30A branch circuits.	
<b>Thermal:</b> up to 41,820 BTU [This number is a worst-case. The actual BTUs/hour will depend on the OS/application software running and the server hardware configurations.]	
<b>Weight:</b> up to 1,678 lb (with sliding-rails) [The network cables are not accounted for since most implementations route the network cables to the ceiling-hung cable rails outside of the rack.]	



<b>Configuration-B Parts List</b>			
<b>Description</b>	<b>Compaq P/N</b>	<b>Qty.</b>	<b>Notes</b>
Sliding rails and cable management solution option	174575-B21	42	Optional for in-rack servicing
Remote Insight Lights-Out Edition option	157866-001	42	N.A. [See Note(a)]
High Voltage 24A PDU option	295363-003	3	N.A. [See Note(b)]
Vertical-Mount PDU Bracket Kit with High Voltage Cables	166097-B21	2	Contains 4 PDU brackets and 11 Y-power cords

**Note:**

This list does not include the rack, the ProLiant DL360 servers, and the network cables.

- (a) Part numbers for the regions outside N.A. are listed in Appendix B on page 83.
- (b) At this time, only one model of the high current (24A) High Voltage PDU is available. This configuration can be used in regions where NEMA electrical standards are followed. See Section 2.3.1 for more details on the high current High Voltage PDU.

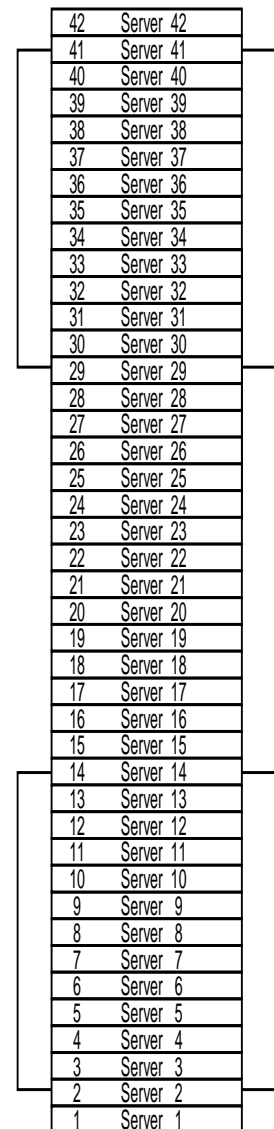
<b>Configuration-B Installation Procedure</b>		
<b>Procedure</b>		<b>Section [page]</b>
ProLiant DL360 Preparation		4.1 [55]
Rack Preparation		4.2 [56]
PDU Installation	Mechanical unit	4.3.2 [59]
	Power cord wiring	4.3.5.2 [63]
Rack Rails Installation		4.4 [74]
Rack Population		4.5 [75]
Cable Dressing	Power cord connections	4.6.1 [76]
	Console cable connections	4.6.2.1 [76]
	Cable management procedure	4.6.3 [79]
Completing the Installation		4.7 [81]

### 3.3 Configuration-C: 42 Servers, 16A High Voltage PDU

This configuration is not recommended if higher current-rating High Voltage PDUs are available. Otherwise, this configuration shows how to deploy 42 ProLiant DL360 servers in a 42U rack using four 16A High Voltage PDUs.

The optional Compaq Remote Insight Lights-Out Edition is recommended for remote console management in this configuration. The network cables originating from each ProLiant DL360 server connect to network switches outside this rack enclosure. This configuration still accommodates a “walk-up” local-console, whereby a person can walk up to the rear of the rack and plug in a set of keyboard/video/mouse (KVM) cables to any server rear panel in the rack.

Configuration-C Summary	
<b><u>Rack Contents</u></b>	
<b>Units</b>	
42 servers with all fixed or all sliding rails with cable trays	
4 High Voltage 16A PDUs vertically mounted in the side panel compartments	
<b>Internal Cables</b>	
22 Y-power cords going to 4 PDUs in the side panels	
<b><u>Cables External to Rack</u></b>	
42 (management) network cables from the optional Remote Insight Lights-Out Edition RJ-45 connector to external switches	
42 (data) network cables from on-board RJ-45 to external switches, assuming use of only one LAN connection per server.	
4 input power cords from the rack to external power outlets	
<b><u>Site Utility Requirements (worst-case)</u></b>	
<b>Power:</b> 4 dedicated 200V-240V 20A branch circuits for N.A. and Japan, or 4 dedicated 200V-240V 16A branch circuits for the rest of the world.	
<b>Thermal:</b> up to 41,820 BTU [This number is a worst-case. The actual BTUs/hour will depend on the OS/application software running and the server hardware configurations.]	
<b>Weight:</b> up to 1,690 lb (with sliding-rails) [The network cables are not accounted for since most implementations route the network cables to the ceiling-hung cable rails outside of the rack.]	



<b>Configuration-C Parts List</b>			
<b>Description</b>	<b>Compaq P/N</b>	<b>Qty.</b>	<b>Notes</b>
Sliding rails and cable management solution option	174575-B21	42	Optional for in-rack servicing
Remote Insight Lights-Out Edition option	157866-001	42	N.A. [See Note(a)]
High Voltage 16A PDU	295363-002	4	N.A. [See Note(a)]
Vertical-Mount PDU Bracket Kit with High Voltage Cables	166097-B21	2	Contains 4 PDU brackets and 11 Y-power cords

**Note:**

This list does not include the rack, the ProLiant DL360 servers, and the network cables.

(a) Part numbers for the regions outside N.A. are listed in Appendix B on page 83.

<b>Configuration-C Installation Procedure</b>		
<b>Procedure</b>		<b>Section [page]</b>
ProLiant DL360 Preparation		4.1 [55]
Rack Preparation		4.2 [56]
PDU Installation	Mechanical unit	4.3.2 [59]
	Power cord wiring	4.3.5.4 [65]
Rack Rails Installation		4.4 [74]
Rack Population		4.5 [75]
Cable Dressing	Power cord connections	4.6.1 [76]
	Console cable connections	4.6.2.1 [76]
	Cable management procedure	4.6.3 [79]
Completing the Installation		4.7 [81]



### 3.4 Configuration-D: 42 De-rated Servers, Low Voltage

The following calculation verifies supporting 42 servers (de-rated Power Budget) with 24A Low Voltage PDUs:

Since there are 4 PDUs supporting 42 servers, each PDU will need to support up to 11 servers. A 24A Low Voltage PDU supporting 11 servers can allocate each server with maximum current of  $(24/11=)$  2.19A. Assuming 110V, the allocated maximum input power for each server will be

$$2.19A * 110V = \underline{241W}$$

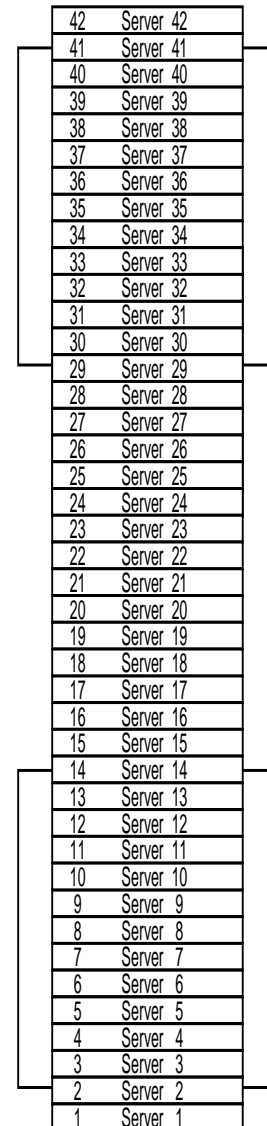
The maximum thermal dissipation per server will be

$$241W * 3.41 = 822 \text{ BTUs/hour}$$

For 42 servers, the total thermal dissipation will be  $(822*42=)$  34,524 BTUs/hour.

In Section 2.2, a fully configured system was measured to consume lower than 200W (Table 2-3, Server Configuration-5). Hence, if each de-rated server configuration input power is lower than 241W then 42 servers can be supported via this configuration summary.

Configuration-D Summary	
<b><u>Rack Contents</u></b>	
<b>Units</b>	
42 servers with all fixed or all sliding rails with cable trays	
4 Low Voltage 24A PDUs vertically mounted in the side panel compartments	
<b>Internal Cables</b>	
42 power cords going to 4 PDUs in the side panels [These cables are supplied with the servers.]	
<b><u>Cables External to Rack</u></b>	
42 (management) network cables from the optional Remote Insight Lights-Out Edition's RJ45 connector to external switches	
42 (data) network cables from on-board RJ-45 to external switches, assuming use of only one LAN connection per server	
4 input power cords from the rack to external power outlets	
<b><u>Site Utility Requirements (worst-case)</u></b>	
<b>Power:</b> 4 dedicated 100V-120V 30A branch circuits.	
<b>Thermal:</b> up to 34,520 BTUs/hour [This number is a worst-case. The actual BTUs/hour will depend on the OS/application software running and the server hardware configurations.]	
<b>Weight:</b> up to 1,690 lb (with sliding-rails) [The network cables are not accounted for since most implementations route the network cables to the ceiling-hung cable rails outside of the rack.]	



<b>Configuration-D Parts List</b>			
<b>Description</b>	<b>Compaq P/N</b>	<b>Qty.</b>	<b>Notes</b>
Sliding rails and cable management solution option	174575-B21	42	Optional for in-rack servicing
Remote Insight Lights-Out Edition option	157866-001	42	N.A. [See Note(a)]
Low Voltage 24A PDU option	295363-001	4	N.A. [See Note(a) & (b)]
Vertical-Mount PDU Bracket Kit	191265-B21	1	Contains 8 PDU brackets

**Note:**

This list does not include the rack, the ProLiant DL360 servers, and the network cables.

- (a) Part numbers for the regions outside N.A. are listed in Appendix B on page 83.
- (b) The Low Voltage PDUs are available only in N.A and Japan.

<b>Configuration-D Installation Procedure</b>		
<b>Procedure</b>		<b>Section [page]</b>
ProLiant DL360 Preparation		4.1 [55]
Rack Preparation		4.2 [56]
PDU Installation	Mechanical unit	4.3.2 [59]
	Power cord wiring	4.3.5.7 [68]
Rack Rails Installation		4.4 [74]
Rack Population		4.5 [75]
Cable Dressing	Power cord connections	4.6.1 [76]
	Console cable connections	4.6.2.1 [76]
	Cable management procedure	4.6.3 [79]
Completing the Installation		4.7 [81]

### 3.5 Configuration-E: 36 Full-rated Servers, Low Voltage

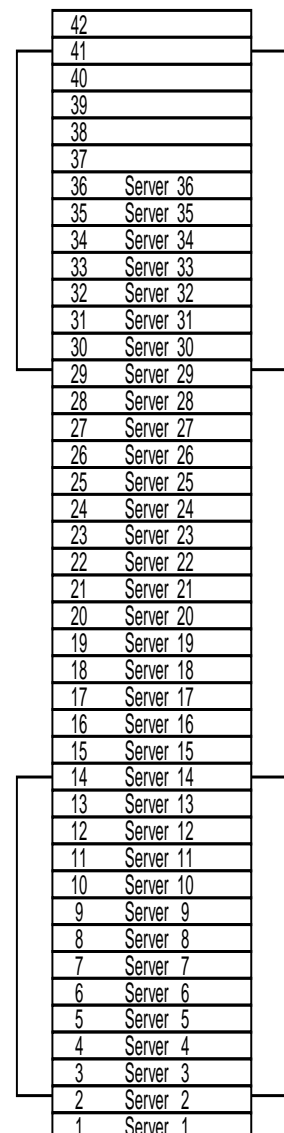
This configuration shows a 42U rack with a maximum number of servers in a low voltage facility. **If high voltage input is available, then this configuration is not recommended, because fewer than 42 ProLiant DL360 servers will be supported in a 42U rack, considering the maximum input current rating for the servers.** In N.A., assuming 110V line voltage, only up to 36 servers can be supported with 4 Low Voltage 24A PDUs. In Japan, assuming 100V line voltage, only up to 32 servers can be supported with 4 Low Voltage 24A PDUs. This example configuration is illustrated here for the N.A. market.

Note that up to 4 Compaq Low Voltage PDUs can be installed in the sides of a Compaq 36U or 42U racks. Each ProLiant DL360 server can consume up to 2.7A @110V, i.e., each 24A PDU can support up to 9 ProLiant DL360 servers. Therefore, with 4 Low Voltage 24A PDUs, only up to 36 servers can be supported.

Note that up to 42 servers may be installed, if the deployment plan can support de-rated power for each ProLiant DL360 server power supply. See Section 3.4.

The remaining space in a 42U rack is available for other devices, such as network switches. If no network switches are installed in this rack, then there will be several standard network cables exiting the rack, which are to be routed to appropriate off-rack switches. In the configuration summary below, all network switches are located outside of the rack.

Configuration-E Summary	
<b><u>Rack Contents</u></b>	
<b>Units</b>	
36 servers with all fixed or all sliding rails with cable trays	
4 Low Voltage 24A PDUs vertically mounted in the side panel compartments	
<b>Internal Cables</b>	
36 power cords going to 4 PDUs in the side panels [These cables are supplied with the servers.]	
<b><u>Cables External to Rack</u></b>	
36 (management) network cables from the optional Remote Insight Lights-Out Edition RJ-45 connector to external switches	
36 (data) network cables from on-board RJ-45 to external switches, assuming use of only one LAN connection per server.	
4 input power cords from the rack to external power outlets	
<b><u>Site Utility Requirements (worst-case)</u></b>	
<b>Power:</b> 4 dedicated 100V-120V 30A branch circuits.	
<b>Thermal:</b> up to 35,850 BTUs/hour [This number is a worst-case. The actual BTUs/hour will depend on the OS/application software running and the server hardware configurations.]	
<b>Weight:</b> up to 1,518 lb (with sliding-rails) [The network cables are not accounted for since most implementations route the network cables to the ceiling-hung cable rails outside of the rack.]	



<b>Configuration-E Parts List</b>			
<b>Description</b>	<b>Compaq P/N</b>	<b>Qty.</b>	<b>Notes</b>
Sliding rails and cable management solution option	174575-B21	36	Optional for in-rack servicing
Remote Insight Lights-Out Edition option	157866-001	36	N.A. [See Note(a)]
Low Voltage 24A PDU option	295363-001	4	N.A. [See Note(a) & (b)]
Vertical-Mount PDU Bracket Kit	191265-B21	1	Contains 8 PDU brackets

**Note:**

This list does not include the rack, the ProLiant DL360 servers, and the network cables.

(a) Part numbers for the regions outside N.A. are listed in Appendix B on page 83.

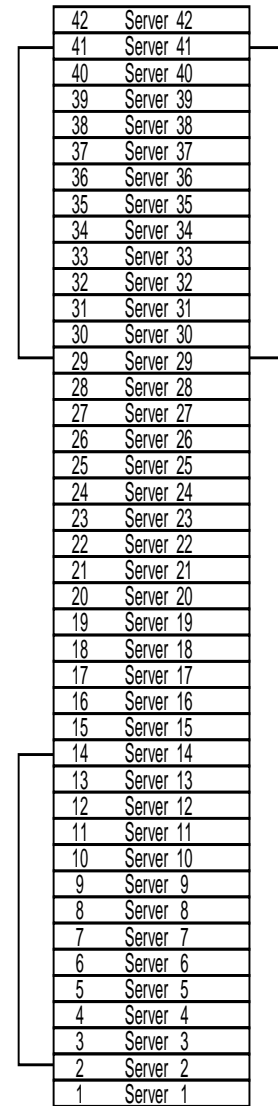
(b) The Low Voltage PDUs are available only in N.A and Japan.

<b>Configuration-E Installation Procedure</b>		
<b>Procedure</b>		<b>Section [page]</b>
ProLiant DL360 Preparation		4.1 [55]
Rack Preparation		4.2 [56]
PDU Installation	Mechanical unit	4.3.2 [59]
	Power cord wiring	4.3.5.6 [67]
Rack Rails Installation		4.4 [74]
Rack Population		4.5 [75]
Cable Dressing	Power cord connections	4.6.1 [76]
	Console cable connections	4.6.2.1 [76]
	Cable management procedure	4.6.3 [79]
Completing the Installation		4.7 [81]

### 3.6 Configuration-F: 42 Servers, Off-Rack Local Console, High Voltage

This configuration shows a 42U rack with a maximum number of servers in a high voltage facility with server management via local console. Therefore, there will be several KVM cables from each server exiting the rack, which are to be routed to KVM (Server Console) switches located off-rack. **This configuration is not recommended because of long/bulky KVM cables and the inability to manage any server from any console.**

Configuration-F Summary	
<b><u>Rack Contents</u></b>	
<b>Units</b>	
42 servers with all fixed or all sliding rails with cable trays	
3 High Voltage 24A PDUs vertically mounted in the side panel compartments	
<b>Internal Cables</b>	
22 Y-power cords going to 3 PDUs in the side panels	
<b><u>Cables External to Rack</u></b>	
42 sets of KVM cables (126 cables worst-case) from the servers to the external Server Console Switches	
42 (data) network cables from on-board RJ-45 to external switches, assuming use of only one LAN connection per server	
3 input power cords from the rack to external power outlets	
<b><u>Site Utility Requirements (worst-case)</u></b>	
<b>Power:</b> 3 dedicated 200V-240V 30A branch circuits.	
<b>Thermal:</b> up to 41,820 BTU [This number is a worst-case. The actual BTUs/hour will depend on the OS/application software running and the server hardware configurations.]	
<b>Weight:</b> up to 1,678 lb (with sliding-rails) [The KVM and the network cables are not accounted for since most implementations route these cables to the ceiling-hung cable rails outside of the rack.]	



Configuration-F Parts List			
Description	Compaq P/N	Qty.	Notes
Sliding rails and cable management solution option	174575-B21	42	Optional for in-rack servicing
High Voltage 24A PDU option	295363-003	3	N.A. only [See Note(a)]
Vertical-Mount PDU Bracket Kit with High Voltage Cables	166097-B21	2	Contains 4 PDU brackets and 11 Y-power cords

**Note:**

This list does not include the rack, the ProLiant DL360 servers, and the network cables.

- (a) At this time, only one model of the high current (24A) High Voltage PDU is available. This configuration can be used in regions where NEMA electrical standards are followed. See Section 2.3.1 for more details on the high current High Voltage PDU.

Configuration-F Installation Procedure		
Procedure		Section [page]
ProLiant DL360 Preparation		4.1 [55]
Rack Preparation		4.2 [56]
PDU Installation	Mechanical unit	4.3.2 [59]
	Power cord wiring	4.3.5.2 [63]
Rack Rails Installation		4.4 [74]
Rack Population		4.5 [75]
Cable Dressing	Power cord connections	4.6.1 [76]
	Console cable connections	4.6.2.1 [76]
	Cable management procedure	4.6.3 [79]
Completing the Installation		4.7 [81]

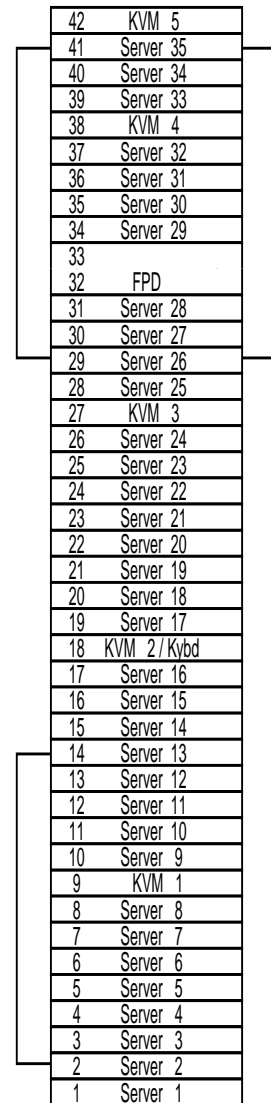
### 3.7 Configuration-G: 35 Servers, Stand-Alone Rack, 24A High Voltage PDU

This configuration can be used for a high voltage facility with server management via local console, where a 42U rack has to be “stand-alone,” that is, all the necessary local console management devices are to be populated in the same rack. The network cables are routed to the network switches located off-rack. This configuration is suitable where some racks need to be isolated from others and require an in-rack local console. A co-location facility may be an example.

Up to 35 ProLiant DL360 servers can be installed in this configuration. Note that although the Compaq in-rack keyboard (with trackball) takes up 1U space, a Server Console Switch can be installed at the back of the keyboard. The Compaq in-rack flat panel display (FPD) unit takes up 2U space when it is fully retracted inside the rack.

If the network switches also need to be installed in the same rack, then two additional 1U spaces will be required, that is, only 33 ProLiant DL360 servers can be installed.

Configuration-G Summary	
<b><u>Rack Contents</u></b>	
<b>Units</b>	
35 servers with all fixed or all sliding rails with cable trays	
5 KVMs, 1 FPD, 1 Keyboard, 1 Keyboard tray	
3 High Voltage 24A PDUs vertically mounted in the side panel compartments.	
<b>Internal Cables</b>	
22 Y-power cords going to 3 PDUs in the side panels	
<b>40 KVM cables:</b> [See Figure 4-22 for the cabling diagram.]	
35 from each server to a corresponding Server Console Switch in the rack	
4 from four Server Console Switches (KVM 1-4) to the top-level Server Console Switch (KVM 5) to cascade the KVM switches.	
1 from the top-level Server Console Switch to the FPD and the keyboard/trackball (different cable)	
<b><u>Cables External to Rack</u></b>	
35 (data) network cables from on-board RJ-45 to external switches, assuming use of only one LAN connection per server.	
3 input power cords from the rack to external power outlets	
<b><u>Site Utility Requirements (worst-case)</u></b>	
<b>Power:</b> 3 dedicated 200V-240V 30A branch circuits.	
<b>Thermal:</b> up to 35,000 BTU [This number is a worst-case. The actual BTUs/hour will depend on the OS/application software running and the server hardware configurations.]	
<b>Weight:</b> up to 1,567 lb (with sliding-rails) [The network cables are not accounted for since most implementations route these cables to the ceiling-hung cable rails outside of the rack.]	



Configuration-G Parts List			
Description	Compaq P/N	Qty.	Notes
Sliding rails and cable management solution option	174575-B21	35	Optional for in-rack servicing
Server Console Switch option	400337-001	5	1x8 Port KVM
Internal Keyboard with Trackball option	185152-186	1	[See Note(a)]
1U Keyboard Tray option	338056-B21	1	
TFT 5000R Rack Mount Flat Panel Monitor option	120207-001	1	
High Voltage 24A PDU option	295363-003	3	N.A. [See Note(b)]
CPU-to-Server Console Cables option	110936-B24, or 110936-B25	39	3 ft for fixed rails 6 ft for sliding rails [These 3 ft and 6 ft cables will be available 3Q00.]
Vertical-Mount PDU Bracket Kit with High Voltage Cables	166097-B21	2	Contains 4 PDU brackets and 11 Y-power cords

**Note:**

This list does not include the rack, the ProLiant DL360 servers, and the network cables.

- (a) Part numbers for the regions outside N.A. are listed in Appendix B on page 83.
- (b) At this time, only one model of the high current (24A) High Voltage PDU is available. This configuration can be used in regions where NEMA electrical standards are followed. See Section 2.3.1 for more details on the high current High Voltage PDU.

Configuration-G Installation Procedure		
Procedure		Section [page]
ProLiant DL360 Preparation		4.1 [55]
Rack Preparation		4.2 [56]
PDU Installation	Mechanical unit	4.3.2 [59]
	Power cord wiring	4.3.5.3 [64]
Rack Rails Installation		4.4 [74]
Rack Population		4.5 [75]
Cable Dressing	Power cord connections	4.6.1 [76]
	Console cable connections	4.6.2.3 [77]
	Cable management procedure	4.6.3 [79]
Completing the Installation		4.7 [81]



### 3.8 Configuration-H: 35 De-rated Servers, Stand-Alone Rack, 24A High Voltage PDU

This configuration is the same as Configuration-G, except one PDU was removed for easier cable installation. The following calculation verifies supporting 42 servers (de-rated Power Budget) with 24A High Voltage PDUs:

Two PDUs will be supporting 35 servers, 5 KVM switches and 1 FPD. For simplicity, assume the KVM switches and the FPD consumes about the same amount of power as the servers. Therefore, each PDU will need to support up to 21 servers or devices. A 24A Low Voltage PDU supporting 21 devices can allocate each device with maximum current of  $(24/21=)$  1.15A. Assuming 208V, the allocated maximum input power for each device will be

$$1.15A * 208V = 240W$$

The maximum thermal dissipation per device will be

$$240W * 3.41 = 818 \text{ BTUs/hour}$$

For 42 devices, the total thermal dissipation will be  $(818*41=)$  33,555 BTUs/hour.

In Section 2.2, a fully configured system was measured to consume lower than 200W (Table 2-3, Server Configuration-5). Hence, if each de-rated server configuration input power is lower than 240W then 42 devices (35 servers and 6 other devices) can be supported via this configuration summary.

Configuration-H Summary	
<b><u>Rack Contents</u></b>	
<b>Units</b>	
35 servers with all fixed or all sliding rails with cable trays	
5 KVMs, 1 FPD, 1 Keyboard, 1 Keyboard tray	
2 High Voltage 24A PDUs vertically mounted in the side panel compartments.	
<b>Internal Cables</b>	
22 Y-power cords going to 2 PDUs in the side panels	
40 KVM cables: [See Figure 4-22 for the cabling diagram]	
35 from each server to a corresponding Server Console Switch in the rack	
4 from four Server Console Switches (KVM 1-4) to the top-level Server Console Switch (KVM 5) to cascade the KVM switches.	
1 from the top-level Server Console Switch to the FPD and the keyboard/trackball (different cable)	
<b><u>Cables External to Rack</u></b>	
35 (data) network cables from on-board RJ45 to external switches, assuming use of only one LAN connection per server.	
2 input power cords from the rack to external power outlets	
<b><u>Site Utility Requirements (worst-case)</u></b>	
<b>Power:</b> 2 dedicated 200V-240V 30A branch circuits.	
<b>Thermal:</b> up to 33,560 BTU [This number is a worst-case. The actual BTUs/hour will depend on the OS/application software running and the server hardware configurations.]	
<b>Weight:</b> up to 1,555 lb (with sliding-rails) [The network cables are not accounted for since most implementations route these cables to the ceiling-hung cable rails outside of the rack.]	

42	KVM 5
41	Server 35
40	Server 34
39	Server 33
38	KVM 4
37	Server 32
36	Server 31
35	Server 30
34	Server 29
33	
32	FPD
31	Server 28
30	Server 27
29	Server 26
28	Server 25
27	KVM 3
26	Server 24
25	Server 23
24	Server 22
23	Server 21
22	Server 20
21	Server 19
20	Server 18
19	Server 17
18	KVM 2 / Kybd
17	Server 16
16	Server 15
15	Server 14
14	Server 13
13	Server 12
12	Server 11
11	Server 10
10	Server 9
9	KVM 1
8	Server 8
7	Server 7
6	Server 6
5	Server 5
4	Server 4
3	Server 3
2	Server 2
1	Server 1

Configuration-H Parts List			
Description	Compaq P/N	Qty.	Notes
Sliding rails and cable management solution option	174575-B21	35	Optional for in-rack servicing.
Server Console Switch option	400337-001	5	1x8 Port KVM
Internal Keyboard with Trackball option	185152-186	1	[See Note(a)]
1U Keyboard Tray option	338056-B21	1	
TFT 5000R Rack Mount Flat Panel Monitor option	120207-001	1	
High Voltage 24A PDU option	295365-003	2	N.A. [See Note(b)]
CPU-to-Server Console Cables option	110936-B24, or 110936-B25	39	3 ft for fixed rails 6 ft for sliding rails [These 3 ft and 6 ft cables will be available 3Q00.]
Vertical-Mount PDU Bracket Kit with High Voltage Cables	166097-B21	2	Each kit contains 4 PDU brackets and 11 Y-power cords.

**Note:**

This list does not include the rack, the ProLiant DL360 servers, and the network cables.

- (a) Part numbers for the regions outside N.A. are listed in Appendix B on page 83.
- (b) At this time, only one model of the high current (24A) High Voltage PDU is available. This configuration can be used in regions where NEMA electrical standards are followed. See Section 2.3.1 for more details on the high current High Voltage PDU.

Configuration-H Installation Procedure		
Procedure		Section [page]
ProLiant DL360 Preparation		4.1 [55]
Rack Preparation		4.2 [56]
PDU Installation	Mechanical unit	4.3.2 [59]
	Power cord wiring*	4.3.5.1 [62]
Rack Rails Installation		4.4 [74]
Rack Population		4.5 [75]
Cable Dressing	Power cord connections	4.6.1 [76]
	Console cable connections	4.6.2.3 [77]
	Cable management procedure	4.6.3 [79]
Completing the Installation		4.7 [81]

\* **Note:** Use the same cabling diagram for 42 servers case. KVM switch and FPD units do not consume as much power as ProLiant DL360.

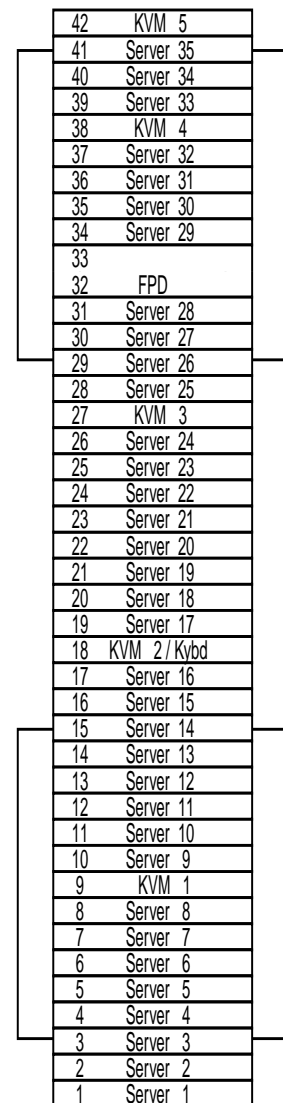
### 3.9 Configuration-I: 35 Servers, Stand-Alone Rack, Low Voltage

This configuration is a recommended practice for a low voltage facility with server management via local console, where a 42U rack has to “stand-alone,” that is, all the necessary local console management devices are to be populated in the same rack. The network cables are routed to the network switches located off-rack. An example application for this configuration may be for co-location facilities.

Up to 35 ProLiant DL360 servers can be installed in this configuration. Note that although the Compaq in-rack keyboard (with trackball) takes up 1U space, a Server Console Switch can be installed at the back of the keyboard. The Compaq in-rack flat panel display (FPD) unit takes up 2U space when it is fully retracted inside the rack.

If the network switches are also need to be installed in the same rack, then 2U spaces will be required, that is, only 33 ProLiant DL360 servers can be installed.

Configuration-I Summary	
<b><u>Rack Contents</u></b>	
<b>Units</b>	
35 servers with all fixed or all sliding rails with cable trays	
5 KVMs, 1 FPD, 1 Keyboard, 1 Keyboard tray	
4 Low Voltage 24A PDUs vertically mounted in the side panel compartments	
<b>Internal Cables</b>	
41 power cords going to 4 PDUs in the side panels [These cables are supplied with the devices or servers.]	
<b>40 KVM cables:</b> [See Figure 4-22 for the cabling diagram]	
35 from each server to a corresponding Server Console Switch in the rack	
4 from four Server Console Switches (KVM 1-4) to the top-level Server Console Switch (KVM 5) to cascade the KVM switches.	
1 from the top-level Server Console Switch to the FPD and the keyboard/trackball	
<b><u>Cables External to Rack</u></b>	
35 (data) network cables from on-board RJ45 to external switches, assuming use of only one LAN connection per server.	
4 input power cords from the rack to external power outlets	
<b><u>Site Utility Requirements (worst-case)</u></b>	
<b>Power:</b> 4 dedicated 100V-120V 30A branch circuits.	
<b>Thermal:</b> up to 35,000 BTU [This number is a worst-case. The actual BTUs/hour will depend on the OS/application software running and the server hardware configurations.]	
<b>Weight:</b> up to 1,579 lb (with sliding-rails) [The network cables are not accounted for since most implementation routes these cables to the ceiling-hung cable rails outside of the rack.]	



Configuration-I Parts List			
Description	Compaq P/N	Qty.	Notes
Sliding rails and cable management solution option	174575-B21	35	Optional for in-rack servicing
Server Console Switch option	400337-001	5	1x8 Port KVM
Internal Keyboard with Trackball option	185152-186	1	[See Note(a)]
1U Keyboard Tray option	338056-B21	1	
TFT 5000R Rack Mount Flat Panel Monitor option	120207-001	1	
Low Voltage 24A PDU option	295363-001	4	N.A. [See Note(b)]
CPU-to-Server Console Cables option	110936-B24, or 110936-B25	39	3 ft for fixed rails 6 ft for sliding rails [These 3 ft and 6 ft cables will be available 3Q00.]
Vertical-Mount PDU Bracket Kit	191265-B21	1	Contains 8 PDU brackets

**Note:**

This list does not include the rack, the ProLiant DL360 servers, and the network cables.

(a) Part numbers for the regions outside N.A. are listed in Appendix B on page 83.

(b) Low Voltage PDUs are available for N.A. and Japan.

Configuration-I Installation Procedure		
Procedure		Section [page]
ProLiant DL360 Preparation		4.1 [55]
Rack Preparation		4.2 [56]
PDU Installation	Mechanical unit	4.3.2 [59]
	Power cord wiring	4.3.5.5 [66]
Rack Rails Installation		4.4 [74]
Rack Population		4.5 [75]
Cable Dressing	Power cord connections	4.6.1 [76]
	Console cable connections	4.6.2.3 [77]
	Cable management procedure	4.6.3 [79]
Completing the Installation		4.7 [81]



### 3.10 Configuration-J: 36U Rack, 36 De-rated Servers, High Voltage

This configuration is a recommended "best practice" for a high voltage facility (N.A. only) where **36 ProLiant DL360 servers are to be installed in a 36U rack.**

There are 36 servers and 2 PDUs. Therefore, each PDU will need to support 18 servers. A 24A High Voltage PDU supporting 18 servers can allocate each server with maximum current of  $(24/18=)$  1.34A.

Assuming 208V, the allocated maximum input power for each server will be

$$1.34A * 208V = 279W$$

The maximum thermal dissipation per server will be

$$279W * 3.41 = 952 \text{ BTUs/hour}$$

For 36 servers, the total thermal dissipation will be  $(952*36=)$  34,272 BTUs/hour.

In Section 2.2, a fully configured system was measured to consume lower than 200W (Table 2-3, Server Configuration-5). Hence, if each de-rated server configuration input power is lower than 279W then 36 servers can be supported via this configuration summary.

Remote console management via Remote Insight Lights-Out Edition is recommended when deploying a large number of servers, such as this configuration. The network cables are routed to the network switches located off-rack. This configuration still allows the use of a "walk-up" local console, where a person can walk up to the rear of the rack and plug in a set of KVM cables to a particular server.

Configuration-J Summary	
<b><u>Rack Contents</u></b>	
<b>Units</b>	
36 servers with all fixed or all sliding rails with cable trays	
2 High Voltage 24A PDUs vertically mounted in the side panel compartments	
<b>Internal Cables</b>	
18 Y-power cords going to 2 PDUs in the side panels	
<b><u>Cables External to Rack</u></b>	
36 (management) network cables from the optional Remote Insight Lights-Out Edition RJ-45 connector to external switches	
36 (data) network cables from on-board RJ-45 to external switches, assuming use of only one LAN connection per server.	
2 input power cords from the rack to external power outlets	
<b><u>Site Utility Requirements (worst-case)</u></b>	
<b>Power:</b> 2 dedicated 200V-240V 30A branch circuits.	
<b>Thermal:</b> up to 34,270 BTU [This number is a worst-case. The actual BTUs/hour will depend on the OS/application software running and the server hardware configurations].	
<b>Weight:</b> up to 1,406 lb (with sliding-rails) [The network cables are not accounted for since most implementations route the network cables to the ceiling-hung cable rails outside of the rack].	

36	Server 36
35	Server 35
34	Server 34
33	Server 33
32	Server 32
31	Server 31
30	Server 30
29	Server 29
28	Server 28
27	Server 27
26	Server 26
25	Server 25
24	Server 24
23	Server 23
22	Server 22
21	Server 21
20	Server 20
19	Server 19
18	Server 18
17	Server 17
16	Server 16
15	Server 15
14	Server 14
13	Server 13
12	Server 12
11	Server 11
10	Server 10
9	Server 9
8	Server 8
7	Server 7
6	Server 6
5	Server 5
4	Server 4
3	Server 3
2	Server 2
1	Server 1

<b>Configuration-J Parts List</b>			
<b>Description</b>	<b>Compaq P/N</b>	<b>Qty.</b>	<b>Notes</b>
Sliding rails and cable management solution option	174575-B21	36	Optional for in-rack servicing
Remote Insight Lights-Out Edition option	157866-001	36	N.A. [See Note(a)]
High Voltage 24A PDU option	295363-003	2	N.A. [See Note(b)]
Vertical-Mount PDU Bracket Kit with High Voltage Cables	166097-B21	2	Contains 4 PDU brackets and 11 Y-power cords

**Note:**

This list does not include the rack, the ProLiant DL360 servers, and the network cables.

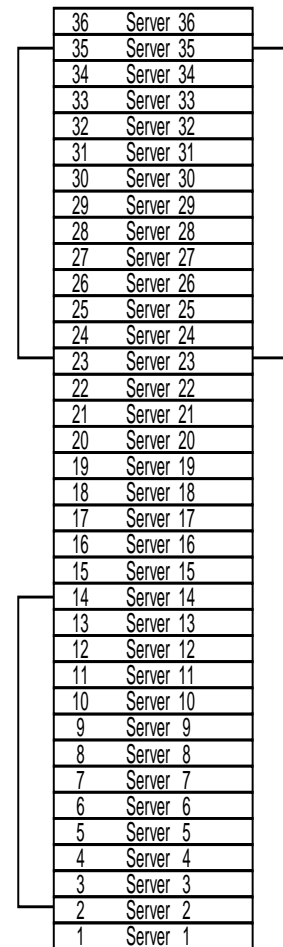
- (a) Part numbers for the regions outside N.A. are listed in Appendix B on page 83.
- (b) At this time, only one model of the high current (24A) High Voltage PDU is available. This configuration can be used in regions where NEMA electrical standards are followed. See Section 2.3.1 for more details on the high current High Voltage PDU.

<b>Configuration-J Installation Procedure</b>		
<b>Procedure</b>		<b>Section [page]</b>
ProLiant DL360 Preparation		4.1 [55]
Rack Preparation		4.2 [56]
PDU Installation	Mechanical unit	4.3.2 [59]
	Power cord wiring	4.3.5.8 [69]
Rack Rails Installation		4.4 [74]
Rack Population		4.5 [75]
Cable Dressing	Power cord connections	4.6.1 [76]
	Console cable connections	4.6.2.1 [76]
	Cable management procedure	4.6.3 [79]
Completing the Installation		4.7 [81]

### 3.11 Configuration-K: 36U Rack, 36 Servers, 24A High Voltage PDU

This configuration shows a Compaq 36U rack where 36 servers in a high voltage facility. Remote console management via the optional Remote Insight Lights-Out Edition is recommended. The network cables are routed to the network switches located off-rack.

Configuration-K Summary
<p><b><u>Rack Contents</u></b></p> <p><b>Units</b>                      36 servers with all fixed or all sliding rails with cable trays                      3 High Voltage 24A PDUs vertically mounted in the side panel compartments</p> <p><b>Internal Cables</b>                      18 Y-power cords going to 3 PDUs in the side panels</p>
<p><b><u>Cables External to Rack</u></b></p> <p>36 (management) network cables from the optional Remote Insight Lights-Out Edition RJ-45 connector to external switches</p> <p>36 (data) network cables from on-board RJ-45 to external switches, assuming use of only one LAN connection per server.</p> <p>3 input power cords from the rack to external power outlets</p>
<p><b><u>Site Utility Requirements (worst-case)</u></b></p> <p><b>Power:</b> 3 dedicated 200V-240V 30A branch circuits.</p> <p><b>Thermal:</b> up to 35,850 BTU [This number is a worst-case. The actual BTUs/hour will depend on the OS/application software running and the server hardware configurations].</p> <p><b>Weight:</b> up to 1,418 lb (with sliding-rails) [The network cables are not accounted for since most implementations route the network cables to the ceiling-hung cable rails outside of the rack].</p>



<b>Configuration-K Parts List</b>			
<b>Description</b>	<b>Compaq P/N</b>	<b>Qty.</b>	<b>Notes</b>
Sliding rails and cable management solution option	174575-B21	36	Optional for in-rack servicing
Remote Insight Lights-Out Edition option	157866-001	36	N.A. [See Note(a)]
High Voltage 24A PDU option	295363-003	3	N.A. [See Note(b)]
Vertical-Mount PDU Bracket Kit with High Voltage Cables	166097-B21	2	Contains 4 PDU brackets and 11 Y-power cords

**Note:**

This list does not include the rack, the ProLiant DL360 servers, and the network cables.

- (a) Part numbers for the regions outside N.A. are listed in Appendix B on page 83.
- (b) At this time, only one model of the high current (24A) High Voltage PDU is available. This configuration can be used in regions where NEMA electrical standards are followed. See Section 2.3.1 for more details on the high current High Voltage PDU.

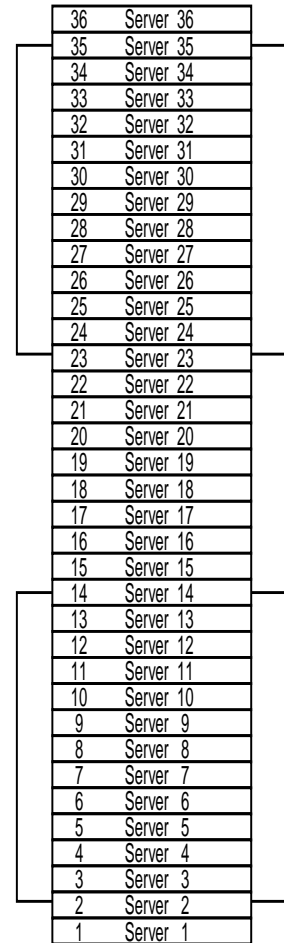
<b>Configuration-K Installation Procedure</b>		
<b>Procedure</b>		<b>Section [page]</b>
ProLiant DL360 Preparation		4.1 [55]
Rack Preparation		4.2 [56]
PDU Installation	Mechanical unit	4.3.2 [59]
	Power cord wiring	4.3.5.9 [70]
Rack Rails Installation		4.4 [74]
Rack Population		4.5 [75]
Cable Dressing	Power cord connections	4.6.1 [76]
	Console cable connections	4.6.2.1 [76]
	Cable management procedure	4.6.3 [79]
Completing the Installation		4.7 [81]



### 3.12 Configuration-L: 36U Rack, 36 Servers, Low Voltage

This configuration shows a Compaq 36U rack with 36 servers in a low voltage facility. Remote console management via the optional Remote Insight Lights-Out Edition is recommended for this configuration. The network cables are routed to the network switches located off-rack.

Configuration-L Summary	
<b><u>Rack Contents</u></b>	
<b>Units</b>	
36 servers with all fixed or all sliding rails with cable trays	
4 Low Voltage 24A PDUs vertically mounted in the side panel compartments	
<b>Internal Cables</b>	
36 power cords going to 4 PDUs in the side panels [These cables are supplied with the servers.]	
<b><u>Cables External to Rack</u></b>	
36 (management) network cables from the optional Remote Insight Lights-Out Edition RJ-45 connector to external switches	
36 (data) network cables from on-board RJ-45 to external switches, assuming use of only one LAN connection per server.	
4 input power cords from the rack to external power outlets	
<b><u>Site Utility Requirements (worst-case)</u></b>	
<b>Power:</b> 4 dedicated 100V-120V 30A branch circuits.	
<b>Thermal:</b> up to 35,850 BTU [This number is a worst-case. The actual BTUs/hour will depend on the OS/application software running and the server hardware configurations].	
<b>Weight:</b> up to 1,430 lb (with sliding-rails) [The network cables are not accounted for since most implementations route the network cables to the ceiling-hung cable rails outside of the rack].	



<b>Configuration-L Parts List</b>			
<b>Description</b>	<b>Compaq P/N</b>	<b>Qty.</b>	<b>Notes</b>
Sliding rails and cable management solution option	174575-B21	36	Optional for in-rack servicing
Remote Insight Lights-Out Edition option	157866-001	36	N.A. [See Note(a)]
Low Voltage 24A PDU option	295363-001	4	N.A. [See Note(a) & (b)]
Vertical-Mount PDU Bracket Kit	191265-B21	1	Contains 8 PDU brackets

**Note:**

This list does not include the rack, the ProLiant DL360 servers, and the network cables.

- (a) Part numbers for the regions outside N.A. are listed in Appendix B on page 83.
- (b) The Low Voltage PDUs are available for N.A. and Japan.

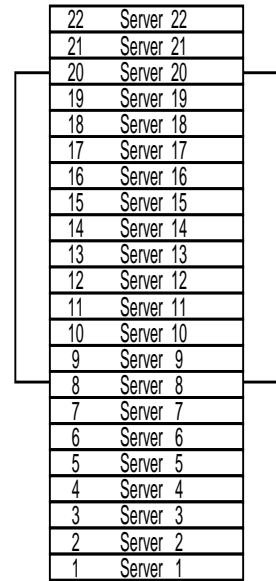
<b>Configuration-L Installation Procedure</b>		
<b>Procedure</b>		<b>Section [page]</b>
ProLiant DL360 Preparation		4.1 [55]
Rack Preparation		4.2 [56]
PDU Installation	Mechanical unit	4.3.2 [59]
	Power cord wiring	4.3.5.10 [71]
Rack Rails Installation		4.4 [74]
Rack Population		4.5 [75]
Cable Dressing	Power cord connections	4.6.1 [76]
	Console cable connections	4.6.2.1 [76]
	Cable management procedure	4.6.3 [79]
Completing the Installation		4.7 [81]



### 3.13 Configuration-M: 22U Rack, 22 Servers, High Voltage

This configuration shows a “best practice” for Compaq 22U racks with 22 servers in a high voltage facility. Remote console management via the optional Remote Insight Lights-Out Edition is recommended. The network cables are routed to the network switches located off-rack.

Configuration-M Summary
<p><b><u>Rack Contents</u></b></p> <p><b>Units</b>                      22 servers with all fixed or all sliding rails with cable trays                      2 High Voltage 24A PDUs vertically mounted in the side panel compartments</p> <p><b>Internal Cables</b>                      11 Y-power cords going to 2 PDUs in the side panels</p>
<p><b><u>Cables External to Rack</u></b></p> <p>22 (management) network cables from the optional Remote Insight Lights-Out Edition RJ-45 connector to external switches</p> <p>22 (data) network cables from on-board RJ-45 to external switches, assuming use of only one LAN connection per server.</p> <p>2 input power cords from the rack to external power outlets</p>
<p><b><u>Site Utility Requirements (worst-case)</u></b></p> <p><b>Power:</b> 2 dedicated 200V-240V 30A branch circuits.</p> <p><b>Thermal:</b> up to 21,900 BTU [This number is a worst-case. The actual BTUs/hour will depend on the OS/application software running and the server hardware configurations].</p> <p><b>Weight:</b> up to 940 lb (with sliding-rails) [The network cables are not accounted for since most implementations route the network cables to the ceiling-hung cable rails outside of the rack].</p>



<b>Configuration-M Parts List</b>			
<b>Description</b>	<b>Compaq P/N</b>	<b>Qty.</b>	<b>Notes</b>
Sliding rails and cable management solution option	174575-B21	22	Optional for in-rack servicing
Remote Insight Lights-Out Edition option	157866-001	22	N.A. [See Note(a)]
High Voltage 24A PDU option	295363-003	2	N.A. [See Note(b)]
Vertical-Mount PDU Bracket Kit with High Voltage Cables	166097-B21	1	Contains 4 PDU brackets and 11 Y-power cords

**Note:**

This list does not include the rack, the ProLiant DL360 servers, and the network cables.

- (a) Part numbers for the regions outside N.A. are listed in Appendix B on page 83.
- (b) At this time, only one model of the high current (24A) High Voltage PDU is available. This configuration can be used in regions where NEMA electrical standards are followed. See Section 2.3.1 for more details on the high current High Voltage PDU.

<b>Configuration-M Installation Procedure</b>		
<b>Procedure</b>		<b>Section [page]</b>
ProLiant DL360 Preparation		4.1 [55]
Rack Preparation		4.2 [56]
PDU Installation	Mechanical	4.3.2 [59]
	Power cord wiring	4.3.5.11 [72]
Rack Rails Installation		4.4 [74]
Rack Population		4.5 [75]
Cable Dressing	Power cord connections	4.6.1 [76]
	Console cable connections	4.6.2.1 [76]
	Cable management procedure	4.6.3 [79]
Completing the Installation		4.7 [81]

### 3.14 Configuration-N: 22U Rack, Low Voltage PDU

This configuration shows a maximum number of ProLiant DL360 servers in a Compaq 22U rack in a low voltage facility. If console management is done via the optional Remote Insight Lights-Out Edition then all network switches to where the network cables connect can be located in the same rack or elsewhere.

As explained in Section 2.4, a 24A Low Voltage PDU can support up to nine full-rated ProLiant DL360 servers. Therefore, with two 24A Low Voltage PDUs, 18 servers can be supported.

22 servers can be used if the servers' power budget is de-rated as follows:

The maximum current draw for each server when a 24A Low Voltage PDU is used to support 11 servers will be as follows:

$$\text{Maximum input current per server} = 24A / 11 \text{ servers} = \underline{2.19A @ 110V}$$

That means the maximum input power each server can consume will be

$$2.19A * 110V = \underline{241W}$$

The maximum thermal dissipation per server will be

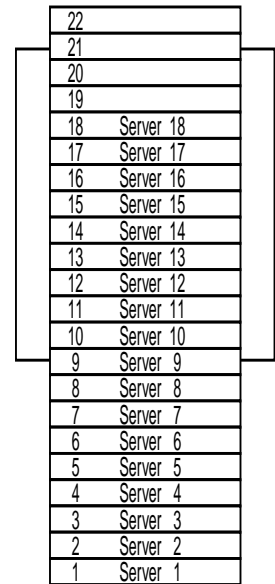
$$241W * 3.41 = 822 \text{ BTUs/hour}$$

For 22 servers, the total thermal dissipation will be (822\*22=) 18,084 BTUs/hour.

In Section 2.2, a fully configured system was measured to consume lower than 200W (Table 2-3, Server Configuration-5). Hence, if each de-rated server configuration input power is lower than 241W, then 22 servers can be supported via this configuration summary.

The configuration summary below is for the 18-server configuration.

Configuration-N Summary	
<b><u>Rack Contents</u></b>	
<b>Units</b>	
18 servers with all fixed or all sliding rails with cable trays	
2 Low Voltage 24A PDUs vertically mounted in the side panel compartments	
<b>Internal Cables</b>	
18 power cords going to 2 PDUs in the side panels [These cables are supplied with the servers.]	
<b><u>Cables External to Rack</u></b>	
18 (management) network cables from the optional Remote Insight Lights-Out Edition RJ4-5 connector to external switches	
18 (data) network cables from on-board RJ-45 to external switches, assuming use of only one LAN connection per server.	
2 input power cords from the rack to external power outlets	
<b><u>Site Utility Requirements (worst-case)</u></b>	
<b>Power:</b> 2 dedicated 100V-120V 30A branch circuits.	
<b>Thermal:</b> up to 18,000 BTU [This number is a worst-case. The actual BTUs/hour will depend on the OS/application software running and the server hardware configurations.]	
<b>Weight:</b> up to 825 lb (with sliding-rails) [The network cables are not accounted for since most implementation routes the network cables to the ceiling-hung cable rails outside of the rack.]	



<b>Configuration-N Parts List</b>			
<b>Description</b>	<b>Compaq P/N</b>	<b>Qty.</b>	<b>Notes</b>
Sliding rails and cable management solution option	174575-B21	18	Optional for in-rack servicing
Remote Insight Lights-Out Edition option	157866-001	18	N.A. [See Note(a)]
Low Voltage 24A PDU option	295363-001	2	N.A. [See Note(a) & (b)]
Vertical-Mount PDU Bracket Kit	191265-B21	1	This kit contains 8 PDU brackets. Only 4 PDU brackets will be needed

**Note:**

This list does not include the rack, the ProLiant DL360 servers, and the network cables.

(a) Part numbers for the regions outside N.A. are listed in Appendix B on page 83.

(b) The Low Voltage PDUs are available for N.A. and Japan.

<b>Configuration-N Installation Procedure</b>		
<b>Procedure</b>		<b>Section [page]</b>
ProLiant DL360 Preparation		4.1 [55]
Rack Preparation		4.2 [56]
PDU Installation	Mechanical	4.3.2 [59]
	Power cord wiring	4.3.5.12 [73]
Rack Rails Installation		4.4 [74]
Rack Population		4.5 [75]
Cable Dressing	Power cord connections	4.6.1 [76]
	Console cable connections	4.6.2.1 [76]
	Cable management procedure	4.6.3 [79]
Completing the Installation		4.7 [81]

## 4 Installation Procedures

**NOTE:** Take necessary precautions for all procedures. Refer to *Safety Guidelines* on page 5 of this white paper.

This section describes the preparation and brief installation procedures that are common to various configurations described in Section 3 in the following steps:

### 1. ProLiant DL360 Preparation

#### 2. Rack Preparation

#### 3. PDU Installation

#### 4. Rack Rails Installation

#### 5. Server Installation in a Rack

#### 6. Cable Dressing

#### 7. Completing the Installation

Execute these steps in order.

Execute these steps in order.

Compaq recommends that customers execute Steps 2 through 4 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. Compaq also recommends that customer execute Steps 5 through 7 in order. Step 1 can be done any time before Step 5.

### 4.1 ProLiant DL360 Preparation

This section briefly describes the server preparation. Refer to the *Compaq ProLiant DL360 Setup and Installation Guide* and accompanying documentation for details.

The ProLiant DL360 comes with standard fast deployment fixed rack rail kit designed for 29-inch deep square-hole racks, like the Compaq racks. If the application does not require in-rack servicing, then the factory-equipped fixed-rails may be used for installation.

The sliding rails and cable management solution option allows the server to be extended fully from the rack, temporarily locked in place for servicing, and without removing the cables from the server. It also provides better access to the rear cabling connections. The rails are designed for 29-inch deep square-hole racks, like the Compaq racks. If customers choose to use the sliding rail and cable management solution option, then replace the factory-mounted fixed server rails with the optional sliding server rails on the server. Then install the optional cable tray to the rear of the server chassis per the instructions that come with the option.

Prior to installing a ProLiant DL360 server in a rack, install all the necessary optional components inside the server, such as the Remote Insight Lights-Out Edition, additional processor, and additional DIMMs.

## 4.2 Rack Preparation

Most of the discussions in this section will focus around Compaq 42U racks. The rack selection criteria and recommendations are beyond the scope of this document. A bustle or an extension kit may be required if the installation will end up with several cables for all the ProLiant DL360 servers, for example, KVM cables described in Section 3.6 configuration.



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

- Do not attempt to move or relocate an equipment rack populated with servers. A fully populated rack can weigh as much as 1,800 pounds. The rack may become unstable and cause serious personal injury or damage to the equipment.
  - Do not install the ProLiant DL360 Servers into the rack until the rack has been located in its final location.
  - Slide rails, PDUs, power cords and cables can be pre-installed into the rack in a build-room or on the data center floor prior to moving it to the final location.
  - Prior to installing the servers, ensure that the leveling jacks are extended to the floor and that the full weight of the rack rests on the leveling jacks. The casters are not designed to support the full weight of a populated rack.
  - Prior to installing the servers, ensure that the stabilizing kit has been installed on stand-alone racks, or that multiple racks are coupled together.
- 

See additional rack warnings on page 7.

### 4.2.1. 9000-Series Rack Preparation

Compaq does not recommend rolling a 9142 or a 9136 rack on factory-mounted casters when it is fully populated with ProLiant DL360 servers. However, if this is to be done then care must be taken for the rack to be sturdy while pushing the racks on their casters. Make sure that the casters originally equipped with the 9000-series racks are changed before carrying out any high-volume deployment of ProLiant DL360 servers in a 9000-series rack. See *Customer Advisory Caster Wheels on 9000 Series Racks May Break When Moved Under Load (Document number EX991108\_CW01)* for details. The replacement casters can be acquired from Compaq free of charge.

### 4.2.2. 7000-Series Rack Preparation

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**Important:** To effectively cool the ProLiant DL360 servers installed in 7122 and 7142 racks, the front rack door must be replaced with the High Air Flow Rack Door Insert (See Table 4-1 for the part numbers).

---

Before installing a Compaq PDU using a pair of Vertical-Mount PDU Brackets, the support brackets on a 7000-series rack need to be adjusted. Adjust the center support bracket to be equally spaced between two PDUs in the rack side panels. The *Vertical-Mount PDU Brackets Option Kit* installation guide describes more detailed information on how to adjust the 7000-series rack center support bracket.

Compaq strongly recommends the use of the 7000 Extension/Bustle Kit (P/N 154392-B21) to have more space at the rear of a 7142 rack for cable bundles. Compaq does not recommend transporting a 7142 rack when it is fully populated with ProLiant DL360 servers.



### 4.2.3. Attaching Multiple Racks

Depending on the application, a rack may be stand-alone or connected with other racks. Coupling kits (P/N 120669-B21 for the 9000-series and P/N 165664-001 for the 7000-series) are available to connect two racks side-by-side. The middle racks do not have the side-panels installed. Only the outsides of the end racks should have the side-panels installed. **Note that a side-panel of a 7000-series rack is not installable when a PDU is mounted using the Vertical-Mount PDU brackets in that side.**

Table 4-1 lists the Baying and other kits for both 9000- and 7000-series racks.

**Table 4-1. Rack deployment parts**

9000-Series Rack Options	
<b>9000 Baying / Coupling Kit</b> The baying kit is used to join two or more racks together to create a multi-bay configuration. The baying kit supports 24-inch and 600 mm floor tile spacing. Sides of adjacent rack frames are joined together and optional side panels are then placed on the two ends of the multi-bay configuration.	120669-B21
<b>Ballast Kit</b> The ballast is designed to provide additional stability and support when used with the Stabilizer Kit. It is typically used when very heavy equipment is routinely installed, removed, or accessed within the rack. This kit must be assembled with both ballasts, one on each side. It is recommended that the ballast kit be used in conjunction with the stabilizer or baying kit.	120672-B21
<b>Stabilizer Option Kit</b> This anti-tip stabilizer provides stability and support when equipment is installed, removed, or accessed within the rack. It is recommended that customers use a stabilizer option kit with a stand-alone rack.	120673-B21
<b>9000 Extension / Bustle Kit</b> The bustle kit attaches to the rear of the 9000-series rack and provides an additional 3.9 inches of space to the depth of the rack. Customers may find this option a popular feature for providing more space for cable management or extended equipment mounted in the rack. This product easily secures to the rear of the rack with several screws. The rear door is then attached to the bustle kit, providing a completely secure rack.	120679-B21
<b>9142 Side Panels</b> Side panels for the Rack 9142 (42U). Two side panels are included in a kit.	120670-B21
<b>9136 Side Panels</b> Side panels for the Rack 9136 (36U). Two side panels are included in a kit. [Note: 9122 (22U) rack comes with the side panels.]	120671-B21
7000-Series Rack Options	
<b>7000 Extension / Bustle Kit</b> The Extension Kit for the Rack 7142 is a steel collar that attaches to the front and/or rear of the rack 7142. This feature allows customers additional space in the rack for large equipment or cable management.	154392-B21
<b>Rack Side-Wall Kit (42U only) Kit</b> Side panels for the Rack 7142 (42U). Two side panels are included in a kit.	165652-001
<b>Coupling Kit</b>	165664-001
<b>Rack Stabilizing Feet (42U only) Kit</b>	189907-001
<b>High Air Flow Rack Door Insert</b> (to effectively cool the ProLiant DL360 serves)	
	for 7122
	for 7142
	for 7142 (6 pack)
	157847-B21
	327281-B21
	327281-B22

### 4.3 PDU Installation

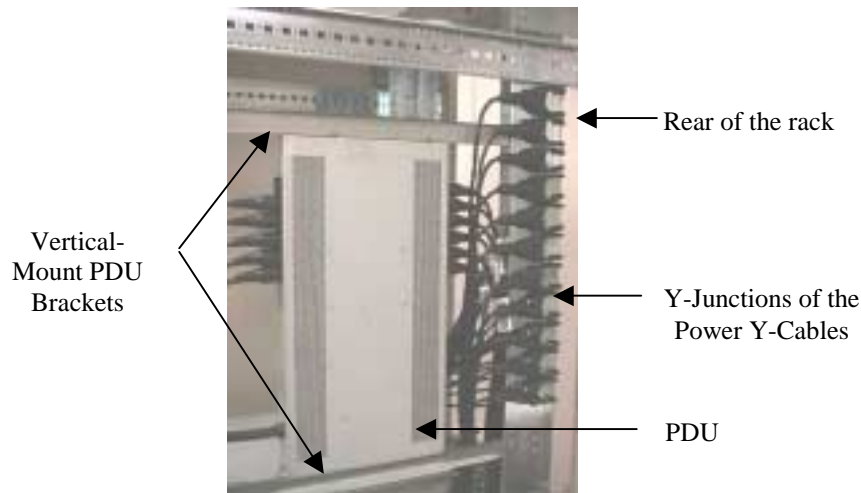
PDU installation will vary depending on the number of servers to be installed in a rack, the rack size, and the PDU type selected. This section describes installation guidelines on where to install the PDUs in a rack and how to connect the power cords to the PDUs.

The PDU voltage selection will be primarily dictated by the facility power source availability. It is highly recommended to use high voltage power lines, especially to deploy a 42U rack full of ProLiant DL360 servers since there will be fewer number of external power lines, internal cables, and PDUs. In some cases, facility low voltage infrastructure may not have enough provision (for example, high enough current breakers) to support 42 servers in a 42U rack.

#### 4.3.1. Vertically Orienting the PDUs

To support a rack-full of ProLiant DL360 servers, two to four PDUs are to be installed in the side-panel compartments of the 9000- and 7000-series racks. For the 7000-series racks, the rack frames in the side panel compartments must be adjusted to fit the PDUs in a vertical orientation. The PDUs cannot be mounted horizontally, because the ProLiant DL360 rack rails will interfere with the PDUs. Vertical-mount PDU brackets are needed to install the currently shipping Compaq PDUs in vertical orientation in these racks as shown in Figure 4-1.

**Figure 4-1. A PDU installed in the side panel compartment of a rack using the vertical-mount PDU brackets and Y-power cords.**



There are two option kits available for the Vertical-mount PDU brackets:

1. The *Vertical-Mount PDU Bracket with High Voltage Cables Kit* (P/N 166097-B21)

This kit contains 4 Vertical-mount PDU brackets, 11 Y-cables, and accessory hardware for high-volume deployment using High Voltage PDUs.

2. The *Vertical-Mount PDU Bracket Kit* (P/N 191265-B21)

This kit contains 8 Vertical-mount PDU brackets and accessory hardware for high-volume deployment. This kit is primarily meant for Low Voltage PDU installations where the power cords that come with the servers can be used.

The installation card in these kits contains detailed instructions on how to mount the Vertical-Mount PDU Brackets on a PDU and in a rack.

### 4.3.2. Installing Multiple PDUs in a Rack

The following sections describe where to mount the necessary number of PDUs in a rack.

In all the installations, route the input power cord for each PDU either towards the top or the bottom of the rack, depending on the power source outlets location.

Make sure that the rack grounding wires for all the PDUs are properly connected by following the instructions came with the PDUs. Grounding accessories are described in Section 1.2 (Glossary).

Section 3 shows several rack configurations including the PDU locations. Note that these PDU locations will vary depending on whether the sliding-rails or the fixed-rails are used.

#### 4.3.2.1. Mounting 2 PDUs on One-Side

This installation applies to 36U and 42U Compaq 9000- and 7000-series racks. When mounting one or two PDUs, mount the PDUs on the side where the cables exit the cable trays. This will allow the power cords to be routed easily to the cable trays. If fixed-rails are used for the servers, then mount the PDUs on the left side, viewing from the front. If sliding-rails are used, then mount the PDUs on the right side, viewing from the front.

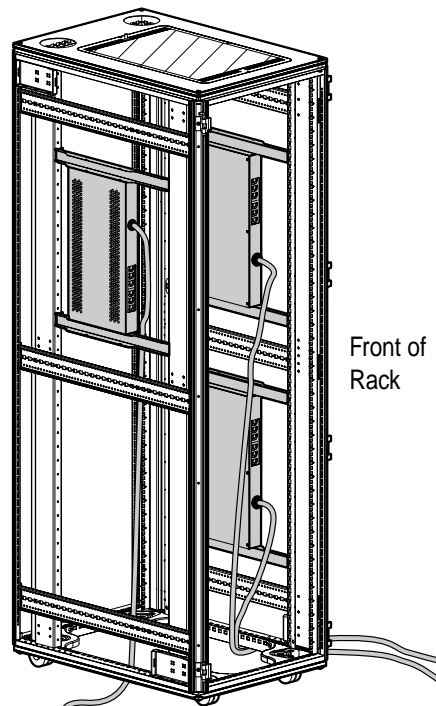
#### 4.3.2.2. Mounting 1 PDU on Each Side

This procedure is primarily for 22U racks. It is not recommended to mount the PDU in these positions for 36U or 42U racks.

#### 4.3.2.3. Mounting 3 PDUs

This installation applies to 36U and 42U Compaq 9000- and 7000-series racks. When mounting three PDUs, mount two PDUs on the side where the cable trays are closest to the rear frame of the rack, and mount the third PDU in the upper half of the other side. This will allow the power cords to be routed relatively easily. If fixed-rails are used, then mount the two PDUs on the left side, viewing from the front. If sliding-rails are used, then mount the two PDUs on the right side, viewing from the front, as shown in Figure 4-2.

Figure 4-2. Three PDUs installed in a 42U rack.



#### 4.3.2.4. Mounting 4 PDUs

A 36U or a 42U rack can accept up to four Compaq PDUs – one in each half side-panel compartment. There are no special location considerations when mounting four PDUs.

### 4.3.3. PDU Cord Set Choices

This section explains the Compaq high voltage and low voltage power cord choices.

#### 4.3.3.1. High Voltage Power Cords

The Power Y-Cables shipped with the *Vertical-Mount PDU Bracket Kit with High Voltage Cables* are 10 ft long cable, where the “single” side is 6 ft long and the “double” side is 4 ft long as shown in Figure 4-3. These Y-cables are optimized to work with both fixed-rails and sliding-rails installation, and they are designed to work with Compaq High Voltage PDUs.

Figure 4-3. Power Y-cable and the connector types in P/N 166097-B21.

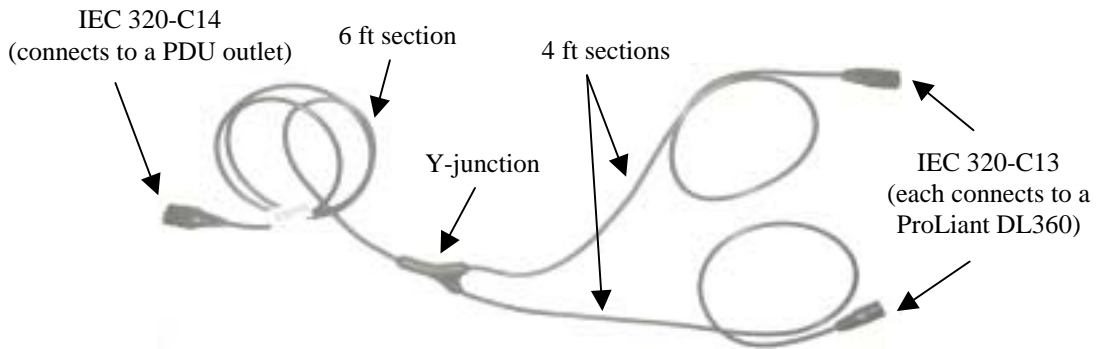


Table 4-2. High Voltage power cord choices.

Description	Compaq P/N	Note
Vertical-Mount PDU Bracket with High Voltage Cables Kit	166097-B21	There are 4 PDU brackets and 11 Y-cables in this kit. Each cable is 10 ft long and has 6 ft section on the single-side and 4 ft sections on the dual-side.
10A 7ft Y-Cable	Available 3Q00	There are 6 Y-cables in this package. Each cable is 7 ft long and has 4 ft section on the single-side and 3 ft sections on the dual-side.
10A IEC-to-IEC jumper cables kit	6 ft 142257-001 8 ft 142257-002 12 ft 142257-003	If a longer cable is needed for the high voltage Y-power cords, then the IEC-to-IEC jumper cables can be used to extend their length.

### 4.3.3.2. Low Voltage Power Cords

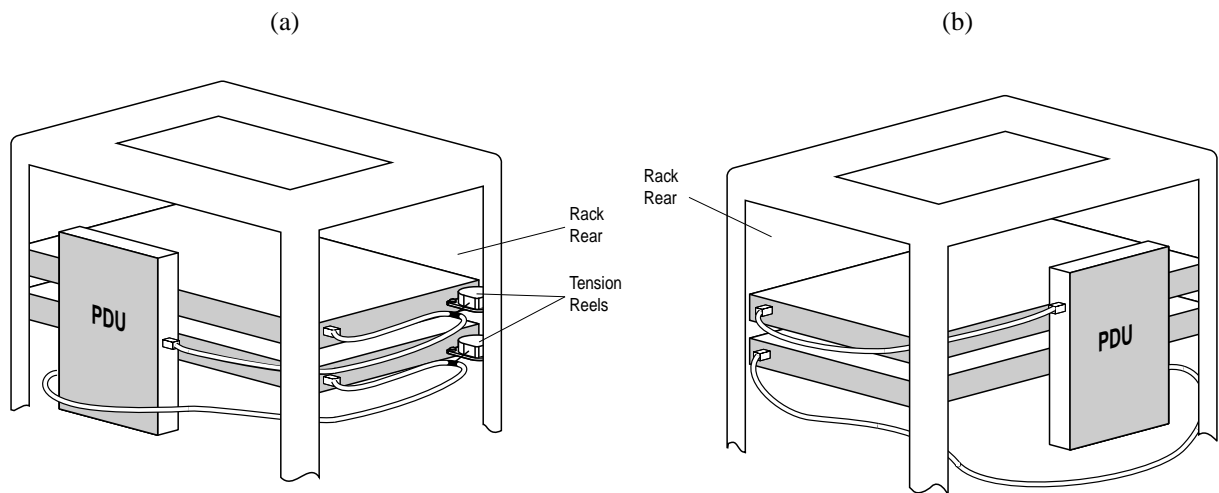
When a PDU is mounted vertically in the side compartment of a 36U or a 42U Compaq rack, the optimum power cord length requirement will vary depending on the rail choice. A general guideline is that the sliding rail option will require about 3 ft longer cables. An additional 3 ft of cable slack is needed for the sliding rails for a server to be pulled out without disconnecting the cables.

Each ProLiant DL360 is shipped with a 12 ft long (single) low voltage power cord. The optimum low voltage power cord lengths are about 3 ft to 5 ft for fixed rails, and 6 ft to 8 ft for sliding rails, when deploying the servers in Compaq racks with the PDUs installed with vertical-mount brackets. Customers can use the 12 ft cables and fold them in the rack side panel compartments, or acquire shorter length cables instead, for either fixed or sliding rails installations.

### 4.3.4. Power Cord Routing

Route the power cords as shown in Figure 4-4(a) and (b) for sliding and fixed rails, respectively. The rack rails are not shown in the figure for simplicity. The cables shown are single cables.

**Figure 4-4. (a) Sliding rail cabling for low voltage cables. (b) Fixed rail cabling for low voltage cables.**

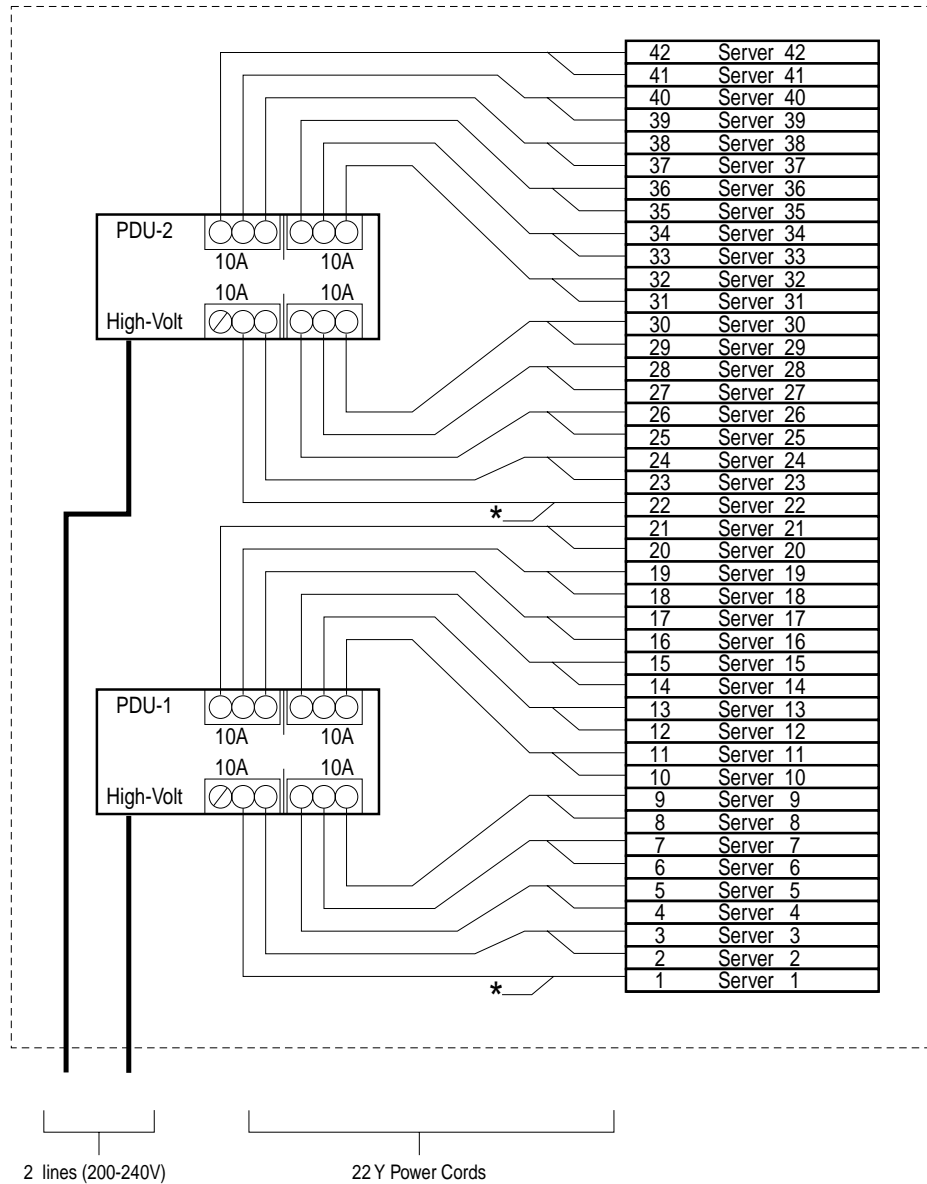


The routing will be similar for the Y-power cords, except tying the Y-junctions on the vertical frame so that the power cords on the dual-side will be presented towards the rear of the rack, as shown in Figure 4-1. By doing so, it will be easier to locate the power cords in vertical order. It is recommended to label the power cords to minimize confusion after the servers are installed in the rack, and the power cords are to be connected to them.

### 4.3.5. PDU Cabling Diagrams

Sections 4.3.5.1 through 4.3.5.12 show how the power cords are connected between the PDUs and the servers or other devices, for example, KVM switch box. The illustrations in these sections are shown primarily for the electrical connections, and they do not have full mechanical relevance. For example, the PDUs seem to be in horizontal orientation. This is not to be confused with the physical orientation of the PDUs in the rack. See Section 4.3.1 and 4.3.2 on how and where to mount the PDUs properly in the racks, respectively.

**4.3.5.1. High Voltage 2-PDU Cabling Diagram (42U Rack)**

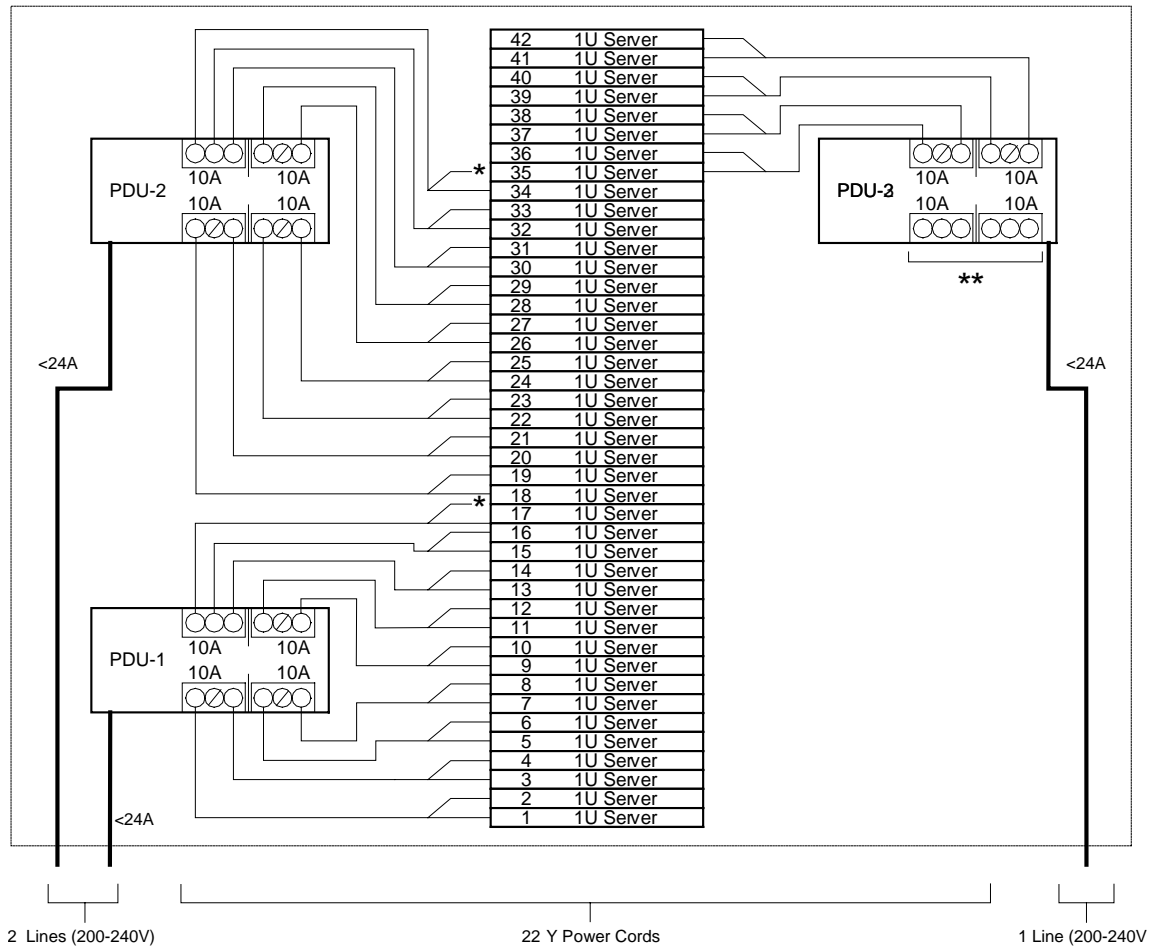


**Figure 4-5. 42U rack high voltage diagram for 2 PDUs**

**Notes**

- See Section 4.3.3 for power cord information and power cord routing choices.
- The high voltage PDUs shown in this figure are 24A rated.
- Two Vertical-Mount PDU Bracket Kits with High Voltage Cables are required for this installation. All 22 cables will be used.
- \*There are 11 Y-cables connected to each PDU to support 21 servers in the above figure. Ten of the Y-cables are connected to 20 servers. The 11<sup>th</sup> Y-cable connects only to 1 server.
- **No power cords should be connected to all the unused outlets marked with the symbol Ø in the above figure.**

**4.3.5.2. High Voltage 3-PDU Cabling Diagram (42U Rack)**



**Figure 4-6. 42U rack cabling diagram for 3 PDUs.**

**Notes**

- See Section 4.3.3 for power cord information and power cord routing choices.
- The high voltage PDUs shown in this figure are 24A rated.
- Two Vertical-Mount PDU Bracket Kits with High Voltage Cables are required for this installation. All 22 cables will be used.
- There are Y-cables connected to each PDU to support 17 servers in the above figure. Eight of the Y-cables are connected to 16 servers. The 9<sup>th</sup> Y-cable connects only to 1 server. The Y-cable end that is not connected is shown with an \*.
- For PDU-1 and PDU-2, there are 3 remaining power outlets, but the PDU rated current capacity has been allocated for the servers. **No power cords should be connected to all the unused outlets marked with the symbol Ø in the above figure.**
- For PDU-3, there are 8 power outlets still open. Only 11.2A of current capacity has been allocated for the servers. If the remaining outlets (marked with \*\*) are used, then the total current draw from these should not exceed 12.8A for the 24A PDU.

### 4.3.5.3. High Voltage 3-PDU Cabling Diagram for In-Rack Local Console (42U Rack)

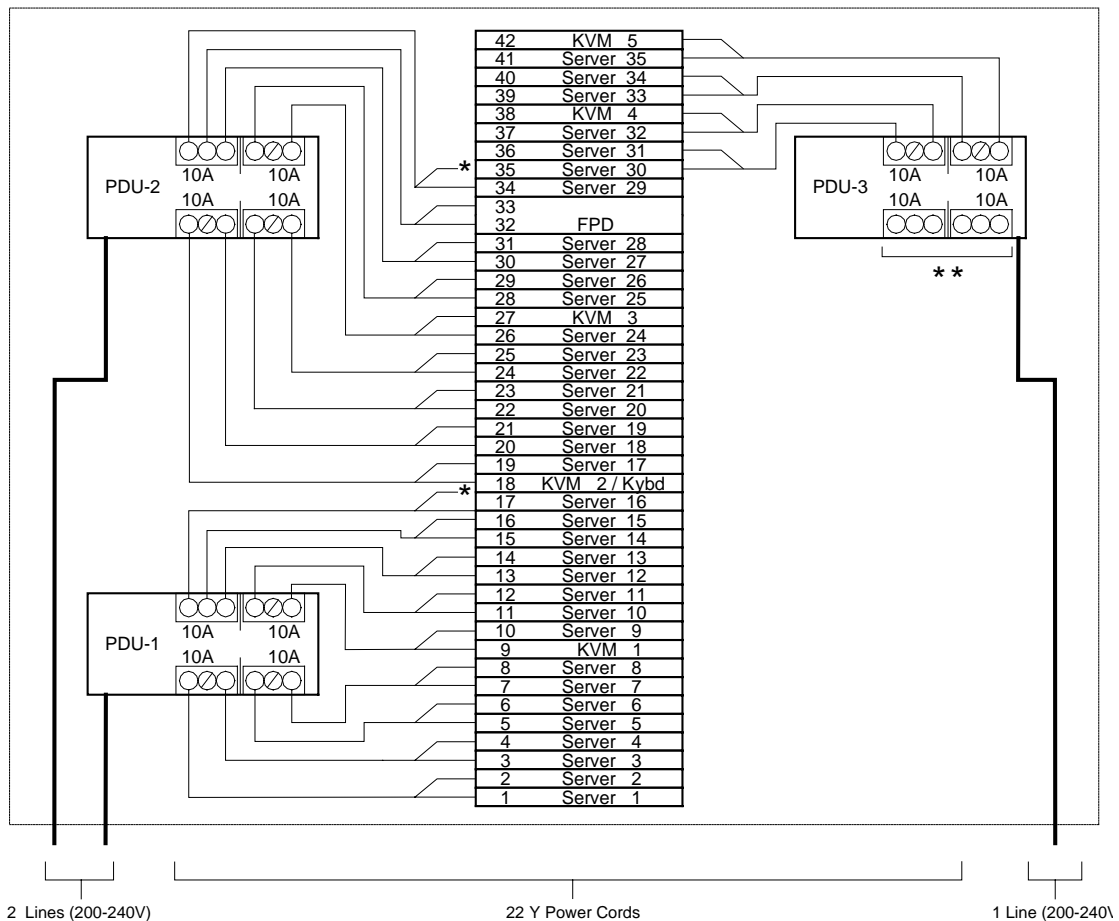


Figure 4-7. 42U rack cabling diagram for 3 PDU in-rack local console.

#### Notes

- Only up to 35 ProLiant DL360 servers are supported in this configuration.
- See Section 4.3.3 for power cord information and power cord routing choices.
- The High Voltage PDUs shown in this figure are 24A rated. At 208V input voltage for each ProLiant DL360 server the input current for each server is not more than 1.41A. Therefore, up to 17 servers can be supported per PDU. With 3 PDUs and Y-power cords, up to 42 servers can be supported in this configuration. However, if a rack is to be populated with Server Console Switches, a keyboard and a flat panel display for the rack to be "stand-alone," then only 35 1U spaces will be left for the servers.
- Two Vertical-Mount PDU Bracket Kits with High Voltage Cables are required for this installation. All 22 cables will be used.
- No power cords should be connected to all the unused outlets marked with the symbol  $\emptyset$  in the above figure.
- There are Y-cables connected to each PDU to support 17 servers in the above figure. Eight of the Y-cables are connected to 16 servers. The 9<sup>th</sup> Y-cable connects only to 1 server. The Y-cable end that is not connected is shown with an \*.
- The unused power outlets on PDU-3 (marked with \*\*) can be used as long as the total current drawn from these outlets do not exceed 12.7A at 208V.



#### 4.3.5.4. High Voltage 4-PDU Cabling Diagram (42U Rack)

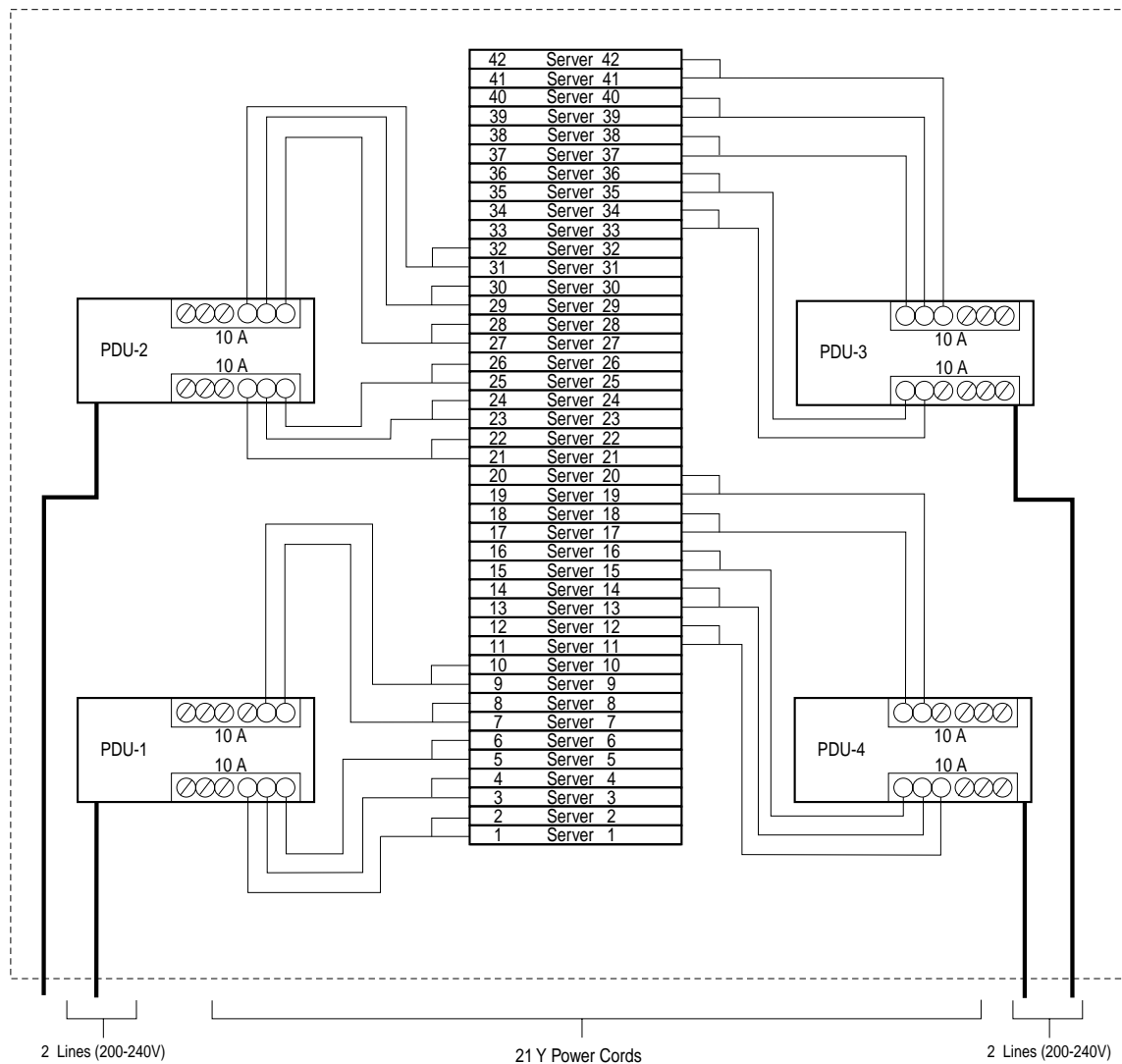


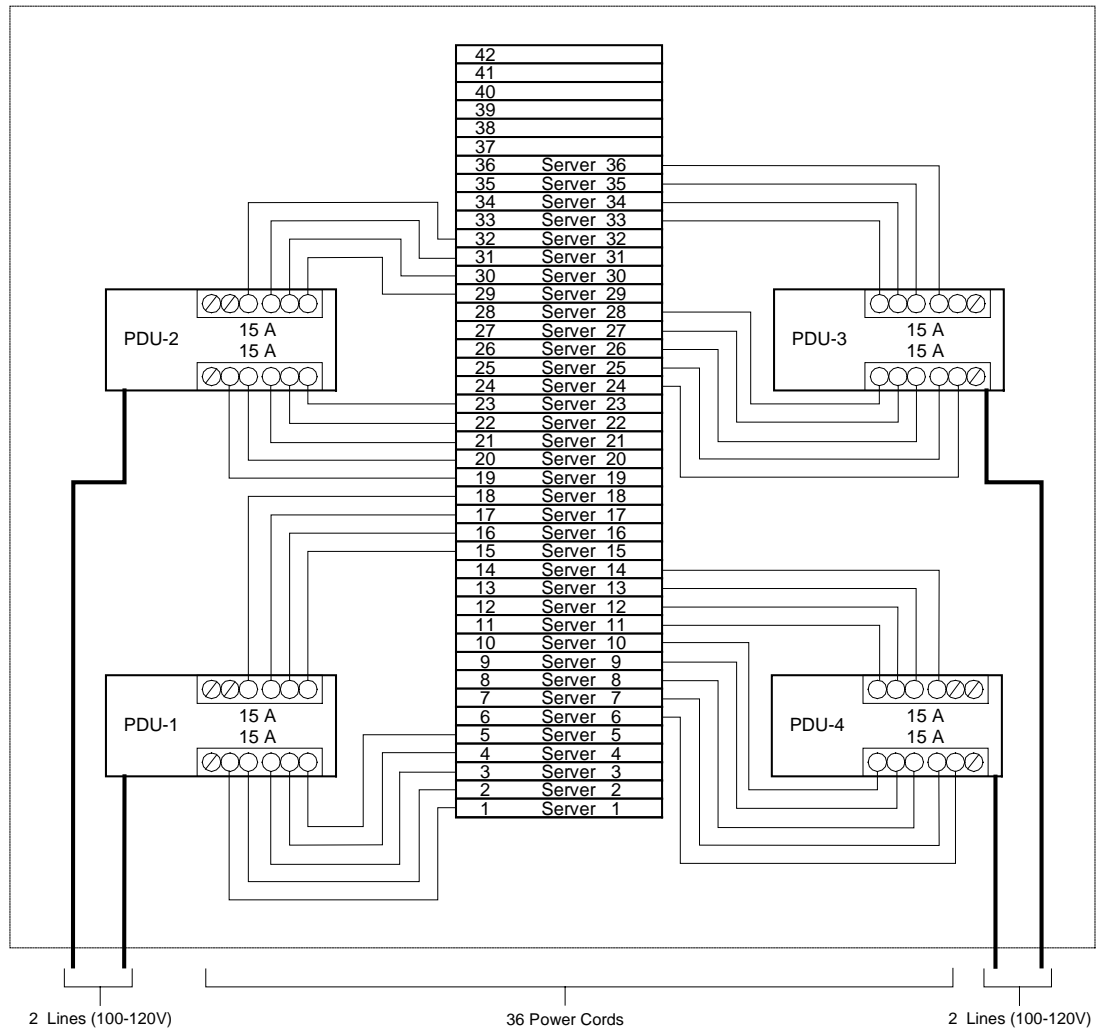
Figure 4-8. 42U rack cabling diagram for 4 PDUs

**Notes**

- See Section 4.3.3 for power cord information and power cord routing choices.
- The high voltage PDUs shown in this figure are 16A rated.
- Two Vertical-Mount PDU Bracket Kits with High Voltage Cables are required for this installation. Only 21 out of 22 cables will be used.
- For PDU-1, -3 and -4, there are 5 Y-cables to support 10 servers on each PDU.
- For PDU-2, there are 6 Y-cables to support 12 servers.
- For each PDU, there are 6 or 7 remaining power outlets, but the PDU rated current capacity has been allocated for the servers. **No power cords should be connected to all the unused outlets marked with the symbol Ø in the above figure.**



**4.3.5.6. Low Voltage 4-PDU Cabling Diagram for Remote Console (36 servers in a 42U Rack)**



**Figure 4-10. 42U rack cabling diagram for 4 PDUs**

**Notes**

- See Section 4.3.3 for power cord information and power cord routing choices.
- The low voltage PDUs shown in this figure are 24A rated.
- One Vertical-Mount PDU Bracket Kit is required. The power cords that came with the ProLiant DL360 servers can be used in this configuration.
- Each PDU supports 9 servers using single power cords.
- **No power cords should be connected to all the unused outlets marked with the symbol Ø in the above figure.**

#### 4.3.5.7. Low Voltage 4-PDU Cabling Diagram for Remote Console (42 servers in a 42U Rack)

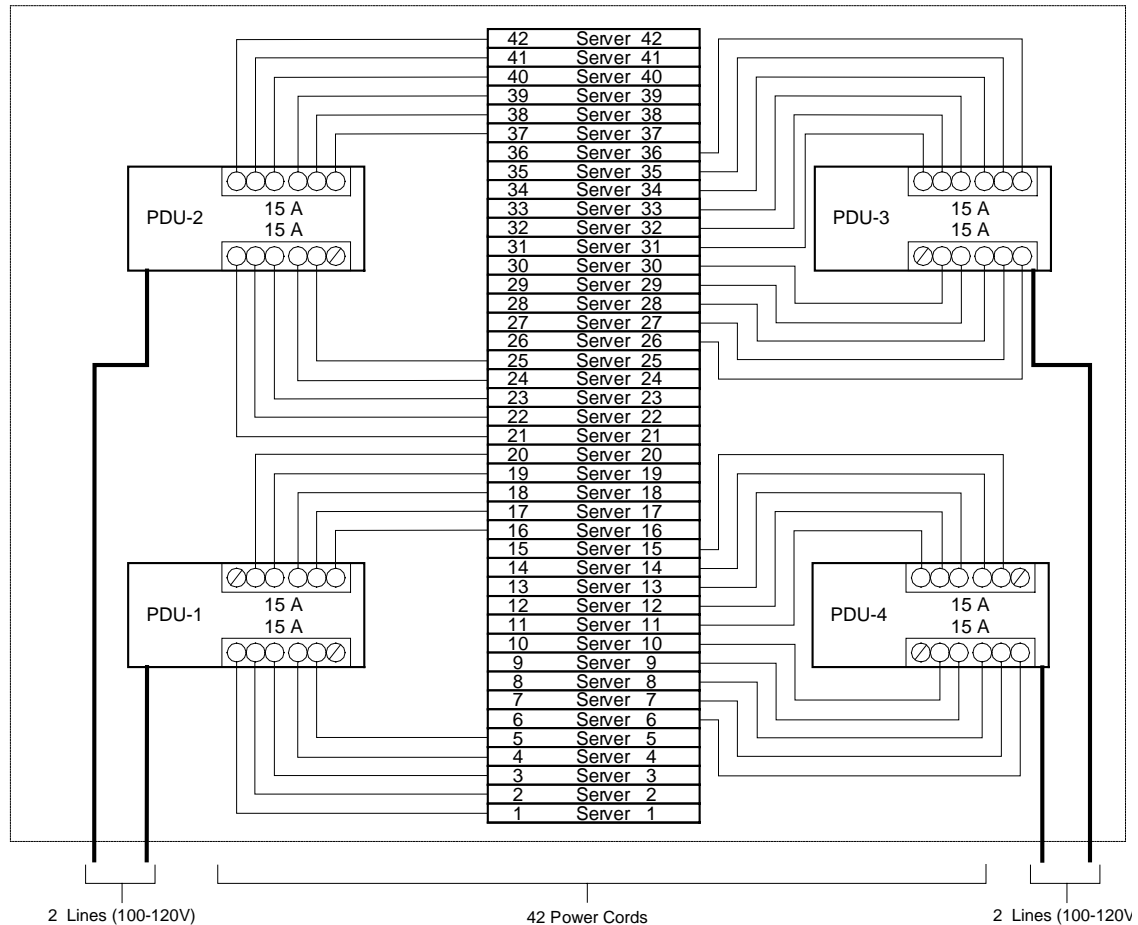
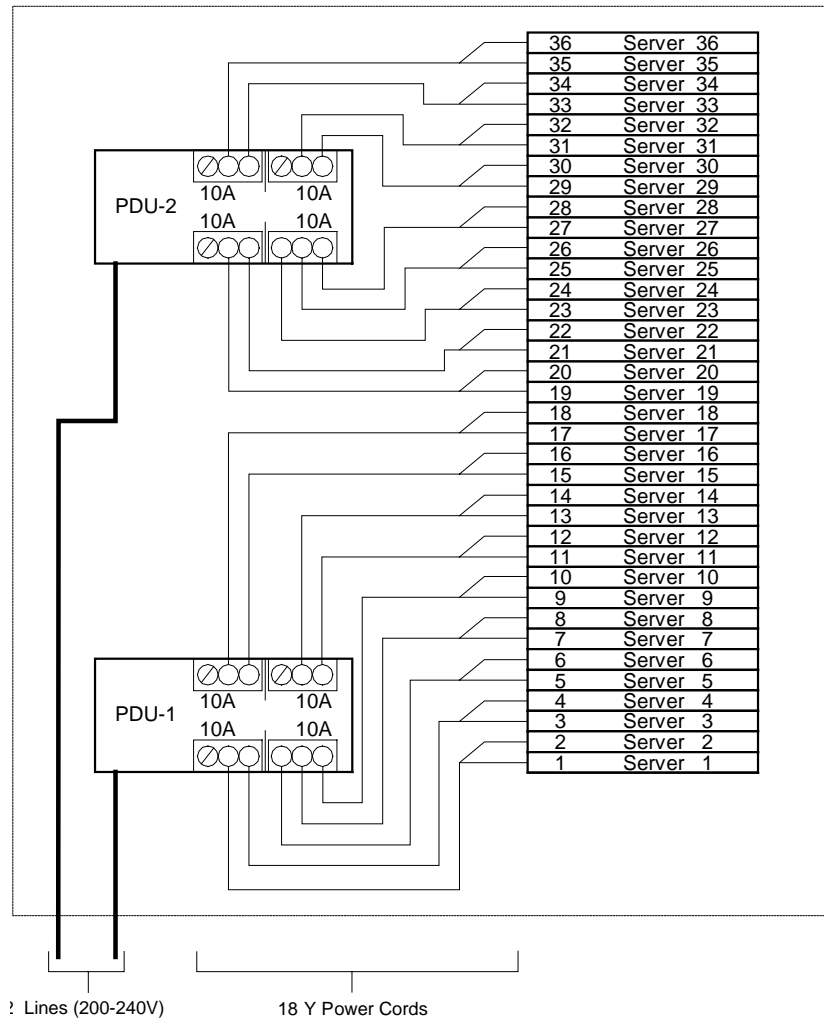


Figure 4-11. 42U rack cabling diagram for 4 PDU remote console

#### Notes

- See Section 4.3.3 for power cord information and power cord routing choices.
- This cabling is to support the ProLiant DL360 servers with de-rated power budget.
- The low voltage PDUs shown in this figure are 24A rated.
- One Vertical-Mount PDU Bracket Kit is required. The power cords that came with the ProLiant DL360 servers can be used in this configuration.
- Each PDU supports 9 servers using single power cords.
- **No power cords should be connected to all the unused outlets marked with the symbol Ø in the above figure.**

**4.3.5.8. High Voltage 2-PDU Cabling Diagram with Y-Cables (36U Rack)**



**Figure 4-12. 36U rack cabling diagram for 2 PDUs with y-cables**

**Notes**

- See Section 4.3.3 for power cord information and power cord routing choices.
- The high voltage PDUs shown in this figure are 24A rated.
- Two Vertical-Mount PDU Bracket Kits with High Voltage Cables are required for this installation. Only 18 out of 22 cables will be used.
- For PDU-1 and PDU-2, there are Y-cables connected to each PDU to support 18 servers in the above figure. Each of the 9 Y-cables is connected to 2 servers.
- **No power cords should be connected to all the unused outlets marked with the symbol Ø in the above figure.**

#### 4.3.5.9. High Voltage 3-PDU Cabling Diagram with Y-Cables (36U Rack)

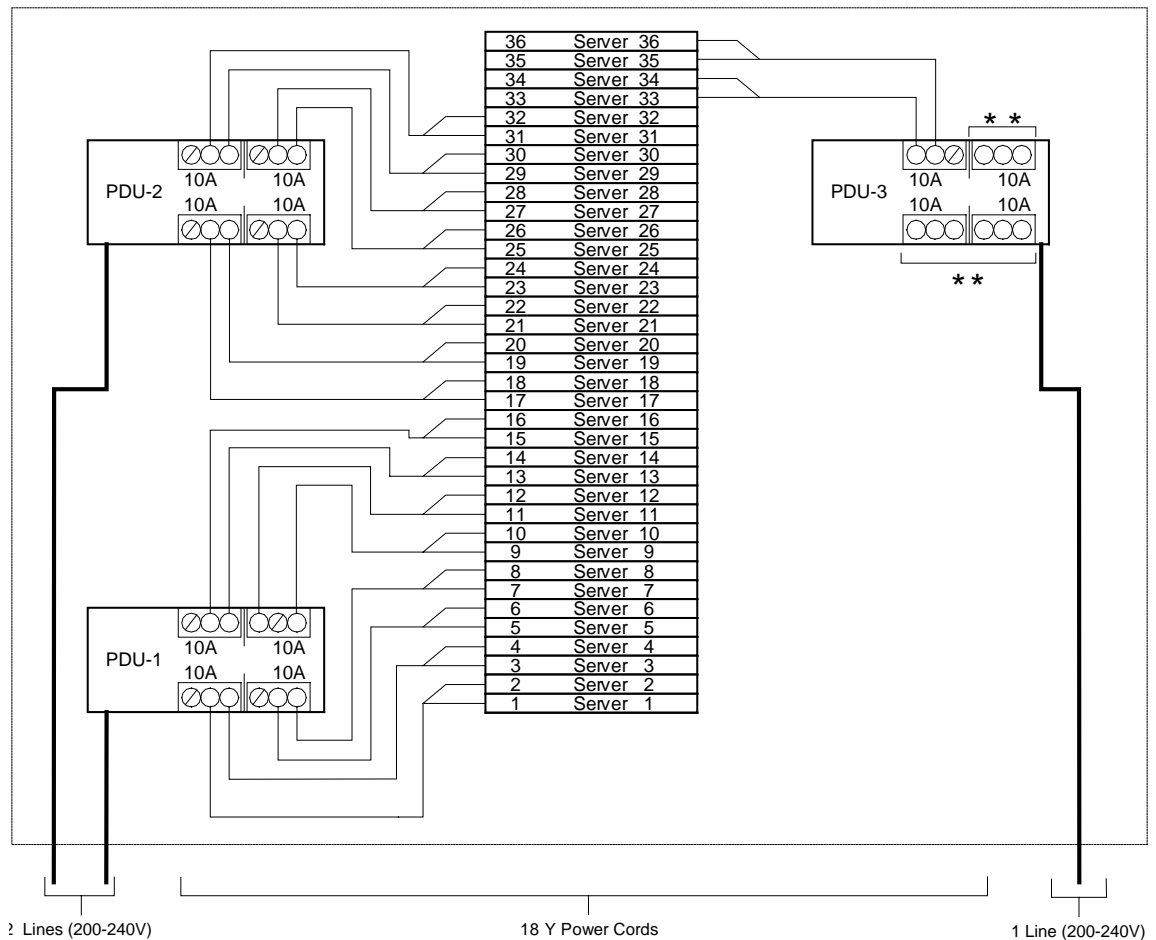
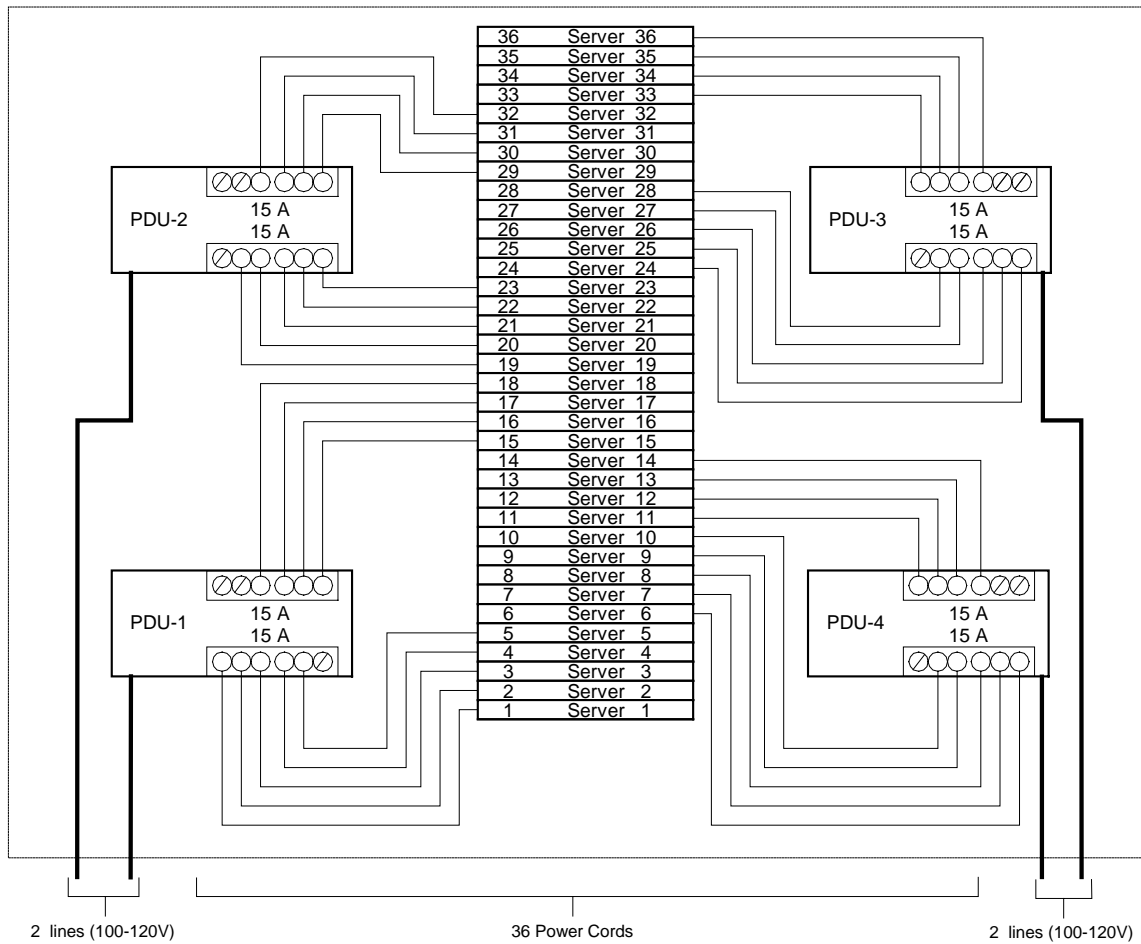


Figure 4-13. 36U rack cabling diagram for 3 PDUs with Y-cables

#### Notes

- See Section 4.3.3 for power cord information and power cord routing choices.
- The high voltage PDUs shown in this figure are 24A rated.
- Two Vertical-Mount PDU Bracket Kits with High Voltage Cables are required for this installation. Only 18 out of 22 cables will be used.
- For PDU-1 and PDU-2, there are 8 Y-cables connected to each PDU to support 16 servers in the above figure. Each of the 8 Y-cables is connected to 2 servers.
- For PDU-1 and PDU-2, there are 4 remaining power outlets, but the PDU current capacity has been allocated for the servers.
- **No power cords should be connected to all the unused outlets marked with the symbol Ø in the above figure.**
- For PDU-3, there are 9 power outlets still open (marked with \*\*). Only 11.2A of current capacity has been allocated for the servers. The total current draw from the remaining outlets by other off-rack devices must not exceed 12.8A for the 24A PDU.

**4.3.5.10. Low Voltage 4-PDU Cabling Diagram with Single Cables (36U Rack)**



**Figure 4-14. 36U rack cabling diagram for 4 PDUs with single cables**

**Notes**

- See Section 4.3.3 for power cord information and power cord routing choices.
- The low voltage PDUs shown in this figure are 24A rated.
- One Vertical-Mount PDU Bracket Kit is required. The power cords that came with the ProLiant DL360 servers can be used in this configuration.
- All the PDUs current capacity has been allocated for the servers and the other devices in the rack.
- **No power cords should be connected to all the unused outlets marked with Ø.**

#### 4.3.5.11. High Voltage 2-PDU Cabling Diagram with Y-Cables (22U Rack)

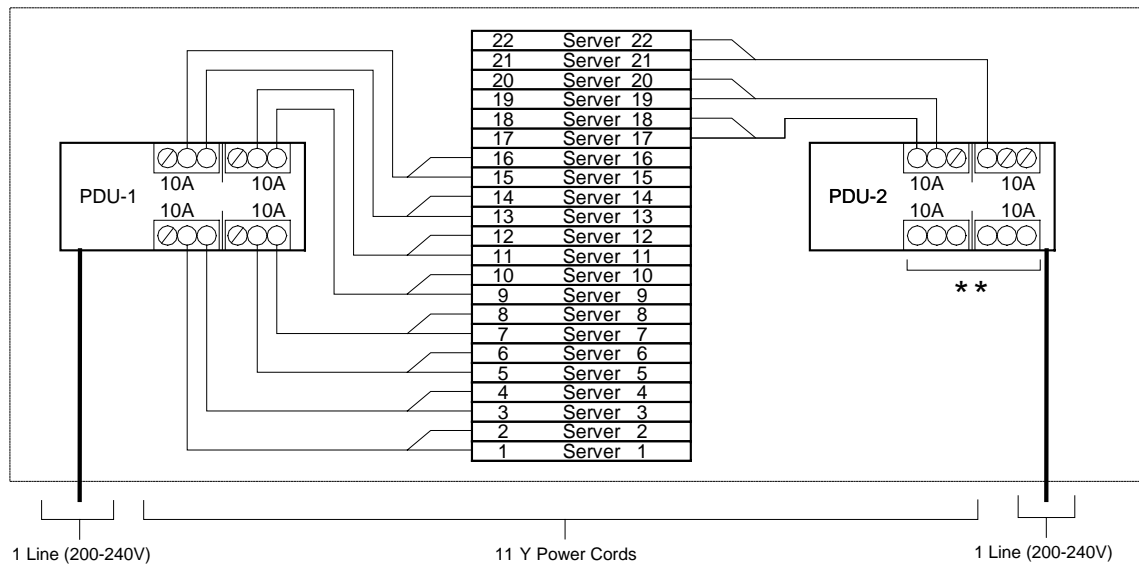


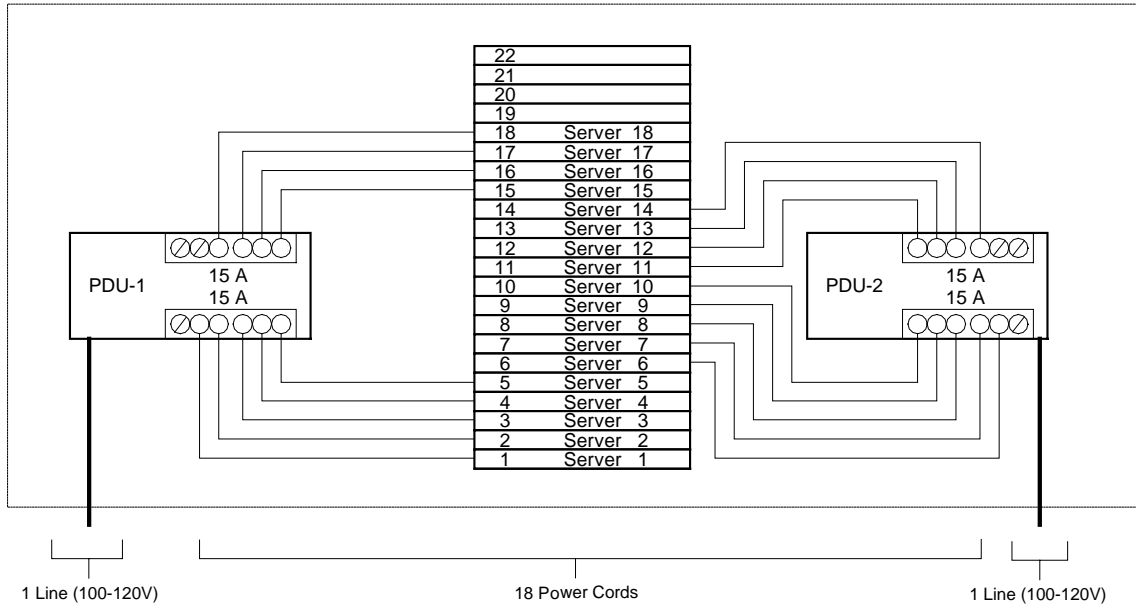
Figure 4-15. 22U rack cabling diagram for 2 PDUs with y-cables

#### Notes

- See Section 4.3.3 for power cord information and power cord routing choices.
- The high voltage PDUs shown in this figure are 24A rated.
- One Vertical-Mount PDU Bracket Kit with High Voltage Cables is required for this installation.
- For PDU-1, there are 8 Y-cables connected to the PDU to support 16 servers in the above figure. Each of the 8 Y-cables is connected to two servers.
- For PDU-2, there are 6 power outlets still open (marked with \*\*). 16.8A of current capacity has been allocated for the servers. The total current draw from the remaining outlets by other off-rack devices must not exceed 7.2A for the 24A PDU.
- **No power cords should be connected to all the unused outlets marked with Ø.**



**4.3.5.12. Low Voltage 2-PDU Cabling Diagram (18 servers in a 22U Rack)**



**Figure 4-16. 22U rack cabling diagram for 2 PDUs**

**Notes**

- See Section 4.3.3 for power cord information and power cord routing choices.
- The low voltage PDUs shown in this figure are 24A rated.
- One Vertical-Mount PDU Bracket Kit is required for this installation. The power cords that came with the ProLiant DL360 servers can be used in this configuration.
- For PDU-1, there are 9 single cables supporting 9 servers in the above figure.
- **No power cords should be connected to all the unused outlets marked with Ø.**

## 4.4 Rack Rails Installation

This section only outlines the general procedure. For detailed installation procedures for the fast deployment kit that ships with the server, refer to the *Compaq ProLiant DL360 Setup and Installation Guide*. For details on installation of the sliding rail and cable management solution option, refer to the *Sliding Rails and Cable Management Solution for ProLiant DL360 Servers Guide*.

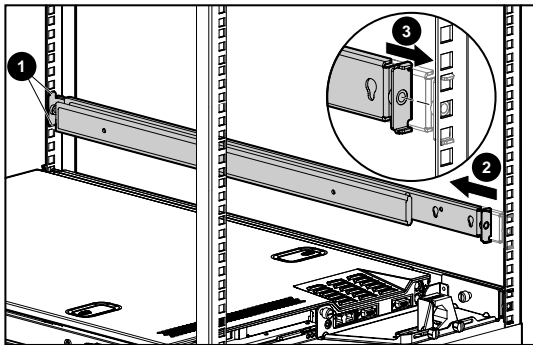
The fixed rails are shipped with the ProLiant DL360 server. It is faster and easier to install several ProLiant DL360 servers in Compaq racks using the fixed rails. If a server needs to be serviced, the cables on the server rear panel are disconnected first, and the server is moved to a bench.

The optional sliding rails are necessary if the ProLiant DL360 servers are to be serviced in-rack or while still attached to the cabling. Before installing the rack rails, route the power cords from the PDUs to the rear part of the rack, and feed them towards the top or the bottom of the rack depending on the facility power outlet locations.

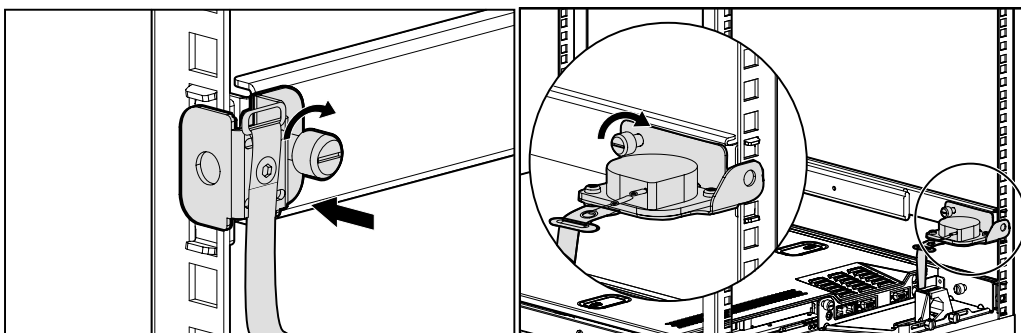
Use the rack template to properly identify the required space and location for the first server, install either the fixed rack rails or the sliding rack rails. Both types of rack rails are designed to snap in place without screws or nuts. It is recommended that the rails should be secured by screws if the rack is transported or added mechanical integrity. Note that the left- and right-side fixed rack rails are different. They need to be installed correctly in the rack to be operational. Install the rack rails to accommodate all the servers (and other devices) in the rack.

For sliding rail installation, a cable rack bracket and a cable tension reel are to be installed on each pair of sliding rack rails, as shown in Figure 4-17 and Figure 4-18.

**Figure 4-17. Spring-loaded sliding rack rails are shown here with installation steps (1) (2) & (3).**



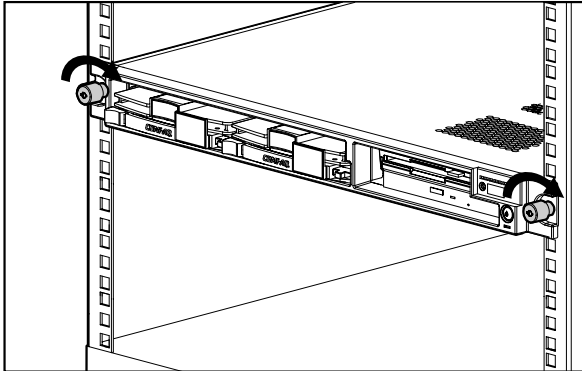
**Figure 4-18. Cable rack bracket and cable tension reel bracket for the sliding rail cable management system**



## 4.5 Server Installations in a Rack

Install the ProLiant DL360 servers and other devices in the rack, starting from the bottom of the rack. Temporarily fasten the thumbscrews on the front of each server (as shown in Figure 4-19), to prevent them from sliding forward and causing the rack to become unstable.

**Figure 4-19. Securing a server on the rack**



The following rack warning is repeated from page 7 to highlight its importance:

---

**IMPORTANT:** Because the rack allows you to stack computer components on a vertical rather than horizontal plane, you must take precautions to provide for rack stability and safety and to protect both personnel and property. Heed all cautions and warnings in the installation instructions that came with the server.

---



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

- Before beginning work on the rack, be sure that the leveling jacks are extended to the floor, that the full weight of the rack rests on the leveling jacks, and that either the stabilizer kit is installed or multiple racks are coupled together for stability.
  - Always load the heaviest item first, and load the rack from the bottom up. This 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.
  - The bottom stabilizers on the equipment must be fully installed. Be sure that the equipment is properly supported/braced when installing options and cards.
  - A rack may become unstable if more than one ProLiant DL360 servers are fully extended for any reason. Fully extend only one ProLiant DL360 server at a time.
-

## 4.6 Cable Installation

Follow the procedure detailed in the *Compaq ProLiant DL360 Setup and Installation Guide* or in the *Sliding Rails and Cable Management Solution for ProLiant DL360 Servers Guide* to properly secure the cables on the fixed or sliding rail cable tray, respectively.

All cables need to be snugly routed on the rack frame rail using the D-Ring cable hooks. The rear door should close easily over the cables. If additional space is required for the cables at the rear of the rack then use the rack extension or the bustle kit.

### 4.6.1. Power Cord Connection

After making sure that the PDU power outlets are not live, connect the power cords to the servers.



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

- Unplug the power cord from the system.
- Do not disable the power cord grounding plug. The grounding plug is an important safety feature.
- Plug the power cord into a grounded (earthed) electrical outlet that is easily accessible at all times.

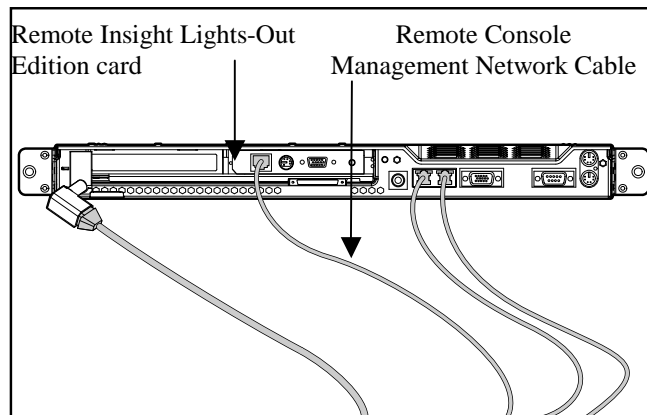
### 4.6.2. Console Management Choices

#### 4.6.2.1. Remote Console Management Cables

Refer to the *ProLiant DL360 Setup and Installation Guide* for more details on installing Compaq Remote Insight Lights-Out Edition in ProLiant DL360. **Note that ProLiant DL360 provides an internal cable that eliminates the need for the external loop-back cable for the keyboard/mouse and the external power adapter.** This greatly reduces the total number of cables to be managed and saves the trouble of providing 42 more power outlets.

There will be one CAT5 cable connected to the Remote Insight Lights-Out Edition RJ-45 connector.

**Figure 4-20. Network cables connection to Remote Insight Lights-Out Edition RJ-45 network jacks**



### 4.6.2.2. Off-Rack Local Console Cabling

There are no special considerations in connecting the KVM cables to the servers. A local console is a console in the vicinity of the rack. The cable lengths required for local console connection will depend on the location of the off-rack consoles or console switches.

### 4.6.2.3. In-Rack Local Console Cabling Using Server Console Switches

Table 4-3 lists the components used in this section for local console management. Figure 4-21 illustrates the video, keyboard and mouse cables connection on the ProLiant DL360 server rear panel. Figure 4-22 demonstrates how five 1x8-port Server Console Switches are cascaded.

**Table 4-3. Local Console Management Parts**

Description	Compaq P/N	Notes
Server Console Switch 1x8-port (100-230VAC)	400337-001	N.A. See Appendix B -- Parts Reference for regions outside of N.A.
TFT5000R Flat Panel Monitor	120207-001	N.A. See Appendix B -- Parts Reference for regions outside of N.A.
Keyboard with Trackball	185152-406	N.A. See Appendix B -- Parts Reference for regions outside of N.A.
1U Rack Keyboard Drawer	338056-B21	A Server Console Switch may be mounted behind the keyboard drawer (0U installation)
CPU-to-Switchbox Cable	110936-B24	3 ft cables are recommended cable lengths for fixed rails.
CPU-to-Switchbox Cable	110936-B25	6 ft cables are recommended cable lengths for sliding rails.

**Figure 4-21. Video, keyboard, and mouse cables connected to a ProLiant DL360 rear panel. Also shown here are the power cord and two network cables.**

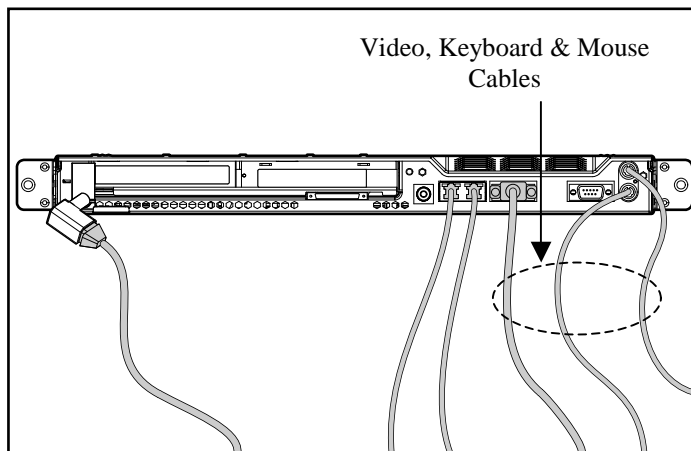
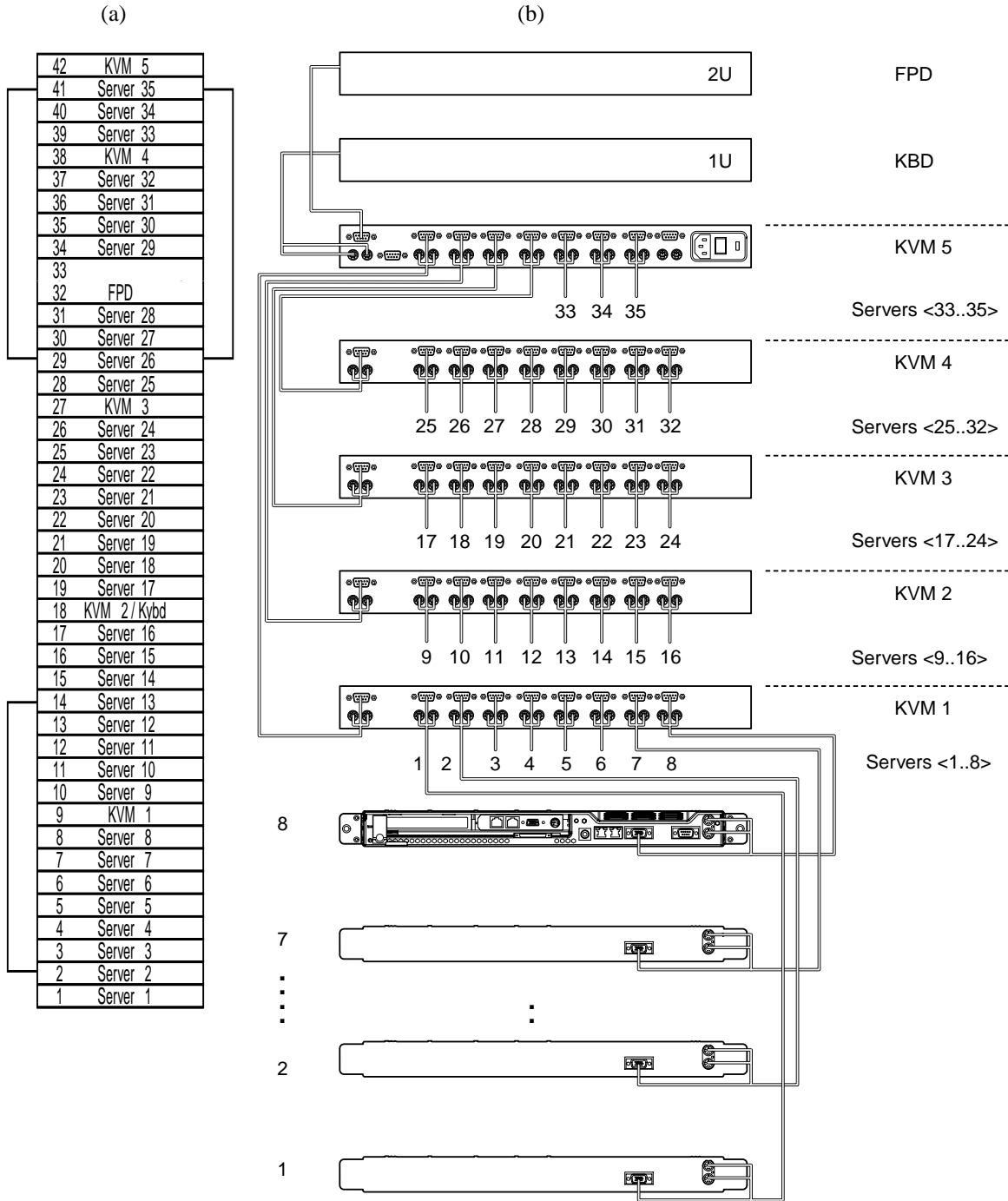


Figure 4-22(a) shows an in-rack local-console rack configuration for a 42U rack. The PDUs shown on the sides of the rack are irrelevant for this figure. Figure 4-22(b) shows the wiring diagram where five cascaded Server Console (KVM) switches support 35 ProLiant DL360 servers, a 1U keyboard/trackball, and a 2U flat panel monitor.

**Figure 4-22. Server Console (KVM) switch placement and cascading diagram**



### 4.6.3. Cable Management Procedure

Cable management procedure will depend on the rail solution used for an installation.

#### 4.6.3.1. Fixed-Rail Cable Management

For details on the installation procedures in this section, refer to the *Compaq ProLiant DL360 Setup and Installation Guide*.

Figure 4-23 shows how the power cord and other peripheral/network cables from the server rear panel connectors are routed into the cable tray clamp. Figure 4-24 shows how to bundle the cables together for fixed rail installations. The cable bundles should be routed vertically through the cable D-rings attached on the rack frame.

Figure 4-23. Cable tray clamps securing step on a fixed rail cable tray

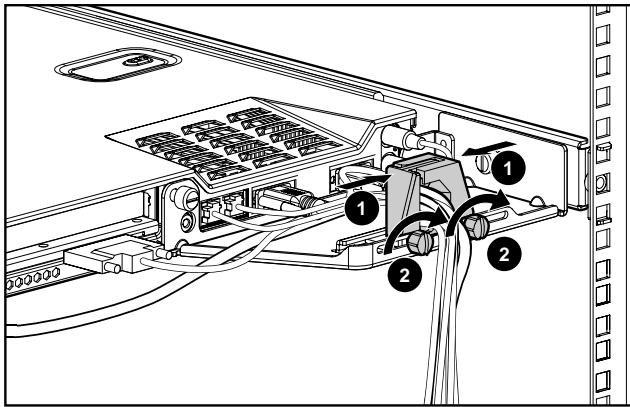
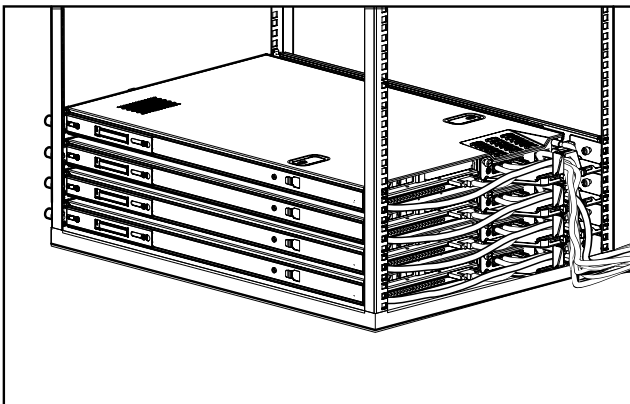


Figure 4-24. Cable bundle grouping for fixed rail installation



### 4.6.3.2. Sliding-Rail Cable Management

For details on the installation procedures in this section, refer to the *Sliding Rails and Cable Management Solutions for ProLiant DL360 Servers Guide* and the option's documentation.

Figure 4-25 shows how the cables are attached on the server rear panel and are routed through the plastic wheels on the Sliding Mount Cable Tray, starting with the cables closest to the tray.

**Figure 4-25. Sliding rail cable routing sequence**

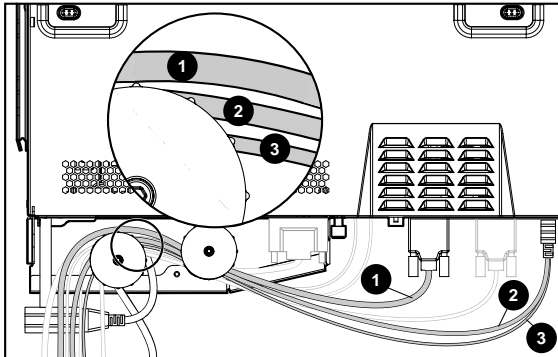


Figure 4-26 shows how the cables are tied together after they are routed on the cable tray.

**Figure 4-26. Cable ties for sliding rail cable tray**

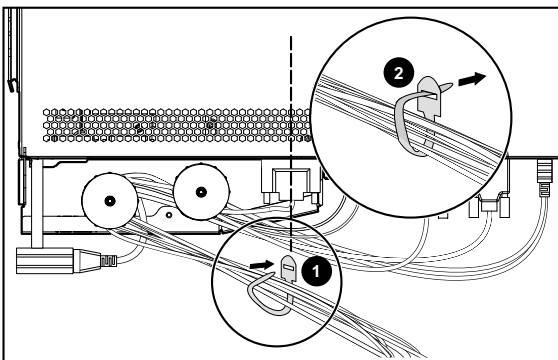
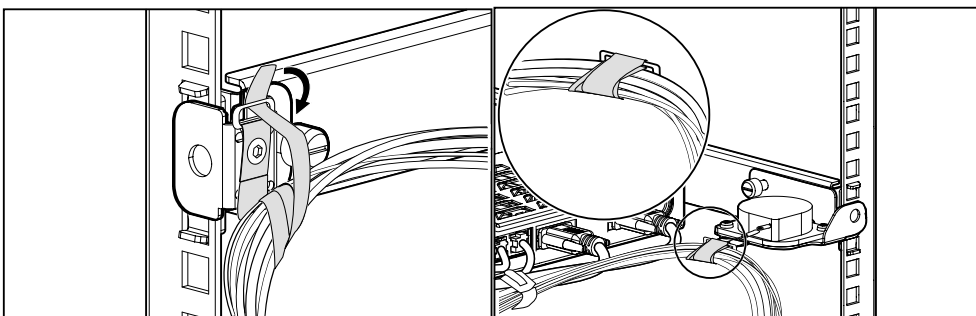


Figure 4-27 shows how the cable bundle is tied to the rack attach bracket and the tension reel bracket.

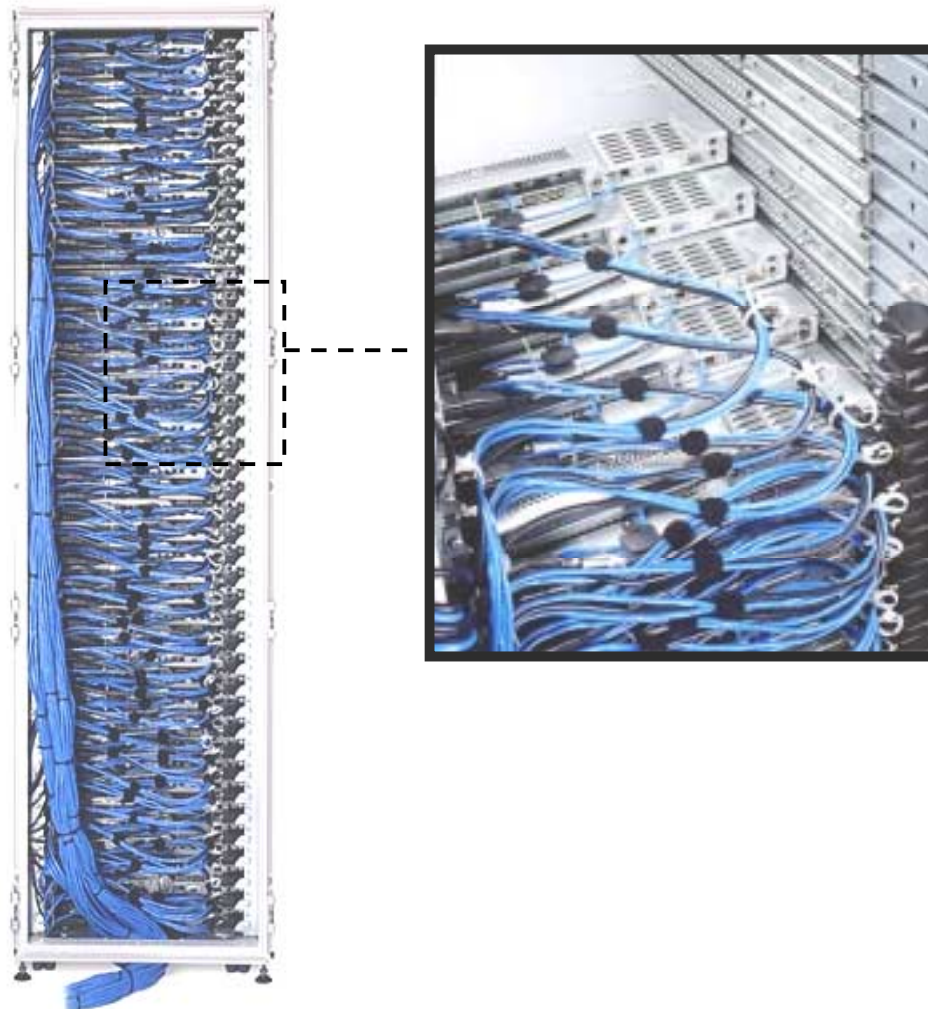
**Figure 4-27. Sliding rail cable rack attach bracket and tension reel bracket**





After the cable management system installation of several ProLiant DL360 servers, the rear of the rack will look similar to Figure 4-28. Note that the cables exiting the rack are shown here at the bottom of the rack, though many customers might route these cables towards the top of the rack. Also note the extended stabilizer feet on the rack. The expanded view shows the cable management system where a few ProLiant DL360 servers are partially extended out at the front of the rack.

**Figure 4-28. Completed cable management system installation using sliding rails with remote management network cables**



## 4.7 Completing the Installation

- Secure the rack rails if necessary to comply with requirements for certain geographic areas, such as areas where earthquakes may occur.
- Secure each ProLiant DL360 server in the rack by tightening the front panel thumbscrews on the front bezel.
- Secure the other units (if any) in the rack by tightening the appropriate mounting screws.
- Install the side panels for the outside side compartment, if the rack is located at the end of a suited rack row.
- Install the front and rear doors.

The installation is now complete.

## Appendix A -- Related Documents

*Customer Advisory: Caster Wheels on 9000 Series Racks May Break When Moved Under Load*

Document number EX991108\_CW01

Web: [http://www.compaq.com/support/techpubs/customer\\_advisories/EX991108\\_CW01\\_1.html](http://www.compaq.com/support/techpubs/customer_advisories/EX991108_CW01_1.html)

*Compaq 9000 Series Rack Brochure*

Document number 0266-0799A-NAEN

Web link: [ftp://ftp.compaq.com/pub/products/storageworks/options/9000\\_Series\\_Profile.pdf](ftp://ftp.compaq.com/pub/products/storageworks/options/9000_Series_Profile.pdf)

*Compaq 9000 Series Universal Racks white paper*

Document number ECG0145-0899-A

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

*Compaq Rack 9000 Series Catalog*

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

*Compaq Rack 7000 Series Catalog*

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

*Installing Compaq Rack-Mountable Components into Third-Party Racks*

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

*Compaq Rack Options and Accessories Catalog*

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

*Compaq Power Management Products Catalog*

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

*Compaq Power Distribution Unit Information Guide*

Document number ECG045/0299

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

*Compaq Power Distribution Unit QuickSpecs*

Document number DA-10253-00-002

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

*Compaq Server Console Switch (KVM) Information Guide white paper*

Document number ECG0155/0699-A

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

*Compaq Server Console Switch User Guide*

Document number 141555-001

Web: [ftp://ftp.compaq.com/pub/supportinformation/techpubs/user\\_reference\\_guides/141555-001.pdf](ftp://ftp.compaq.com/pub/supportinformation/techpubs/user_reference_guides/141555-001.pdf)

*Compaq Server Console Switch Brochure*

Document number 0304-0799A-NAEN

Web: [ftp://ftp.compaq.com/pub/products/storageworks/options/KVM\\_Profile.pdf](ftp://ftp.compaq.com/pub/products/storageworks/options/KVM_Profile.pdf)

*Compaq Flat Panel Monitor Rackmount (TFT5000R) QuickSpecs*

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

*Compaq Internal Keyboard with Trackball and 1U Keyboard Drawer QuickSpecs*

Web: [ftp://ftp.compaq.com/pub/products/storageworks/options/iukeyboard\\_qs.pdf](ftp://ftp.compaq.com/pub/products/storageworks/options/iukeyboard_qs.pdf)

*Compaq 1U Keyboard Drawer and Internal Keyboard Brochure*

Document number NA020A/0499

Web: [ftp://ftp.compaq.com/pub/products/storageworks/options/iukeyboard\\_brochure.pdf](ftp://ftp.compaq.com/pub/products/storageworks/options/iukeyboard_brochure.pdf)

## Appendix B -- Parts Reference

The parts referred to in this white paper are listed in this appendix. Refer to *Compaq ProLiant DL360 Quickspecs* for more option parts.

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

APD Asia Pacific

EURO Europe

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

U.K. United Kingdom

POWER MANAGEMENT			
Power part	Compaq P/N	Notes	
Vertical-Mount PDU Brackets Option Kit	191265-B21	8 brackets	
Vertical-Mount PDU Brackets Option with High Voltage Cables Kit	166097-B21	4 brackets and 11 Y-power cords. Each Y-power cord is 10 ft in length (6 ft single-section and 4 ft dual-sections). These cables are not available separately from this option kit.	
7 ft High Voltage Power Y-cable	Available 3Q00	4 ft single-section and 3 ft dual-sections.	
10A IEC-to-IEC jumper cable kit	6 ft / 2.0 m 8 ft / 2.5 m 12 ft / 3.0 m	142257-001 142257-002 142257-003	There is one cable per kit. This cable is to connect between a Compaq High Voltage PDU and a server.
High Voltage 16A PDU	295363-002 (N.A.) 295363-B32 (Int'l)		
High Voltage 24A PDU	295363-003	N.A. only	
Low Voltage 24A PDU	295363-001 (N.A.) 295363-291 (Japan)		

CONSOLE MANAGEMENT			
Part	Compaq P/N	Notes	
TFT5000R Flat Panel Monitor	N.A. Japan	120207-001 120207-291	The power cord shipped with this switch is for low voltage PDUs. See the note below for high voltage power cabling.
TFT5000R Flat Panel Monitor	International	120207-B31	See the note below for high voltage power cabling.
Server Console Switch 1x8-port (100-230VAC).	N.A. International Japan	400337-001 400337-291	The power cord shipped with this switch is for low voltage PDUs. See the note below for high voltage power cabling.
Server Console Switch 1x8-port (100-230VAC)	International	400337-B31	See the note below for high voltage power cabling.
<p><i>Note: The following cables may be used to connect to a Compaq High Voltage PDU:</i></p> <ul style="list-style-type: none"> <li>• 10 ft Y-cables supplied with Vertical-Mount PDU Brackets Option with High Voltage Cables Kit (166097-B21),</li> <li>• 7 ft High Voltage Y-power cord, or 10A IEC-to-IEC jumper cable. Refer to the Power Management table on page 83.</li> </ul>			
CPU-to-Server Console Cable	110936-B21 110936-B22 110936-B23 110936-B24 110936-B25	1 Cable, 12 ft 1 Cable, 20 ft 1 Cable, 40 ft 1 Cable, 3 ft (Available 3Q00) 1 Cable, 6 ft (Available 3Q00)	
CPU-to-Server Console Cable (Plenum Rated)	149363-B21 149364-B21	1 Cable, 20 ft 1 Cable, 40 ft	
Keyboard/Video/Mouse extension cables	169989-001		
1U Rack Keyboard Drawer	338056-B21	Server Console Switch may be mounted behind keyboard drawer (0U installation)	
Keyboard with trackball	185152-406, -036, -046, -056, -066, -076, -086, -096, -106, -116, -136, -186, -296, -B36	U.S., U.K., Germany, France, Italy, Spain, Denmark, Norway, Sweden/Finland, Swiss, Portugal, Belgium, Japan, International	
Remote Insight Lights-Out Edition	157866-001, -021, -371	N.A., EURO, APD, Japan	

<b>RACK DEPLOYMENT</b>		
<b>Part</b>	<b>Compaq P/N</b>	<b>Notes</b>
Sliding rails and cable management solution option	174575-B21	For DL360 server in-rack serviceability
Grounding Option Kit	120682-B21	
<b>9000-Series Racks</b>		
Ballast Option Kit	120672-B21	
Baying Kit	120669-B21	
Bustle Kit	120679-B21	Extends rear part of rack to gain cabling space
Stabilizer Option Kit	120673-B21	
Compaq Rack 9142 (42U)	120663-B21, B22, B23	Pallet, Shock Pallet, Crated
9142 Side Panel Kit	120670-B21	
Compaq Rack 9136 (36U)	120664-B21, -B22, -B23	Pallet, Shock Pallet, Crated
9136 Side Panel Kit	120671-B21	
Compaq Rack 9122 (22U)	120655-B21, -B22, -B23	Pallet, Shock Pallet, Crated
<b>7000-Series Racks</b>		
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, -291	Others, Japan
Compaq Rack 7142 (42U)	165753-001, -002, -003, -293	N.A., Air Shipment, International, Japan
Rack Sidewall Kit (42U only)	165652-001	
Rack Extension Kit for 7142	154392-B21	
Coupling Kit (42U only)	165664-001	
Compaq Rack 7122 (22U)	163747-001, -002, -292	N.A., International, Japan