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hp ProLiant DL560 server high-density deployment

table of contents

abstract

This white paper is a planning guide to expedite concentrated deployments of multiple HP ProLiant DL560 servers in a single rack. Use this white paper in conjunction with documents for server and rack deployment products. This paper is written for Field Systems Engineers (FSEs) and customers (IT managers, system managers, account managers, and installers).

executive summary

Many business enterprises and service providers use network infrastructure and Web applications that work best on dedicated servers. This creates the need to fit a large number of smaller servers into existing server rooms and data centers. HP meets this need with the density-optimized line of ProLiant servers, such as the ProLiant DL560 server. At a height of 2U each, up to 21 servers can physically fit in a single 42U rack. While this server has clear space-saving benefits, its compressed size presents new challenges for rapid server deployment, as well as cable management and environmental considerations.

HP engineers have developed innovations in rapid high-volume deployment and improved cable management for large installations of ProLiant servers. This white paper introduces planning, power and thermal considerations, server and rack requirements, and installation configurations. It also outlines the products associated with high-volume deployment in rack configurations, such as keyboard, video, and mouse infrastructure.

symbols and warnings

symbols in text

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

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

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

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

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

symbols on equipment

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

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

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

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

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

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

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

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

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

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

server warnings

Adhere to the following guidelines when servicing or installing an HP server:

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

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

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

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

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

rack warnings

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

- Do not attempt to move or relocate an equipment rack populated with servers. A fully populated rack can weigh as much as 771 kg (1,700 lb). The rack might become unstable and cause serious personal injury or equipment damage.
- Before installing the servers, extend the leveling jacks to the floor and rest the full weight of the rack on the leveling jacks. Either install the stabilizer kit or couple multiple racks together for stability.
- Always load the heaviest item first and load the rack from the bottom to the top. Loading in this manner makes the rack "bottom-heavy" and helps prevent the rack from becoming unstable.
- Extend only one server at a time. A rack might become unstable if more than one server is fully extended for any reason.

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

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

where to find information

This white paper is divided into sections that address important aspects of planning and installing a high-volume of servers in HP branded or Compaq branded 7000-, 9000-, and 10000-series racks. The information in each section is outlined in table 1 and the appropriate steps to follow for high-volume server deployment is detailed in table 2.

table 1: where to find information

section	description	where to find
introduction	Explains the purpose and scope of this white paper	Page 5
understanding power, thermal, weight, and console management considerations	Lists important information about the server, racks, PDUs, and related options to help choose a rack configuration	Page 6
power distribution solutions	Discusses specifics of PDU choices	Page 13
console management systems	Discusses different options for server management	Page 19
planning rack configurations	Discusses issues related to deciding on rack configurations	Page 9
installation procedures	Describes installation procedures	Page 13

table 2: steps for high-volume server deployment

step	description
step 1	Choose PDUs from table 5.
step 2	Determine PDUs and related options from table 7 and table 8.
step 3	Determine rack configuration. Refer to "planning rack configurations" on page 9.
step 4	Determine rail, console, and cable configurations. Refer to "rack management solutions" on page 17.
step 5	Install the ProLiant DL560 server. Refer to "installation procedures" on page 13.

introduction

HP designed the dense ProLiant DL560 server to meet the challenges associated with deploying a high concentration of servers in a single rack. HP suggests that customers evaluate their environments, power distribution, console, cable, and thermal management choices well in advance to ensure efficient deployments.

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

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

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

Refer to the *HP ProLiant DL560 Server QuickSpecs* at http://www.hp.com/products/servers/platforms for detailed specifications and options for this server.

understanding power, thermal, weight, and console management considerations

Power, thermal, and weight are the most important considerations for optimizing a hardware installation in high-volume server environments.

In the standard single-processor configuration, the ProLiant DL560 server includes one 550-watt power supply that can operate off high or low AC power. Multi-processor configurations are shipped with two, fully redundant power supplies. Single power supply units can be upgraded to a dual-power supply configuration with a redundant power supply option kit. The power supplies are hot-pluggable, allowing powered-up removal and replacement.

The ProLiant DL560 server uses an IEC C13-type AC plug that requires a power cable with an IEC C14 receptacle at one end. Power cord kits that are compatible with the physical and electrical requirements of the DL560 are available from HP and listed later in this document.

Server maximum parameters, necessary to perform worst-case calculations for the power, thermal, and weight requirements for any number of servers, are provided in table 3 and table 4. For more precise calculations, refer to the ProLiant DL560 Power Calculator utility or the Rack/Site Preparation Utility, discussed later in this document.

The ProLiant DL560 server power specifications are provided in table 4. Values are derived from the product specification, as well as the Power Calculator utility, with a unit in the nominal and maximum configurations.

table 3: ProLiant DL560 server parameters

dimensions (H x W x D)	
8.59 x 44.45 x 65.45 cm (3.38 x 17.50 x 25.75 in)	
server weights	
Minimum configuration: 1 x processor, 2 x 256-MB DIMMs, 0 x hard drives, 1 x CD-ROM drive, 1 x diskette drive, 5 x fans, 1 x power supply	20.8 kg (45.8 lb)
Average configuration: 2 x processor, 4 x 512-MB DIMMs, 2 x hard drives, 1 x CD-ROM drive, 1 x diskette drive, 10 x fans, 2 x power supply	25.5 kg (56.2 lb)
Maximum configuration: 4 x processor, 6 x 2-GB DIMMs, 2 x hard drives, 1 x CD-ROM drive, 1 x diskette drive, 10 x fans, 2 x power supplies, 3 PCI cards, Battery-Backed Write Cache Enabler	27.7 kg (61 lb)
component weights	
CD-ROM drive	0.30 kg (0.66 lb)
Diskette drive	0.33 kg (0.72 lb)
256-MB DIMM	0.02 kg (0.05 lb)
512-MB DIMM	0.02 kg (0.05 lb)
2-GB DIMM	0.04 kg (0.08 lb)
Hard drive	0.82 kg (1.8 lb)
Processor/heatsink assembly with PPM (Processor Power Module)	0.59 kg (1.3 lb)
Fan	0.11 kg (0.24 lb)
Power supply	2.18 kg (4.8 lb)
Power supply blank	0.20 kg (0.43 lb)
Battery-Backed Write Cache Enabler	0.11 kg (0.24 lb)
Remote Insight Lights-Out Edition II board	0.21 kg (0.46 lb)
PCI card *	0.32 kg (0.7 lb)
Server chassis without components listed above	14.74 kg (32.50 lb)
* Any third-party PCI cards used in the server must comply with the industry-standard PCI specifications for dimension, weight, power, and thermal requirements.	

continued

table 3: ProLiant DL560 server parameters (continued)

rack rails and hardware weights	
Cable arm	0.81 kg (1.8 lb)
Slide (2)	2.07 kg (4.6 lb)
Rail (2)	1.8 kg (4.0 lb)
Total Weight:	4.7 kg (10.4 lb)
relative humidity (non-condensing)	
Operating	10 to 90%
Non-operating	5 to 95%

table 4: ProLiant DL560 server power specifications

	input voltage					
	100	**115**	**208**	**220**	**230**	**240**
power supply rated output (W)	550	550	550	550	550	550
nom. input wattage (W)	333	329	325	321	318	314
max. input wattage (W)	503	496	496	490	483	477
nom. input current draw (A)	3.4	2.9	1.6	1.5	1.4	1.3
max. input current draw (A)	5.1	4.4	2.4	2.3	2.1	2.0
nom. input (VA)	340	336	332	328	324	636
max. input (VA)	513	506	506	500	493	487
max. thermal (BTU/Hr)	1715	1693	1691	1670	1648	1628
efficiency (%)	70	72	75	75	75	76
power factor	0.98	0.98	0.98	0.98	0.98	0.98
mom. leakage current (mA)	0.31	0.36	0.65	0.69	0.72	0.75
max. leakage current (mA)	0.63	.72	1.30	1.39	1.44	1.50
nom inrush current (A) @ 20 ms	25	25	25	25	25	25
max inrush current (A) @ 20 ms	50	50	50	50	50	50

Note: These values are derived from a combination of product specifications and the Power Calculator configured as below in "Nom" and "Max:"

- Nom. = Nominal rating of a unit operating with one or two processors, up to 2 DIMMs, 2 hard drives, one PCI card, and one power supply.
- Max. = Maximum rating of a fully loaded unit: 4 processors, 6 DIMMs, 2 hard drives, 3 PCI cards, and 2 power supplies.

planning rack configurations

Several important factors are considered when planning a rack configuration:

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

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

online calculators

HP provides online calculator utilities that simplify the process of determining power requirements and offer convenient "what if" calculations. These utilities, available online at no charge, offer several advantages over "scratch pad" methods using nameplate specifications:

- Calculations are based on formulas using actual measurements of equipment running a test software utility that exercises the server resources.
- Calculations are based on active components exercised at 100% duty cycle, generally allowing headroom for a typical installation design.
- Air volume calculations based on measurements taken in equipment operating with an airflow chamber.

The ActiveAnswers section of the HP website provides two types of online calculators:

Note: Microsoft® Excel must be installed on the system you are using to view these utilities.

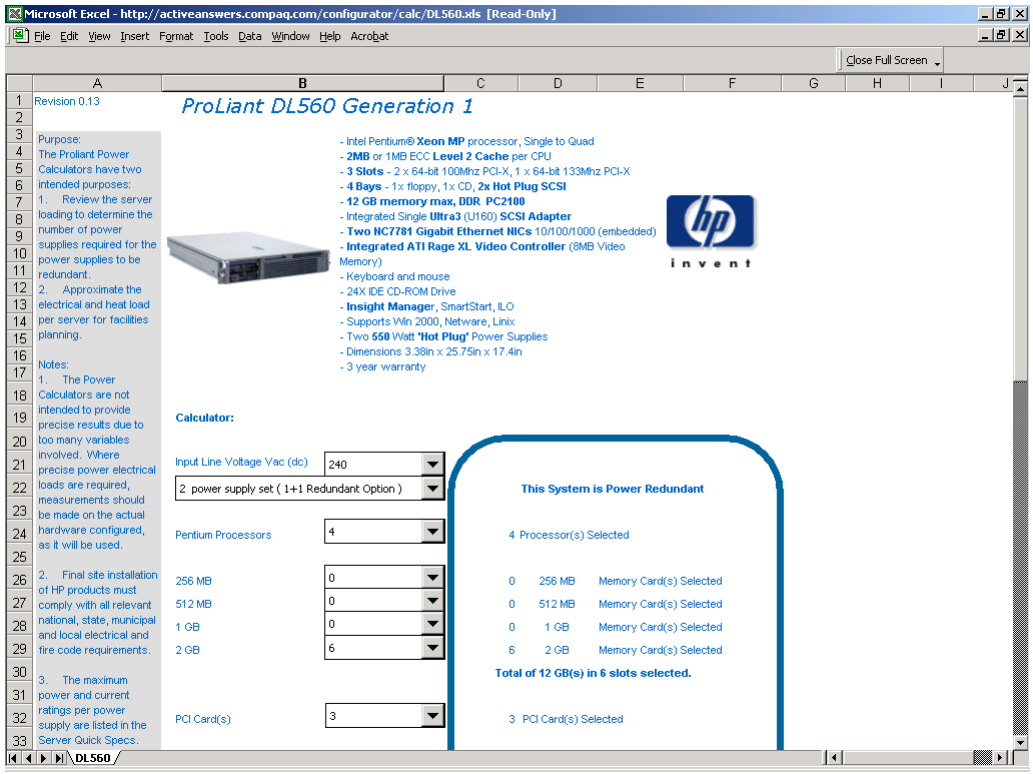
- Power Calculator utility—calculates the power requirements for a single DL560 server.
- Rack/Site Preparation utility—calculates the power, vertical space, and airflow/cooling requirements for a complete rack of equipment.

power calculator utility

The Power Calculator utility computes the power requirements for a single DL560 server. Using drop-down menus, select the number of processors, memory amount, hard drive type and amount, and PCI card compliment of the server. Each configuration change is re-calculated instantly, and a yellow warning message is displayed if a particular parameter does not work or seriously impedes performance.

To access the Power Calculator utility, refer to http://activeanswers.compaq.com/configurator/calc/DL560.xls.

figure 1: Opening Screen of Power Calculator utility



The Power Calculator utility is convenient for small server system planning or for making minor additions to existing installations. For a more thorough analysis of a complete installation, the Rack/Site Preparation utility is recommended.

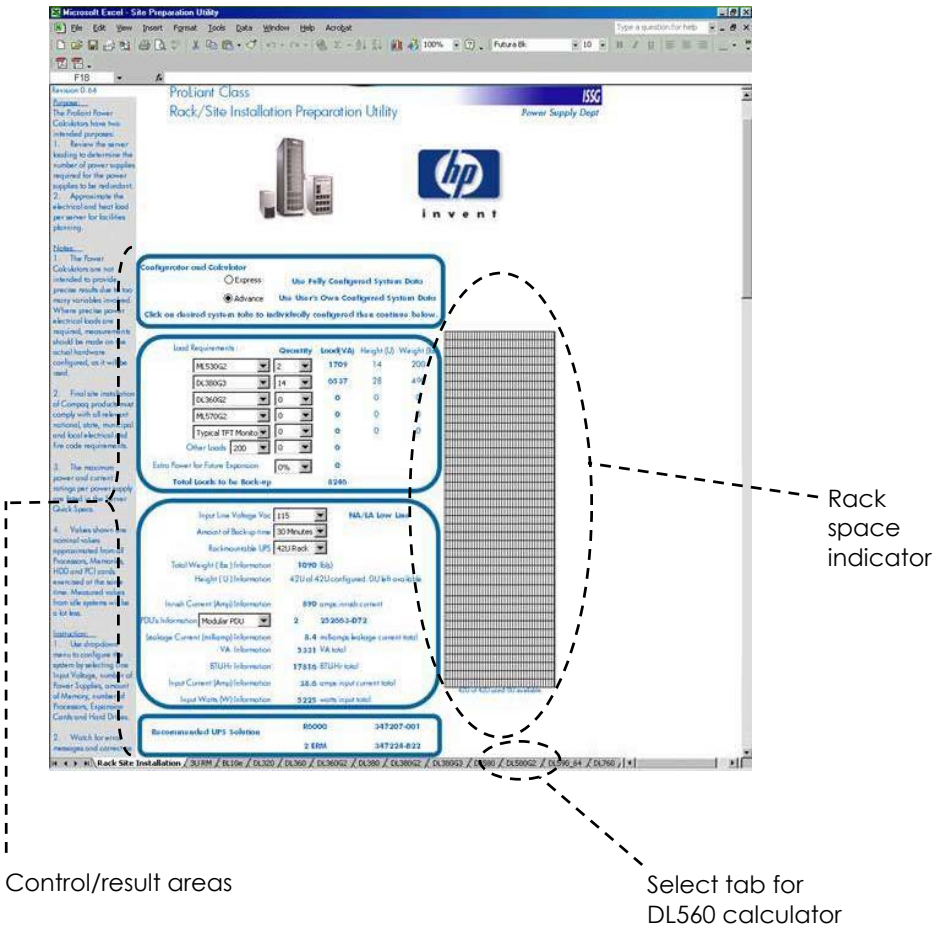
rack/site preparation utility

The Rack/Site Preparation utility will calculate all power, vertical rack space, and airflow requirements for a complete server installation. In addition, the Rack/Site Preparation utility includes sub-calculators for determining the power requirements of individual components.

The Rack/Site Preparation utility is accessed through the HP ActiveAnswers website. The user is presented with the main screen (figure 2), which includes four control/result areas, individual calculator tabs, and a rack space indicator.

To access the Rack/Site Preparation utility, refer to http://activeanswers.compaq.com/configurator/calc/Site Preparation Utility.XLS.

figure 2: Opening Screen of Rack/Site Preparation Utility

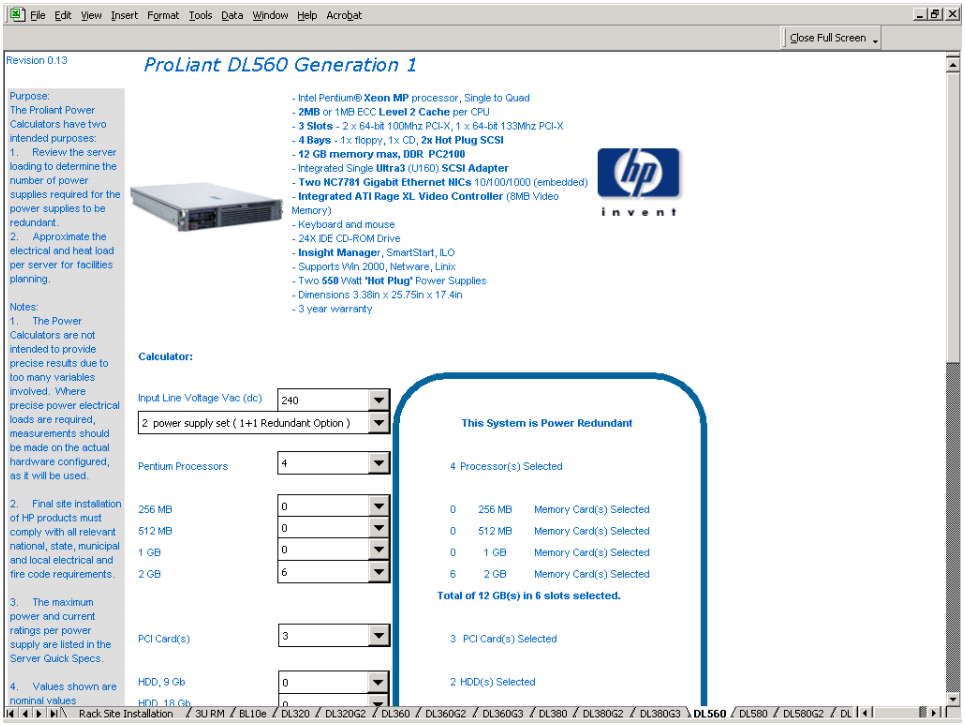


To use the Rack/Site Preparation utility:

1. Select either the **Express** or **Advanced** mode of calculation.
   - Express calculation uses pre-set values for components and can be used for producing a quick estimate of system requirements.
   - Advanced calculation requires the user to configure individual components and is recommended for final installation planning.

   If **Express** mode is selected, proceed to step 5.
2. Select the **DL560** tab at the bottom of the screen. The individual component configuration page is displayed.

figure 3: opening screen of individual component calculator



3. Starting with the line voltage, select the configuration parameters desired, scrolling down to ensure all appropriate parameters are chosen. Be aware of error messages indicating possible problems.
4. When component configuration is complete, click on the **Rack Site Installation** tab to return to the main calculator page (figure 2).
5. Complete the **Load Requirements** and **Input Line Voltage** configuration areas. Each configuration change will be calculated instantly. The rack space indicator indicates the amount of vertical space used/available.

installation procedures

overview

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

1. Observe symbols on equipment, server warnings, and rack warnings.
2. Prepare the server.
3. Prepare the rack.
4. Install PDUs.
5. Install the rack rails.
6. Install a server in the rack.
7. Connect the cables.
8. Complete the installation.

server preparation

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

rack preparation

Rack selection criteria and recommendations are beyond the scope of this document. A bustle or an extension kit may be required if the installation will end up with several cables for all the servers, for example, KVM cables. For complete details on rack installation, refer to the documentation shipped with the rack.

power distribution solutions

HP recommends using power distribution units (PDUs) in installations where a number of server units can place serious loading demands on the AC power bus. HP offers PDUs that provide safety and reliability to multi-server installations.

The units described in this white paper offer 0U/1U mounting options and feature circuit-breaker protection of equipment in groups.

For more information, refer to table 5 or http://www.hp.com/products/ups.

A PDU using the 0U rack mounting option is shown in figure 4. This configuration may be preferable in a high-density installation requiring the maximum amount of vertical space for servers and other active components. The 0U configuration offers the following advantages:

- saves vertical rack space for equipment requiring more operator/maintenance accessibility
- easy access to power connections

figure 4: 0U Rack Mounting Option

A PDU using the 1U rack mounting option is shown in figure 5. This configuration may be preferable in installations where operator or maintenance accessibility to all components is key. The 1U configuration offers the following advantages:

- easy access to all switches and circuit breakers
- easy viewing of circuit status LED
- easy access for service replacement or upgrade

figure 5: 1U Rack Mounting Option

modular PDUs

The Modular PDU consists of a control unit that connects to the power bus (or to a UPS) and four extension bars that distribute power to the equipment groups. The control unit includes a 15A circuit breaker for each of the four C19-type extension bar outputs. Available in low- and high-voltage versions, the modular PDU comes with a choice of three types of extension bars to accommodate a variety of distribution requirements. The control unit may be rack-mounted in a 0U or 1U configuration. The extension bars include mounting brackets for attachment to vertical rack supports.

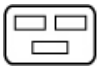
figure 6: modular PDU components

Control Unit

Extension Bar (I of 4)

Depending on configuration, extension bar deployment may be optional (i.e., equipment may be connected directly to the control unit with the appropriate jumper cord). Several versions of Modular PDUs are available to meet a variety of electrical requirements as indicated in table 5.

table 5: modular PDU types

name part number	voltage / amperage	AC Bus Plug Type	Extension Bar Output Receptacle Type (Qty)
24A NA/JPN Low 252663-D71	100-127 / 24	NEMA L5-30P 	4 x NEMA 5-15R (8) 
24A NA/JPN High 252663-D72	200-240 / 24	NEMA L6-30P 	4 x IEC 320 C13 (8) 
32A International 252663-B31	200-240 / 32	IEC 309 32A 	4 x IEC 320 C13 (8) 
40A Worldwide 252663-B21	200-240 / 40	Terminal for hardwiring	3 x IEC 320 C13 (8)  1 x IEC 320 C19 (4) 
16A Worldwide 252663-B24	200-240 / 16A	Detachable input cord; IEC 320 C-20 	2 x IEC 320 C13 (8) 

figuring type and number of PDUs

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

HP PDUs support both high-voltage and low-voltage applications. The input current rating for a ProLiant DL560 server is either 2.3 A at 240 volts or 4.9 A at 115 volts. To determine the number of servers supported by a PDU, divide the current rating of the PDU by the total input current rating of the server.

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

non-redundant power

Example

One high-voltage PDU has a current rating of 24 A. The server has a total input current rating of 2.3 A at 200 volts.

24 A (PDU current rating)/2.3 A (server total input current rating) = 10.4

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

Example

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

24 A (PDU current rating)/4.9 A (server total input current rating) = 4.9

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

redundant power

Under normal operating conditions, servers with multiple power supplies equally distribute the power load across each power supply and subsequently each power feed. For example, a server with two power supplies distributes 50 percent of the power load to each power feed.

In the event that a power feed fails, the second power feed must be able to handle 100 percent of the power load. Each PDU in a redundant configuration must support the entire load in the event a power failure occurs on one of the power feeds. Therefore, you should calculate the number of servers per PDU according to the examples under "non-redundant power." The resulting redundant configuration will have double the power supplies and double the PDUs.

Redundant PDU configurations should be tested thoroughly at the time of installation to ensure that load-handling capabilities are fully redundant before placing the servers into production. After the rack is assembled, power up the rack and disconnect power to one of the PDUs. The rack should operate normally on the remaining PDU and power feed.

selecting server power cords

The appropriate server power cord to use depends on the cable management system installed in the rack. Generally, the sliding rail cable management system requires a power cord that is 1.8 m (6 ft) in length. This length provides enough slack for the power cord to route through the cable management solution.

power cords

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

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

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

table 6: hp high-voltage power cables

cable	hp part number	description
10A IEC-to-IEC Cables kit	142257-001 (1.8 m/6 ft) 142257-002 (2.4 m/8 ft) 142257-003 (3.0 m/10 ft) 142257-006 (1.4 m/4.5 ft) 142257-007 (1.4 m/4.5 ft), 15 cables	The IEC-to-IEC cables can be used either as individual power cords to connect PDUs or to extend the length of the high-voltage Y-cables. The server ships with one 3.0-m (10-ft) IEC to IEC cable, part number 142263-003.

rack management solutions

To determine the best rack management solution, consider the service and upgrade demands of the servers deployed in the rack. Refer to the following sections for information on available rack management solutions.

For rack rail installation procedures, refer to the “installing rack rails” section on page 18.

standard square-hole rack rails

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

For detailed instructions on installing standard rack rails, refer to the *HP ProLiant DL560 Server User Guide*.

round-hole rack cabinet solution

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

telco rack solution

The server design supports deployment in telco racks. If you are installing the server into a telco rack, order the appropriate option kit at http://www.racksolutions.com/hp.

installing rack rails

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

1. Remove the server rails from the left and right standard rails.
2. Insert the rails into the rack holes.
3. Install the server rails onto the chassis.

Repeat the procedure for any subsequent rack rails. For detailed instructions on installing standard rack rails, refer to the *HP ProLiant DL560 Server User Guide* or *HP ProLiant DL560 Quick Setup Poster*.

installing a server into a rack

To properly install servers:

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

For detailed instructions on server installation, refer to the *HP ProLiant DL560 Server User Guide* or *HP ProLiant DL560 Quick Setup Poster*.

connecting cables

This section discusses connecting and routing cables with different cable management solutions and different console management solutions. Connect cables and devices as follows:

1. Connect the cables to each device installed in the rack, working from the bottom to the top.
2. Connect the cables to the bottom piece of equipment.
3. Bundle the cables and route them through the cable management solution.
4. Connect the cables to the console switchbox.
5. Connect the power cord to the PDU. Do not connect the PDU to any power source until all equipment is fully deployed in the rack.

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

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

- Unplug the power cord from the system.
- Do not disable the power-cord-grounding plug. The grounding plug is an important safety feature.
- Plug the power cord into a grounded (earthed) electrical outlet that is easily accessible at all times.
- Do not route the power cord where it can be walked on or pinched by items placed against it. Pay particular attention to the plug, electrical outlet, and the point where the cord extends from the server.

routing power cords

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

high-voltage and low-voltage power cords

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

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

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

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

completing the installation

To complete the installation:

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

console management systems

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

table 7: local console management options

option	hp part number	description
1x1x16 IP Console Switch	262585-B21	16-port KVM switch - provides access for 2 simultaneous user sessions (1 network session and 1 local session at a rack-mounted console)
3x1x16 IP Console Switch	262586-B21	16-port KVM switch - provides access for up to 4 simultaneous user sessions (3 network sessions and 1 local session at a rack-mounted console)
Interface Adapters (8 per Pack)	262587-B21	Transitions traditional KVM cabling to CAT5 - one needed for each server (convenient 8-pack)
Interface Adapters (Single Pack)	262588-B21	Transitions traditional KVM cabling to CAT5 - one for each server
Expansion Module	262589-B21	Enables tiering of up to 8 servers per port on the IP console switch
CAT5 Cables 3 FT (4 per Pack)	263474-B21	4-pack of 3 ft UTP CAT5 cables with RJ-45 connectors
CAT5 Cables 6 FT (8 per Pack)	263474-B22	8-pack of 6 ft UTP CAT5 cables with RJ-45 connectors
CAT5 Cables 12 FT (8 per Pack)	263474-B23	8-pack of 12 ft UTP CAT5 cables with RJ-45 connectors
CAT5 Cables 20 FT (4 per Pack)	263474-B24	4-pack of 20 ft UTP CAT5 cables with RJ-45 connectors
CAT5 Cables 40 FT (1 per Pack)	263474-B25	Single 40 ft UTP CAT5 cable with RJ-45 connectors
TFT5600 Rack-Mount Keyboard and Monitor	221546-001	1U integrated keyboard and monitor.
TFT5110R Flat Panel Monitor	281683-B21	1U rack-optimized monitor (keyboard not included).
Integrated Keyboard and Drawer	257054-001	1U Keyboard with Hot keys

in-rack local IP consoles

With an in-rack local console, all equipment, servers, switchboxes, keyboards, keyboard drawers, and video displays are installed together in the same rack. The HP switchboxes mount behind the keyboard drawer and do not consume extra U-space in the rack. Using the TFT5600 RKM and an IP console switch will consume a total of 1U to accommodate up to 128 servers. One console switchbox can support up to 16 directly attached servers with no user blocking. Up to eight servers may be tiered or cascaded on each switch port using either a legacy Compaq KVM switch or an Expansion Module; however, only one user can access tiered switches or servers connected by Expansion Modules at any one time. Critical devices requiring frequent access should be attached directly to a switch port. Server accessibility should be assessed by the IT manager before deployment to determine the appropriate server density per console switch.

The number of devices that fully populate a 47U, 42U, or 36U rack with an in-rack local console is outlined in table 8.

table 8: device configuration for an in-rack local IP console

device or cable	47U rack	42U rack	36U rack
ProLiant DL560 Servers	23	20	17
KVM IP Console Switches	1	1	1
Interface adapters	22	20	17
UTP CAT5 cables for KVM access	22	20	17
Expansion modules	4-16	3-16	3-16
TFT5600 RKM (integrated monitor/keyboard)	1	1	1

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

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

power configuration examples

The high/low voltage and dual-power supply capabilities of the ProLiant DL560 server makes it adaptable to a variety of power configurations. Each of the following examples suggests a method of power distribution for a group of servers mounted in a rack. These examples illustrate server power only and do not take into account such accessories as KVM switches and display monitors that are typically included in an installation.

high voltage (208 VAC) 10-chassis non-redundant power configuration

The following illustration (figure 7) shows a configuration where high voltage (208 VAC) is distributed to ten server chassis in a rack that receives primary power from one bus. A modular PDU that consists of a control unit and two extension bars is connected to the primary power source. The control unit can handle a maximum of 24 amps. Under normal operation, the power supply in each server would support the full load of each server. Therefore under normal conditions, the PDU would be loaded to approximately 24 amps, leaving no headroom for auxiliary devices, such as KVM switches, a TFT display, and rack monitoring devices. Refer to table 9 for power statistics for the high voltage 10-chassis configuration.

figure 7: high voltage (208 VAC) 10-chassis non-redundant power configuration

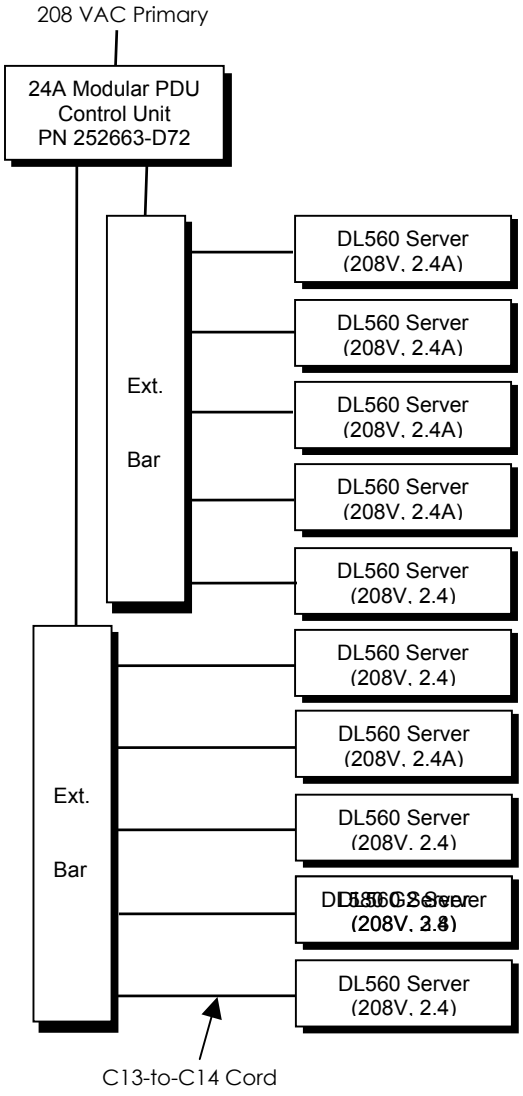


table 9: power statistics for high voltage 10-chassis non-redundant power configuration

description	value
control unit current handling capacity	24 amperes
control unit load	~ 24 amperes under normal operation (Server load in example is based on the Power Calculator output using 4 processors, 6 GB memory, 72-GB hard drives x 2, and 2 PCI cards)
headroom current available for rack peripherals	0 amperes If additional infrastructure loads are required to support the operation of the rack, it is suggested that you add additional PDUs or remove one or more servers to create headroom for peripherals.
power cord used for server-to-extension bar jumper	C13 to C14 (PN 142256-006) quantity of 1 C13 to C14 (PN 142256-007) quantity of 15

high voltage (208VAC) 10-chassis redundant power configuration

The following illustration (figure 8) shows a redundant power configuration where high voltage (208 VAC) is distributed to ten server chassis in a rack that receives primary and secondary power busses. A modular PDU that consists of a control core and two extension bars is connected to each power bus. Each control core can handle a maximum of 24 amps. Under normal operation, the power supplies in each server would be sharing the load of the server and each PDU would only see 50% of the full load of each server. Therefore, under normal conditions, each PDU would be loaded to approximately 12 amps. However, if either the primary or the secondary feed were to fail, the remaining PDU would be loaded to the full load of each server or approximately 24 amps. In this case, either core could be called on to provide about 24 amps to the servers, leaving no headroom for auxiliary devices, such as KVM switches, a TFT display, and rack monitoring devices. Refer to table 9 for power statistics for the high voltage 10-chassis configuration.

figure 8: high voltage (208 VAC) 10-chassis redundant power configuration

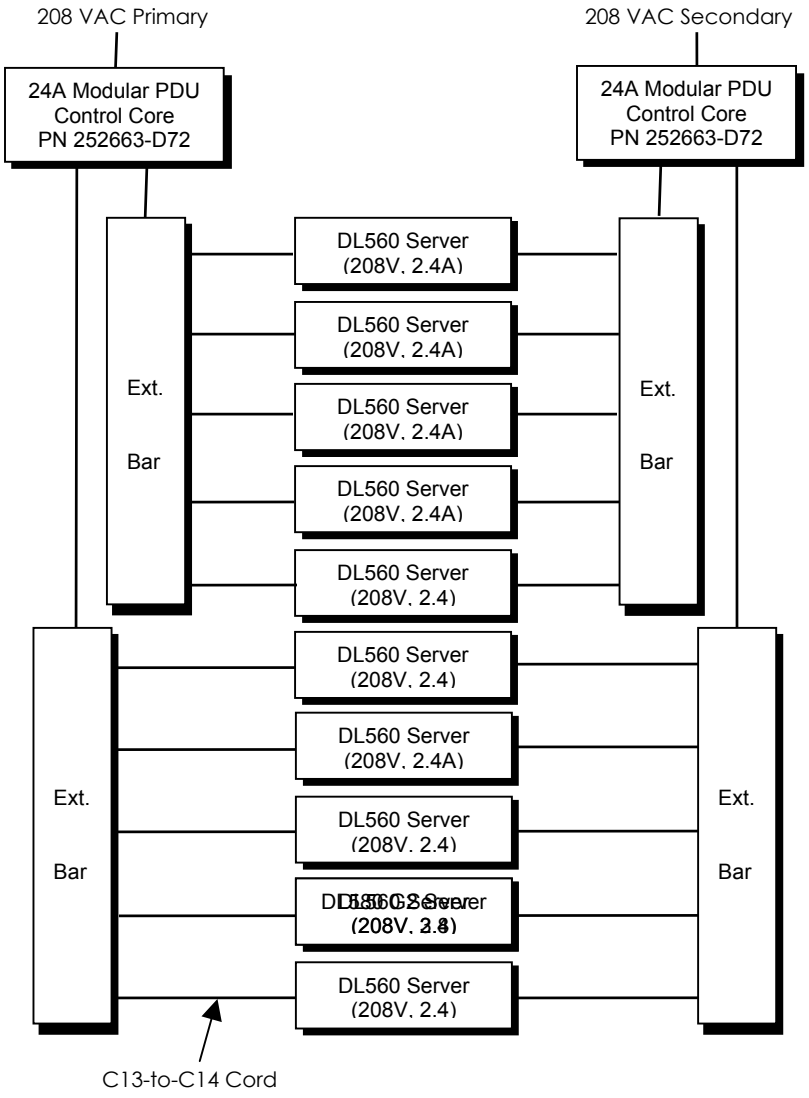


table 10: power statistics for high voltage 10-chassis redundant power configuration

description	value
control unit current handling capacity	24 amperes
control unit load	~ 12 amperes under normal operating conditions with both feeds active ~ 24 amperes under fault condition where either the primary or secondary power feed has failed (Server load in example is based on the Power Calculator output using 4 CPUs, 6-GB memory, 72-GB hard drives x 2, and 2 PCI cards)
headroom current available for rack peripherals	0 amperes If additional infrastructure loads are required to support the operation of the rack, it is suggested that you add additional PDUs or remove one or more servers to create headroom for peripherals.
power cord used for server-to-extension bar jumper	C13 to C14 (PN 142256-006) quantity of 1 C13 to C14 (PN 142256-007) quantity of 15

high voltage (230 VAC) 15-chassis redundant power configuration

The following illustration (figure 9) shows a redundant power configuration where high voltage (230 VAC) is distributed to 15 server chassis in a rack that receives primary and secondary power busses. Each power bus is handled by a modular PDU that consists of a control unit and three extension bars. Each control unit can handle a maximum of 32 amps. Under normal operation, the power supplies in each server would be sharing the load of the server and each PDU would only see 50% of the full load of each server. Therefore, under normal conditions, each PDU would be loaded to approximately 15.75 amps. However, if either the primary or the secondary feed were to fail, the remaining PDU would be loaded to the full load of each server or approximately 31.5 amps. In this case, either core could be called on to provide approximately 31.5 amps to the servers, leaving about 0.5 amps of headroom for auxiliary devices, such as KVMs, a TFT display, and rack monitoring devices. Refer to table 11 for power statistics for the high voltage 15-chassis configuration.

figure 9: high voltage (230 VAC) 15-chassis redundant power configuration

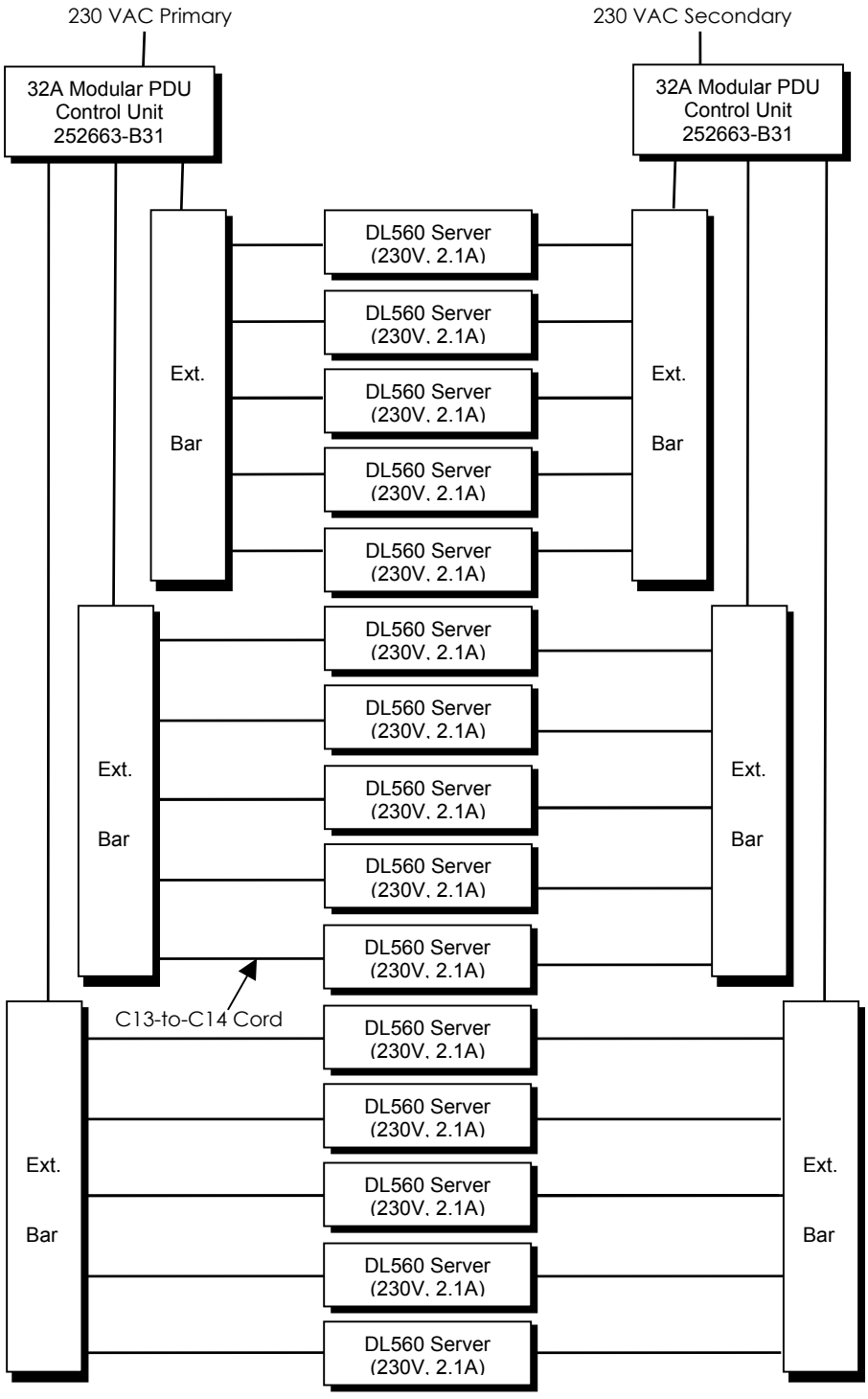


table 11: power statistics for high voltage 15-chassis power configuration

description	value
control unit current handling capacity	32 amperes
control unit load	~15.75 amps under normal operating conditions with both feeds active ~31.5 amperes under fault condition where either the primary or secondary power feed has failed (Power Calculator output using 4 CPUs, 6-GB memory, 72-GB hard drives x 2, and 2 PCI cards)
headroom current available for peripheral devices	0.5 amperes
power cord used for server-to-extension bar jumper	C13 to C14 (PN 142256-006) quantity of 1 C13 to C14 (PN 142256-007) quantity of 15

low voltage (120 VAC) 5-chassis redundant power configuration with modular PDUs

The following illustration (figure 10) shows a configuration of three server units operating off primary and secondary low voltage busses through two modular PDUs rated at 24 amps each. With a combined server load of 22.0 amps, about 2.0 amps are left for peripheral devices. The servers are connected directly to the extension bars with NEMA 5-15P power cords. Refer to table 12 for power statistics for the low voltage 5-chassis configuration.

figure 10: low voltage (120 VAC) 5-chassis redundant power configuration w/modular PDU

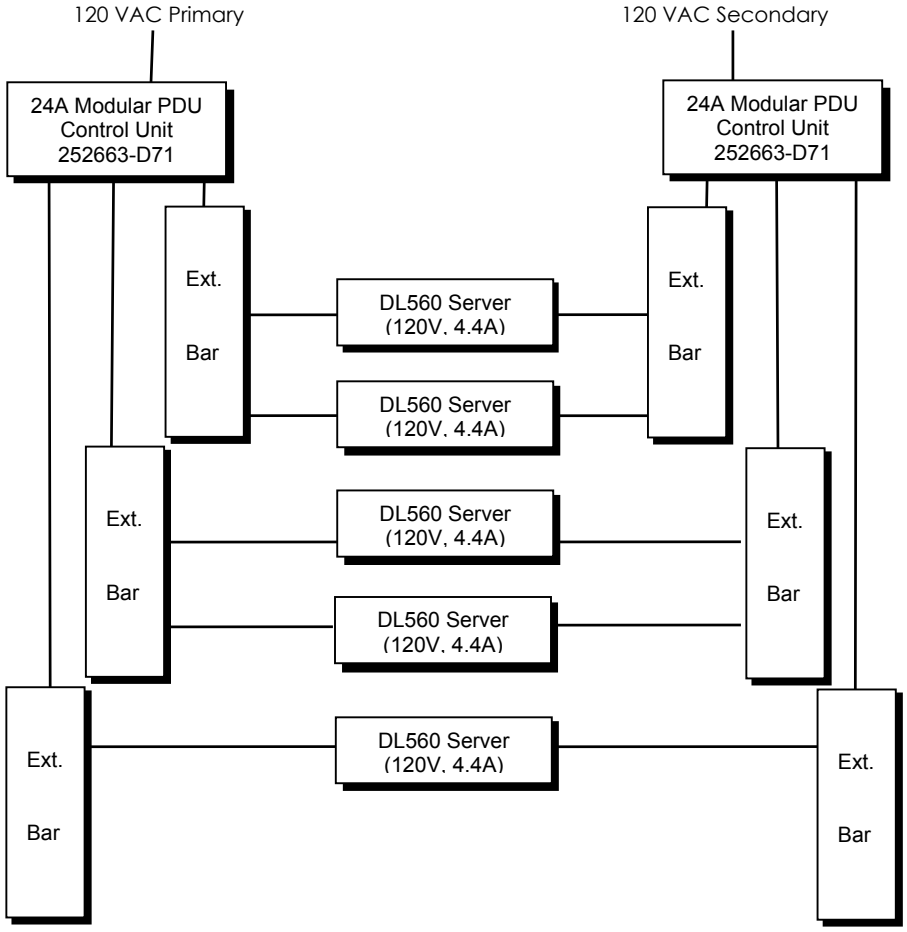


table 12: power statistics for low voltage 5-chassis power configuration (w/modular PDUs)

description	value
control unit current handling capacity	24 amperes
control unit server load	22.0 amperes (Power Calculator output using 4 CPUs, 6-GB memory, 72-GB hard drives x 2, and 2 PCI cards)
headroom current available for peripheral services	2.0 amperes
power cord used for server-to-control unit jumper	C13 to C14 (PN 142256-006) quantity of 1 C13 to C14 (PN 142256-007) quantity of 15

reference information and glossary

additional resources

Additional documentation, that may be helpful during high-density server and rack deployment, is listed in table 13 and available at http://www.hp.com.

table 13: additional resources

document	part number
Power Distribution Solutions for the ProLiant DL580 G2 server white paper	TC0301013WP
HP ProLiant DL360 Generation 3 Server High-Density Deployment white paper	1763-1102A-WWEN
HP Power and Cooling Trends in the Datacenter white paper	TC030203TB

glossary

1U—A rack unit (1U) is 4.45 cm (1.75 in) in vertical dimension. The height of a device (also known as form factor) can be expressed in rack units (U). The ProLiant DL560 server is a 2U server.

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

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

Ground leakage current—Residual current flow through the grounding conductor, which is always undesirable. With data processing occurring at ever-increasing speeds, most IT equipment includes capacitors in the power circuits to filter radio frequency (RF) signals to ground. While effective at filtering RF, these components tend to allow a small amount of AC current to pass to the ground. Leakage current is additive so that as more equipment is connected to the AC mains, the amount of leakage can increase.

High Voltage—180-264 VAC (200-240 VAC nominal) supplied to areas where load requirements are such that high voltage is more economical. Common in commercial applications in North America, numerous foreign countries also use this range as the AC appliance standard.

In-Rack Keyboard—The 1U rack keyboard drawer and the internal keyboard with trackball are designed to work together to save room in space-constrained, rack-mount environments. The 1U keyboard drawer requires only half the rack depth and provides enough space behind it to mount an HP Server Console switch.

Inrush current—A high, momentary current draw occurring when power is first applied to electrical systems. This current drain is not relative to the power-on requirements of equipment, but instead is due to the capacitive and inductive properties of components in the power supply.

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

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

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

Low Voltage—90-132 VAC (100-120 VAC nominal) supplied at utility outlets in homes and offices. This is the AC appliance standard used in North America, Latin America, and Japan.

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

Network Interface Controllers (NICs)—Controllers that are embedded on the system board of the ProLiant DL560 server.

Power density—The amount (product) of amps and voltage provided to a system (VA). A 120-VAC 30-amp circuit will deliver a power density of 3600 VA while a 208-VAC 30-amp circuit (single-phase) will deliver a power density of 6240 VA.

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

Power factor (pf)—An efficiency rating that indicates the amount of watts actually consumed by a load from the volt-amperes delivered to it. The rating is expressed as either a decimal number between 0 and 1 or a percentage of the formula of dividing watts by volt-amperes. A power factor of 1 indicates that a device receiving 1 VA is consuming 1 watt.

Power service—Point at where electrical power enters a building or equipment room.

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

Remote Insight Lights-Out Edition II (RILOE II)—The Remote Insight Lights-Out Edition II is designed to provide remote access and control of ProLiant server products from anywhere on the network with a standard Web browser. Consequently, customers can deploy a server in a true "headless" fashion with a minimum of only three cables per server: one power cord for the server, one network cable for the LAN connection, and one network cable for the RILOE management LAN connection. Using the RILOE II, customers can deploy 21 ProLiant DL560 servers in a 42U rack with significantly fewer cables than in a local console.

Server Console Switch—A device that enables multiple servers in a rack to be accessed and managed by a single keyboard, mouse, and monitor. These switches are also known as KVM switches.

Sliding Rail—A tool-free rack management system designed for in-rack serviceability.

UID LED and Switch—The blue Unit Identification (UID) LED identifies that the ProLiant DL560 server requires service. A UID switch toggles both the front and rear UID LEDs simultaneously.

Volt-ampere (VA)—A rating of apparent power (i.e., the amount of AC power that is available to or can be handled by utility equipment) measured with a voltmeter and an ammeter. In single-phase systems, VA = E × I, where E = volts and I = current in amperes. In three-phase systems, VA = 1.73 × E × I.

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

Watt (W)—A rating of true power consumed by the product and measured with an input power meter. In single-phase systems, W = E x I x pf, where E = volts, I = current in amperes, and pf = power factor.

For detailed information about the products in this glossary, refer to http://www.hp.com/ .

for more information

Product information: 1-800-345-1518

Pre-sales: 1-800-282-6672

Post-sales: 1-800-652-6672

Business partner sales consulting: 1-800-888-5874

For more information on ProLiant servers, refer to http://www.hp.com/servers/proliant.

For more information on HP 9000 and 10000 series racks and options, refer to http://www.hp.com/products/racks.

Learn more about optional rack features at http://www.hp.com/products/rackoptions.

Learn more about ProLiant server power protection and management at http://www.hp.com/products/ups.

feedback

Please direct comments and regarding this communication to the ISS Technology Communications Group at TechCom@HP.com

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