Data Center Planning

Flex System Data Center Planning v2.0.3

FLEX SYSTEM ENTERPRISE CHASSIS

The Flex System Enterprise Chassis is a simple, integrated infrastructure platform that supports a mix of compute, storage, and networking resources to meet the demands of your applications. The 14 node, 10U chassis delivers high-speed performance and is designed for simple deployment.

POWER: FLEXIBILITY & EFFICIENCY

The system monitors and manages power usage on all major chassis components so you have total control over power consumption. Available power supply options are -48V DC, HVDC and 80 PLUS Platinum-certified AC power supplies which can be configured in either a single or three-phase power domain.

COOLING: OPTIMIZATION

The chassis design optimizes cooling with cooling zones within the chassis which manages the fan modules based on node configuration within the chassis. The system can increase the speed of certain fan modules to cool potential hot spots, and use lower speeds for other fan modules where appropriate.

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Revision History

1.0.0 – April 30, 2012	Initial Release.
1.2.0 – December 17, 2012	Update information and configurations for the 2100W optional PSU. Added information on PDU line cords. Correct 2500W PSU amp rating. Added System x PureFlex power & cooling part numbers.
1.3.0 – June 7, 2013	Added PureFlex Configuration Examples, new PDUs, System x ToR Switches & System x Storwize V7000 Power Numbers section. Updated Flex System line cord section.
1.3.1 – July 12, 2013	Fix UPS example diagrams. Updated switch part numbers.
1.3.2 – August 27, 2013	Updated the "PSU Compatibility Matrix" section to include x222.
2.0.0 – June 30th, 2014	Added number node support, revised content. Split diagrams out.
2.0.1 – November 30th, 2014	Changed format and emails. Remove Power System information. Added -48V DC PSU information.
2.0.2 – January 14th, 2015	Updates to x240 M5 power on policy.
2.0.3 -April 1st, 2015	Update to template. Add -48VDC information

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Table of Contents

Introduction

The Flex System Enterprise Chassis covered in this guide is currently marketed worldwide. The intent of this guide is to provide power information for installation planning and configuring of Flex System Enterprise Chassis.

How to use this guide

Any Flex System Enterprise Chassis configuration examples documented in this guide state the supported redundancy in the "System x Flex Power Management Policies" table. Flex System Enterprise Chassis has configurations with N+N redundancy, where the goal is to provide the support for two power source configurations. To take full advantage of this redundancy and reliability, the chassis must be powered from two independent distribution panels and the System x Flex Power Management Policy must be set to a policy that is N+N capable. When properly wired and the appropriate power policy set, the System x Flex SE chassis can remain in operation if one of the two power sources fails.

Power connections to the System x Flex chassis must be wired to comply with local and/or national electrical codes. Consult your local AHJ (Authority Having Jurisdiction) to ensure compliance.

Important Notice: For an accurate representation of your configurations power please use the System x Power Configurator tool located at: http://www.ibm.com/support/entry/portal/docdisplay?lndocid=LNVO-PWRCONF

For Flex System PDU configuration examples refer to the ***"Flex System PDU Planning Guide"*** available for download from: http://www.ibm.com/support/entry/portal/docdisplay?lndocid=LNVO-PWRCONF

Flex System power and cooling overview

Use the System x Power Configurator tool to estimate power consumption and heat load for the Flex System Enterprise Chassis configurations. Download the tool from the following link:
http://www.ibm.com/support/entry/portal/docdisplay?lndocid=LNVO-PWRCONF

Flex System Power Supply Unit (PSU) overview

2100W AC PSU – Rating & Part Number Information		
Power Supply Unit Part Numbers	PN: 47C7633	FC: A3JH
DC Output Wattage	2100W	
Nominal Input Voltage Range	200-208, 220-240V AC @ 50-60 Hz.	
PSU Max Input Amps @ 200-240V:	11.8A	

2500W AC PSU – Rating & Part Number Information		
Power Supply Unit Part Numbers	PN: 43W9049	FC: A0UD
DC Output Wattage	2500W	
Nominal Input Voltage Range	200-208, 220-240V AC @ 50-60 Hz.	
PSU Max Input Amps @ 200-240V:	13.8A	

2500W -48 DC PSU – Rating & Part Number Information		
Power Supply Unit Part Numbers	PN: 00FJ635	FC: A5VC
DC Output Wattage	2500W	
Nominal Input Voltage Range	48V (-48V to -60V)	
PSU Max Input Amps @ 200-240V:	56A	

2500W HVDC PSU – Rating & Part Number Information		
Power Supply Unit Part Numbers	PN: 00FJ635	FC: A5VC
DC Output Wattage	2500W	
Nominal Input Voltage Range	240-380 V DC (192 V - 400 V input range)	
PSU Max Input Amps @ 200-240V:	11.5A	

Figure 1 displays the AC, HVDC, and -48VDC power supply options for the Flex System Enterprise Chassis.

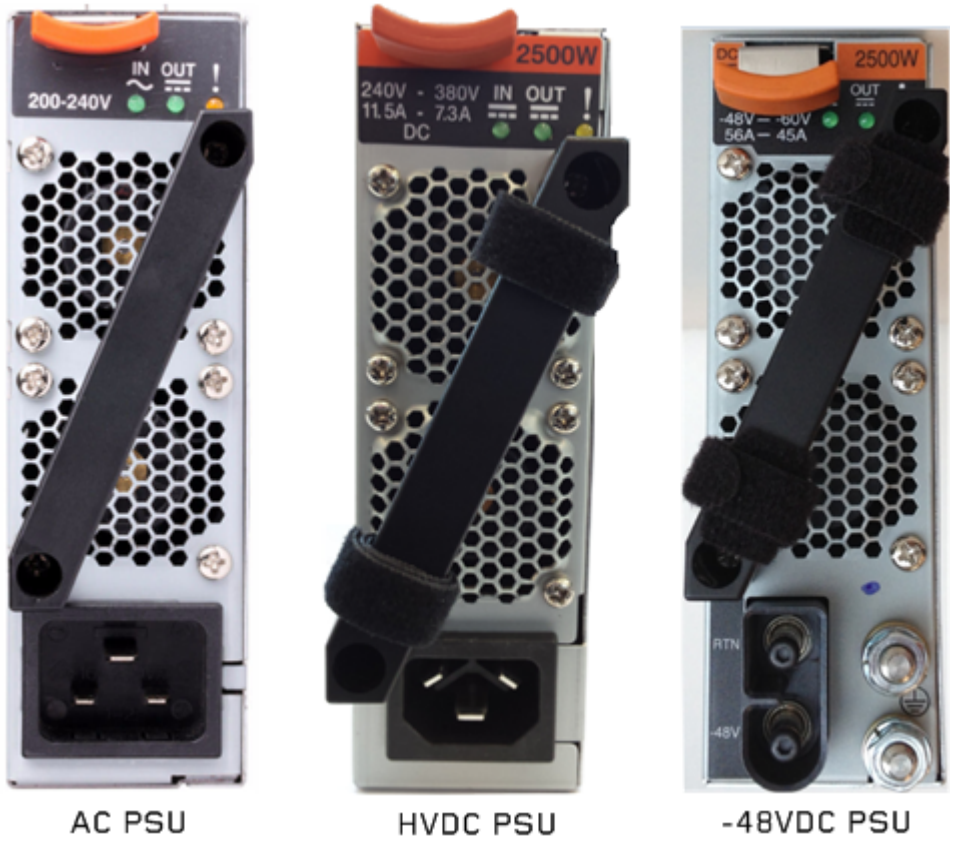


Figure 1: Flex System Enterprise Chassis PSU options

Flex System power topology overview

The following diagram is an illustration of the power topology in the Flex System Chassis.

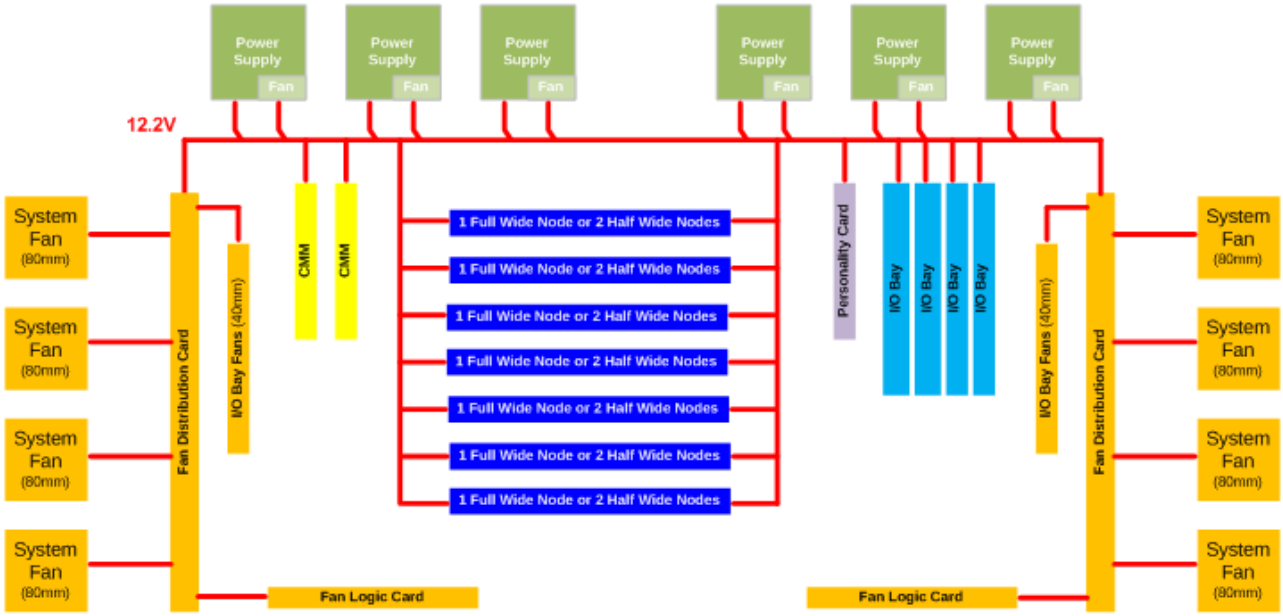


Figure 2: Power topology diagram

Flex System Power Supply placement

The power supplies in the Flex System Chassis are labeled from bottom to top, right to left, when viewed from the rear of the chassis as seen in Figure 3.

Figure 3: Flex System Enterprise Chassis power supply locations

Power Supply and cooling configuration rules

- Mixing of the 2100W PSU and the 2500W PSU, is not supported in the same chassis. All power supplies installed in the chassis must be identical.
- PSUs can be added as required to meet the power load requirements of the chassis configuration.
- The minimum number of PSUs (both AC and DC) required to power the chassis is 2. Refer to Minimum PSU Requirements for additional information on PSU installation requirements.
- The minimum number of 80mm fans to cool the chassis is 4. Refer to Flex System fans for additional information on fan installation requirements.
- PSUs, fans and nodes should be installed from the bottom up.
- The PSU installation order is: 1, 4, 2, 5, 3, and 6.
- AC and DC power supplies can not be mixed in the same chassis.

80 PLUS

80 PLUS is a performance specification for power supplies used within servers and computers. To meet the 80 PLUS standard, the power supply must have an efficiency of 80% or greater, at 20%, 50%, and 100% of rated load with PF of 0.9 or greater. The standard has several grades, such as Bronze, Silver, Gold, Platinum, and Titanium. More information on 80 PLUS is available at http://www.80PLUS.org.

The power supplies used in Flex System are hot-swap high efficiency 80 PLUS Platinum power supplies operating at 94% efficiency. The efficiency varies by load as shown in the table below.

The 80 PLUS Lenovo reports are available from:
http://www.plugloadsolutions.com/80PlusPowerSuppliesDetail.aspx?id=49&type=2

Flex System fans

This section discusses the cooling zones in the Flex System Enterprise Chassis.

The chassis consists of 40mm fans and 80mm fans. The following table lists the ordering part number for the 80mm fan modules. These are shipped in pairs.

Part Number	Feature Code	Description
43W9078	A0UA	80mm Fan Module Pair

The Chassis is cooled from front to rear where cool air enters the front and warm air exits at the back as seen in Figure 10.

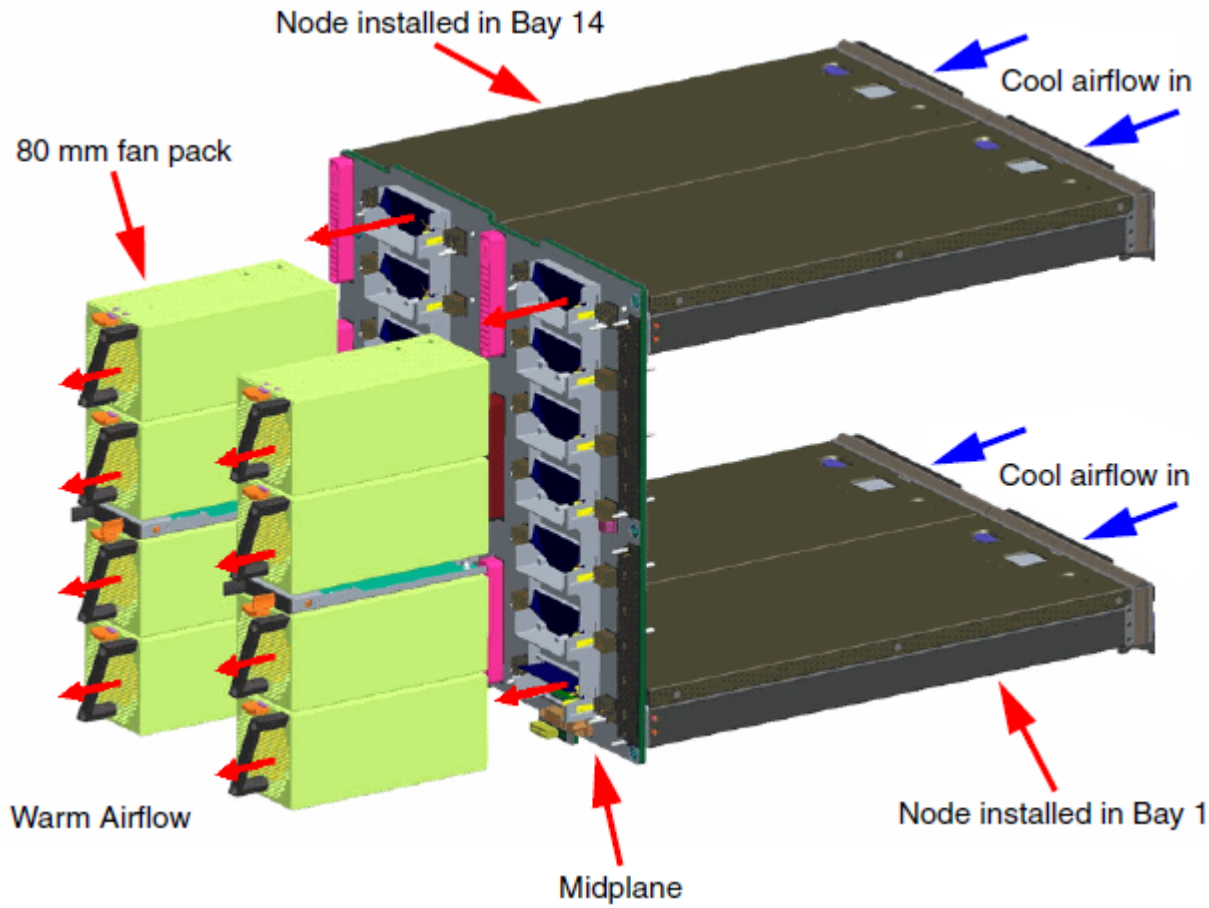


Figure 4: Flex System airflow

The 40mm fans are responsible for cooling the switch modules and the CMM via 2 fan packs that each consist of 2 x 40mm fans side by side. The fan packs are pre-installed and ship standard in bays 5 and 10. Figure 5 displays a single fan pack that consists of the 2x 40mm fans.

Note that the PSUs also contain 2x 40mm fans that are independently powered (by the chassis midplane) to cool the PSUs.

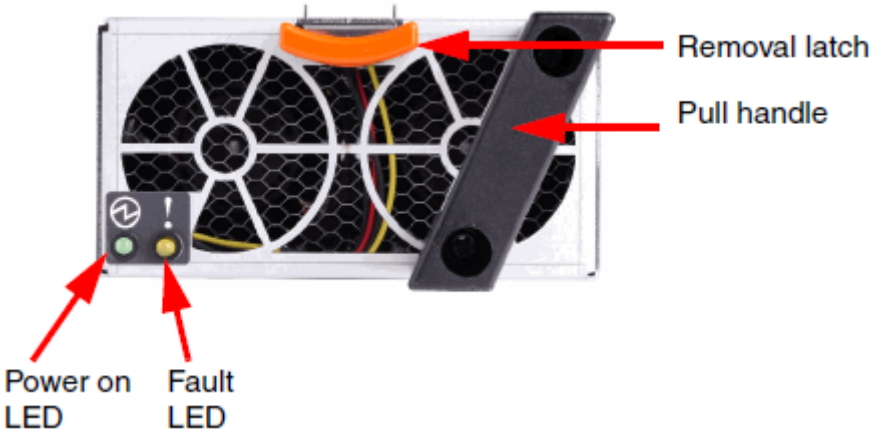


Figure 5: Flex System 2x 40mm fans, counter rotating

The 80mm fans are used to cool the installed nodes and are installed in bays 1-4 and 6-9. Figure 6 displays the 80mm fan.

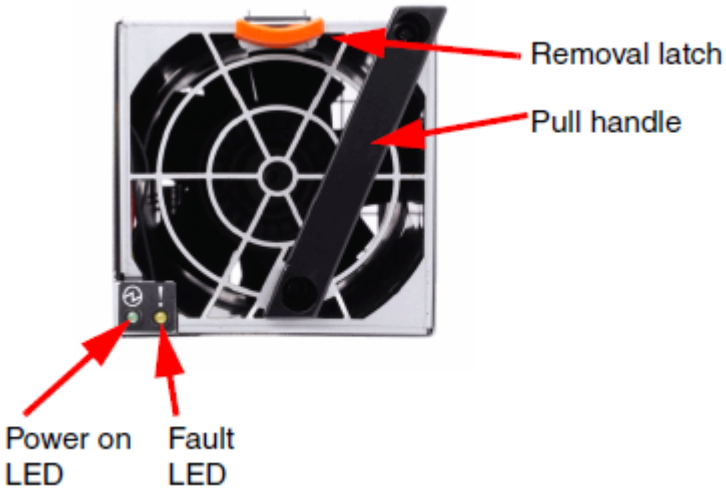


Figure 6: Flex System 80mm fan, counter rotating

The location of the 40mm fans in bays 5 and 10 and the 80 mm fans in bays 1-4 and 6-9 at the rear of the chassis are displayed in Figure 7.

Figure 7: Flex System 40mm and 80mm fan locations

Flex System cooling zones

There are 4 cooling zones in the Flex System Enterprise Chassis. The zones are broken up into Zone 1 (fans 1-4), Zone 2 (fans 6-9), Zone 3 (fan 5), and Zone 4 (fan 10). Zone 1 and 2 cool the nodes and Zone 3 and 4 cool the switches and CMM.

Zone 1 and Zone 2 are displayed in Figure 8 below. These zones are cooled by the 80mm fans. The 40mm fans in bays 5 and 10 are shipped pre-installed in the chassis and cool zones 3 and 4 respectively. The chassis is cooled from front to rear, where cool air enters the front and warm air is pushed out the rear.

Figure 8: Flex System 80mm fan cooling zones

The following table lists the quantity of 80mm fans required per number of nodes installed to maintain cooling redundancy of N+1.

Zone 1		Zone 2		Total	
# of 80mm Fans Required	# of Nodes Installed	# of 80mm Fans Required	# of Nodes Installed	Up to # of Fans	Up to # of Nodes
2	1-2	2	1-2	2 fans	4 nodes
3	3-4	3	3-4	6 fans	8 nodes
4	5-6	4	5-6	8 fans	12 nodes

Fans installed in bays 1, 2, 6, and 7 (4 total) will cool node bays 1, 2, 3, and 4.
Fans installed in bays 1, 2, 3, 6, 7, and 8 (6 total) will cool node bays 1, 2, 3, 4, 5, 6, 7, and 8.
Fans installed in bays 1, 2, 3, 4, 6, 7, 8, and 9 (all fans) will cool node bays 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, and 12.
Fans 5 and 10 are responsible for cooling Zone 3 and Zone 4. These Zones contain the switches and CMM at the rear of the Chassis as seen in Figure 9.

Figure 9: Flex System 40mm fan cooling zones

Fans installed in bay 5 will cool switch modules 2 and 4, and CMM 1, and 2.
Fans installed in bay 10 will cool switch modules 1 and 3.

The fans are managed by the Chassis Management Module (CMM) in the Chassis. The CMM will report on the fan speed, zone., status and state. Figure 10 displays a screen shot of the Fan and Cooling page from the CMM.

Fans and Cooling

Cooling Devices | Cooling Zones | Acoustic Attenuation

Fan	Speed (RPM)	Speed (% of maximum)	Zone	Status	Controller State
Fan 1	2560	26%	1	Normal	Operational
Fan 2	2560	26%	1	Normal	Operational
Fan 3	3072	27%	1	Normal	Operational
Fan 4	2496	25%	1	Normal	Operational
Fan 5	8704	39%	3	Normal	Operational
Fan 6	2624	26%	2	Normal	Operational
Fan 7	2560	26%	2	Normal	Operational
Fan 8	3072	27%	2	Normal	Operational
Fan 9	2496	25%	2	Normal	Operational
Fan 10	8704	39%	4	Normal	Operational

Figure 10: CMM Fans and Cooling page

Flex System power considerations

The following section discusses the System x Power Maximizer software tool and how it is integrated and used with the Flex System to help budget the system power and determine power policies.

System x Power Maximizer

System x Power Maximizer is an integrated software tool for determining the as-configured total power budget for all new System x, Flex System, iDataPlex, and NeXtScale systems. This technology takes a more granular approach of determining system and chassis power budget than using look-up tables in system management devices. The benefits of this allow power policies to be set based on actual component power consumption under any supported operating condition or workload. Power policies are able to be more accurately maintained without unnecessary over-budgeting to ensure as much available power is provisioned by the system as the policies allow. This prevents resiliency and performance impacts such as unexpected throttling and system nodes powering off unexpectedly.

The System x Power Maximizer functions by running separate, sub-system specific workloads and then calculates a total worst-case power consumption estimate. The result of the System x Power Maximizer is reported to the respective management interface for determining power-on support and redundancy policy of the supported systems. The System x Power Maximizer result is not directly reported to any user interface, but the power policies are managed by this configuration specific power budget. This means that as the configurations change, the enclosure will automatically manage the provisioned power according to the power policy set by the end user.

The System x Power Maximizer software is an integrated part of each node and is hidden and not accessible to the end-user. The software runs when the node is powered-on as a component of the uEFI. The power requirement of the node is determined by the Power Maximizer software and is communicated to the Chassis Management Module (CMM) of the Flex System Chassis. The CMM is discussed in the next section.

Chassis Management Module (CMM)

The Flex Chassis can accommodate up to 2 Chassis Management Module (CMM). The speed of the fans and power budgeting in the Flex Chassis system are both controlled by the CMM. The CMM is located at the rear of the Flex Chassis enclosure and is a hot swappable component as seen in Figure 11.

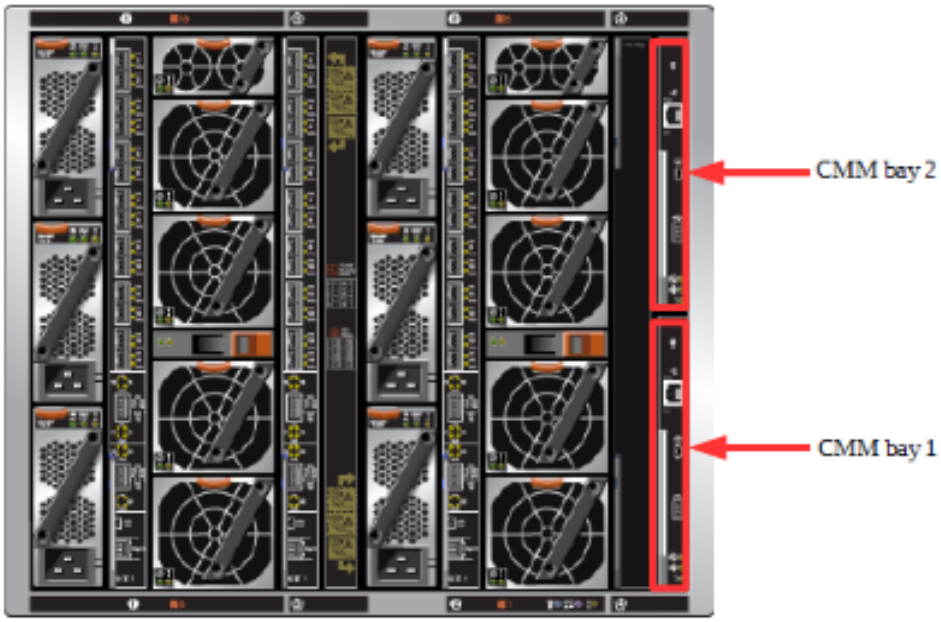


Figure 11: CMM bay 1 and bay 2

The CMM controls the following functions:

- Power control/policies
- Fan management
- Chassis and compute node initialization
- Switch management
- Diagnostics
- Resource discovery and inventory management
- Resource alerts and monitoring management
- Chassis and compute node power management
- Network management

The CMM provides power management functions for the user via a web GUI or CLI. Refer to the Flex System CMM Power and Thermal Overview section on page 45 for additional information on the CMM interface.

You can connect locally to the CMM via serial or remotely to the web interface via a 10/100/1000Mbps Ethernet port located on the CMM device. By default the CMM web interface is configured with a static IP address. The log in credentials are listed below:

IP address: 192.168.70.100
Subnet: 255.255.255.0
User ID: USERID (all capital letters)
Password: PASSWORD (where the 'o' in password is a zero)

The following section discusses the power policies that are configurable via the CMM.

Power Policies in the CMM

The web GUI via the CMM is used for configuring the chassis power policy. The following policies can be configured:

- AC Power source redundancy (N+N):
  Power is allocated under the assumption that no throttling of the nodes is allowed if a power supply fault occurs. This is an N+N configuration.

- AC Power source redundancy with compute node throttling allowed (N+N):
  Power is allocated under the assumption that throttling of the nodes are allowed if a power supply fault occurs. This is an N+N configuration.

- Power Module Redundancy (N+1):
  Maximum input power is limited to one less than the number of power modules when more than one power module is present. One power module can fail without affecting compute node operation. Multiple power node failures can cause the chassis to power off. Some compute nodes might not be able to power on if doing so exceeds the power policy limit.

- Power Module Redundancy with compute node throttling allowed (N+1):
  This mode can be described as over-subscription mode. Operation in this mode assumes that a node's load can be reduced (or throttled) to the continuous load rating within a specified time. This process occurs following a loss of one or more power supplies. The Power Supplies can exceed their continuous rating of 2500w for short periods. This is for an N+1 configuration.

- Basic Power Management:
  This allows the total output power of all power supplies to be used. When operating in this mode, there is no power redundancy. If a power supply fails or an AC feed to one or more supplies is lost, the entire chassis might shut down. There is no power throttling.

The CMM will determine the total power accessible based on the installed PSUs. It will not allow a compute node to turn on if there is insufficient power available. The following chapter discusses the power-on policies in the CMM.

Flex System power-on policies for 2100W and 2500W PSU

This section discusses the number of nodes you can install in the Flex System Chassis based on the number of PSUs, the type of node, type of CPU installed and the redundancy level required. These tables assume all ITEs are fully configured and throttling and over-subscription are enabled. Currently, we don't have a method to plan for less than worst case or configuration based planning. System x Power Configurator, in the future, will be able to validate configurations that are less than worst case and are configuration based. For more information on 'What is N+N and N+1 redundancy' refer to page 81.

x220 power-on policy

The following table represents the number of supported x220 nodes powered on, when installed in the Flex System Chassis. These are based on the type of CPU(s) installed, the type and number of PSUs installed and the level of redundancy required from the PSUs (N+N or N+1).

2100W PSU with x220 Nodes				
Microprocessor SKU (W)	N+1, N=5 6 PSUs total	N+1, N=4 5 PSUs total	N+1, N=3 4 PSUs total	N+N, N=3 6 PSUs total
50	14	14	14	14
60	14	14	14	14
70	14	14	14	14
80	14	14	14	14
95	14	14	14	14

2500W PSU with x220 Nodes				
Microprocessor SKU (W)	N+1, N=5 6 PSUs total	N+1, N=4 5 PSUs total	N+1, N=3 4 PSUs total	N+N, N=3 6 PSUs total
50	14	14	14	14
60	14	14	14	14
70	14	14	14	14
80	14	14	14	14
95	14	14	14	14

x222 power-on policy

The following table represents the number of supported x222 nodes powered on, when installed in the Flex System Chassis. These are based on the type of CPU(s) installed, the type and number of PSUs installed and the level of redundancy required from the PSUs (N+N or N+1).

2100W PSU with x222 Nodes				
Microprocessor SKU (W)	**N+1, N=5 6 PSUs total**	**N+1, N=4 5 PSUs total**	**N+1, N=3 4 PSUs total**	**N+N, N=3 6 PSUs total**
50	14	14	13*	14
60	14	14	12*	13*
70	14	14	11*	12*
80	14	14	10*	11*
95	14	13*	9*	10*

*Supported but with limitations on the number of compute nodes that can be installed.

2500W PSU with x222 Nodes				
Microprocessor SKU (W)	**N+1, N=5 6 PSUs total**	**N+1, N=4 5 PSUs total**	**N+1, N=3 4 PSUs total**	**N+N, N=3 6 PSUs total**
50	14	14	14	14
60	14	14	14	14
70	14	14	14	14
80	14	14	13*	14
95	14	14	12*	13*

*Supported but with limitations on the number of compute nodes that can be installed.

x240 power-on policy

The following table represents the number of supported x240 nodes powered on, when installed in the Flex System Chassis. These are based on the type of CPU(s) installed and type and number of PSUs installed and the level of redundancy required from the PSUs (N+N or N+1).

2100W PSU with x240 Nodes				
Microprocessor SKU (W)	N+1, N=5 6 PSUs total	N+1, N=4 5 PSUs total	N+1, N=3 4 PSUs total	N+N, N=3 6 PSUs total
60	14	14	14	14
70	14	14	13*	14
80	14	14	13*	13*
95	14	14	12*	12*
115	14	14	11*	12*
130	14	14	11*	11*
135	14	14	10*	11*

*Supported but with limitations on the number of compute nodes that can be installed.

2500W PSU with x240 Nodes				
Microprocessor SKU (W)	N+1, N=5 6 PSUs total	N+1, N=4 5 PSUs total	N+1, N=3 4 PSUs total	N+N, N=3 6 PSUs total
60	14	14	14	14
70	14	14	14	14
80	14	14	14	14
95	14	14	14	14
115	14	14	14	14
130	14	14	13*	14
135	14	14	13*	14

*Supported but with limitations on the number of compute nodes that can be installed.

X240 M5 power-on policy

The following table represents the number of supported x240 M5 nodes powered on, when installed in the Flex System Chassis. These are based on the type of CPU(s) installed and type and number of PSUs installed and the level of redundancy required from the PSUs (N+N or N+1).

2100W PSU with x240 M5 Nodes				
Microprocessor SKU (W)	N+1, N=5 6 PSUs total	N+1, N=4 5 PSUs total	N+1, N=3 4 PSUs total	N+N, N=3 6 PSUs total
52	14	14	11	11
55	14	14	11	11
65	14	14	11	11
75	14	14	11	11
85	14	14	11	11
90	14	14	11	11
105	14	14	11	11
120	14	14	11	11
135	14	13	11	11
145	14	13	11	11

2500W PSU with x240 M5 Nodes				
Microprocessor SKU (W)	N+1, N=5 6 PSUs total	N+1, N=4 5 PSUs total	N+1, N=3 4 PSUs total	N+N, N=3 6 PSUs total
52	14	14	14	14
55	14	14	14	14
65	14	14	14	14
75	14	14	14	14
85	14	14	14	14
90	14	14	14	14
105	14	14	13	14
120	14	14	13	14
135	14	14	12	13
145	14	14	12	13

x440 power-on policy

The following table represents the number of supported x440 nodes powered on, when installed in the Flex System Chassis. These are based on the type of CPU(s) installed and type and number of PSUs installed and the level of redundancy required from the PSUs (N+N or N+1).

2100W PSU with x440 Nodes				
Microprocessor SKU (W)	N+1, N=5 6 PSUs total	N+1, N=4 5 PSUs total	N+1, N=3 4 PSUs total	N+N, N=3 6 PSUs total
95	7	7	6*	6*
115	7	7	5*	6*
130	7	7	5*	5*

*Supported but with limitations on the number of compute nodes that can be installed.

2500W PSU with x440 Nodes				
Microprocessor SKU (W)	N+1, N=5 6 PSUs total	N+1, N=4 5 PSUs total	N+1, N=3 4 PSUs total	N+N, N=3 6 PSUs total
95	7	7	7	7
115	7	7	7	7
130	7	7	6*	7

*Supported but with limitations on the number of compute nodes that can be installed.

FSM power-on policy

The following table represents the number of supported FSM nodes, when installed in the Flex System Chassis. These are based on the type of CPU(s) installed and type and number of PSUs installed and the level of redundancy required from the PSUs (N+N or N+1).

2100W PSU with FSM Nodes				
Microprocessor SKU (W)	N+1, N=5 6 PSUs total	N+1, N=4 5 PSUs total	N+1, N=3 4 PSUs total	N+N, N=3 6 PSUs total
95	2	2	2	2

2500W PSU with FSM Nodes				
Microprocessor SKU (W)	N+1, N=5 6 PSUs total	N+1, N=4 5 PSUs total	N+1, N=3 4 PSUs total	N+N, N=3 6 PSUs total
95	2	2	2	2

V7000 power-on policy

The following table represents the number of supported V7000 nodes powered on, when installed in the Flex System Chassis. These are based on the type of CPU(s) installed and type and number of PSUs installed and the level of redundancy required from the PSUs (N+N or N+1).

2100W PSU with V7000 Nodes				
Microprocessor SKU (W)	**N+1, N=5 6 PSUs total**	**N+1, N=4 5 PSUs total**	**N+1, N=3 4 PSUs total**	**N+N, N=3 6 PSUs total**
All	3	3	3	3

2500W PSU with V7000 Nodes				
Microprocessor SKU (W)	**N+1, N=5 6 PSUs total**	**N+1, N=4 5 PSUs total**	**N+1, N=3 4 PSUs total**	**N+N, N=3 6 PSUs total**
All	3	3	3	3

Minimum PSU Requirements

The following tables represent the minimum number of PSU(s) required based on the number and type of nodes installed (half wide or full wide) and the type of PSU redundancy required.

2500W PSU – Half Wide Nodes Minimum PSU Required For N+N						
# of Half Wide Nodes	500 W ITE		600 W ITE		700 W ITE	
	# of PSU*	Fault	# of PSU*	Fault	# of PSU*	Fault
14	6	408	6	408	Not Supported	
13	6	444	6	440	Not Supported	
12	6	476	6	476	6	476
11	6	500	6	520	6	520
10	4	329	6	572	6	572
9	4	374	4	374	6	644
8	4	431	4	431	6	700
7	4	493	4	493	4	493
6	4	500	4	575	4	575
5	4	500	4	600	4	700
4	2	296	4	600	4	700
3	2	395	2	395	2	395
2	2	500	2	593	2	593
1	2	500	2	600	2	700

*Theoretical number that may require unrealistic throttle levels.

Note: When a fault occurs, all Nodes in the chassis must throttle to the average power, in watts, indicated in the "Fault" column. For more information on N+N and N+1 redundancy see "What is N+N and N+1 redundancy" section on page 81 in this document.

2100W PSU – Half Wide Nodes Minimum PSU Required For N+N						
# of Half Wide Nodes	500 W ITE		600 W ITE		700 W ITE	
	# of PSU*	Fault	# of PSU*	Fault	# of PSU*	Fault
14	Not Supported		Not Supported		Not Supported	
13	6	347	Not Supported		Not Supported	
12	6	376	Not Supported		Not Supported	
11	6	410	6	410	Not Supported	
10	4	451	6	451	Not Supported	
9	4	500	6	510	6	510
8	4	331	6	584	6	584
7	4	378	4	378	6	667
6	4	441	4	441	4	441
5	4	500	4	546	4	546
4	2	500	4	600	4	700
3	2	261	4	600	4	700
2	2	392	2	392	2	392
1	2	500	2	600	2	700

*Theoretical number that may require unrealistic throttle levels.

Note: When a fault occurs, all Nodes in the chassis must throttle to the average power, in watts, indicated in the "Fault" column. For more information on N+N and N+1 redundancy see "What is N+N and N+1 redundancy" section on page 81 in this document.

2500W PSU – Full Wide Nodes Minimum PSU Required For N+N						
# of Full Wide Nodes	1000 W ITE		1200 W ITE		1400 W ITE	
	# of PSU*	Fault	# of PSU*	Fault	# of PSU*	Fault
7	6	816	6	816	Not Supported	
6	6	953	6	953	6	953
5	4	658	6	1143	6	1143
4	4	863	6	863	6	1400
3	4	1000	4	1150	4	1150
2	2	593	4	1200	4	1400
1	2	1000	2	1185	2	1185

*Theoretical number that may require unrealistic throttle levels.

Note: When a fault occurs, all Nodes in the chassis must throttle to the average power, in watts, indicated in the "Fault" column. For more information on N+N and N+1 redundancy see "What is N+N and N+1 redundancy" section on page 81 in this document.

2100W PSU – Full Wide Nodes Minimum PSU Required For N+N						
# of Full Wide Nodes	1000 W ITE		1200 W ITE		1400 W ITE	
	# of PSU*	Fault	# of PSU*	Fault	# of PSU*	Fault
7	6	645	Not Supported		Not Supported	
6	6	752	Not Supported		Not Supported	
5	6	902	6	902	6	902
4	4	662	6	1168	6	1168
3	4	883	4	883	4	883
2	4	1000	4	1200	4	1400
1	2	784	2	784	2	784

*Theoretical number that may require unrealistic throttle levels.

Note: When a fault occurs, all Nodes in the chassis must throttle to the average power, in watts, indicated in the "Fault" column. For more information on N+N and N+1 redundancy see "What is N+N and N+1 redundancy" section on page 81 in this document.

2500W PSU – Half Wide Nodes Minimum PSU Required For N+1						
# of Half Wide Nodes	500 W ITE		600 W ITE		700 W ITE	
	# of PSU*	Fault	# of PSU*	Fault	# of PSU*	Fault
14	4	414	4	414	5	590
13	4	446	4	446	5	635
12	4	483	4	483	4	483
11	4	500	4	527	4	527
10	3	333	4	580	4	580
9	3	379	3	379	4	653
8	3	436	3	436	4	700
7	3	499	3	499	3	499
6	3	500	3	582	3	582
5	3	500	3	600	3	700
4	2	296	3	600	3	700
3	2	395	2	395	2	395
2	2	500	2	593	2	593
1	2	500	2	600	2	700

*Theoretical number that may require unrealistic throttle levels.

Note: When a fault occurs, all Nodes in the chassis must throttle to the average power, in watts, indicated in the "Fault" column. For more information on N+N and N+1 redundancy see "What is N+N and N+1 redundancy" section on page 81 in this document.

2100W PSU – Half Wide Nodes Minimum PSU Required For N+1						
# of Half Wide Nodes	500 W ITE		600 W ITE		700 W ITE	
	# of PSU*	Fault	# of PSU*	Fault	# of PSU*	Fault
14	5	475	5	475	5	475
13	4	353	5	512	5	512
12	4	383	5	555	5	555
11	4	417	4	417	5	605
10	4	459	4	459	5	666
9	4	500	4	519	4	519
8	3	336	4	594	4	594
7	3	384	3	384	4	679
6	3	448	3	448	3	448
5	3	500	3	554	3	554
4	3	500	3	600	3	700
3	2	261	3	600	4	700
2	2	392	2	392	2	392
1	2	500	2	600	2	700

*Theoretical number that may require unrealistic throttle levels.

Note: When a fault occurs, all Nodes in the chassis must throttle to the average power, in watts, indicated in the "Fault" column. For more information on N+N and N+1 redundancy see "What is N+N and N+1 redundancy" section on page 81 in this document.

2500W PSU – Full Wide Nodes Minimum PSU Required For N+1						
# of Full Wide Nodes	1000 W ITE		1200 W ITE		1400 W ITE	
	# of PSU*	Fault	# of PSU*	Fault	# of PSU*	Fault
7	4	828	4	828	5	1180
6	4	966	4	966	4	966
5	3	666	4	1159	4	1159
4	3	873	3	873	3	873
3	3	1000	3	1163	3	1163
2	2	593	3	1200	3	1400
1	2	1000	2	1185	2	1185

*Theoretical number that may require unrealistic throttle levels.

Note: When a fault occurs, all Nodes in the chassis must throttle to the average power, in watts, indicated in the "Fault" column. For more information on N+N and N+1 redundancy see "What is N+N and N+1 redundancy" section on page 81 in this document.

2100W PSU – Full Wide Nodes Minimum PSU Required For N+1						
# of Full Wide Nodes	1000 W ITE		1200 W ITE		1400 W ITE	
	# of PSU*	Fault	# of PSU*	Fault	# of PSU*	Fault
7	4	656	5	951	5	951
6	4	765	5	1109	5	1109
5	4	918	4	918	4	918
4	3	672	4	1188	4	1188
3	3	896	3	896	3	896
2	3	1000	3	1200	3	1400
1	2	784	2	784	2	784

*Theoretical number that may require unrealistic throttle levels.

Note: When a fault occurs, all Nodes in the chassis must throttle to the average power, in watts, indicated in the "Fault" column. For more information on N+N and N+1 redundancy see "What is N+N and N+1 redundancy" section on page 81 in this document.

System x Power Configurator

The System x Power Configurator is a software tool designed to assist with calculating System x Systems environmental information. The data in the System x Power Configurator tool is derived from running real-world workloads across a number of configurations to properly characterize component power consumption under various conditions. The current workloads are a combination of Floating Point and Small FFT Processor workloads as well as running configuration-tuned versions of HPL (Portable Implementation of the High-Performance Linpack Benchmark) and Stream to exercise multiple sub-systems of the IT systems. The two highest power consuming sub-systems in a non-HPC (High Performance Computing) IT system are processor and memory, so focus is given to exercising those sub-systems to correctly model power consumption under traditional and virtual workloads. For HPC type IT systems, some configurations contain GPGPU (General Purpose Graphical Processing Unit) or MIC (Many Integrated Core) I/O adapters. These adapters are characterized by running highly parallel graphic rendering workloads for complete characterization. All tests are conducted using default uEFI/BIOS settings.

The System x Power Configurator provides three groups of environmental information. The first represents Idle or minimum power consumption, the second is Maximum power consumption, and the third is Load Factor. Load Factor is a scale factor between Idle and Max that can represent any configurations total aggregate system utilization for a specific workload.

The data reported by System x Power Configurator can be used in certain cases to determine electrical wiring and levels of redundancy. The data reported by System x Power Configurator represents a worst-case power consumption value under normal operating conditions and may not model power consumption under component failure conditions. Final determinations should be made by persons skilled in the art or by contacting power@lenovo.com for assistance.

For Flex System power planning refer to the tables listed in Flex System power-on policies for 2100W and 2500W PSU for the number of nodes supported, powered on. System x Power Configurator, in the future, will be able to validate configurations that are less than worst case and are configuration based.

System x Power Configurator tool link:
http://www.ibm.com/support/entry/portal/docdisplay?lndocid=LNVO-PWRCONF

For questions or clarification please email:
power@lenovo.com

Flex System PDU and line cord selection

The following section discusses the compatible PDUs and their input line cords for both North America and International. Some PDUs have attached line cords while others require a line cord to be ordered separately based on your requirement of Three-phase power or Single-phase power. For information on line cords for connecting the Flex System to PDUs refer to the Flex System power cords section.

PDU and line cord selection – System x

Refer to the following table for line cord and phase options for North American and International PDUs for Flex System. The PDUs are grouped together by type (eg: Switched and monitored PDUs, Enterprise PDUs etc and by geography eg: North American or International).

Part Number	Description	Line cord part number	Phase (ph)	Voltage (V)	Line cord rating (Derated)	Line cord plug	Number / Type of outlet
Switched and Monitored PDUs - North America							
46M4002	System x 1U 9 C19/3 C13 Active Energy Manager (AEM) DPI PDU	40K9614	1ph	200V-240V	30A (24A)	NEMA L6 30P	9 / C19 3 / C13
		40K9615	1ph	200V-240V	60A (48A)	IEC 309 2P+G	
46M4003	System x 1U 9 C19/3 C13 AEM 60A 3 Phase PDU	Attached	3ph Δ	208V	60A (27.7A/ph)	IEC 309 3P+G	9 / C19 3 / C13
46M4167	System x 1U 9 C19/3 C13 Switched and Monitored 30A 3 Phase PDU	Attached	3ph Δ	208V	30A (13.85A/ph)	NEMA L21-30P	9 / C19 3 / C13
46M4134	System x 0U 12 C19/12, C13 Switched and Monitored 50A 3 Phase PDU*	Attached	3ph Δ	208V	50A (23.09A/ph)	CS8365L	12 / C19 12 / C13

Part Number	Description	Line cord part number	Phase (ph)	Voltage (V)	Line cord rating (Derated)	Line cord plug	Number / Type of outlet
Switched and Monitored PDUs - International							
46M4137	System x 0U 12 C19/12 C13 Switched and Monitored 32A 3 Phase PDU	Attached	3ph Y	380V-415V	32A (32A/ph)	IEC 309 3P+N+G	12 / C19 12 / C13
46M4002	System x 1U 9 C19/3 C13 Active Energy Manager DPI PDU	40K9612	1ph	220V-240V	32A	IEC 309 P+N+G	9 / C19 3 / C13
		40K9613	1ph	220V-240V	63A	IEC 309 P+N+G	
		40K9617	1ph	230V-240V	32A	AUS/NZ 3112	
		40K9618	1ph	220V	30A	KSC 8305	
		40K9611	3ph Y	380V-415V	32A (32A/ph)	IEC 309 3P+N+G	
		47C2495	3ph Y	380V-415V	16A (16A/ph)	IEC 309 3P+N+G	

Part Number	Description	Line cord part number	Phase (ph)	Voltage (V)	Line cord rating (Derated)	Line cord plug	Number / Type of outlet
Enterprise PDUs - North America							
71762NX	System x Ultra Density Enterprise 1U PDU C19 PDU	40K9614	1ph	200V-240V	30A (24A)	NEMA L6-30P	9 / C19 3 / C13
		40K9615	1ph	200V-240V	60A (48A)	IEC 309 2P+G	
71763MU	System x Ultra Density Enterprise 1U PDU C19 3 Phase 60A PDU+ Monitored	Attached	3ph	208V	60A (27.7A/ph)	IEC 309 2P+G	9 / C19 3 / C13
71763NU	System x Ultra Density Enterprise 1U PDU C19 3 Phase 60A PDU Basic	Attached	3ph Δ	208V	60A (27.7A/ph)	IEC 309 2P+G	9 / C19 3 / C13
39Y8948	DPI Single Phase C19 Enterprise 1U PDU without line cord	40K9614	1ph	200V-240V	30A (24A)	NEMA L6-30P	6 / C19
		40K9615	1ph	200V-240V	60A (48A)	IEC 309 2P+G	
39Y8923	DPI 60A Three Phase C19 Enterprise 1U PDU with IEC309 3P+G (208 V) fixed line cord	Attached	3ph Δ	208V	60A (27.7A/ph)	IEC 309 3P+G	6 / C19

Part Number	Description	Line cord part number	Phase (ph)	Voltage (V)	Line cord rating (Derated)	Line cord plug	Number / Type of outlet
Enterprise PDUs - International							
71762NX	System x Ultra Density Enterprise 1U PDU C19 PDU (WW)	40K9612	1ph	220V-240V	32A	IEC 309 P+N+G	9 / C19 3 / C13
		40K9613	1ph	220V-240V	63A	IEC 309 P+N+G	
		40K9617	1ph	230V-240V	32A	AUS/NZ 3112	
		40K9618	1ph	220V	30A	KSC 8305	
		40K9611	3ph Y	380V-415V	32A (32A/ph)	IEC 309 3P+N+G	
		47C2495	3ph Y	380V-415V	16A (16A/ph)	IEC 309 3P+N+G	
71762MX	System x Ultra Density Enterprise PDU C19 1U PDU+ (WW)	40K9612	1ph	220V-240V	32A	IEC 309 P+N+G	9 / C19 3 / C13
		40K9613	1ph	220V-240V	63A	IEC 309 P+N+G	
		40K9617	1ph	230V-240V	32A	AUS/NZ 3112	
		40K9618	1ph	220V	30A	KSC 8305	
		40K9611	3ph Y	380V-415V	32A (32A/ph)	IEC 309 3P+N+G	
		47C2495	3ph Y	380V-415V	16A (16A/ph)	IEC 309 3P+N+G	
39Y8948	DPI Single Phase C19 Enterprise 1U PDU without line cord	40K9612	1ph	220V-240V	32A	IEC 309 P+N+G	6 / C19
		40K9613	1ph	220V-240V	63A	IEC 309 P+N+G	
		40K9617	1ph	230V-240V	32A	AUS/NZ 3112	
		40K9618	1ph	220V	30A	KSC 8305	
		40K9611	3ph Y	380V-415V	32A (32A/ph)	IEC 309 3P+N+G	
		47C2495	3ph Y	380V-415V	16A (16A/ph)	IEC 309 3P+N+G	

Part Number	Description	Line cord part number	Phase (ph)	Voltage (V)	Line cord rating (Derated)	Line cord plug	Number / Type of outlet
Front-end PDUs - North America							
39Y8939	30 amp/240V Front-end ½ U PDU	Included	1ph	200V-240V	30A (24A)	NEMA L6-30P	3 / C19
39Y8940	60 amp Front-end ½ U PDU	Included	1ph	200V-240V	60A (48A)	IEC 309 2P+G	3 / C19
Front-end PDUs - International							
39Y8934	DPI 32 amp Front-end ½ U PDU	Included	1ph	200V-240V	32A	IEC 309 P+N+G	3 / C19
39Y8935	DPI 63 amp Front-end ½ U PDU	Included	1ph	200V-240V	63A	IEC 309 P+N+G	3 / C19

Part Number	Description	Line cord part number	Phase (ph)	Voltage (V)	Line cord rating (Derated)	Line cord plug	Number / Type of outlet
0U Basic PDUs - North America							
46M4140	System x 0U 12 C19/12 C13 60A 3ph PDU	Attached	3ph Δ	208V	50A (23.09A/ph)	CS8365L	12 / C19 12 / C13
0U Basic PDUs - International							
46M4143	System x 0U 12 C19/12 C13 32A 3ph PDU	Attached	3ph Y	380V-415V	32A (32A/ph)	IEC 309 3P+N+G	12 / C19 12 / C13
1U Basic HVDC PDU - International							
44T0966*	System x 1U Higher Voltage (HV) DC PDU	Attached	1ph	240V-380V	90A	IEC 309 P+N+G	6 / RF-203P

* Flex System PSU to PDU HVDC line cord ships standard with the HVDC PSU P/N 00AM765.

See the "System x PDU Guide – North America" and the "System x PDU Guide – International" for more information on System x PDUs.

http://www.ibm.com/support/entry/portal/docdisplay?lndocid=LNVO-PWRCONF

Flex System power cords

The following section lists the power cords for the Flex System Enterprise Chassis. This section only applies to System x orders. The topics covered include:

- System x Worldwide power cords (PSU to PDU)*:* Discusses the power cords used world-wide for connecting the Flex System Chassis PSUs to supported PDUs.

- System x North American power cords (PSU to non-PDU)*:* Discusses the power cords used in North America for connecting the Flex System Chassis PSU directly to an outlet (NEMA 6-15R, NEMA L6-20R, and NEMA L15-30R outlets).

- System x International power cords (PSU to non-PDU)*:* Discusses the power cords used Internationally (outside of North America) for connecting the Flex System Chassis PSU directly to an outlet (IEC309 3P+N+G and PDL/Clipsal outlets).

System x Worldwide power cords (PSU to PDU)

These power cords are used worldwide to connect Flex System PSUs to supported PDUs when ordered as part of a System x order.

The PSUs installed in the Flex System Chassis have C20 inlets so will require power cords with C19-C20 plugs to attach to a supported PDU, see Figure 12. One of these power cords needs to be ordered for each PSU that is installed in each Flex System Enterprise Chassis and is connected to a PDU.

Note: Each HVDC power supply for the Flex System Enterprise Chassis ships standard with a power cable to connect to a supported HVDC PDU. Refer to the International PDU guide for additional information on the HVDC PDU, available from:
http://www.ibm.com/support/entry/portal/docdisplay?lndocid=LNVO-PWRCONF

Part Number	Feature Code	Description
39Y7916	6252	2.5m (8.2ft), 16A/100-240V, C19 to IEC 320-C20 Rack Power Cable
N/A	6292	2m (6.5ft), 16A/100-250V, C19 to IEC 320-C20 Rack Power Cable

* Note: The -48V DC and HVDC PSUs ship standard with a line cord

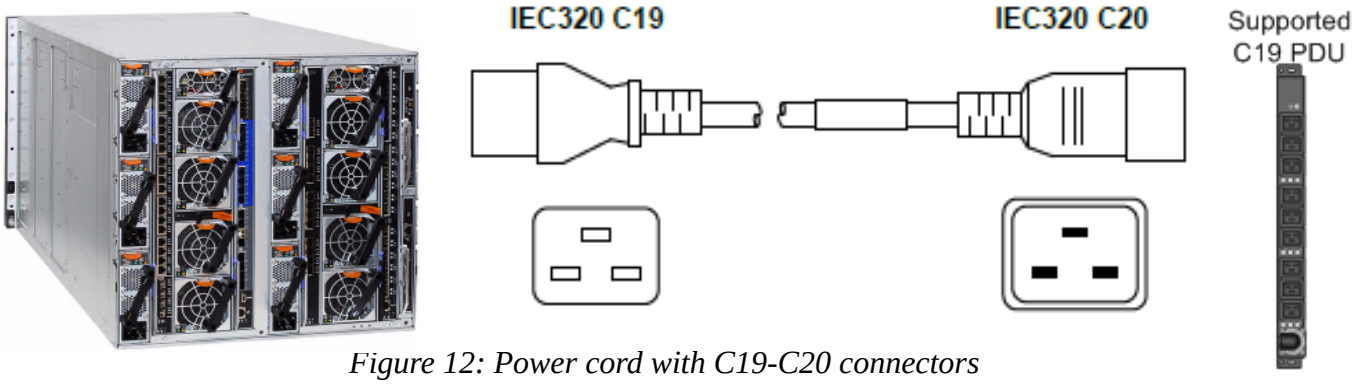


Figure 12: Power cord with C19-C20 connectors

System x North American power cords (PSU to non-PDU)

These power cords are only used in North America or countries on a similar type power grid to connect Flex System PSUs directly to NEMA 6-15R, NEMA L6-20R, and NEMA L15-30R outlets when ordered as part of a System x order.

Part Number	FC	Description
00D7195	6566	2.5m (8.2ft), 15A/208V, C19 to NEMA 6-15P Line Cord (Figure 13)
00D7196	6537	1.8m (6ft), 15A/208V, C19 to NEMA 6-15P Line Cord (Figure 13)
00D7197	A1NV	4.3m (14ft), 15A/250V, C19 to NEMA 6-15P Line Cord (Figure 13)
40K9772	6275	4.3m (14ft), 16A/208V, C19 to NEMA L6-20P Line Cord (Figure 14)
00D7192	A2Y3	4.3m (14ft) 30A @ 208V 3 phase Delta Line Cord NEMA L15-30P - (3P+Gnd) to 3x IEC 320 C19* (Figure 15)

*The NEMA L15-30P (3P-Gnd) to 3X IEC 320 C19 cable is only for use for chassis with 6x PSUs installed. See below for details.

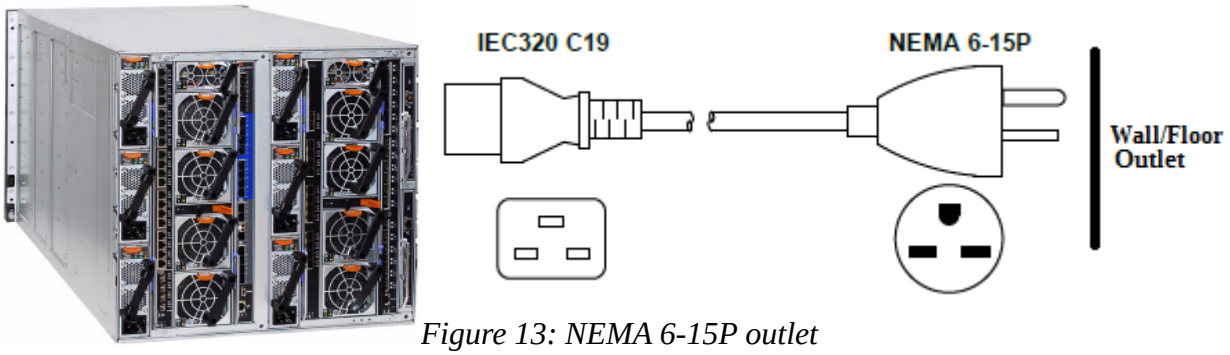


Figure 13: NEMA 6-15P outlet

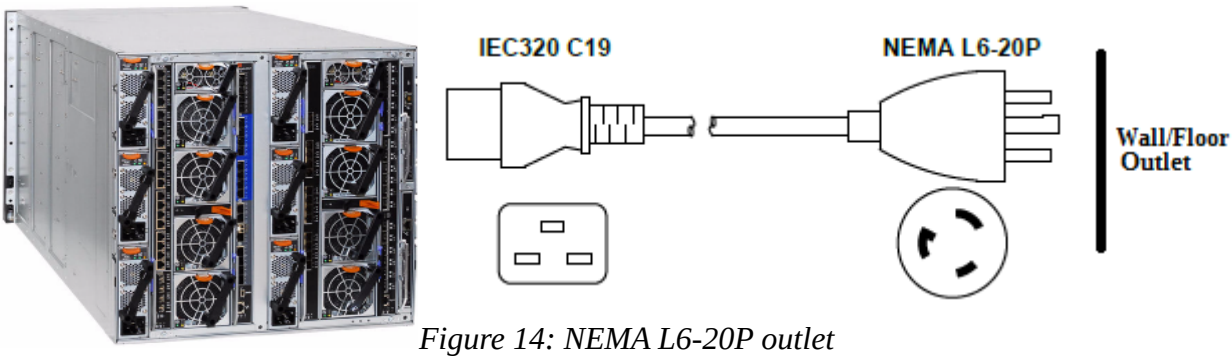


Figure 14: NEMA L6-20P outlet

*The 00D7192 (FC A2Y3) cord is a NEMA L15-30P - (3P+Gnd) to 3X IEC 320 C19

4.3m (14ft) 30A @208V 3 phase Delta line cord seen in Figure 15.

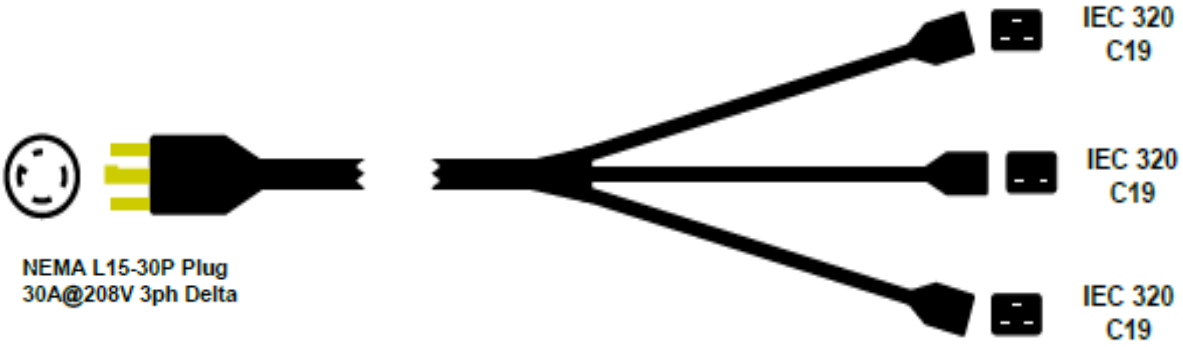


Figure 15: Line cord PN 00D7192 - NEMA L15-30P - (3P+Gnd) to 3x IEC 320 C19

The 30A@208V 3ph Delta Line Cord NEMA L15-30P - (3P+Gnd) to 3x IEC 320 C19 line cord should only be used for Flex System Chassis's that have 6x PSUs installed as seen in Figure 16.

Figure 16: Line cord 00D7192 for use with Flex System with 6x PSUs installed

System x International power cords (PSU to non-PDU)

These power cords are used internationally to connect Flex System PSUs directly to IEC309 3P+N+G and PDL/Clipsal outlets when ordered as part of a System x order.

Part Number	FC	Description
00D7193	A2Y4	4.3m (14ft) 32A@380-415V 3 phase Wye Line Cord IEC309 3P+N+G to 3X IEC 320 C19* (Figure 17)
00D7194	A2Y5	4.3m (14ft) 32A@415V 3 phase Wye Line Cord – Australia & New Zealand PDL/Clipsal 32A (3P+N+Gnd) to 3X IEC 320 C19*^ (Figure 19)

*These line cords can only be used for chassis's with 6x PSUs installed. See below for details.
^This line cord is only for use in Australia or New Zealand.

Figure 17 is the 00D7193 line cord which is an IEC309 3P+N+G to 3x IEC 320 C19 outlets.

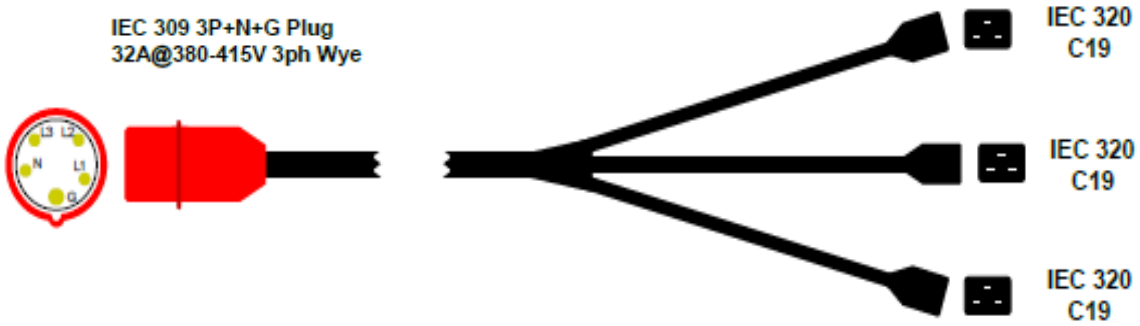


Figure 17: Line cord PN 00D7193 - IEC309 3P+N+G to 3X IEC 320 C19 outlets

The 00D7193 line cord can only be used in conjunction with a Flex System Enterprise Chassis that has 6 PSUs installed as seen in Figure 18.

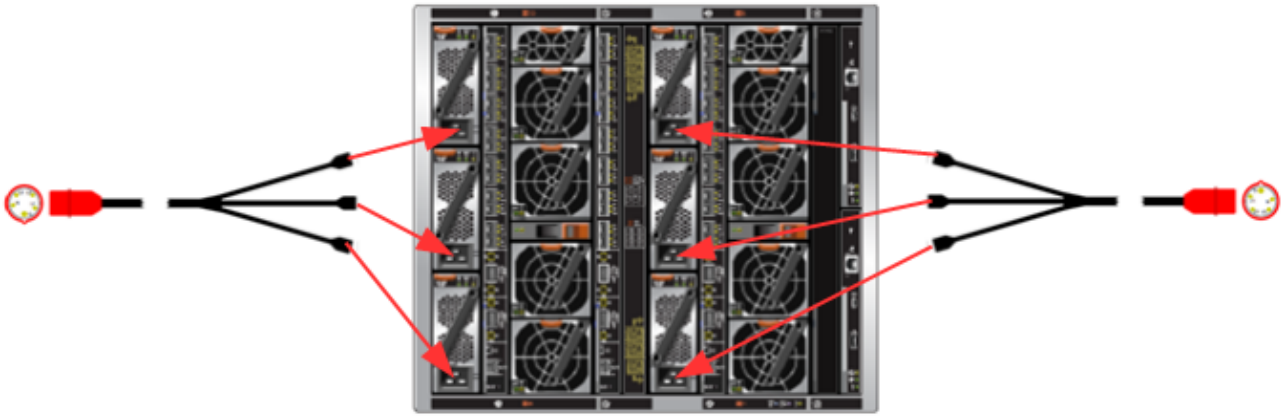


Figure 18: Line cord 00D7193 for use with Flex System with 6x PSUs installed

Figure 19 is the 00D7194 line cord which is an 32A (3P+N+Gnd) to 3X IEC 320 C19 outlets.

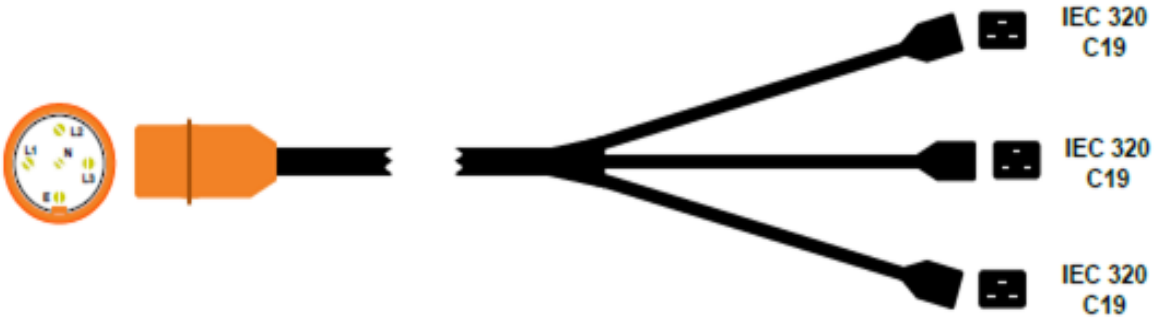


Figure 19: Line cord PN 00D7194 - PDL/Clipsal 32A (3P+N+Gnd) to 3X IEC 320 C19 outlets

The 00D7194 line cord can only be used in conjunction with a Flex System Enterprise Chassis that has 6 PSUs installed as seen in Figure 20. This line cord can only be used in Australia and New Zealand.

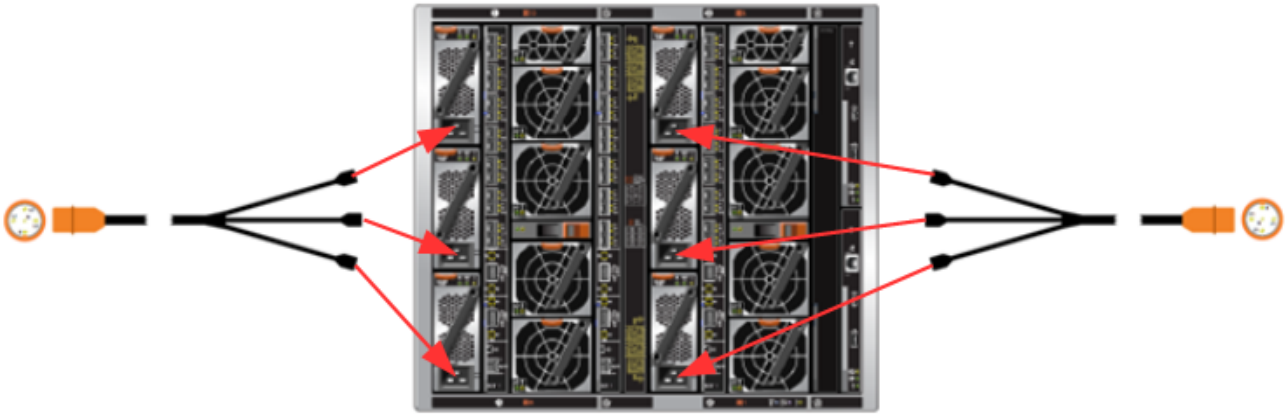


Figure 20: Line cord 00D7194 for use with Flex System with 6x PSUs installed

Flex System CMM Power and Thermal Overview

This section discusses the Flex System Chassis Management Module (CMM) power and thermal capabilities and settings. For details on how to connect to the web interface of the CMM, refer to the Chassis Management Module (CMM) section for details.

Figure 21 displays the CMM home screen after logging in. Most of the CMMs functionality is accessed via the menu running along the top of the screen.

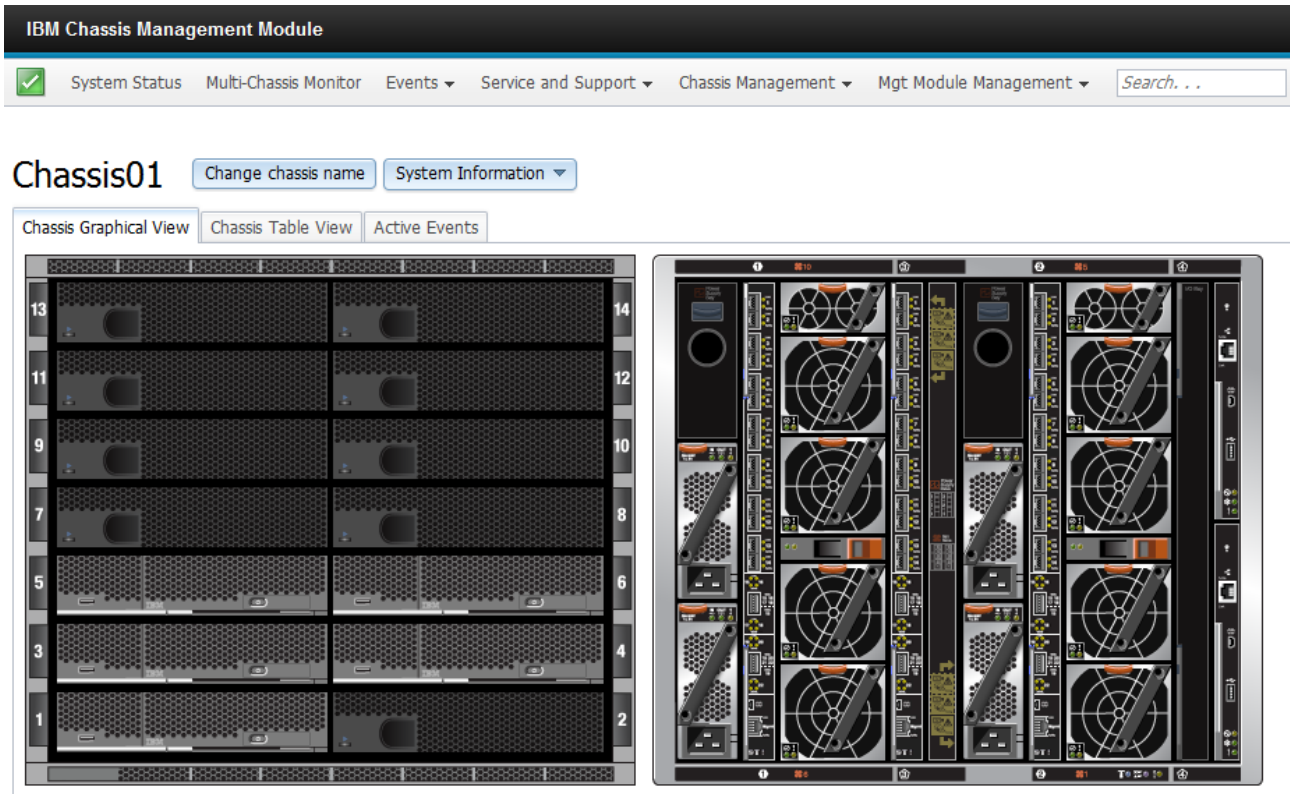


Figure 21: CMM home screen

The following section discusses the CMM settings for thermal (fans and cooling) of the Flex System.

CMM Fans and Cooling

To access information and settings for the fans and cooling in the Flex System Chassis, select the 'Chassis Management > Fans and Cooling' option from the drop down menu at the top, as seen in figure 22.

The Fans and Cooling page is displayed in Figure 23 on page 47.

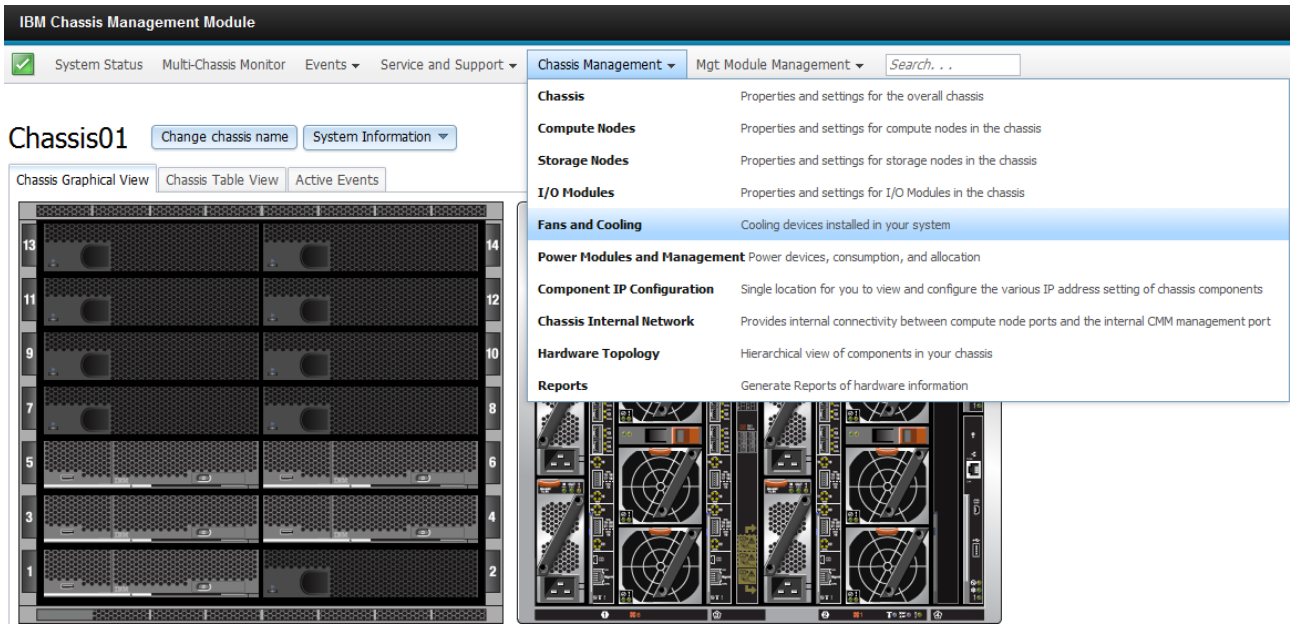


Figure 22: Fans and Cooling menu

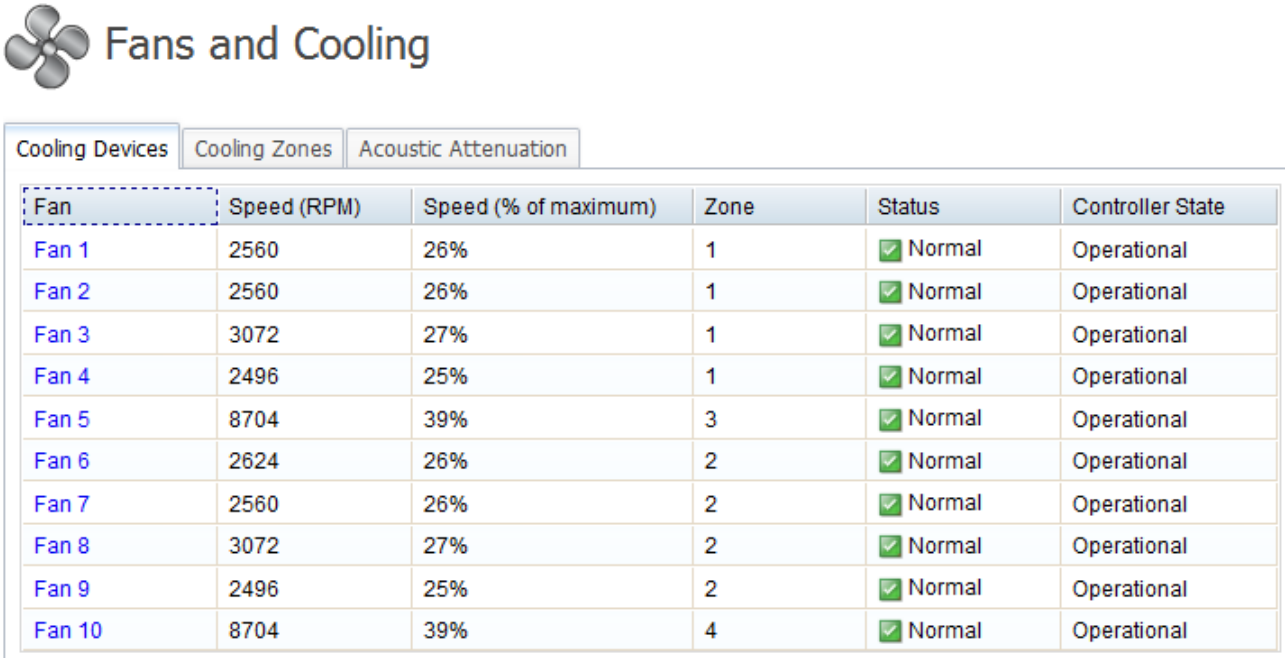
The Fans and Cooling page is broken up into 3 sections via the tabs at the top. These sections include:

- Cooling Devices
- Cooling Zones
- Acoustic Attenuation

The following section discusses each of these options in the CMM.

Cooling Devices

Figure 23 shows the Cooling Devices section. This section lists the fans in bays 1 to 10 and their corresponding cooling zones. For additional information on the cooling zones and the number of fans required for your Flex System, refer to the Flex System cooling zones section on page 13.



Fan	Speed (RPM)	Speed (% of maximum)	Zone	Status	Controller State
Fan 1	2560	26%	1	Normal	Operational
Fan 2	2560	26%	1	Normal	Operational
Fan 3	3072	27%	1	Normal	Operational
Fan 4	2496	25%	1	Normal	Operational
Fan 5	8704	39%	3	Normal	Operational
Fan 6	2624	26%	2	Normal	Operational
Fan 7	2560	26%	2	Normal	Operational
Fan 8	3072	27%	2	Normal	Operational
Fan 9	2496	25%	2	Normal	Operational
Fan 10	8704	39%	4	Normal	Operational

Figure 23: Fans and Cooling page

Selecting a fan will launch the properties of each fan. The properties window is displayed in Figure 24 on page 48.

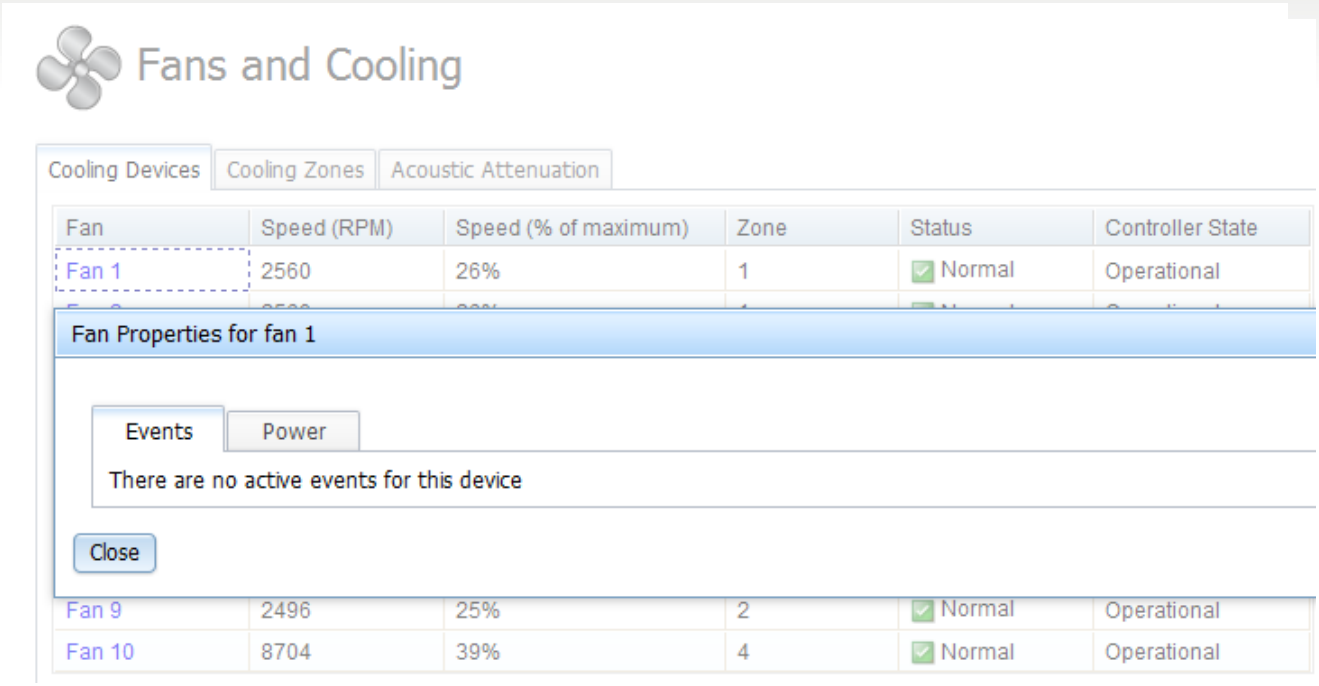


Figure 24: Fans and Cooling properties - Events

The fan properties window is broken up into two sections, Events and Power. The Events tab (Figure 24) will display activity recorded against the fan such as failures or removal of the fan.

The Power tab (Figure 25) will display the power consumption history of the individual fan. The power consumption history can be viewed per hour, or the previous 6, 12, or 24 hours.

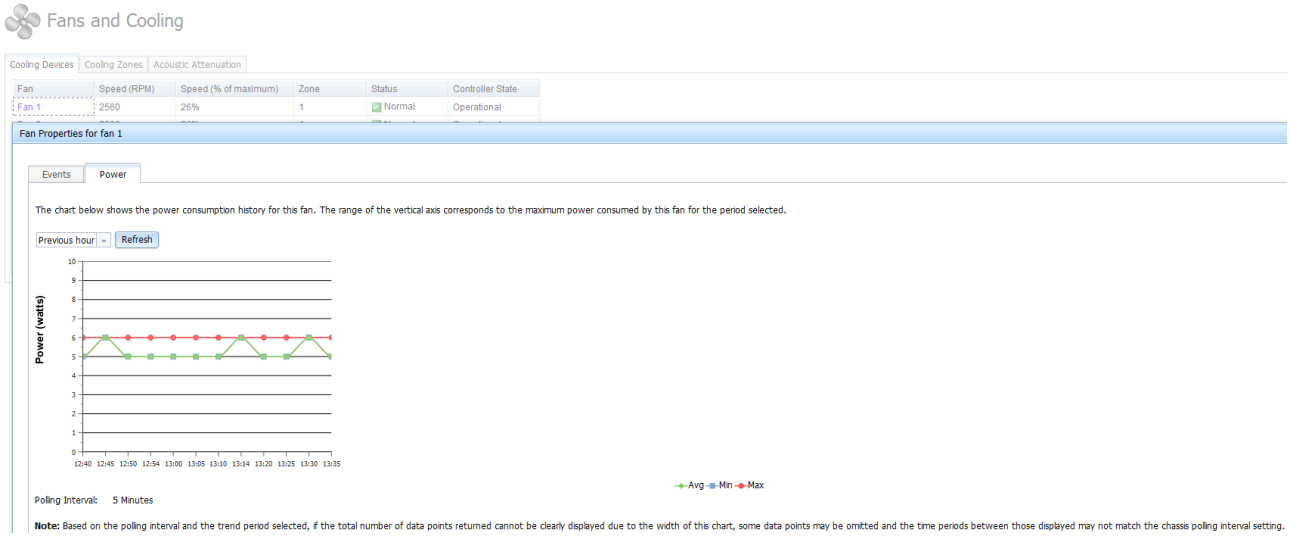


Figure 25: Fans and Cooling properties - Power

Cooling Zones

There are 4 cooling zones in the Flex System Chassis. Refer to the Flex System cooling zones section for additional information on each cooling zone. Figure 26 displays the Cooling Zones page in the CMM.

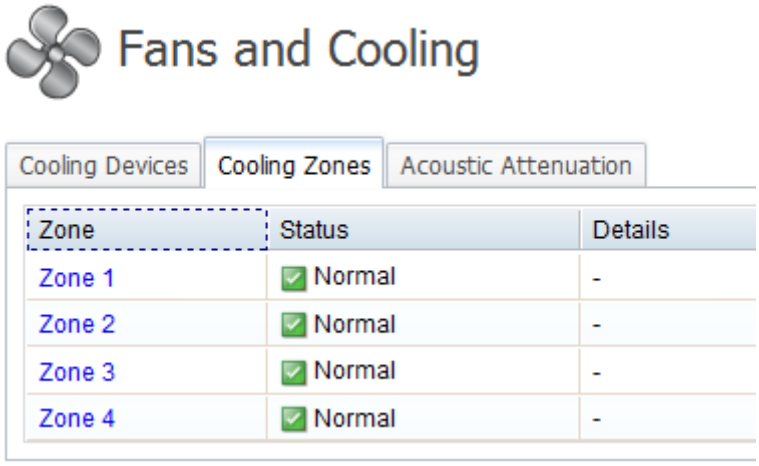


Figure 26: Cooling zones page

Clicking on an individual zone will bring up additional information for that zone. These are called 'Fan Zone Properties for Zone #'. There are two tabs of information, 'Fans' and 'Components'.

The 'Fans' tab (see Figure 27) will display each fans name, speed, status and state for that zone.

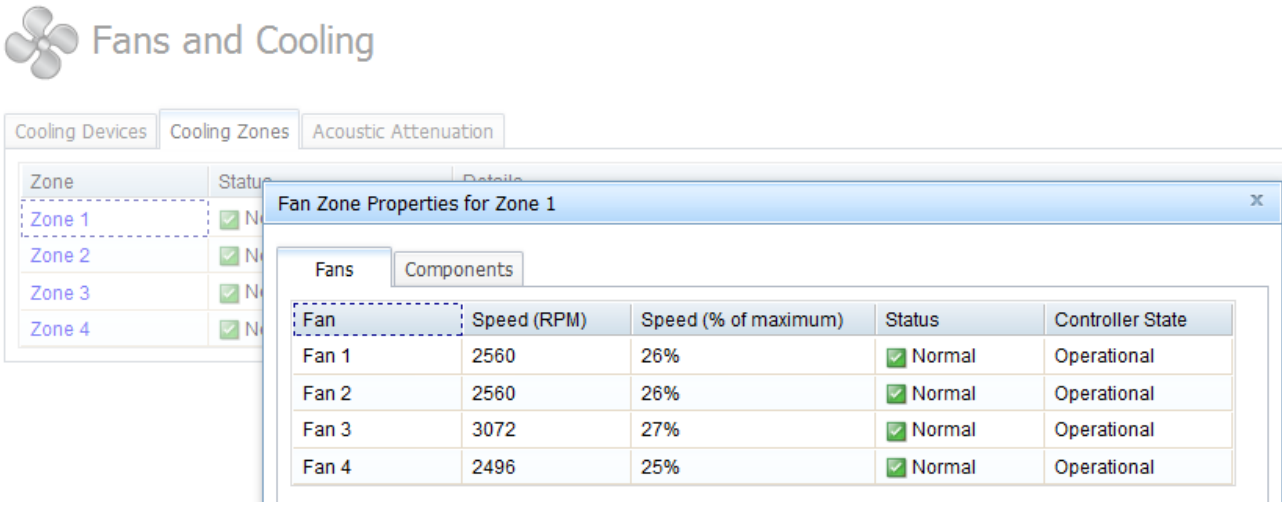


Figure 27: Fan Zone Properties for Zone 1 – Fans tab

The 'Components' tab will display the name of the components being cooled by that zone. For example, Figure 28 shows the components being cooled by Zone 1.

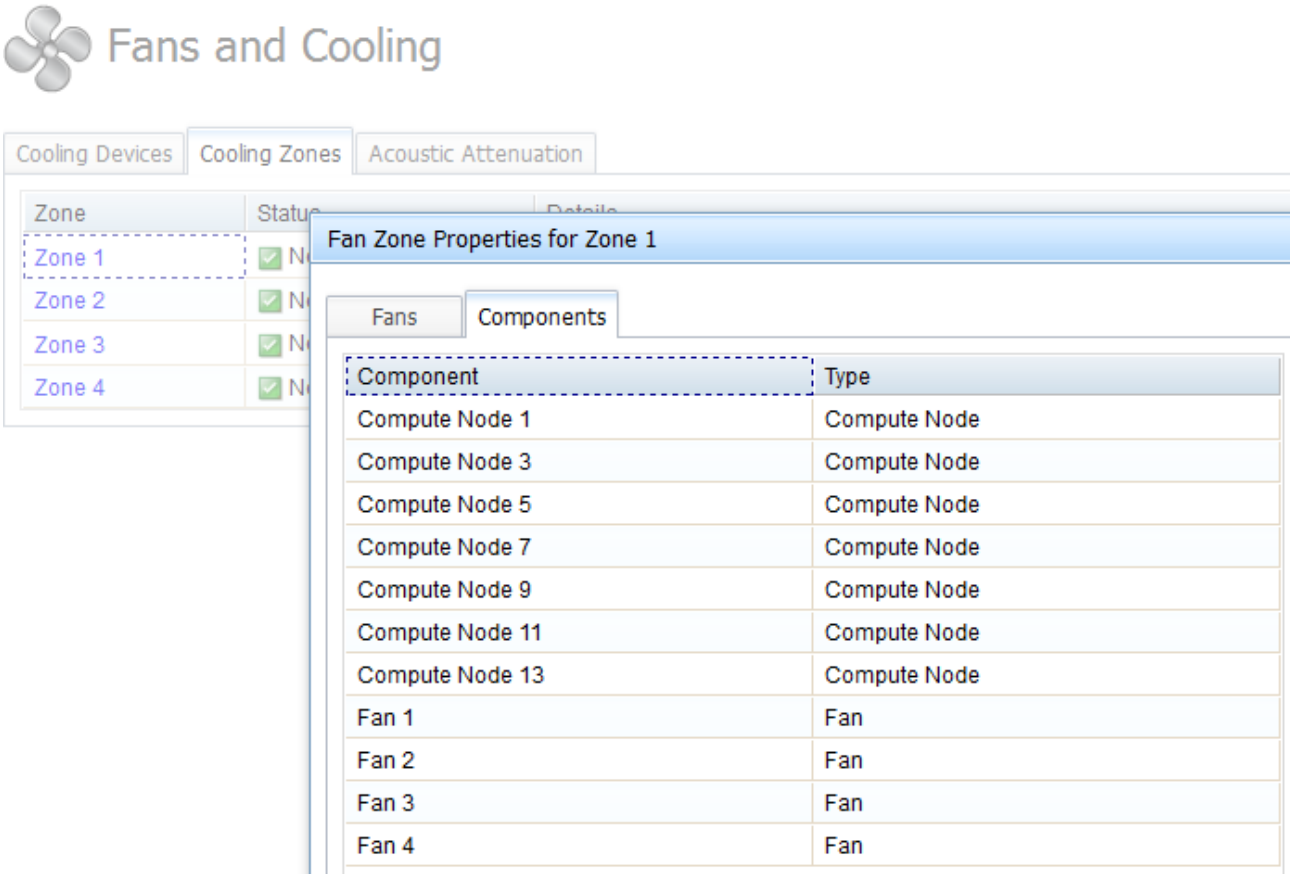


Figure 28: Fan Zone Properties for Zone 1 - Components tab

Acoustic Attenuation

The last tab on the 'Fans and Cooling' page is the 'Acoustic Attenuation' settings. See Figure 29.

Enabling the Acoustic Attenuation mode will enable the fans to favor the noise level over cooling. It will raise the threshold at which the fan speed increases, allowing the system to run hotter and operate quieter.

There are 5 levels of attenuation. Level 1 will raise the threshold the least and slightly reduce noise levels compared to no attenuation.
Level 5 will raise the threshold the most, allowing the system to run in the hottest operational state, providing the greatest level of noise attenuation.

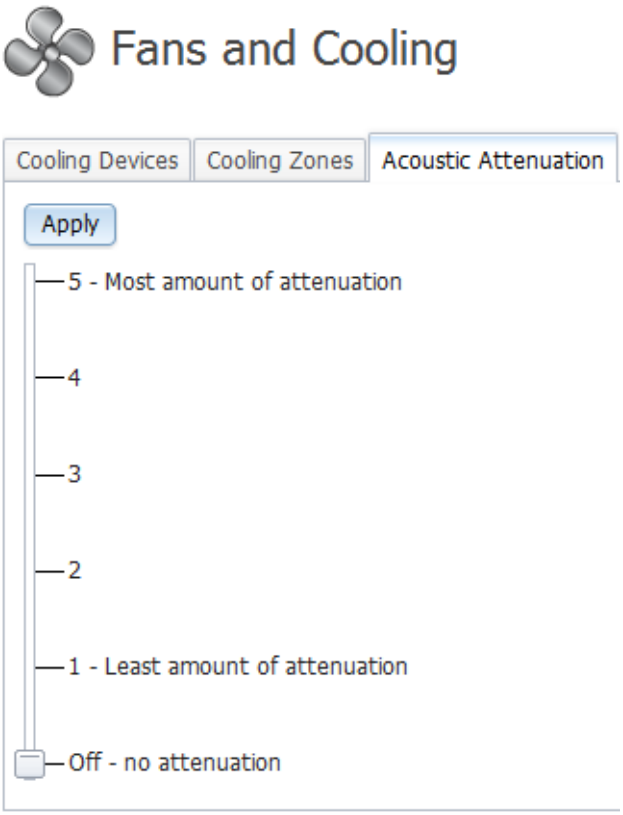


Figure 29: Fans and Cooling page - Acoustic Attenuation

The CMM will determine the highest level of Acoustic Attenuation your system can handle based on the hardware installed in the Chassis, and the amount of cooling it will require. The CMM will not allow you to employ a level that is not supported and will produce an error. See Figure 30 on page 52.

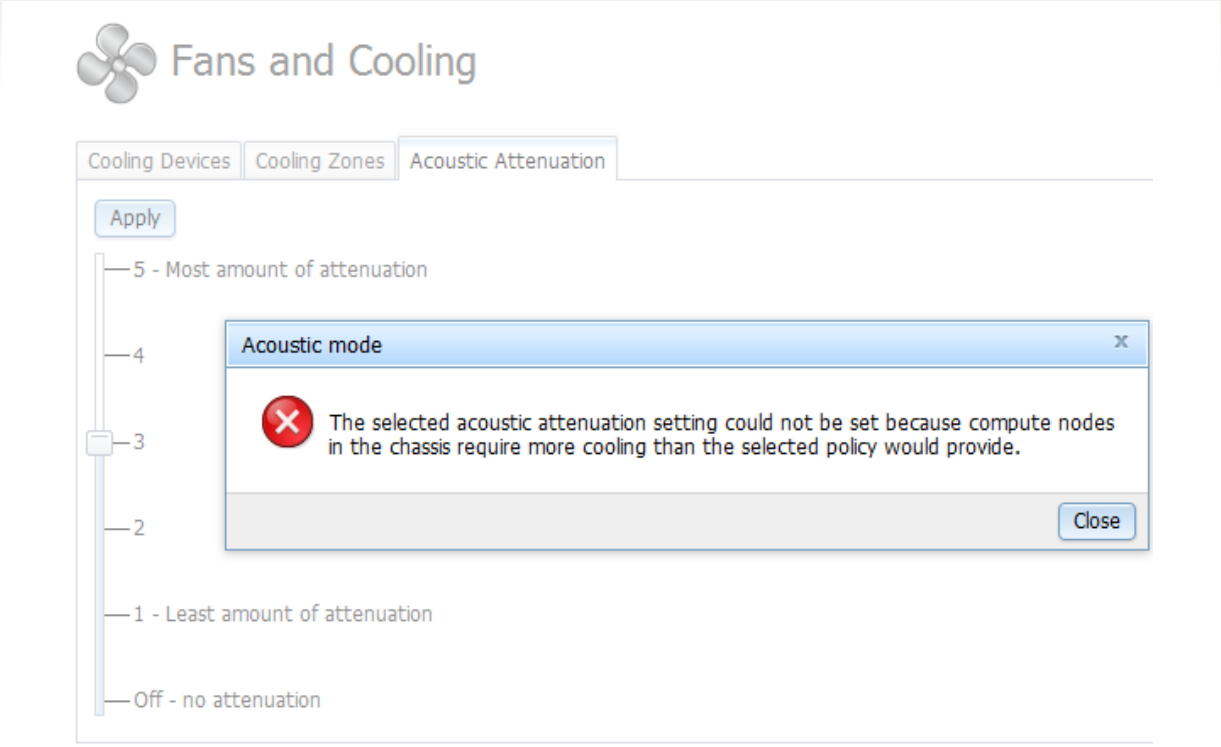


Figure 30: Fans and Cooling page - Acoustic Attenuation error

Use the attenuation level that best balances the noise level of the fans with your systems environmental factors. When a supported level has been selected, the below message will appear.

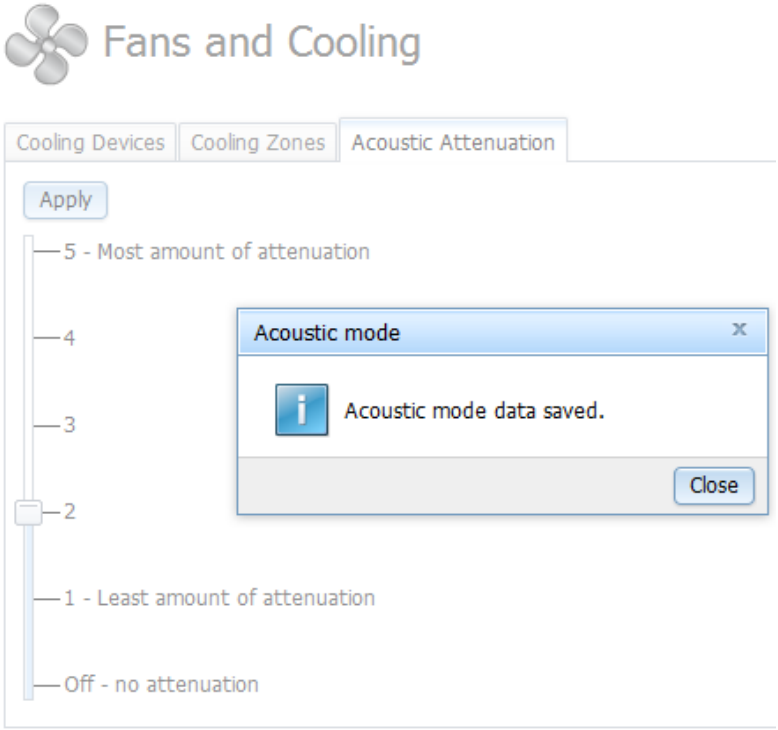


Figure 31: Fans and Cooling page - Acoustic Attenuation Save

The following section discusses the CMM settings for power modules and management of the Flex System.

CMM Power Modules and Management

To access information and settings for the power modules and management in the Flex System Chassis, select the 'Chassis Management › Power Modules and Management' option from the drop down menu at the top, as seen in figure 32.

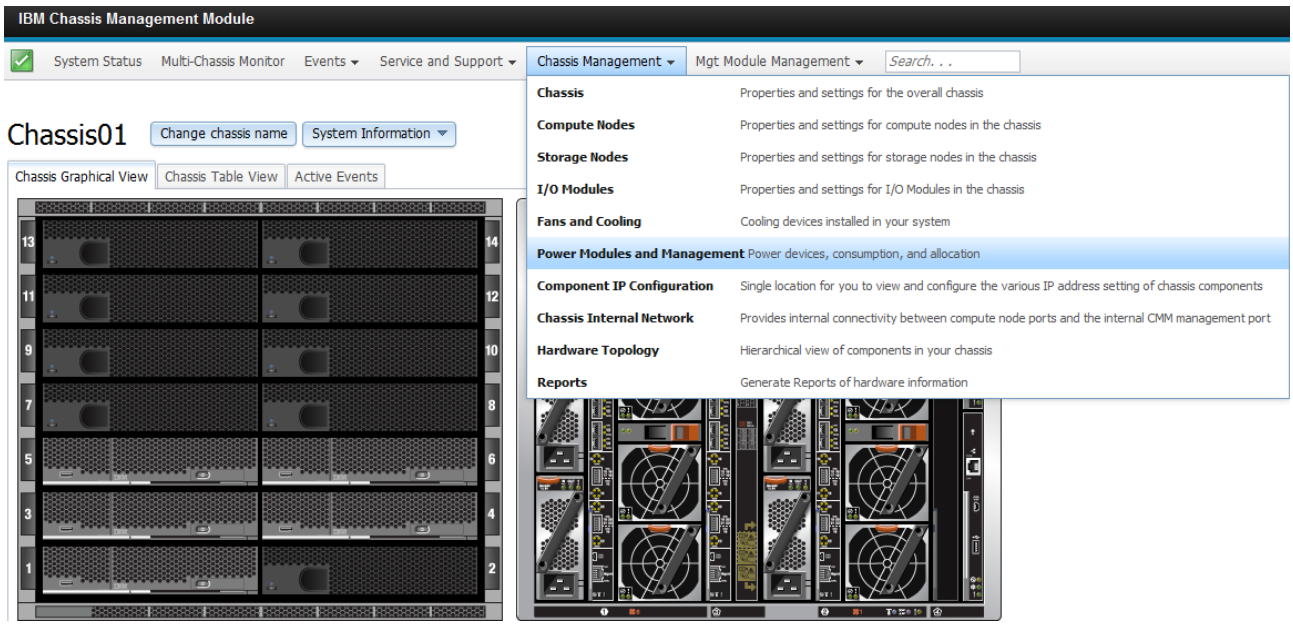


Figure 32: Chassis Management menu - Power Modules and Management

The Power Modules page is displayed in Figure 33 on page 54.

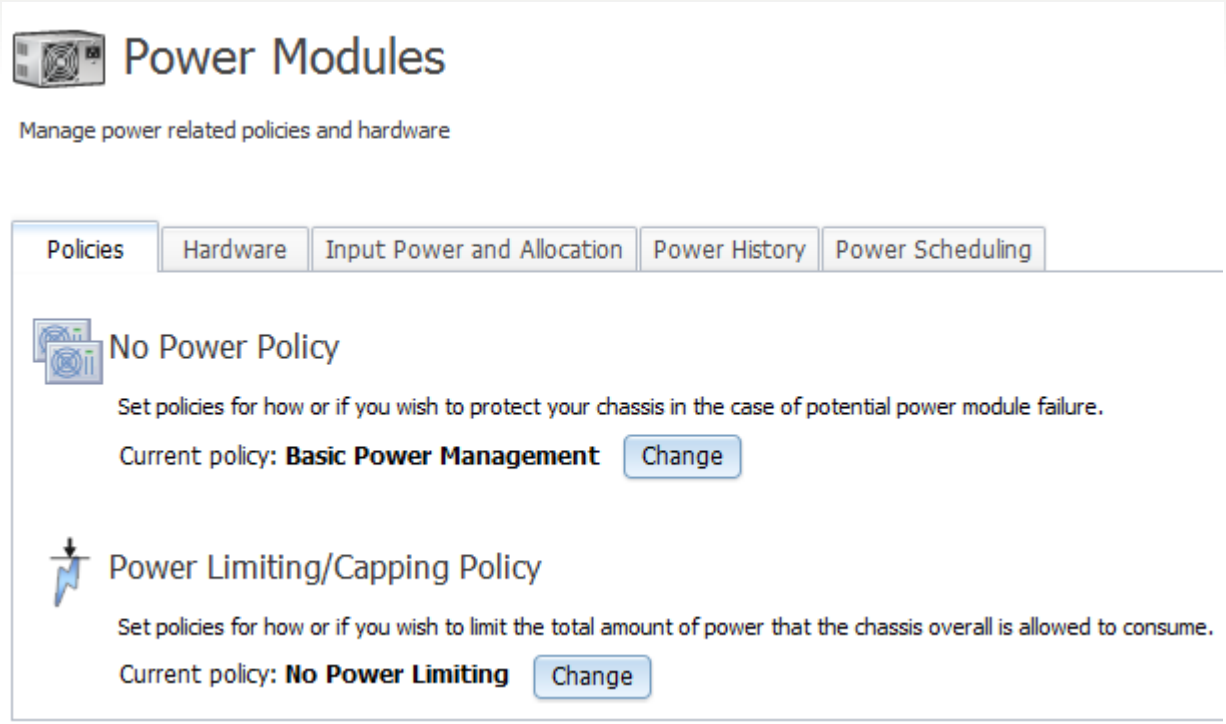


Figure 33: CMM Power Modules page

The Power Modules page is broken up into 5 sections via the tabs at the top. These sections include:

- Power Policies and Power Capping
- Hardware
- Input Power and Allocation
- Chassis Power Consumption History
- Power Scheduling

The following section discusses each of these options in the CMM.

Power Policies and Power Capping

The first tab on the Power Modules page is for power policies as seen in Figure 34. This section allows you to configure the power policy employed by the system and power limiting/capping policy.

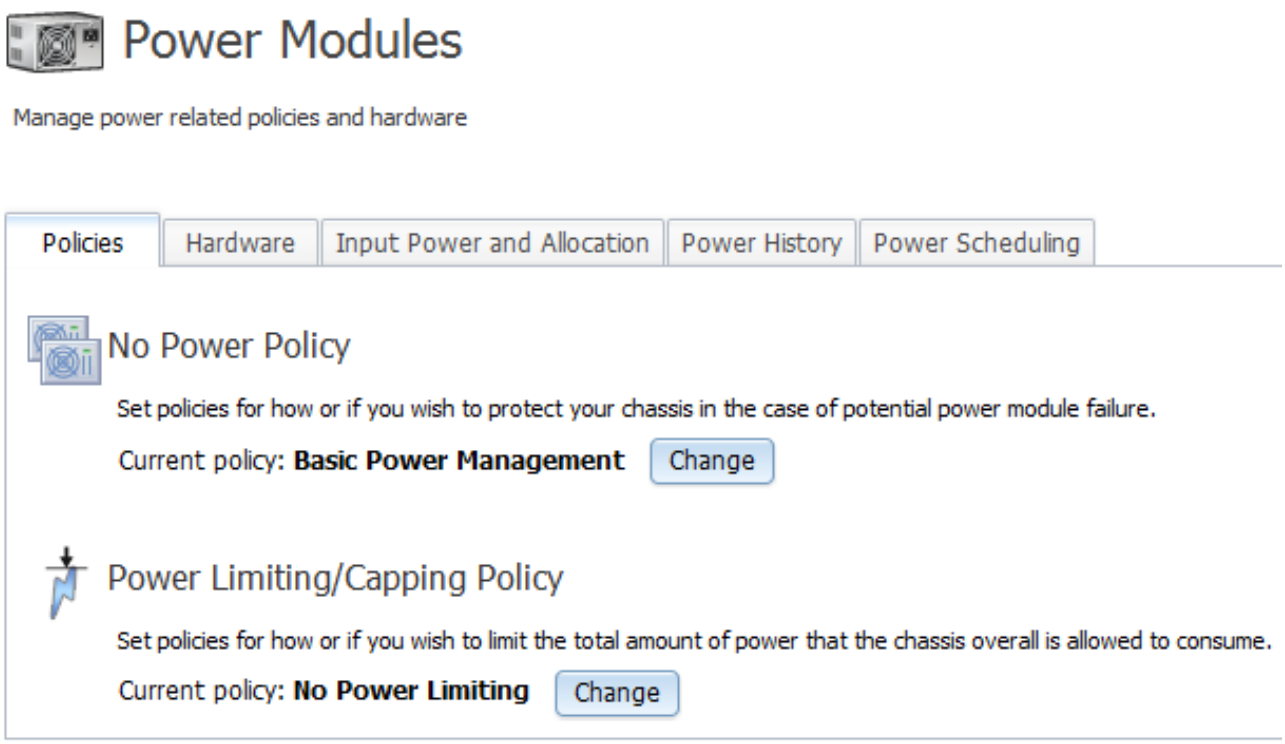


Figure 34: Power Module page - Policies

To change the power policy employed, click the 'Change' button next to the 'Current policy'.

Figure 35 displays the Power Management Policies page where you can set the power policy. For additional information on the power policies refer to the Power Policies in the CMM section on page 17.

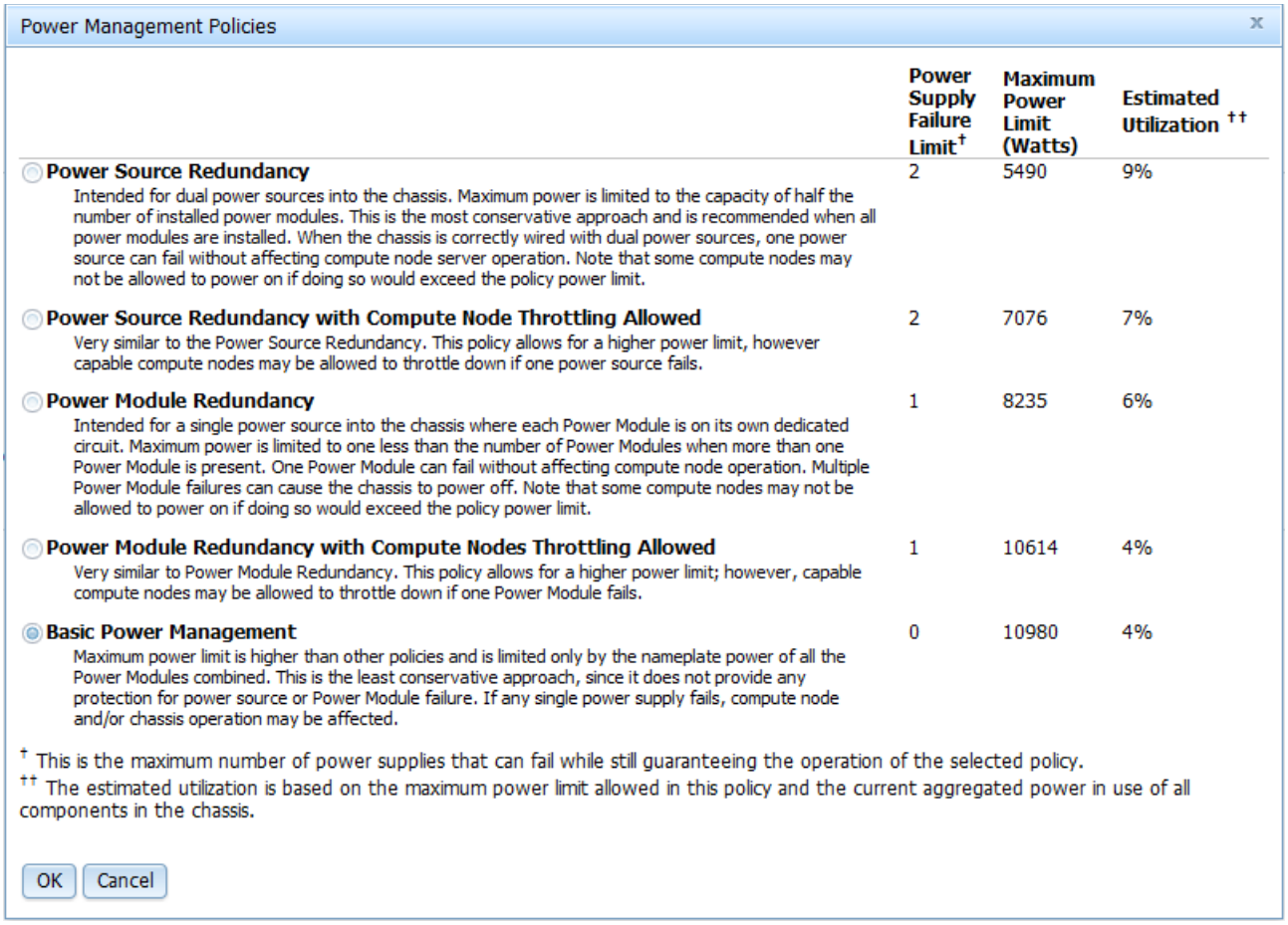


Figure 35: Power Management Policies page

The power capping policy can also be set from the Policies tab, displayed in Figure 36.

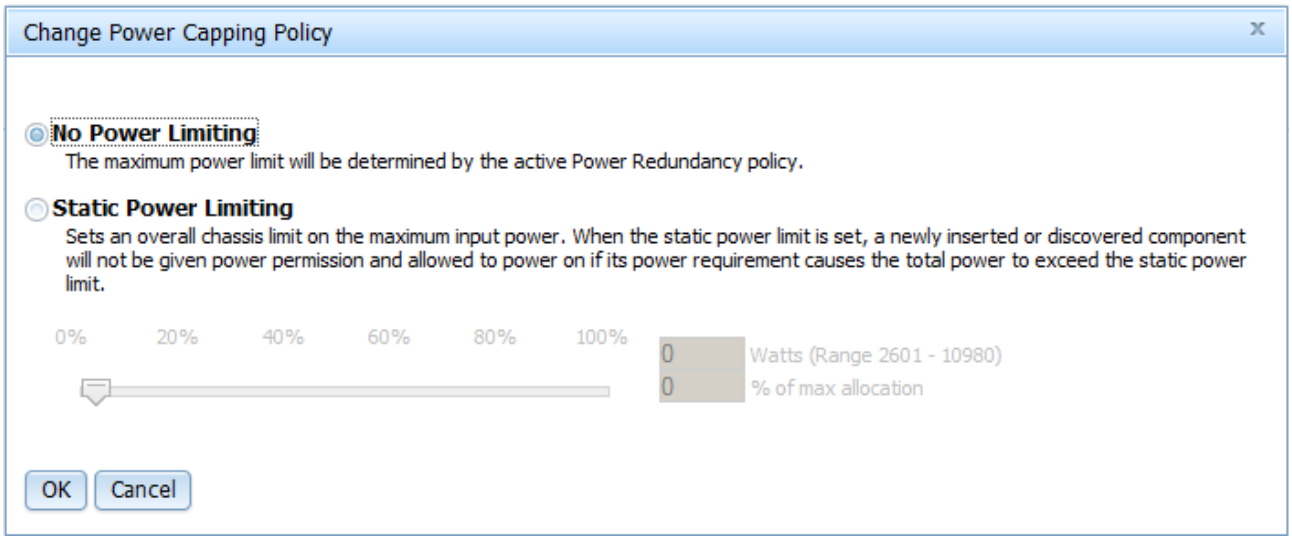


Figure 36: Power capping policy page

There are 2 capping policies available: No Power Limiting, and Static Power Limiting. These are described below.

No Power Limiting:
This is set by default. The maximum input power will be determined by the active power redundancy policy in place.

Static Power Limiting:
This sets an overall chassis limit on the maximum input power. In a situation where powering on a component can cause the limit to be exceeded, the component is prevented from powering on.

For example, if a new piece of hardware is inserted in to the chassis and is discovered by the CMM, the CMM will determine its total power draw required. If the power requirement from the new hardware causes the total power requirement of the chassis to exceed the static power limit set in the Static Power Limiting policy, then that new piece of hardware will not be allowed to turn on.

Note: In many cases it will be such that the peak power consumption of the system will not be high enough to reach the minimum guaranteed power cap, there fore power capping may not occur.

Also note, that enabling power capping and defining a threshold will not have an impact on performance unless the power capping threshold is reached and power capping is occurring.

Hardware

The Hardware tab in the Power Modules page of the CMM is displayed in Figure 37. For additional on the power modules and fans, refer to the Flex System power and cooling overview section on page 6.

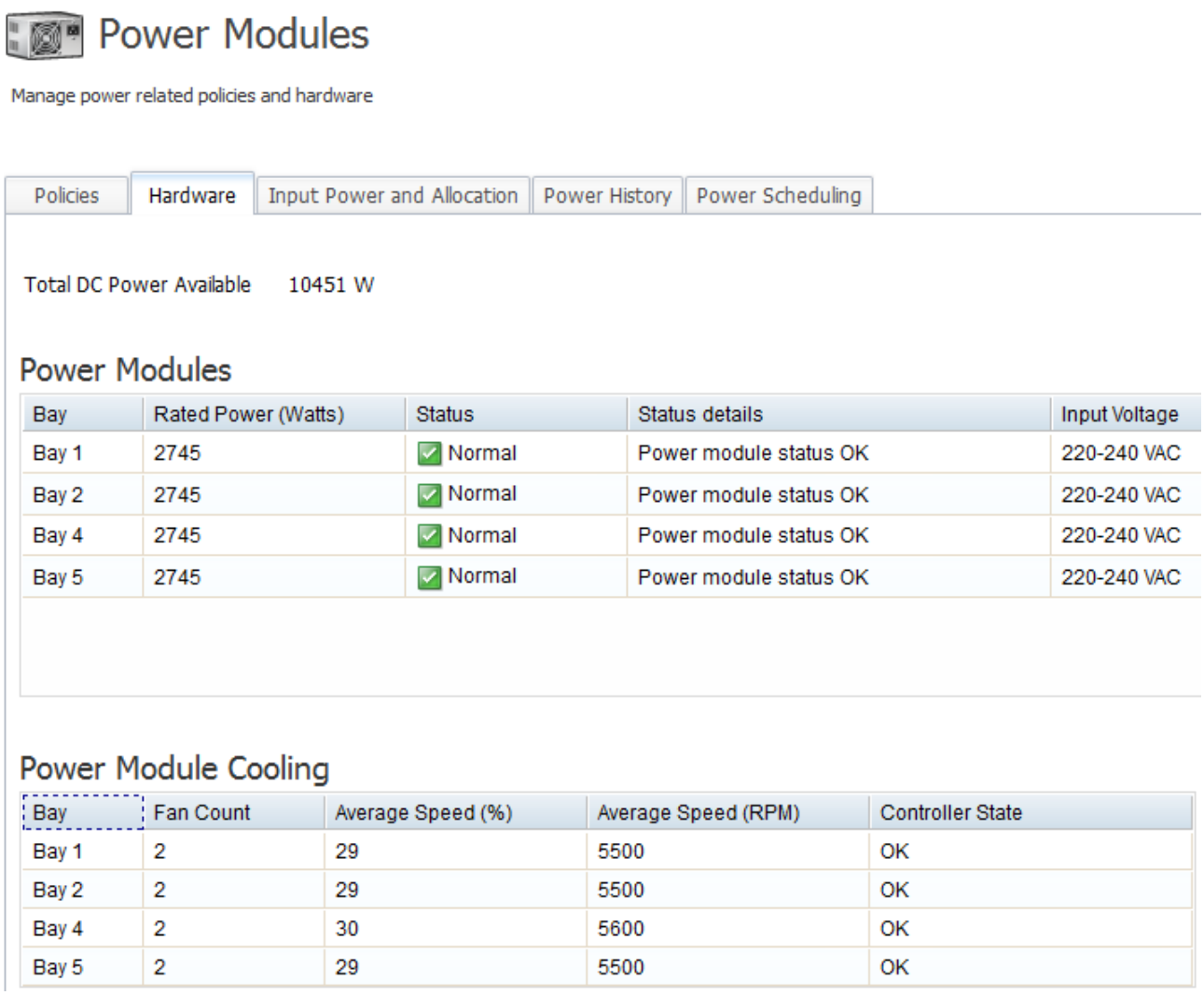


Figure 37: Power Modules page – Hardware tab

Input Power and Allocation

The Input Power and Allocation tab is broken up in to 2 tabs: Overall and Details. The Overall tab is displayed in Figure 38.

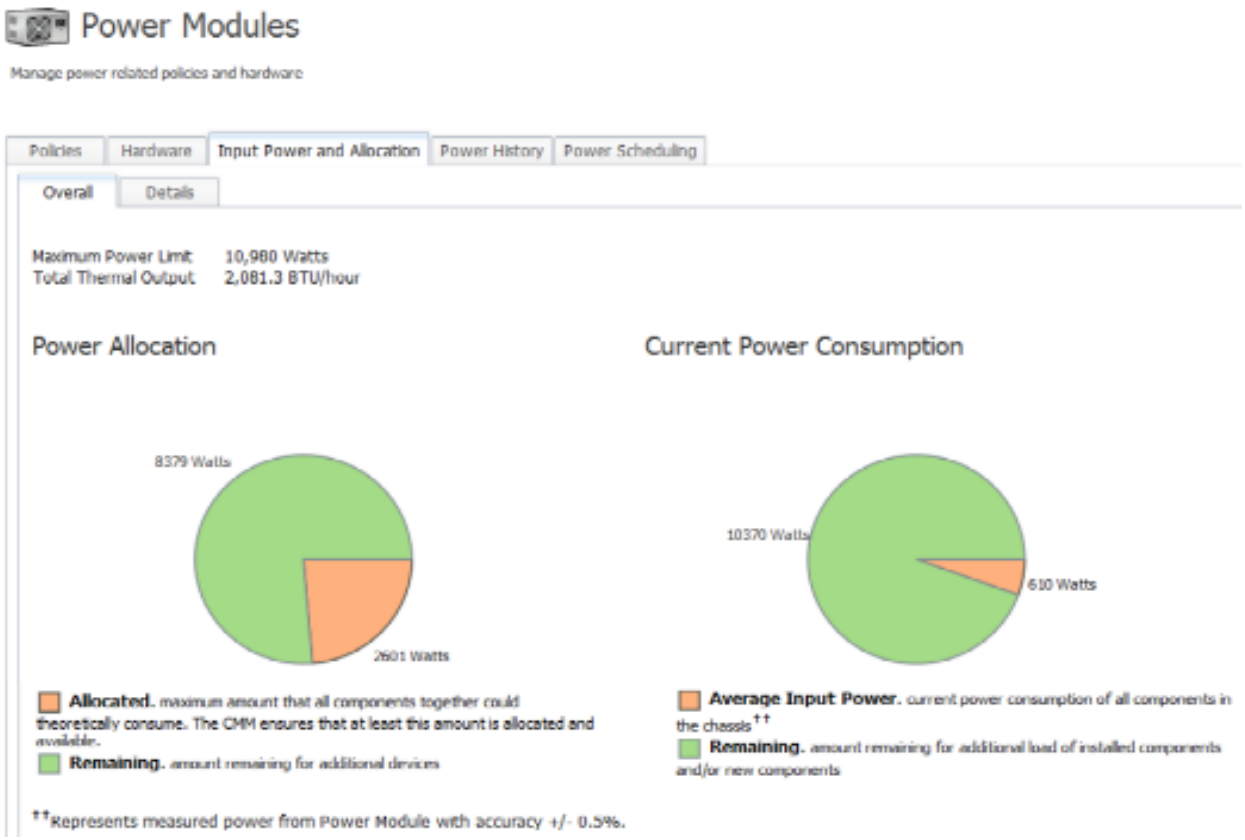


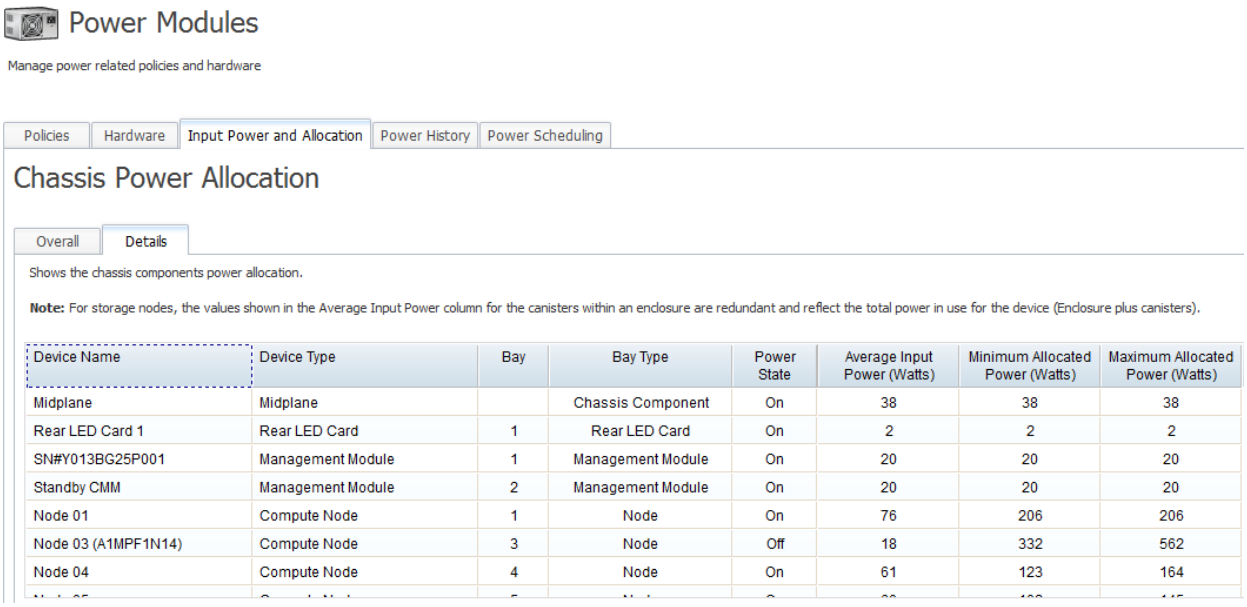
Figure 38: Power Modules page - Input Power and Allocation tab, Overall page

The 'Overall' tab page contains pie graphs to indicate power allocation and current power consumption.

The power consumption usage to available power represents measured power from the power modules with +/- 0.5% accuracy.

The 'Details' tab page is displayed in Figure 39 on page 60.

The 'Details' page displays information about any component that is drawing power in the chassis. It names the module, the bay it resides in, the type of component, its on/off status, the average power in Watts it is drawing, and the minimum, and maximum allocated power (in Watts).



Device Name	Device Type	Bay	Bay Type	Power State	Average Input Power (Watts)	Minimum Allocated Power (Watts)	Maximum Allocated Power (Watts)
Midplane	Midplane		Chassis Component	On	38	38	38
Rear LED Card 1	Rear LED Card	1	Rear LED Card	On	2	2	2
SN#Y013BG25P001	Management Module	1	Management Module	On	20	20	20
Standby CMM	Management Module	2	Management Module	On	20	20	20
Node 01	Compute Node	1	Node	On	76	206	206
Node 03 (A1MPF1N14)	Compute Node	3	Node	Off	18	332	562
Node 04	Compute Node	4	Node	On	61	123	164

Figure 39: Power Modules page - Input Power and Allocation tab, Details page

Chassis Power Consumption History

The Chassis Power Consumption History displays the power consumption of the entire chassis, as seen in Figure 40. The power consumption history can be viewed per hour or the previous 6, 12, or 24 hours.

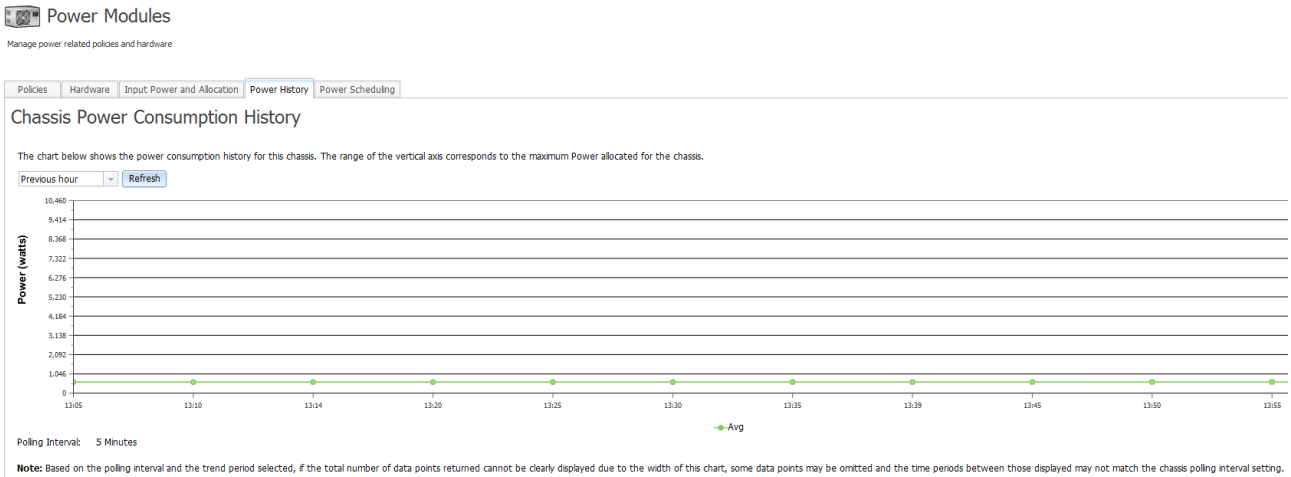


Figure 40: Power Modules page - Chassis Power Consumption History

Power Scheduling

Power schedule entries can be entered here. This can be used for powering off, and on, performing a power cycle, and powering off with a soft shut down for a single system or switch or a group of systems or group of switches.

To set power scheduling you first need to create a group to apply a schedule to. To create a group, select 'Add Group', as seen in Figure 41.

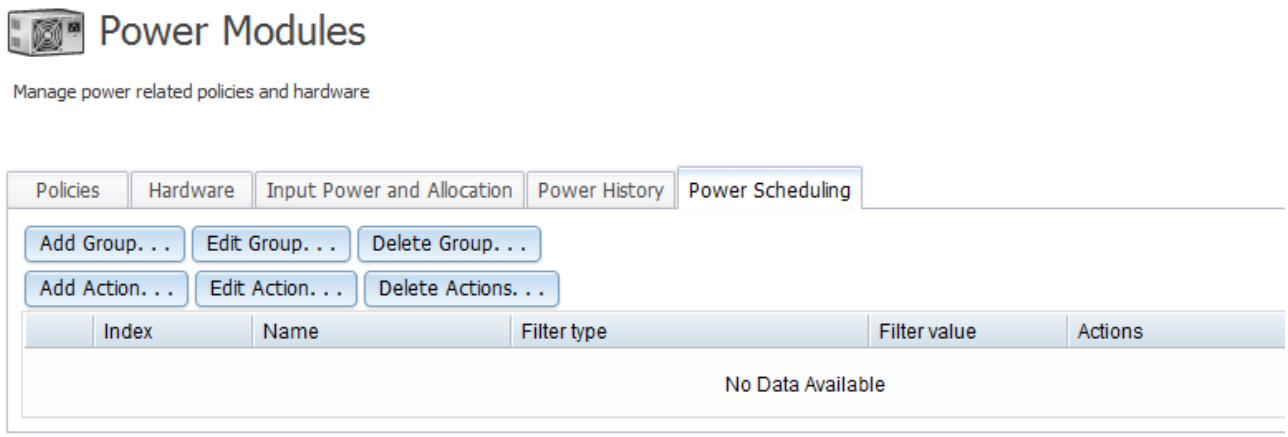


Figure 41: Power Modules page - Power Scheduling tab

The 'Add a new Power Schedule Group' window will appear, as seen in Figure 42.

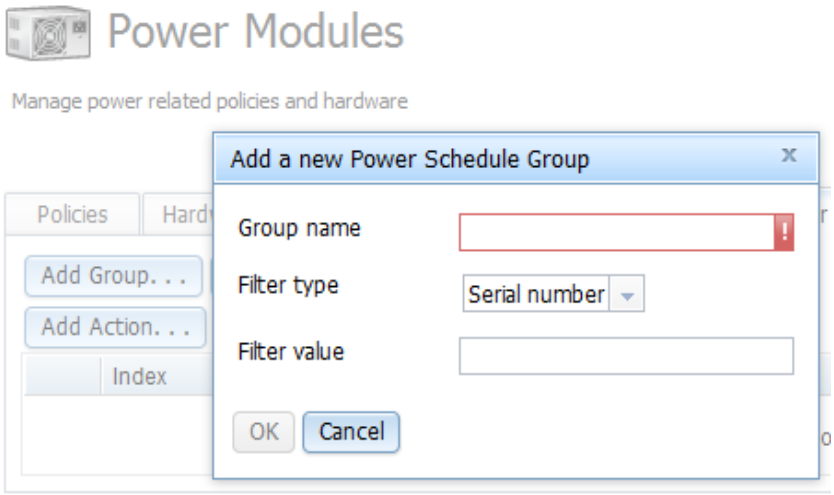


Figure 42: Power Scheduling - Create a new group

Firstly a name for the Power Scheduling group needs to be entered. No white spaces are allowed and you can only use '_' or '.' as special characters, as seen in Figure 43 on page 62.

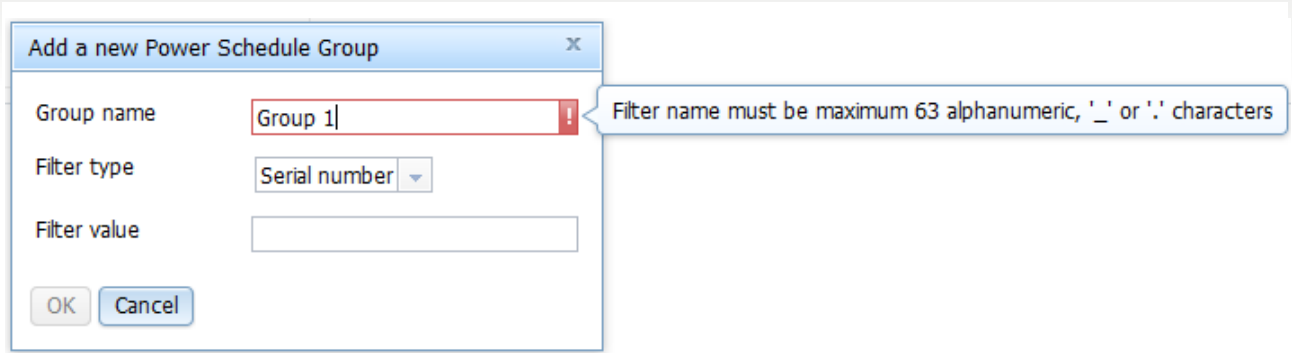


Figure 43: Power Scheduling - Group name error

The targeted hardware will need to be identified by either a Serial number, Machine Type or Slot Number as seen in Figure 44.

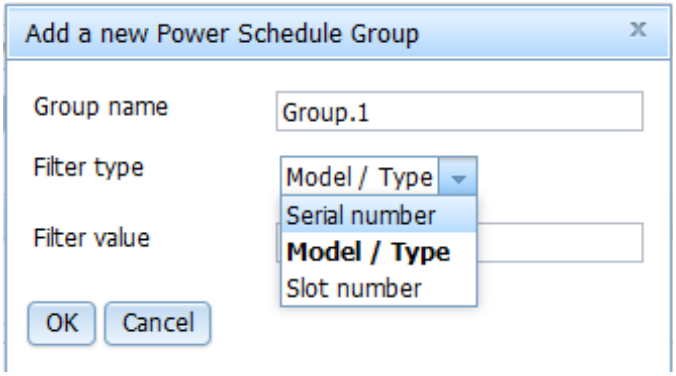


Figure 44: Power Scheduling h/w identification

If you are applying a Power Schedule policy to only 1 system or 1 switch then you can use either the Serial number, Model / Type, or Slot number options to identify the hardware in the Filter type.

If you are applying a Power Schedule policy to multiple systems or switches, then use the 'Slot number' filtering value.

The slot number filter value must have the format 'blade or switch(index or multiple indexes each separated by a comma or colon, or a range of indexes separated by a dash)'. The index value(s) specified for a blade must be between 1 and 14. For switches it must be between 1-4. No white spaces are allowed.

Example for grouping nodes:
blade(1) - for a single node in the chassis in bay 1.
blade(3,6,9) – for nodes in bays 3, 6, and 9.
blade(7-10) – for nodes in bays 7, 8, 9, and 10.
blade(1:2) – for nodes in bays 1, and 2.
blade(1-4:6) - for nodes in bays 1, 2, 3, 4, and 6.

Example for grouping switches:
switch(2) – for a single switch in bay 1.
switch(1,3) – for switches in bays 1, and 3.
switch(2-4) – for switches in bays 2, 3, and 4.

Once you have defined a node, switch or group, click 'OK' to create the Power Schedule Group.
Figure 45 displays the group created. Select the radio button to highlight the group. Click the 'Add Action...' button to add a Power Scheduling action to the node or group.

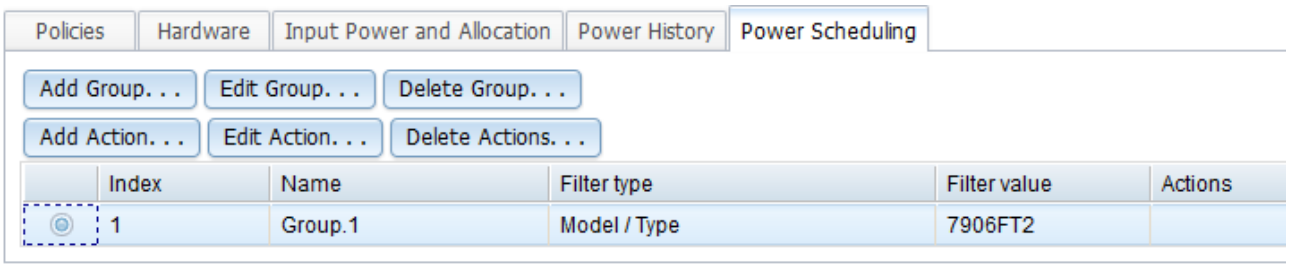


Figure 45: Power Scheduling - Group created

The Power Group Action window is displayed in Figure 46. An action type needs to be selected. Use the drop down menu as seen in Figure 47 on page 64 to select the action.

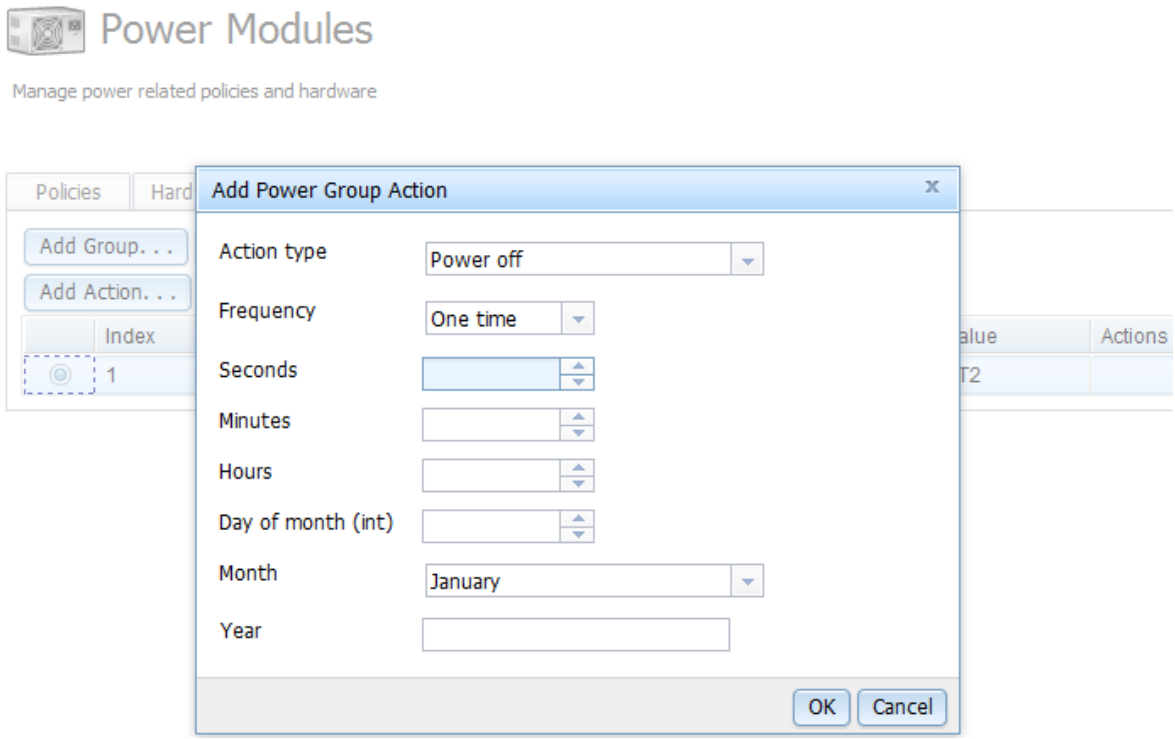


Figure 46: Power Scheduling - Add action

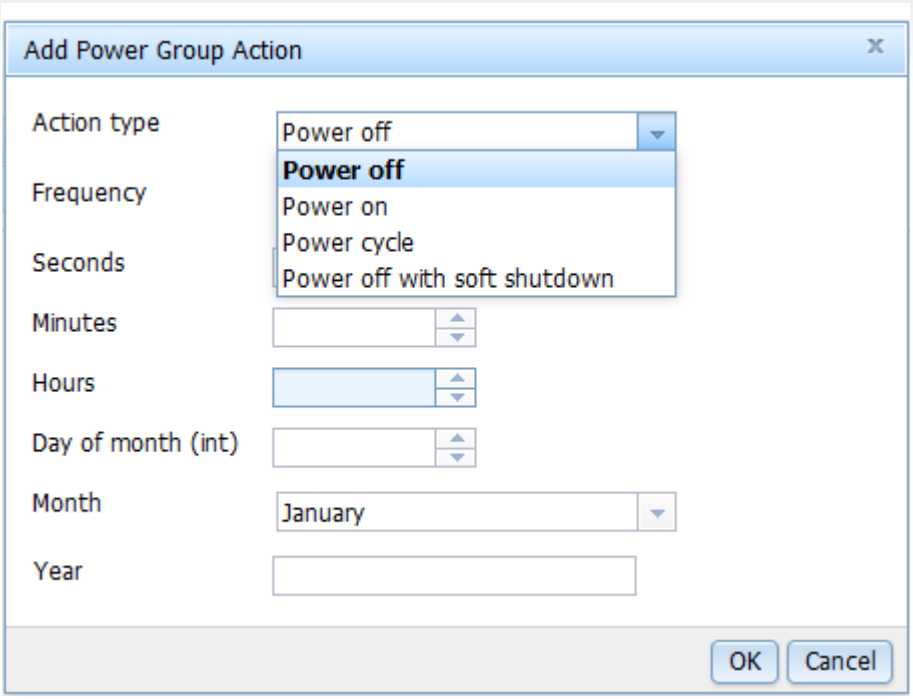


Figure 47: Power Scheduling - Available actions

The actions for the Power group include:
Power off – The system(s) or switch(es) will be power off.
Power on – The system(s) or switch(es) will be powered on.
Power cycle – The system(s) or switch(es) will be cycled (turned off and on), and
Power off with soft shutdown – The system(s) or switch(es) will power off with a soft shutdown.

Once an action type has been selected, the frequency (One time, Daily, or Weekly) can be specified.

The Seconds, Minutes, Hours, Day of month, Month and Year will need to be filled out to schedule the time of the action to take place.

You can add additional groups or add additional actions to an existing group, edit existing groups or actions, or delete existing groups or actions from the menu as seen in Figure 48.

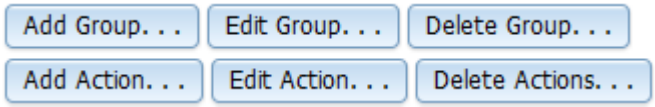


Figure 48: Power Scheduling additional actions

-48V DC Power Connection

The following section discusses the -48V DC power supply cabling connections for the Flex System Enterprise Chassis.

This equipment is designed to permit the connection of the earthed conductor of the dc supply circuit to the earthing conductor at the equipment. If this connection is made, all of the following conditions must be met:

- The chassis should be connected directly to the DC supply system earthing electrode conductor or to a bonding jumper from an earthing terminal bar or bus to which the DC supply system earthing electrode conductor is connected.
- The chassis shall be located in the same immediate area (such as, adjacent cabinets) as any other equipment that has a connection between the earthed conductor of the same DC supply circuit and the earthing conductor, and also the point of earthing of the DC system.
- The DC system should not be earthed elsewhere.
- The DC supply source shall be located within the same premises as this equipment. Switching or disconnecting devices should not be in the earthed circuit conductor between the DC source and the point of connection of the earthing electrode conductor.

The following table describes the circuit breaker and ground cable ratings that apply to the -48 V dc power supply:

Breaker	Listed 70 A	**See Note 1**
Ground cable	4 AWG with Listed lug which can accept M6 ground screws	**See Note 2**
Torque rating for ground screws	4.0 Newton-meters (35.4 inch-pounds)	-

Note 1: The maximum steady state current of the -48 V dc power supply is less then 70 A. However during specific events, such as over subscription, it is possible for the power supply to briefly draw a current greater than 70 A. Therefore it is recommended that the power supply be protected by a circuit breaker that will support up to 90 A for a minimum of 20 ms.

Note 2: If not connecting to a SELV source which provides Reinforced insulation you must use as ground cable.

Connecting the -48V DC powered chassis

A. To connect -48V DC to 60V DC-powered chassis, connect an earth ground cable to
each power supply.

1. Use a 10 mm nut driver to remove the hex nuts from the ground studs.
2. Remove the lock washer and one of the flat washers from each ground stud.
3. Push the ground lug onto the ground studs; then, place the flat washer, the lock washer, and the hex nut back on each ground stud.
4. Use a 10 mm nut driver to tighten the hex nuts to 4.0 - 4.8 Newton meters (35.4 – 42.5 inch-pounds).

B. Connect each power cord from the dc power supplies to a dc power distribution unit (PDU).

Attention: Do not route the power cords over removable modules or allow the cords to interfere with the module handles.
In North America, connect the power cords to a UL-listed PDU only.

C. Make sure that the following LEDs are lit:

1. The DC power and AC power LEDs on each power supply.
2. The power LED on each I/O module.

Note: The power LED on each compute node and on the IBM Flex System Manager management node, if one is installed, flashes slowly to indicate that the node is connected to power and is ready to be turned on.

D. If the LEDs are not lit:

1. Disconnect the chassis from the power source.
2. Reseat all of the components in the chassis.
3. Reconnect the chassis to the power source.

Note: For connectivity examples of the -48V DC chassis, refer to the "Flex System PDU Planning Reference" which can be downloaded from:
http://www.ibm.com/support/entry/portal/docdisplay?lndocid=LNVO-PWRCONF

Cabling

The -48V DC power supply requires 2 cables for connecting and powering:

1. Compact connector from the Flex DC PSU to 2-lug connector to Power Distribution Panel (PDP)

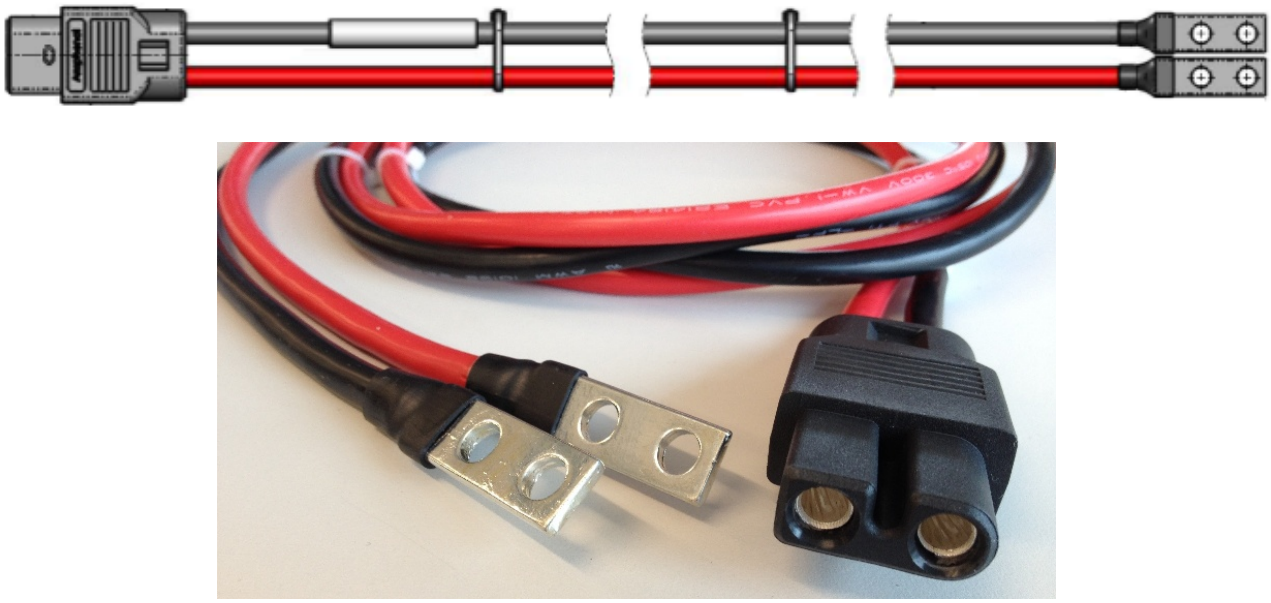


Figure 49: PSU to Power Distribution Panel cable

2. Separate protective 2-lug PSU to Earth ground (GND) cable (to rack common ground system)

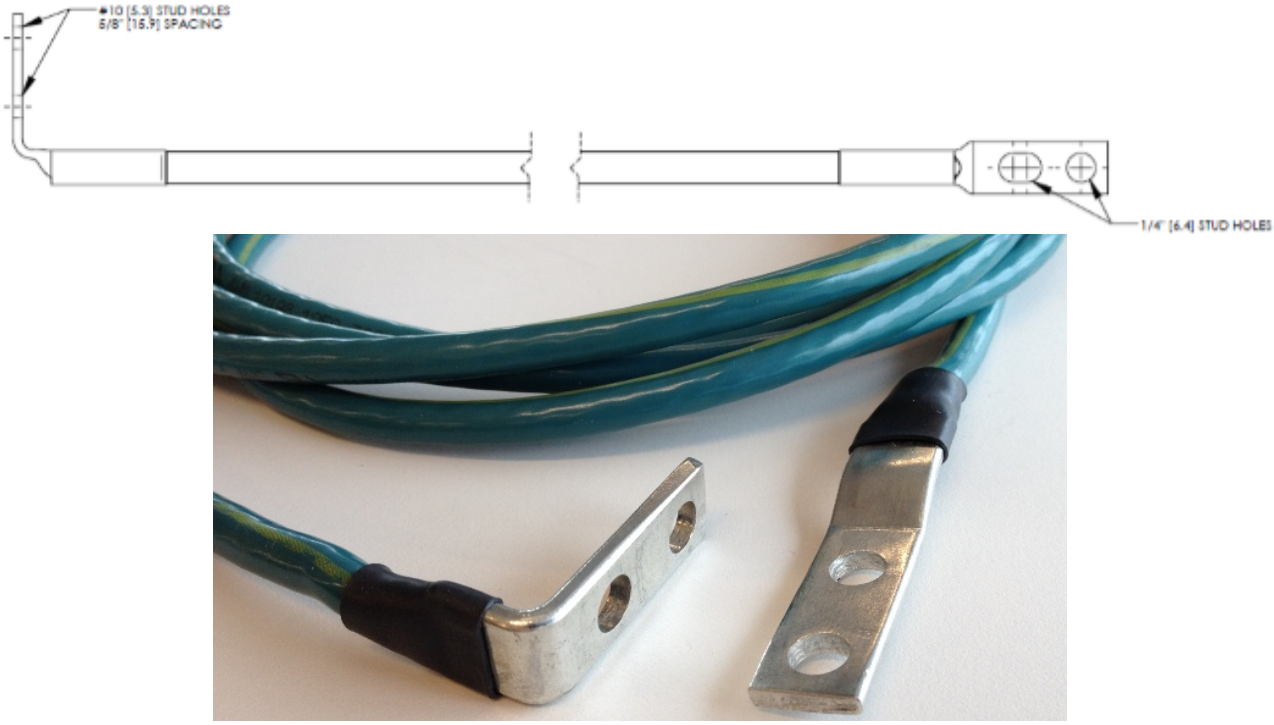


Figure 50: PSU to ground cable example

Figure 51 shows a -48V DC cabling example from the Power Distribution Panel (PDP) to the PSU and the grounding cable.

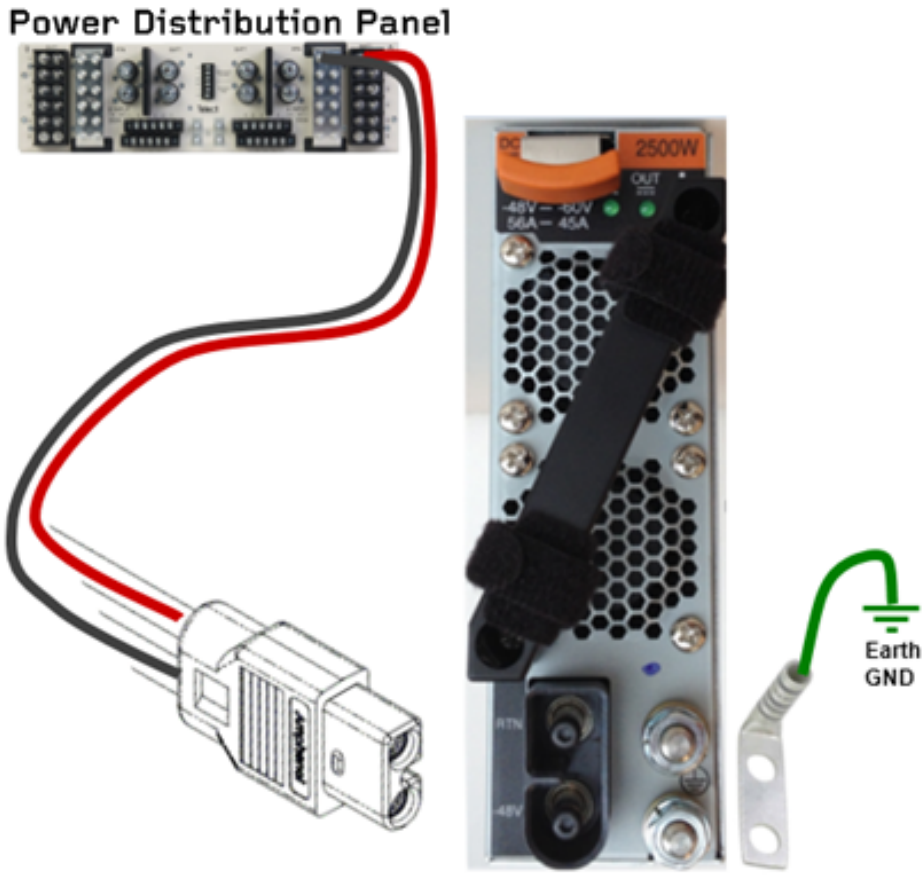


Figure 51: Connectivity example -48V DC PSU to PDP and Ground

Reference Material

The following is material that should be used as a reference throughout this guide.

For PDU and UPS configuration examples refer to the **Flex System and PureFlex System PDU Planning Guide,** located at the following link:

http://www.ibm.com/support/entry/portal/docdisplay?lndocid=LNVO-PWRCONF

PDU Line Cords – additional information

This section provides additional information on the input line cords used with each PDU. For a complete selection of PDUs refer to the: Flex System PDU and line cord selection section.

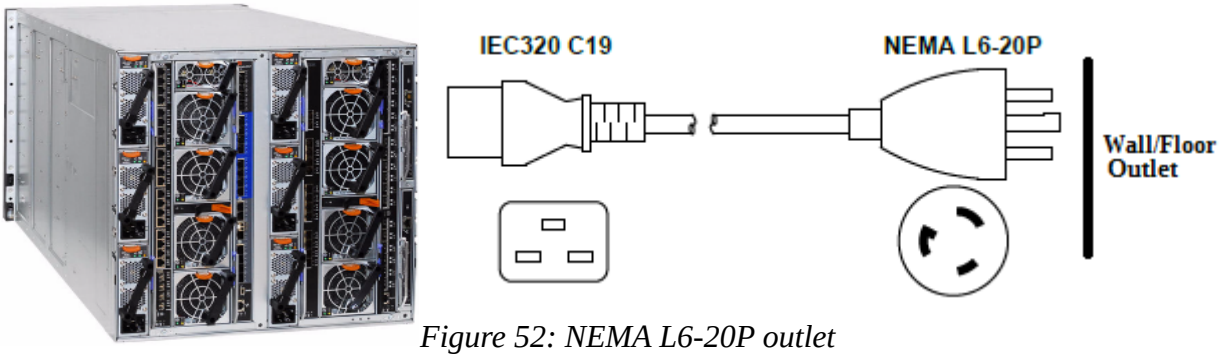


Figure 52: NEMA L6-20P outlet

PDU Line Cord Plug Types – additional information

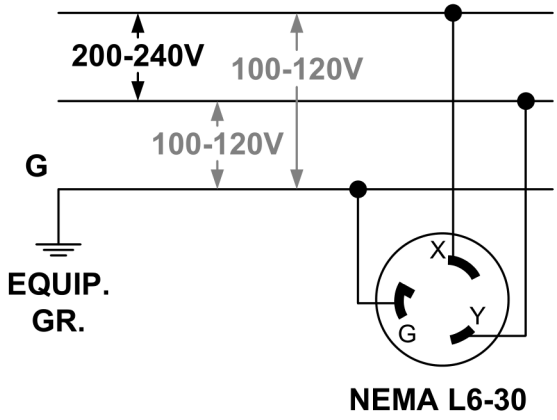
This section provides additional information on the input line cords used with each PDU. For a complete selection of PDUs refer to the: Flex System PDU and line cord selection section.

System x North American PDUs Line Cords

The following input line cords are for North American PDUs.

NEMA L6-30

NEMA L6-30P (4.3m) 30A (24A Derated) @ 200V-240V Single Phase



NEMA L6-30

Compatible with:

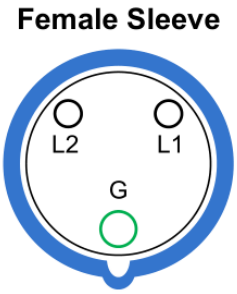
PDU Name	PDU Part Number	Line Cord Part Number	PDU + Line Cord FC	Number / Type of Outlet	Form Factor
Front End Basic	39Y8939	Comes with PDU	A11T	3 / C19 Front	½ U
Enterprise – C13 Basic	39Y8941	40K9614	6012	12 / C13 Front	1U
Enterprise Basic	39Y8948	40K9614	6062	6 / C19 Front	1U
Ultra Density Enterprise Basic	71762NX	40K9614	6500	9 / C19 Front 3 / C13 Back	1U
0U 24 C13 Basic	46M4128	Attached	5924	24 / C13 Front	0U
Enterprise PDU+ - C13 Monitored	39M2816	40K9614	6032	12 / C13 Front	1U
1U 12 C13 Switched & Monitored	46M4004	40K9614	5908	12 / C13 Front	1U
1U 9 C19 / 3 C13 Switched & Monitored	46M4002	40K9614	5901	9 / C19 Front 3 / C13 Back	1U
0U 24 C13U Switched & Monitored	46M4116	Attached	5929	24 / C13 Front	0U

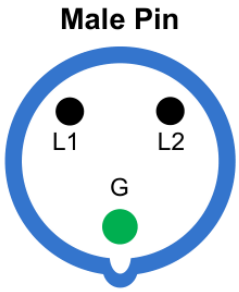
IEC 309 2P+G – 60A@200-240V 1ph

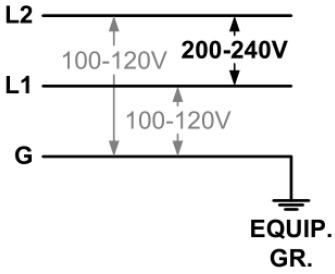
IEC 309 2P+G (4.3m) - 60A (48A Derated) @ 200V-240V Single Phase Plug (Type 360P6W)

Only a receptacle or a connector is needed to mate with the plug on the PDU input line cord. See section "IEC 309 Pin & Sleeve Plug Decode" on page 84 in this document for further details on IEC309.

Matching receptacle listing 360R6W IP-67 HUBBELL, Hubbell receptacle P/N HBL360R6W
Matching connector listing 360C6W IP-67 HUBBELL, Hubbell connector P/N HBL360C6W







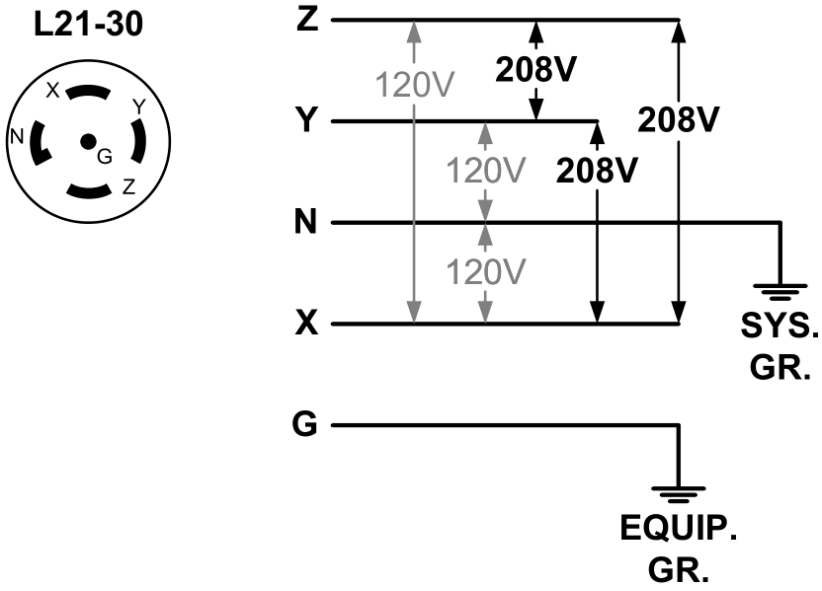
This plug may have a short guide pin

Compatible with:

PDU Name	PDU Part Number	Line Cord Part Number	PDU + Line Cord FC	Number / Type of Outlet	Form Factor
Front End Basic	39Y8940	Comes with PDU	A11U	3 / C19 Front	½ U
Enterprise – C13 Basic	39Y8941	40K9615	6013	12 / C13 Front	1U
Enterprise Basic	39Y8948	40K9615	6063	6 / C19 Front	1U
Ultra Density Enterprise Basic	71762NX	40K9615	6501	9 / C19 Front 3 / C13 Back	1U
Enterprise PDU+ - C13 Monitored	39M2816	40K9615	6033	12 / C13 Front	1U
1U 12 C13 Switched & Monitored	46M4004	40K9615	5909	12 / C13 Front	1U
1U 9 C19 / 3 C13 Switched & Monitored	46M4002	40K9615	5902	9 / C19 Front 3 / C13 Back	1U

NEMA L21-30

Attached 3.0 meter line cord with NEMA L21-30P Plug
30A (13.85A / Phase Derated) @ 200V-240V Three Phase Delta
41.55A Total Derated Circuit Capacity



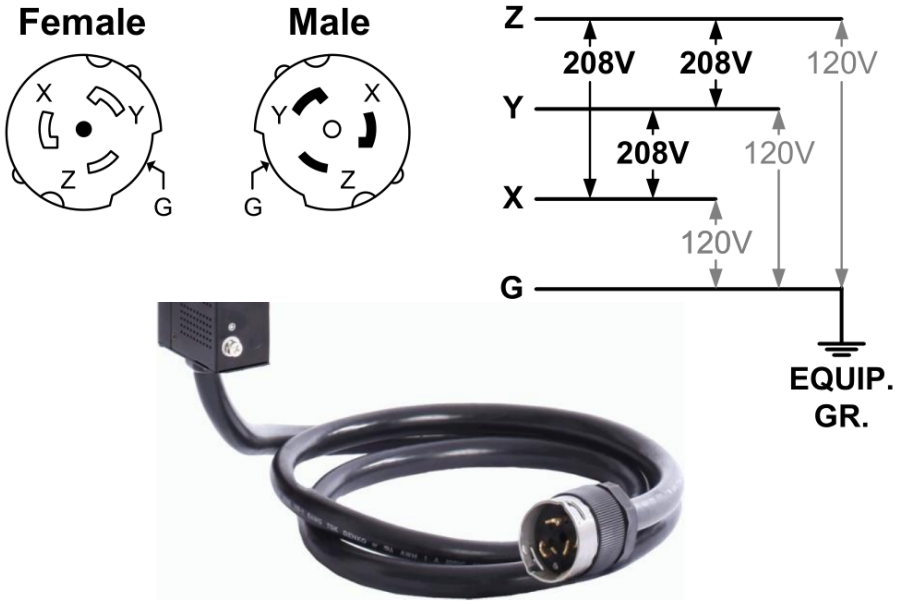
Compatible with:

PDU Name	PDU Part Number	Line Cord Part Number	PDU + Line Cord FC	Number / Type of Outlet	Form Factor
0U 24 C13 Basic	46M4125	Attached	5923	24 / C13 Front	0U
1U 9 C19 / 3 C13 Switched & Monitored	46M4167	Attached	5928	9 / C19 Front 3 / C13 Back	1U

CS8365L – 50A@208V 3ph

Attached 3.0 meter line cord with CS8365L Plug
50A (23.09A / Phase Derated) 200V-240V Three Phase Delta
69.27A Total Derated Circuit Capacity

Only a receptacle or a connector is needed to mate with the plug on the PDU input line cord.
Matching receptacle listing CS8369
Matching connector listing CS8364



Compatible with:

PDU Name	PDU Part Number	Line Cord Part Number	PDU + Line Cord FC	Number / Type of Outlet	Form Factor
0U 12 C19 / 12 C13 Basic	46M4140	Attached	5926	12 / C19 Front 12 / C13 Back	0U
0U 12 C19 / 12 C13 Switched & Monitored	46M4134	Attached	5931	12 / C19 Front 12 / C13 Back	0U

IEC309 3P+G – 60A@208V 3ph

Attached 14-foot (4.3 meter) line cord with IEC-309 60A, 3P4W Plug (Type 460P9W)

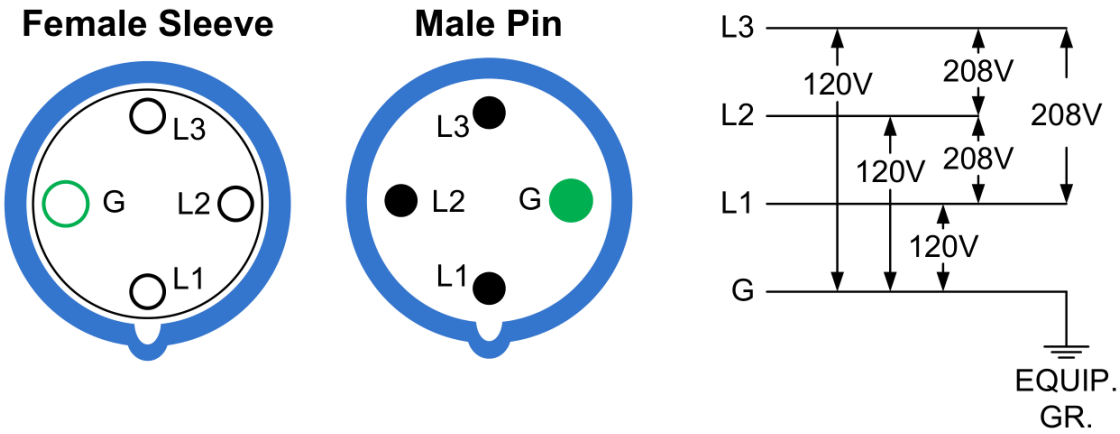
60A (27.7A / Phase Derated) 200V-240V Three Phase Delta

83.1A Total Derated Circuit Capacity

Only a receptacle or a connector is needed to mate with the plug on the PDU input line cord. See section "IEC 309 Pin & Sleeve Plug Decode" on page 84 in this document for further details on IEC309.

Matching receptacle listing 460R9W IP-67 HUBBELL, Hubbell receptacle P/N HBL460R9W

Matching connector listing 460C9W IP-67 HUBBELL, Hubbell connector P/N HBL460C9W



Compatible with:

PDU Name	PDU Part Number	Line Cord Part Number	PDU + Line Cord FC	Number / Type of Outlet	Form Factor
Enterprise Basic	39Y8923	Attached	6061	6 / C19 Front	1U
Ultra Density Enterprise Basic	71763NU	Attached	6051	9 / C19 Front 3 / C13 Back	1U
1U 12 C13 Switched & Monitored	46M4005	Attached	5895	12 / C13 Front	1U
1U 9 C19 / 3 C13 Switched & Monitored	46M4003	Attached	5897	9 / C19 Front 3 / C13 Back	1U

System x International PDUs Line Cords

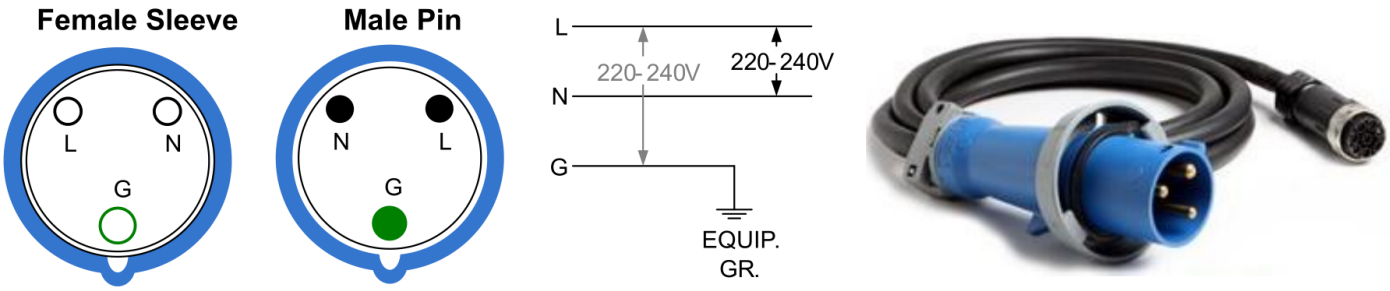
The following input line cords are for International PDUs (outside of North America).

IEC 309 P+N+G – 32A@220-240V 1ph

IEC 309 P+N+G (4.3m) - 32A / 220-240V Single Phase

Only a receptacle or a connector is needed to mate with the plug on the PDU input line cord. See section "IEC 309 Pin & Sleeve Plug Decode" on page 84 in this document for further details on IEC309.

Matching receptacle listing 332R6W IP-67 HUBBELL, Hubbell receptacle P/N HBL332R6W
Matching connector listing 332C6W IP-67 HUBBELL, Hubbell connector P/N HBL332C6

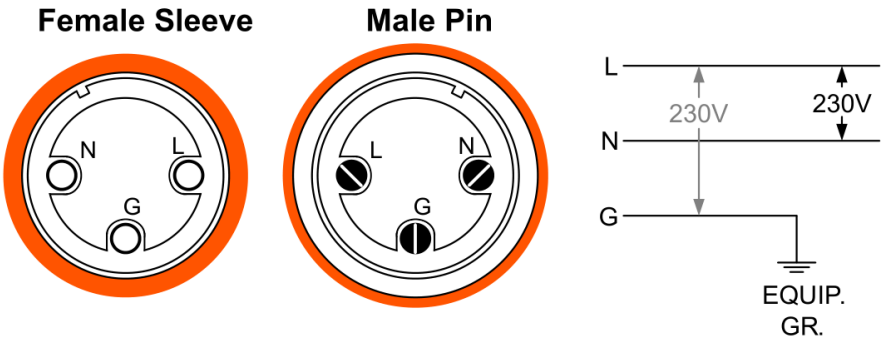


Compatible with:

PDU Name	PDU Part Number	Line Cord Part Number	PDU + Line Cord FC	Number / Type of Outlet	Form Factor
Front End Basic	39Y8934	Comes with PDU	A11V	3 / C19 Front	½ U
Enterprise C13 Basic	39Y8941	40K9612	6014	12 / C13 Front	1U
DPI Enterprise Basic	39Y8948	40K9612	6064	6 / C19 Front	1U
DPI Ultra Density Enterprise Basic	71762NX	40K9612	6502	9 / C19 Front 3 / C13 Back	1U
0U 24 C13 Basic	46M4131	Attached	5925	24 / C13 Front	0U
Enterprise + - C13 Monitored	39M2816	40K9612	6034	12 / C13 Front	1U
1U 12 C13 Switched & Monitored	46M4004	40K9612	5910	12 / C13 Front	1U
1U 9 C19 / 3 C13 Switched & Monitored	46M4002	40K9612	5903	9 / C19 Front 3 / C13 Back	1U
0U 24 C13U Switched & Monitored	46M4119	Attached	5930	24 / C13 Front	0

AUS/NZ 3112 32A – 32A@230V 1ph

P+N+G (PDL P/N 56P332) Australia/New Zealand connector

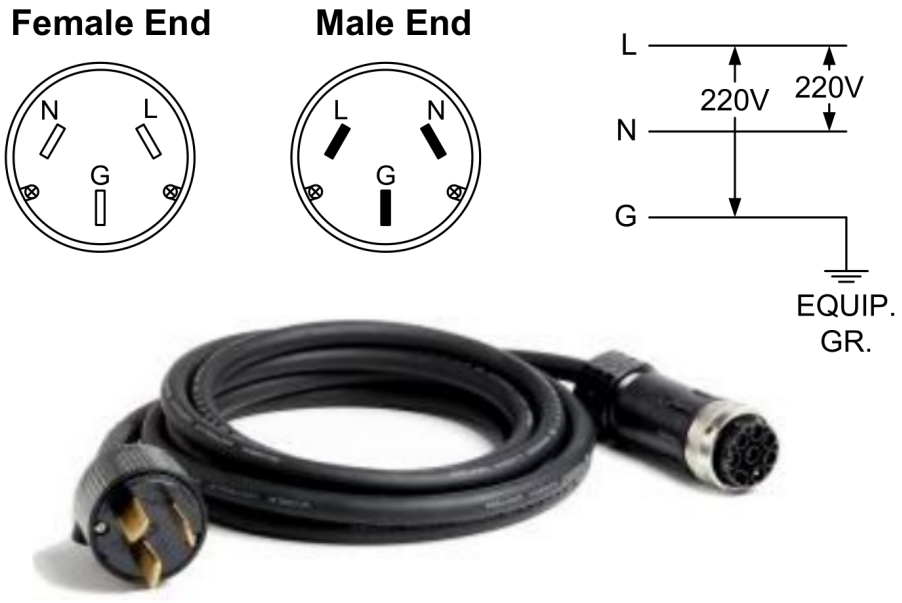


Compatible with:

PDU Name	PDU Part Number	Line Cord Part Number	PDU + Line Cord FC	Number / Type of Outlet	Form Factor
Front End Basic	39Y8936	Comes with PDU	A11Y	3 / C19 Front	½ U
Enterprise C13 Basic	39Y8941	40K9617	6017	12 / C13 Front	1U
DPI Enterprise Basic	39Y8948	40K9617	6067	6 / C19 Front	1U
DPI Ultra Density Enterprise Basic	71762NX	40K9617	6505	9 / C19 Front 3 / C13 Back	1U
Enterprise + - C13 Monitored	39M2816	40K9617	6037	12 / C13 Front	1U
1U 12 C13 Switched & Monitored	46M4004	40K9617	5913	12 / C13 Front	1U
1U 9 C19 / 3 C13 Switched & Monitored	46M4002	40K9617	5906	9 / C19 Front 3 / C13 Back	1U

KSC 8305 30A – 30A@220V 1ph

P+N+G (Shin Ju P/N SJ-P3302) Korea connector



Compatible with:

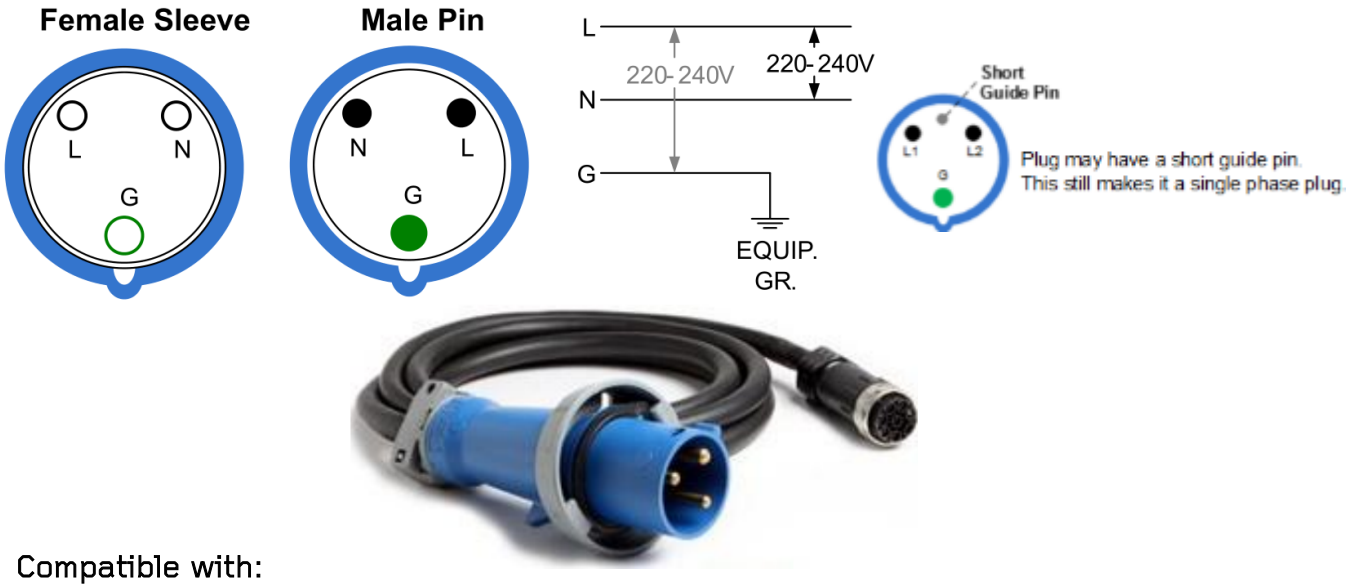
PDU Name	PDU Part Number	Line Cord Part Number	PDU + Line Cord FC	Number / Type of Outlet	Form Factor
Front End Basic	39Y8937	Comes with PDU	A11X	3 / C19 Front	½ U
Enterprise C13 Basic	39Y8941	40K9618	6018	12 / C13 Front	1U
DPI Enterprise Basic	39Y8948	40K9618	6068	6 / C19 Front	1U
DPI Ultra Density Enterprise Basic	71762NX	40K9618	6506	9 / C19 Front 3 / C13 Back	1U
Enterprise + - C13 Monitored	39M2816	40K9618	6038	12 / C13 Front	1U
1U 12 C13 Switched & Monitored	46M4004	40K9618	5914	12 / C13 Front	1U
1U 9 C19 / 3 C13 Switched & Monitored	46M4002	40K9618	5907	9 / C19 Front 3 / C13 Back	1U

IEC 309 P+N+G – 63A@220-240V 1ph

IEC 309 P+N+G (4.3m) - 63A / 220-240V Single Phase

Only a receptacle or a connector is needed to mate with the plug on the PDU input line cord. See section "IEC 309 Pin & Sleeve Plug Decode" on page 84 in this document for further details on IEC309.

Matching receptacle listing 363R6W IP-67 HUBBELL, Hubbell receptacle P/N HBL363R6W
Matching connector listing 363C6W IP-67 HUBBELL, Hubbell connector P/N HBL363C6W



Compatible with:

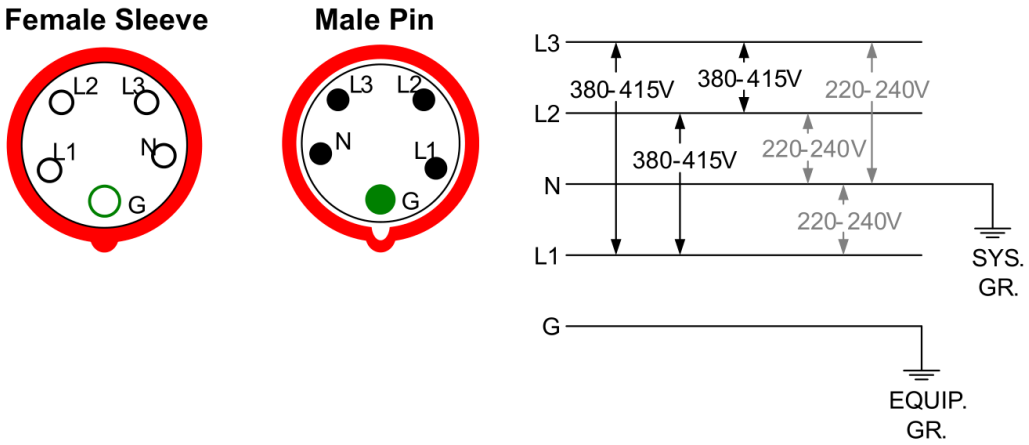
PDU Name	PDU Part Number	Line Cord Part Number	PDU + Line Cord FC	Number / Type of Outlet	Form Factor
Front End Basic	39Y8935	Comes with PDU	A11W	3 / C19 Front	½ U
Enterprise C13 Basic	39Y8941	40K9613	6015	12 / C13 Front	1U
DPI Enterprise Basic	39Y8948	40K9613	6065	6 / C19 Front	1U
DPI Ultra Density Enterprise Basic	71762NX	40K9613	6503	9 / C19 Front 3 / C13 Back	1U
Enterprise + - C13 Monitored	39M2816	40K9613	6035	12 / C13 Front	1U
1U 12 C13 Switched & Monitored	46M4004	40K9613	5911	12 / C13 Front	1U
1U 9 C19 / 3 C13 Switched & Monitored	46M4002	40K9613	5904	9 / C19 Front 3 / C13 Back	1U

IEC309 3P+N+G – 16A@380-415V 3ph

IEC-309 3P+N+G 3.0 meter 16A, 3P5W plug (Type 516P6W)
32A (32A / Phase) 380-415V Three Phase Wye
48A Total Circuit Capacity

Only a receptacle or a connector is needed to mate with the plug on the PDU input line cord. See section "IEC 309 Pin & Sleeve Plug Decode" on page 84 in this document for further details on IEC309.

Matching receptacle listing 516R6W IP-67 HUBBELL, Hubbell receptacle P/N HBL516R6W
Matching connector listing 516C6W IP-67 HUBBELL, Hubbell connector P/N HBL516C6W



Compatible with:

PDU Name	PDU Part Number	Line Cord Part Number	PDU + Line Cord FC	Number / Type of Outlet	Form Factor
Enterprise C13 Basic	39Y8941	47C2495	A3T1	12 / C13 Front	1U
DPI Enterprise Basic	39Y8948	47C2495	A3T3	6 / C19 Front	1U
DPI Ultra Density Enterprise Basic	71762NX	47C2495	A3TC	9 / C19 Front 3 / C13 Back	1U
Enterprise + - C13 Monitored	39M2816	47C2495	A3T2	12 / C13 Front	1U
1U 12 C13 Switched & Monitored	46M4004	47C2495	A3T5	12 / C13 Front	1U
1U 9 C19 / 3 C13 Switched & Monitored	46M4002	47C2495	A3T4	9 / C19 Front 3 / C13 Back	1U
0U 24 C13 Basic	46M4122	Attached	5922	24 / C13 Front	0U

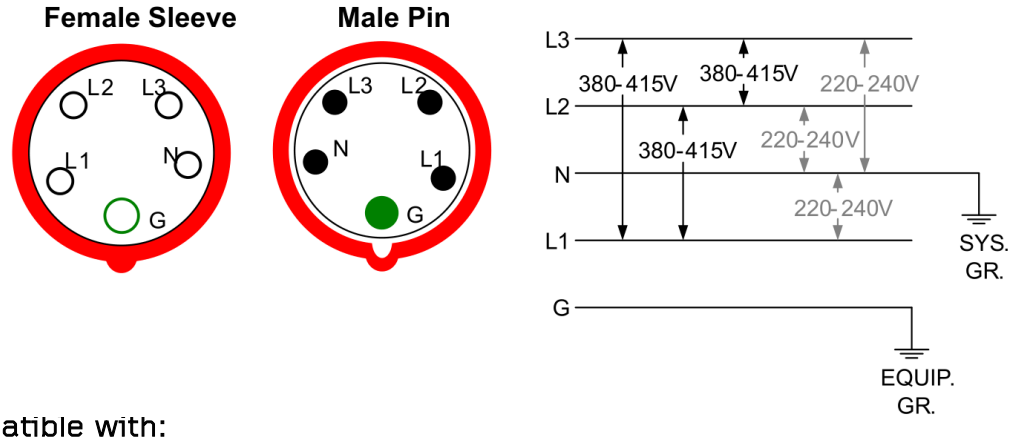
IEC 309 3P+N+G – 32A@380-415V 3ph

IEC-309 3P+N+G (4.3m) 32A, 3P5W plug (Type 532P6W)
32A (32A / Phase) 380-415V Three Phase Wye
96A Total Circuit Capacity

Only a receptacle or a connector is needed to mate with the plug on the PDU input line cord. See section "IEC 309 Pin & Sleeve Plug Decode" on page 84 in this document for further details on IEC309.

Matching receptacle listing 532R6W IP-67 HUBBELL, Hubbell receptacle P/N HBL532R6W

Matching connector listing 532C6W IP-67 HUBBELL, Hubbell connector P/N HBL532C6W



Compatible with:

PDU Name	PDU Part Number	Line Cord Part Number	PDU + Line Cord FC	Number / Type of Outlet	Form Factor
Enterprise C13 Basic	39Y8941	40K9611	6016	12 / C13 Front	1U
DPI Enterprise Basic	39Y8948	40K9611	6066	6 / C19 Front	1U
DPI Ultra Density Enterprise Basic	71762NX	40K9611	6504	9 / C19 Front 3 / C13 Back	1U
0U 12 C19 / 12 C13 Basic	46M4143	Attached	5927	12 / C19 Front 12 / C13 Back	0U
Enterprise + - C13 Monitored	39M2816	40K9611	6036	12 / C13 Front	1U
1U 12 C13 Switched & Monitored	46M4004	40K9611	5912	12 / C13 Front	1U
1U 9 C19 / 3 C13 Switched & Monitored	46M4002	40K9611	5905	9 / C19 Front 3 / C13 Back	1U
0U 12 C19 / 12 C13 Switched & Monitored	46M4137	Attached	5932	12 / C19 Front 12 / C13 Back	0U

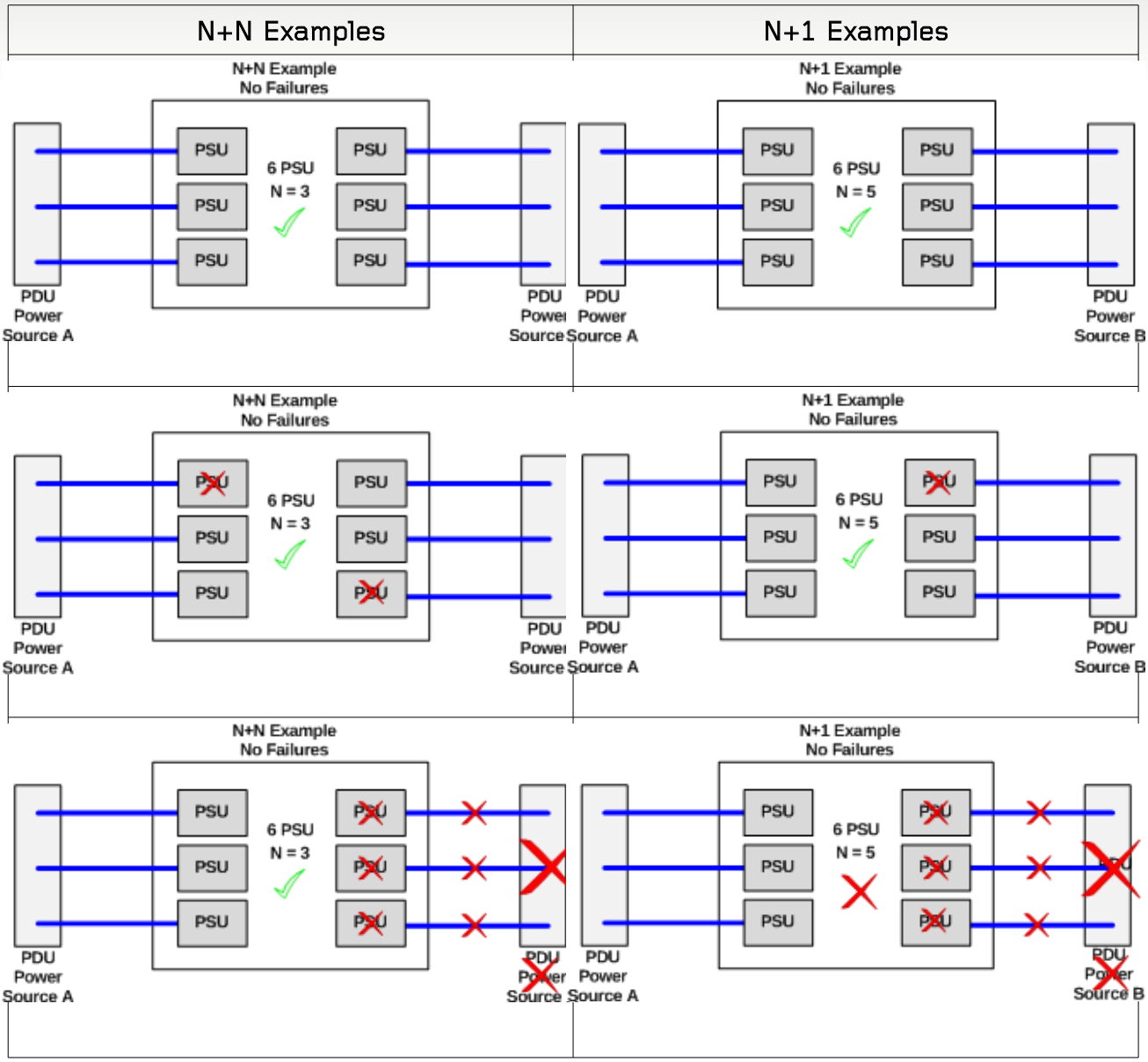
What is N+N and N+1 redundancy

N+N PSU redundancy is where N is the minimum number of PSUs need to keep the system operational, plus N number of PSUs again for redundancy. Essentially, the number of PSUs are double of what is necessary to keep the system operational. N+N is needed when a system needs to be power source redundant (See example "N+N and N+1 Examples" diagram below).

N+1 PSU redundancy is where N is the minimum number of PSUs need to keep the system operational, plus one PSU for redundancy. N+1 is used when a system needs only to tolerate a single PSU failure and stay operational (See example "N+N and N+1 Examples" diagram below). Think of N+1 as having one PSU as a hot spare.

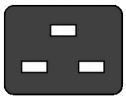
N+N and N+1 Examples

Notice in the N+1 diagrams below that there are two sources. Typically, N+1devices would be connected to one power source since N+1devices do not derive any benefit from two power sources. It is shown here with two power sources to demonstrate this lack of benefit for N+1 devices.


N+N Examples
N+1 Examples
N+N Example
No Failures
6 PSU
N = 3
PSU
PDU
Power
Source A
PDU
Power
Source B
N+1 Example
No Failures
6 PSU
N = 5

IEC 320 Connectors

The following table displays the plug types for different hardware such as monitors, switches, servers, high-end servers, power distribution units (PDUs), and uninterpretable power supplies (UPSs).

Name	Connector	AMP Rating	Use
C5 – Female C6 – Male		2.5A	Laptop Power Supplies And Other Portable Power Supplies
C7 – Female C8 – Male		2.5A	Laptop Power Supplies And Other Portable Power Supplies
C13 – Female C14 – Male		10A	Desktop Computers, Monitors, Switches, And Servers
C15 – Female C16 – Male		10A	Used In Hot Conditions Since It Is Rated To 120^0 C (248^0F), Unlike C13/C14 Which Is Rated To 70^0 C (158^0 F)
C19 – Female C20 – Male		16A	Blade Chassis, Flex System, High-power Servers, UPSs, PDUs, And Other High Current Equipment

Note: IEC 320 has changed to IEC 60320

Rong Fend RF-203P Connector

The following table displays the plug type for the HVDC PDU.

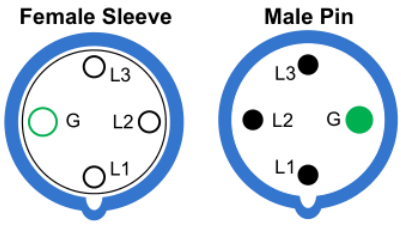
Name	Connector	AMP Rating	Use
RF-203P		10/15A	For systems requiring DC power from a DC power source.

IEC 309 Pin & Sleeve Plug Decode

4	60	R	9	W
Pin Configuration	**Amperage**	**Device Type**	**Polarization**	**Environmental Rating**
3 - 2 Pole + G 4 - 3 Pole + G 5 – 3 Pole + N + G	20 30 32 60 63 100	P - Plug C - Connector R - Receptacle B - Inlet	Clock Position Of Female Sleeve	W-WATERTIGHT (SCREW CAP & LOCKING RING)

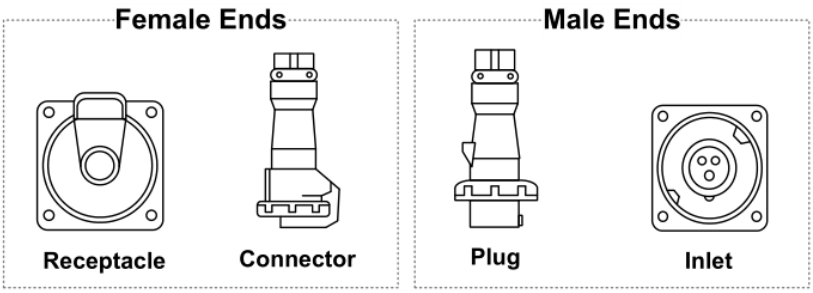
Color	Voltage Rating
Yellow	100V - 130V
Orange	125V/250V
Blue	200V - 250V
Gray	277V
Red	380V - 480V
Black	500V - 690V

- Example
  - IEC309 3P+G Plug
  - 60amp/250V three-phase
  - Hubbell Connector listing 460C9W IP-67
  - P/N HBL460C9W



Pin Configuration Significance

3 Pins = 1ph
4 Pins = 3ph Δ
5 Pins = 3ph Y



Ingress Protection (IP) Decode

Code Letters	First Number	Second Number
Ingress Protection	**Protection Against Ingress of Solid Foreign Objects**	**Protection Against Ingress of Water with Harmful Effects**
IP	0 – No Protection 1 ≥ 50mm Diameter 2 ≥ 12.5mm Diameter 3 ≥ 2.5mm Diameter 4 ≥ 1.0mm Diameter 5 – Dust-Protected 6 – Dust-Tight	0 – No Protection 1 – Vertically Dripping 2 – Dripping At 15° Of Tilt 3 – Spraying Up To 60° Of Tilt 4 – Splashing 5 – Jetting 6 – Power Jetting 7 – Temporary Immersion 8 – Continuous Immersion

First Number: degree of protection for persons against access of hazardous parts inside the enclosure and/or against foreign objects.

Second Number: degree of protection of equipment inside enclosures against damage from ingress of water.

Ingress Protection (IP) is defined in IEC 60529 Standard.

Example: IP67 = Ingress Protection / Dust-Tight / Temporary Immersion

60A Three Phase Delta Power Calculations

$$E_{LL} = E_{AC} = E_{BA} = E_{CB} = 208V$$

$$I_L = 60A$$

$$P_{Total} = \sqrt{3} \times E_{LL} \times I_L \times pf$$

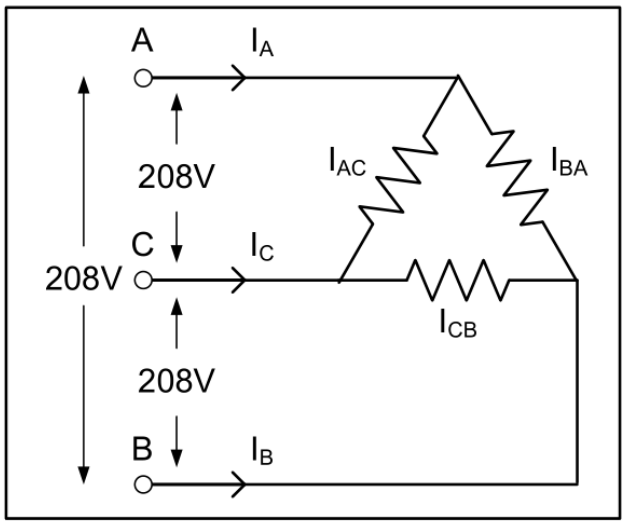
$$= \sqrt{3} \times 208 \times 60 \times 1$$

$$= 21616W$$

$$P_{Derated} = P_{Total} \times 0.8$$

$$= 21616W \times 0.8$$

$$= 17293W$$



$$I_\Phi = I_{AC} = I_{BA} = I_{CB} = \frac{I_L}{\sqrt{3}} = \frac{60}{\sqrt{3}} = 34.64A$$

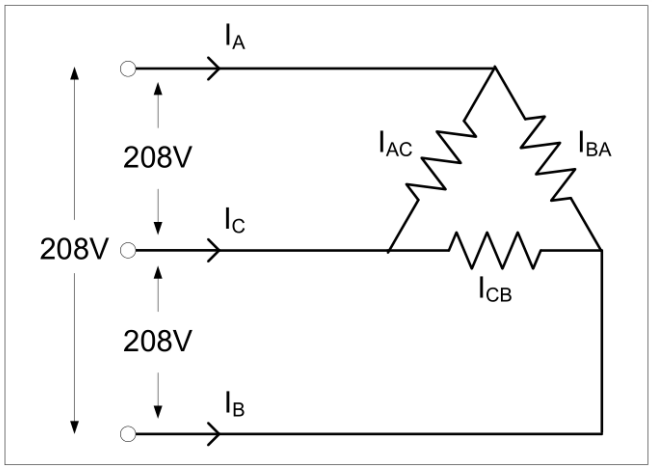
$$I_{Derated} = I_\Phi \times 0.8 = 34.64 \times 0.8 = 27.7A$$

Variables Defined

I_Φ = Phase Current
I_L = Line Current
E_{LL} = Line to Line Voltage
pf = Power Factor
P = Power In Watts

50A Three Phase Delta Power Calculations

$$E_{LL} = 208V$$
$$I_L = 50A$$
$$P_{Total} = \sqrt{3} \times E_{LL} \times I_L \times PF$$
$$= \sqrt{3} \times 208 \times 50 \times 1$$
$$= 18013W$$
$$P_{Derated} = P_{Total} \times 0.8$$
$$= 18013W \times 0.8$$
$$= 14410W$$



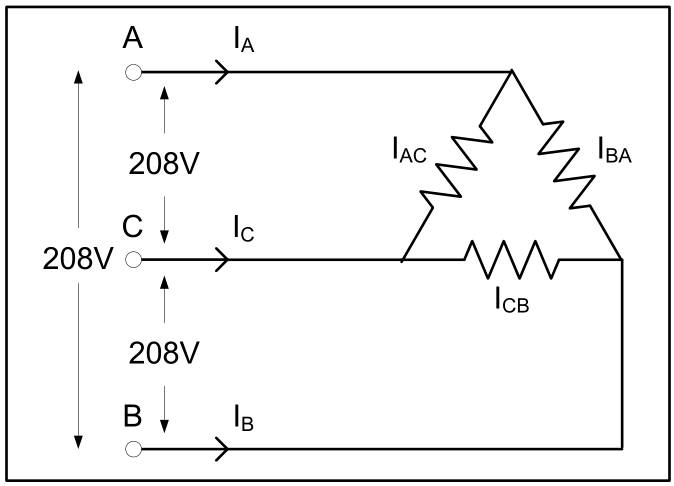
Variables Defined
I_Φ = Phase Current
I_L = Line Current
E_{LL} = Line to Line Voltage
PF = Power Factor
P = Power In Watts

$$I_{AC} = I_{BA} = I_{CB} = \frac{I_L}{\sqrt{3}} = \frac{50}{\sqrt{3}} = 28.86A$$

$$I_{Derated} = I \times 0.8 = 28.86 \times 0.8 = 23.09A$$

30A Three Phase Delta Power Calculations

$$E_{LL} = E_{AC} = E_{BA} = E_{CB} = 208V$$
$$I_L = 30A$$
$$P_{Total} = \sqrt{3} \times E_{LL} \times I_L \times PF$$
$$= \sqrt{3} \times 208 \times 30 \times 1$$
$$= 10808W$$
$$P_{Derated} = P_{Total} \times 0.8$$
$$= 10808W \times 0.8$$
$$= 8646W$$



Variables Defined
I_Φ = Phase Current
I_L = Line Current
E_{LL} = Line to Line Voltage
PF = Power Factor
P = Power In Watts

$$I_\Phi = I_{AC} = I_{BA} = I_{CB} = \frac{I_L}{\sqrt{3}} = \frac{30}{\sqrt{3}} = 17.32A$$

$$I_{Derated} = I_\Phi \times 0.8 = 17.32 \times 0.8 = 13.85A$$

32A Three Phase Delta Power Calculations

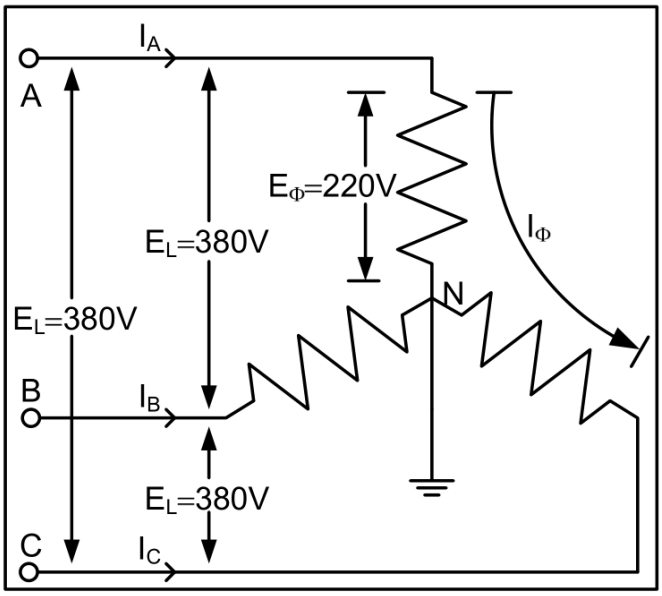
$I_A = I_B = I_C = I_L = I_\Phi = 32A$

$P_\Phi = E_{\Phi Y} \times I_{\Phi Y} \times pf \quad (W)$

$P_{TOTAL} = 3 \times P_\Phi$
$= 3 \times E_L/\sqrt{3} \times I_\Phi \times pf$
$= \sqrt{3} \times E_L \times I_L \times pf$
$= \sqrt{3} \times 380V \times 32A \times 1$
$= 21061W$

$E_{AN} = E_{BN} = E_{CN} = E_\Phi$

$= \frac{E_L}{\sqrt{3}} = \frac{380}{\sqrt{3}} = 220V$



16A Three Phase Delta Power Calculations

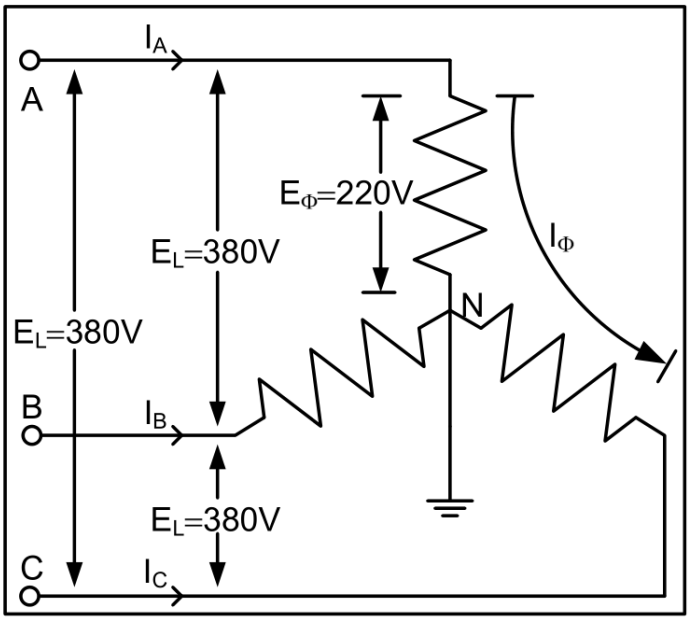
$I_A = I_B = I_C = I_L = I_\Phi = 16A$

$P_\Phi = E_{\Phi Y} \times I_{\Phi Y} \times pf \quad (W)$

$P_{TOTAL} = 3 \times P_\Phi$
$= 3 \times E_L/\sqrt{3} \times I_\Phi \times pf$
$= \sqrt{3} \times E_L \times I_L \times pf$
$= \sqrt{3} \times 380V \times 16A \times 1$
$= 10530W$

$E_{AN} = E_{BN} = E_{CN} = E_\Phi$

$= \frac{E_L}{\sqrt{3}} = \frac{380}{\sqrt{3}} = 220V$



Flex System Power & Cooling Part Numbers

G8264R – System x PureFlex Part Numbers

P/N: 39Y7917 FC: 6212 2.8m (9ft) 10A/230V C13 to CEE7-VII (Europe)
P/N: 39Y7918 FC: 6213 2.8m (9ft) 10A/250V C13 to DK2-5a (Denmark)
P/N: 39Y7919 FC: 6216 2.8m (9ft) 10A/250V C13 to SEV1011-S24507 (Switzerland)
P/N: 39Y7920 FC: 6218 2.8m (9ft) 10A/250V C13 to SI 32 (Israel)
P/N: 39Y7922 FC: 6214 2.8m (9ft) 10A/250V C13 to SABS 164 (South Africa)
P/N: 39Y7923 FC: 6215 2.8m (9ft) 13A/250V C13 to BS 1363/A (UK)
P/N: 39Y7924 FC: 6211 2.8m (9ft) 10A/250V C13 to AS/NZ 3112 (Australia/NZ)
P/N: 39Y7925 FC: 6219 2.8m (9ft) 10A/220-240V C13 to KETI (South Korea)
P/N: 39Y7927 FC: 6269 2.8m (9ft) 10A/250V C13 to IS6538 (India)
P/N: 39Y7928 FC: 6210 2.8m (9ft) 10A/220-240V C13 to GB 2099.1 (China)
P/N: 39Y7929 FC: 6223 2.8m (9ft) 10A/250V C13 to NBR 14136 (Brazil)
P/N: 39Y7930 FC: 6222 2.8m (9ft) 10A/250V C13 to IRAM 2073 (Argentina)
P/N: 39Y7932 FC: 6263 4.3m (14ft) 10A/100-250V C13 to C14 (World Wide)
P/N: 39Y7937 FC: 6201 1.5m (5ft) 10A/100-250V C13 to C14 (World Wide)
P/N: 39Y7938 FC: 6204 2.8m (9ft) 10A/100-250V C13 to C20 (World Wide)
P/N: 46M2592 FC: A1RF 2.8m (9ft) 10A/250V C13 to NEMA 6-15P (US)
P/N: 46M2593 FC: A1RE 2.8m (9ft) 10A/100V C13 to JIS C-8303 (Japan)
P/N: None FC: 6568 1.8m 10A/100-250V, 2xC13PM to IEC 320-C14 (World Wide)
P/N: None FC: 6311 2.8m (9ft) 10A/100-250V C13 to C14 (World Wide)

Rack & Rear Door Heat eXchanger (RDHx) – System x PureFlex Part Numbers

9363-4CX System x PureFlex System 42U Rack
9363-4DX System x PureFlex System 42U Expansion Rack
44X3132 System x PureFlex System Rack Door Kit
1756-42X System x Rear Door Heat eXchanger

Flex System Power & Cooling Part Numbers

Flex System Enterprise Chassis

FC: 6671 2.7m (9ft) 100-240V 10A C13 to C14 World Wide
FC: 6672 1.5m (5) 100-240V 10A C13 to C14 World Wide
FC: 6680 2.7m (9ft) 250V 10A C13 to AS3112-1964 and NZS 198 wall plug #6
* - For this feature, System x Manufacturing chooses the optimum cord length when assembling systems into a rack – 1.5m (5 ft), 2.7m (9 ft), or 4.2m (13.8 ft)

Flex System Enterprise Chassis Documents

System x Power Configurator
http://www.ibm.com/support/entry/portal/docdisplay?lndocid=LNVO-PWRCONF

Flex System Product Guide – System x Redbook
http://www.redbooks.ibm.com/abstracts/sg247984.html?Open

Flex System Higher Voltage DC Solutions
http://www.redbooks.ibm.com/abstracts/redp5180.html?Open

Helpful Links

Flex System & PureFlex System Product Manuals
http://publib.boulder.ibm.com/infocenter/flexsys/information/index.jsp?topic%2Fcom.ibm.acc.common.nav.doc%2Fic-homepage.html

Flex System & PureFlex System at a Glance Guides
http://www.redbooks.ibm.com/portals/flexsystem?Open

Flex System Interoperability Guide
http://www.redbooks.ibm.com/Redbooks.nsf/RedbookAbstracts/redpfsig.html?Open

Other resources related to power and cooling
http://www.ibm.com/support/entry/portal/docdisplay?lndocid=LNVO-POWINF

Hubbell - Twist Lock Plug/Outlet Catalog (Includes NEMA Outlets)
http://www.hubbellcatalog.com/wiring/catalogpages/section-b.pdf

Hubbell - Pin & Sleeve Plug/Outlet Catalog (Includes IEC309 Outlets)
http://www.hubbellcatalog.com/wiring/catalogpages/section-E.pdf

System x® Configuration and Options Guide
http://www.ibm.com/systems/xbc/cog/

System x BladeCenter and System x Reference Sheets
http://www.redbooks.ibm.com/abstracts/redpxref.html

Official System x Visio Stencils
http://www.visiocafe.com/lenovo.htm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