Power distribution solutions for the ProLiant DL580 G2 server

Introduction

This white paper provides power information for system configurations using the ProLiant DL580 Generation 2 (G2) server. This information is intended for field systems engineers, IT managers, installation technicians, or any personnel tasked with the installation and maintenance of the ProLiant DL580 G2 server. This white paper supplements and should be used in conjunction with documentation supplied with or for the ProLiant DL580 G2 server.

Symbols in text

The following symbols can be found in the text of this document:

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.

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

Executive summary

The ProLiant DL580 G2 server is a 4U (7-inch) high unit designed for installation in a standard 19-inch rack. The installation of a multi-unit system can place significant demands on utility power that, if not considered and managed appropriately, can result in downtime due to equipment failure, power main failure, or both. Power management becomes a critical element in an enterprise system handling large volumes of data and/or users where downtime costs can easily run into thousands of dollars per hour.

NOTE: This document discusses only HP products and solutions although the information and ideas presented herein may be applicable to third party hardware.

Glossary

Table 1. Glossary terms

Term	Definition
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.
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.
keyboard/video/mouse	Keyboard/video/mouse (KVM) peripherals. A KVM switch a component that switches a single KVM set between two or more server units.
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

Term	Definition
	connected to the AC mains, the amount of leakage can increase. •
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.
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)	Rack-mounted component that connects directly to the building's AC power infrastructure. The PDU typically provides circuit-breaker protection for groups of AC outlets into which separate AC components of the rack are plugged. Some PDU designs offer primary/secondary switching.
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 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.
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, I = current in amperes. In three-phase systems VA = 1.73 × E × I.
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.

ProLiant DL580 G2 server power requirements

In the standard single-processor configuration, the ProLiant DL580 G2 server includes one 800-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 DL580 G2 server uses an IEC C20-type AC plug that requires a power cable with an IEC C19 receptacle at one end. Power cord kits that are compatible with the physical and electrical requirements of the DL580 G2 are available from HP and listed later in this document.

The ProLiant DL580 G2 server power specifications are provided in the following table using values derived from the product specification as well as the Power Calculator utility with a unit in the nominal and maximum configurations.

Table 2. ProLiant DL580 G2 server power specifications

	Input voltage					
	100	**115**	**208**	**220**	**230**	**240**
power supply rated output (W)	800	800	800	800	800	800
nom. input wattage (W)	677	658	632	632	632	628
max. input wattage (W)	940	913	877	877	877	865
nom. input current draw (A)	7.1	6.0	3.1	2.9	2.8	2.7
max. input current draw (A)	9.9	8.4	4.3	4.1	3.9	3.7
nom. input (VA)	713	693	645	645	645	636
max. input (VA)	989	962	895	895	895	883
max. thermal (BTU/Hr)	3204	3115	2990	2990	2990	2951
efficiency (%)	70	72	75	75	75	76
power factor	0.95	0.95	0.98	0.98	0.98	0.98
mom. leakage current (mA)	0.43	0.50	0.90	0.96	1.00	1.04
max. leakage current (mA)	0.87	1.00	1.81	1.91	2.00	2.09
nom inrush current (A) @ 20 ms	25	25	25	25	25	25
max inrush current (A) @ 20 ms	50	50	50	50	50	50

NOTES:

Nom. = Nominal rating of a unit operating w/ one or two processors, up to 4DIMMs, and up to three PCI cards.
Max. = Maximum rating of a fully loaded unit: 4 processors, 16 DIMMs, 6 PCI cards, and 2 power supplies.
These values are derived from a combination of product specifications and the Power Calculator configured as above in "Nom" and "Max."

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.

Figure 1 shows a PDU using the 0U rack mounting option. 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 1. 0U rack mounting option

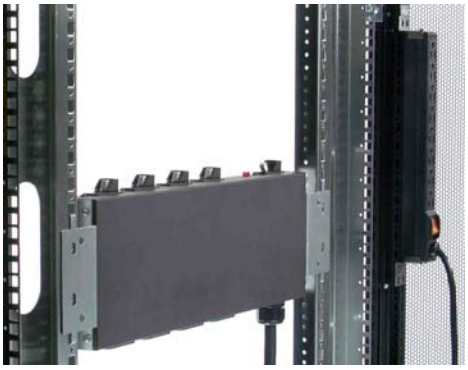


Figure 2 shows a PDU using the 1U rack mounting option. This configuration may be preferable in installations where operator or maintenance accessibility to all components is key. The 1U configuration offers the following advantages:

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

Figure 2. 1U rack mounting option

Modular PDU

The Modular PDU (see Figure 3) consists of a control core that connects to the power bus (or to a UPS) and four extension bars that distribute power to the equipment groups. The control core 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 core may be rack-mounted in a 0U or 1U configuration. The extension bars include mounting brackets for attachment to vertical rack supports.

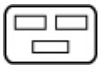
Figure 3. Modular PDU components

Control Core

Extension Bar (I of 4)

Depending on configuration, extension bar deployment may be optional (i.e., equipment may be connected directly to the control core with the appropriate jumper cord). Several versions of Modular PDUs are available to meet a variety of electrical requirements as indicated in Table 3.

Table 3. Modular PDU types

Name, PN	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 	4 x IEC 320 C13 (8) 
40A World Wide, 252663-B21	200-240 / 40	Terminal for hardwiring	3 x IEC 320 C13 (8)  1 x IEC 320 C19 (4) 

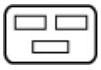
Single input PDU

The Single Input PDU (see Figure 4) consists of one module that distributes power for equipment in groups of three or four. Available in low- and high-voltage versions, the single input PDU provides a circuit breaker for each equipment group. The single input PDU may be rack-mounted in a 0U or 1U configuration.

Figure 4. Single input PDU (shown in 1U mounting configuration)

Several versions of Single Input PDUs are available to meet a variety of electrical requirements as indicated in Table 4.

Table 4. Single input PDU types

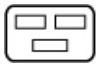
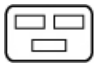
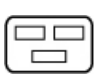
Name, PN	Voltage/Amperage	AC bus connector	Output connector type (qty)
16A World Wide, 207590-B21	200-240 / 16	IEC 320 C20 	IEC 320 C13 (12) 
24A NA/LA/JPN Low, 207590-D71	100-127 / 24	NEMA L5-30P 	NEMA 5-15R (12) 
24A NA/LA/JPN High, 207590-D72	200-240 / 24	NEMA L6-30P 	IEC 320 C13 (12) 
32A International, 207590-B31	200-240 / 32	IEC 309 	IEC 320 C13 (12) 
40A World Wide, 207590-B23	200-240 / 40	Terminal for hardwiring	IEC 320 C13 (6)  IEC 320 C19 (3) 

Power/jumper cords

Although PDUs and servers are typically shipped with power cords, a particular configuration's physical and/or electrical requirements may require different cords, as shown in Table 5.

WARNING: Never cut or splice cords to accommodate a configuration. **Personal injury or equipment damage could result in the use of improper power cords.** The correct factory cord should always be used.

Table 5. Power/jumper cords compatible with the ProLiant DL580 G2 server

Type		Amperage/length	Option kit # (qty per kit)/spares kit
IEC 320 C19  To	NEMA 5-15P 	12A/ 12ft (3.6m)	178968-001/237457-001
IEC 320 C19  To	NEMA L6-20P 	16A / 12ft (3.6m)	235604-001/237458-001
IEC 320 C19  To	IEC 320 C14 	16A / 10ft (3.0m)	291034-B21 (1) / na
IEC 320 C19  To	IEC 320 C20 	10A / 10ft (3.0m)	295633-B21 (1) /295508-001
IEC 320 C19  To	CEE 7/7 "Schuko" 	16A Euro / 12ft (3.6m)	295529-021 (25) /295547-002
IEC 320 C19  To	BS1363 	13A UK / 12ft (3.6m)	295529-03 (25) /295547-031
IEC 320 C19  To	IEC 309 	16A / 12ft (3.6m)	295529-081 (25) /295547-003
IEC 320 C19  To	NEMA L6-20P 	20A / 12ft (3.6m)	340653-001 (1) /295547-001
IEC 320 C19  To	BS-546 	16A C6 S. Africa / 12ft (3.6m)	295529-AR1 (25) /295547-AR1

Power configuration examples

The high/low voltage and dual-power supply capabilities of the ProLiant DL580 G2 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 (208VAC) 6-chassis power configuration

Figure 5 shows a configuration where high voltage (208 VAC) is distributed to six 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. In this case, each core could be called on to provide about 22.8 amps to the servers, leaving a certain amount of headroom for auxiliary devices, such as KVM switches, a TFT display, and rack monitoring devices

Figure 5. High voltage (208 VAC) 6-chassis power configuration

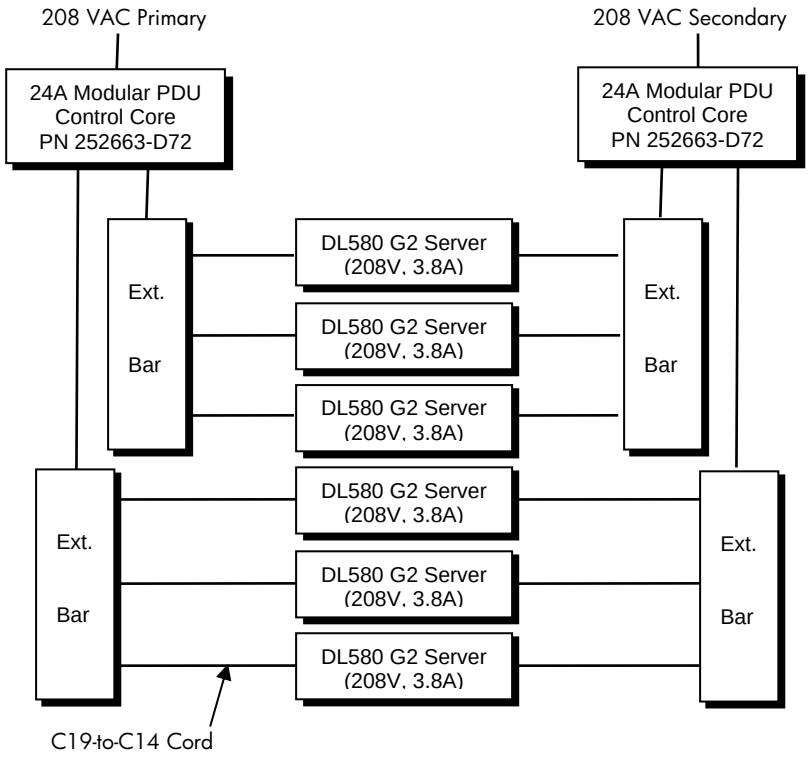


Table 6. Power statistics for high voltage 6-chassis power configuration

core current handling capacity	24 amperes
control core load	22.8 amperes (Power Calculator output using 4 CPUs, 8-GB memory, 72-GB HDD x 4, and 3 PCI cards)
headroom current available for rack peripherals	1.2 amperes
power cord used for server-to-extension bar jumper	C19 to C14 (PN 291034-B21)

High voltage (230 VAC) 9-chassis power configuration

Figure 6 shows a configuration where high voltage (230 VAC) is distributed to nine 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 core and three extension bars. Each control core can handle a maximum of 32 amps. In this case, each core could be called on to provide about 30.6 amps to the servers, leaving a certain amount of headroom for auxiliary devices, such as KVMs, a TFT display, and rack monitoring devices.

Figure 6. High voltage (230 VAC) 9-chassis power configuration

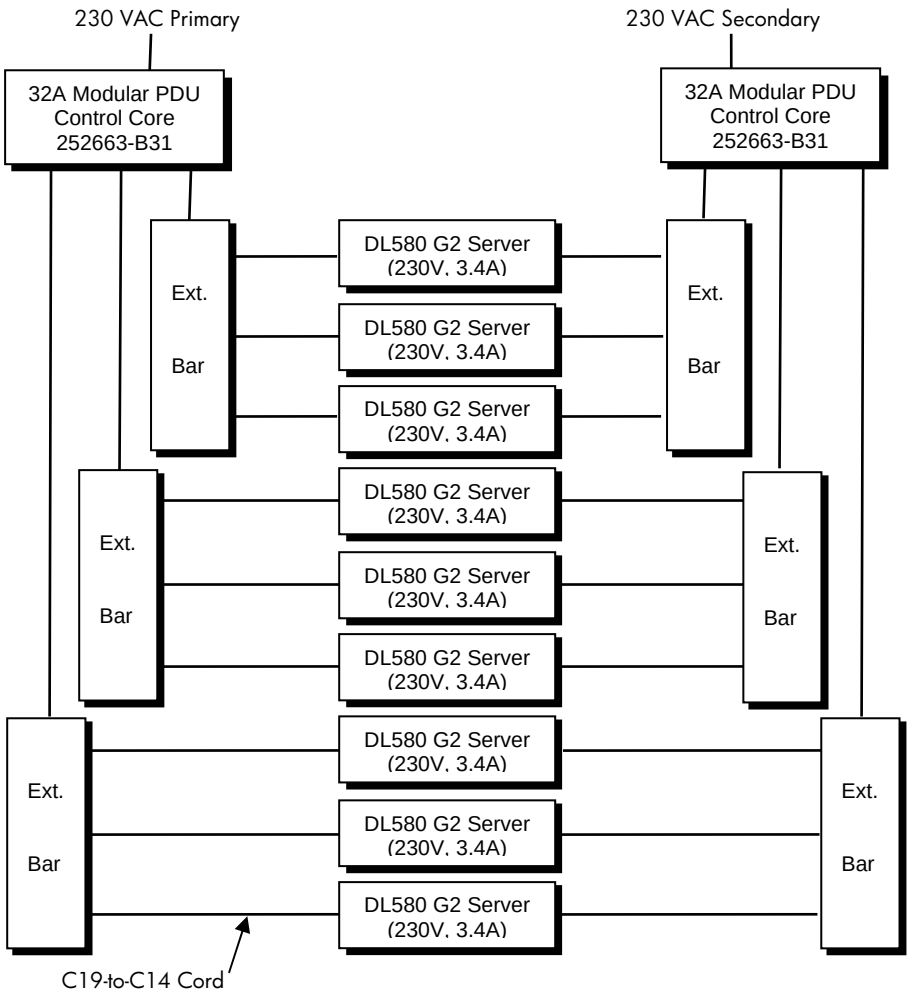


Table 7. Power statistics for high voltage 9-chassis power configuration

core current handling capacity	32 amperes
control core load	30.6 amperes (Power Calculator output using 4 CPUs, 8 GB memory, 72-GB HDD x 4, and 3 PCI cards)
headroom current available for rack peripherals	1.4 amperes
power cord used for server-to-extension bar jumper	C19 to C14 (PN 291034-B21)

Low voltage (120 VAC) 3-chassis power configuration w/modular PDUs

The following figure 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 22.2 amps, approximately 1.8 amps are left for peripheral devices. The servers are connected directly to the modular PDU's control core with C19-C20 jumper cords (PN 295633-B21), which are rated for high voltage but are also rated at 16 amps so they each can easily handle a 7.4-amp current load. The extension bars would be necessary for connecting peripherals with NEMA 5-15P power cords.

Figure 7. Low voltage (120 VAC) 3-chassis power configuration w/modular PDU

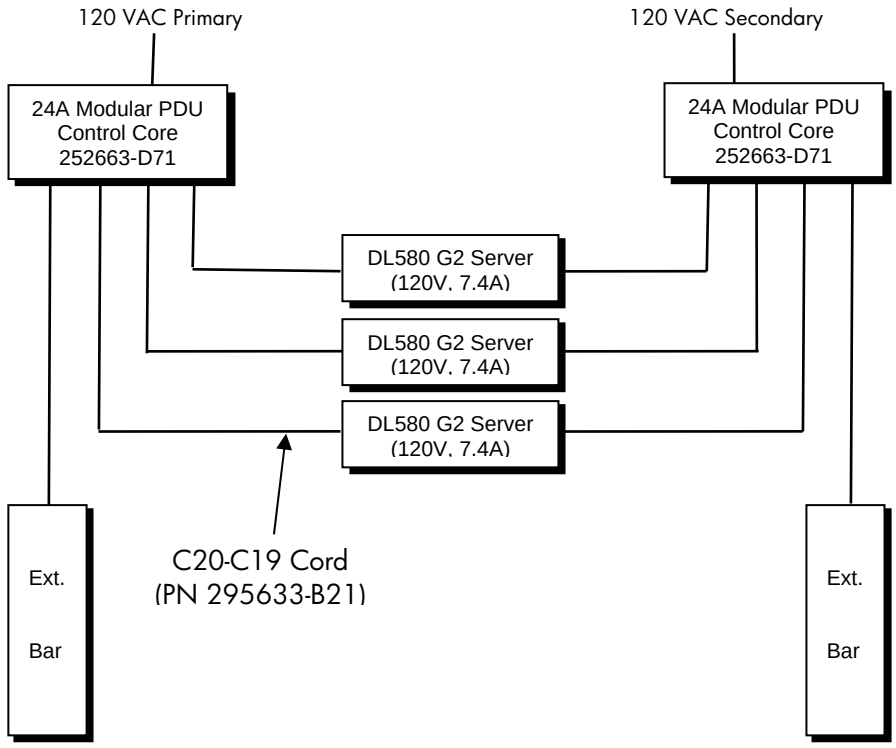


Table 8. Power statistics for low voltage 3-chassis power configuration (w/modular PDUs)

core current handling capacity	24 amperes
control core server load	22.2 amperes (Power Calculator output using 4 CPUs, 8 GB memory, 72-GB HDD x 4, and 3 PCI cards)
headroom current available for peripheral devices	1.8 amperes
power cord used for server-to-control core jumper	C20 to C19 (PN 295633-B21)

Low voltage (120 VAC) 3-chassis power configuration w/single input PDUs

The following figure shows a configuration of three server units operating off primary and secondary low voltage busses through two single input PDUs rated at 24 amps each. With a combined server load of 22.2 amps, approximately 1.8 amps are left for peripheral devices that in this particular case could be plugged into each PDU's 9 remaining NEMA 5-15R outlets. The servers are connected to the primary and secondary PDU modules with C19-C20 jumper cords (PN 178968). These cords are rated at 10 amps each and can easily handle the server's current drain.

Figure 8. Low voltage (120 VAC) 3-chassis power configuration w/single Input PDU

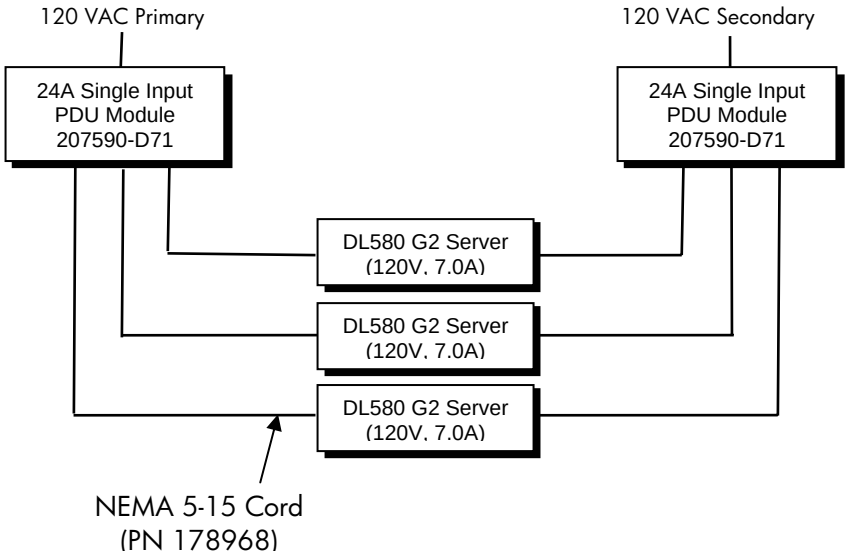


Table 9. Power statistics for low voltage 3-chassis power configuration (w/single input PDUs)

PDU current handling capacity	24 amperes
PDU server load	22.8 amperes
headroom current available for peripheral devices	3 amperes
power cord used for server-to-PDU jumper	NEMA 5-15P to C19 (PN 178968)

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 Windows meat grinder utility.
- 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:

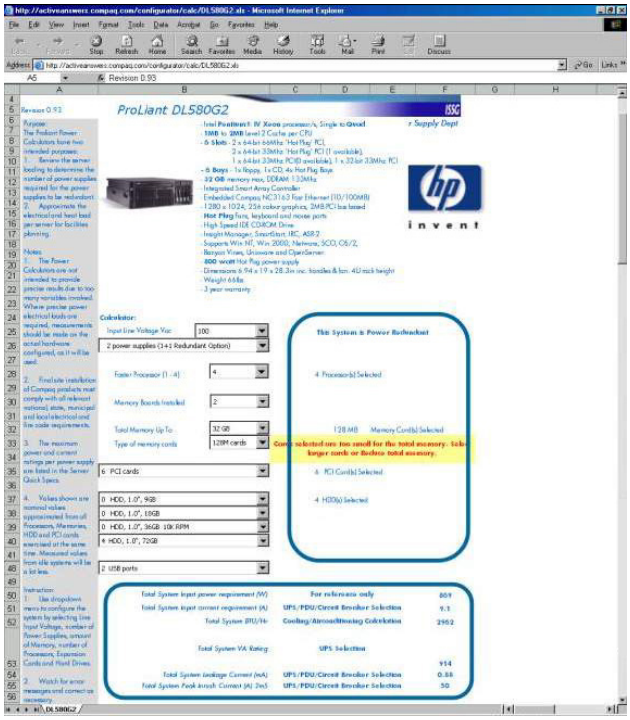
NOTE: Microsoft Excel must be installed on the system you are using to view these utilities

- Power Calculator – calculates the power requirements for a single DL580 G2 server
- Site Preparation Calculator – calculates the power, vertical space, and airflow/cooling requirements for a complete rack of equipment

Power Calculator utility

The Power Calculator utility (Figure 9) computes the power requirements for a single DL580 G2 server. Using drop-down menus, the user selects the number of CPUs, 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 will be displayed if a particular parameter will not work or will seriously impede performance.

Figure 9. Opening screen of Power Calculator utility



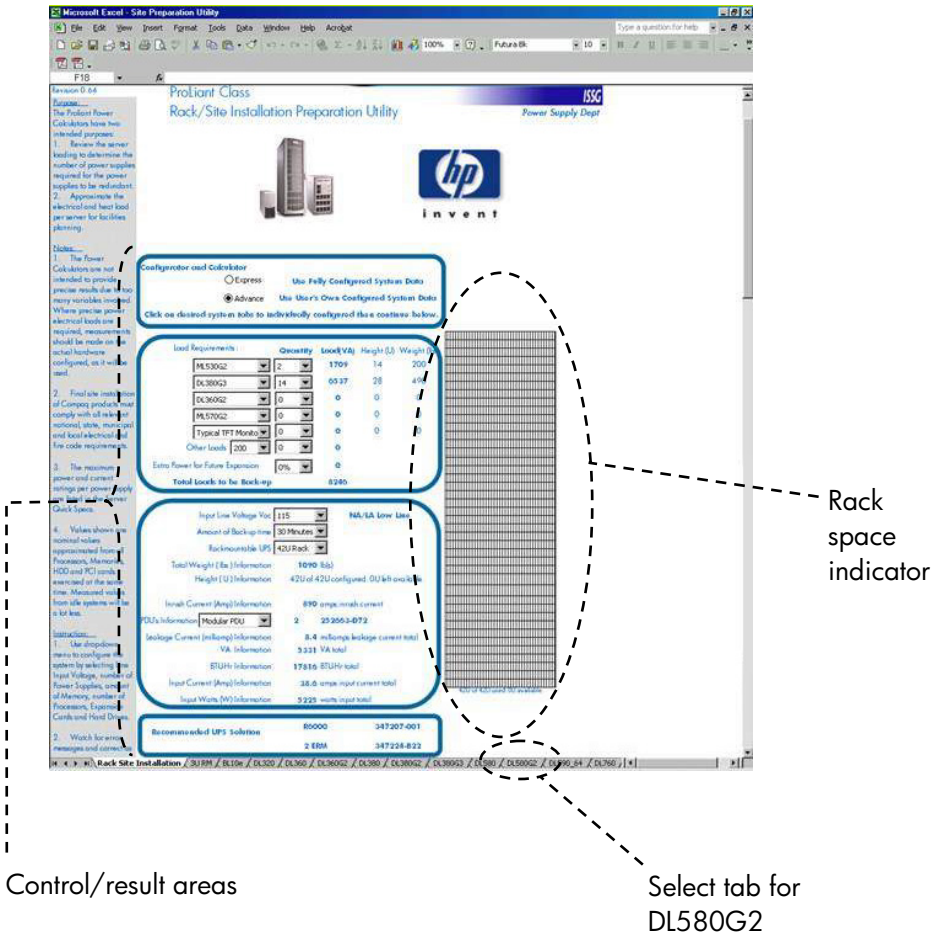
The Power Calculator utility is convenient for small server system planning or for making minor additions to existing installations. For a more thorough analysis of a complete installation, the Rack/Site Preparation utility is recommended.

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 10), which includes four control/result areas, individual calculator tabs, and a rack space indicator.

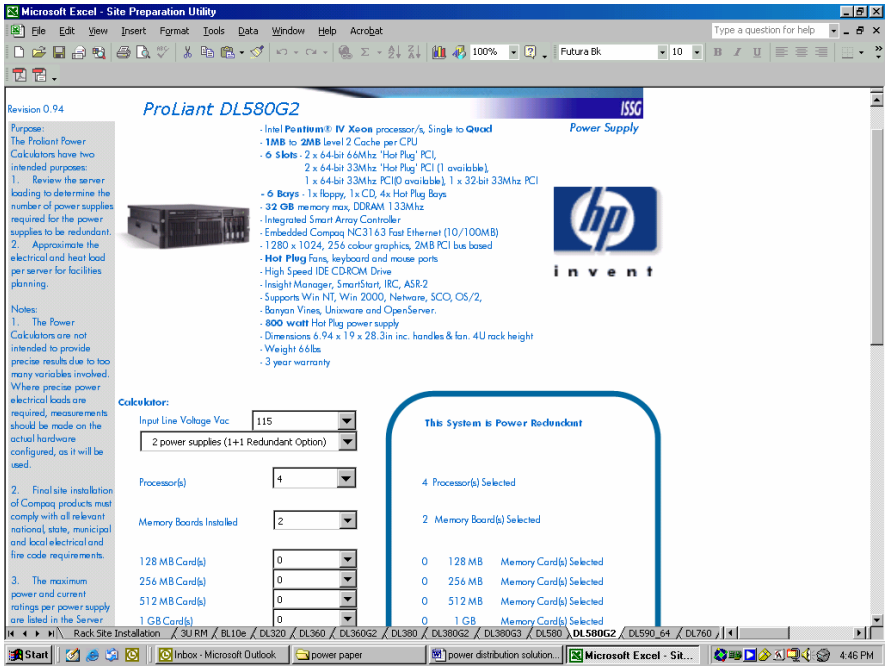
Figure 10. Opening screen of Rack/Site Preparation utility



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 user to configure individual components and is recommended for final installation planning. If “Express” mode is selected, then proceed to step 5.
2. Select “DL580G2” tab at bottom of screen. Individual component configuration page is displayed Figure 11).

Figure 11. 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 “Rack Site Installation” tab to return to the main calculator page (Figure 10).
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.

Conclusion

The load requirements of high-density server installations can be significant. Careful planning using accurate calculations and providing overhead compensation for peripheral devices can greatly reduce the chances for downtime due to power problems.

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

On ProLiant servers visit: www.hp.com/servers/proliant

On HP 9000 and 10000 series racks and options visit: www.hp.com/products/racks

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

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

Call to action

To help us better understand and meet your needs for ISS technology information, please send comments about this paper to: TechCom@HP.com.

TC0301013WP, 1/2003

Printed in the US