Intel® Server Chassis P4000M Family

Technical Product Specification

Intel reference number G27488-005

Revision 1.2

January 2014

Revision History

Date	Revision Number	Modifications
March, 2012	1.0	Initial release.
April, 2012	1.1	Updated Section 5.1.
January, 2014	1.2	Added Section 1.20 Rack Options.

Disclaimers

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1. Product Overview

The Intel® Server Chassis P4000M family is a 4U pedestal, 25” length server chassis that is designed to support Intel® Server Board S2600CP, S2600CO, S2400SC, and S2400GP. This chapter provides a high-level overview of the chassis features. Greater detail for each major chassis component or feature is provided in the following chapters.

1.1 Intel® Server Chassis P4000M Family Design Features

The Intel® Server Chassis P4000M Family make extensive use of tool-less hardware features and, depending on configuration and upgrade features, provides redundant power supply, redundant cooling and hot swappable hard drives capability. Three 5.25-inch half-height peripheral bays are available for the installation of a floppy drive, CD-ROM drive, and/or other accessories.

The standard chassis configuration is pedestal and it provides rackable feature.

1.1.1 Chassis/System Product Code Naming Conventions

The following figure shows the server chassis/system product code naming conventions:

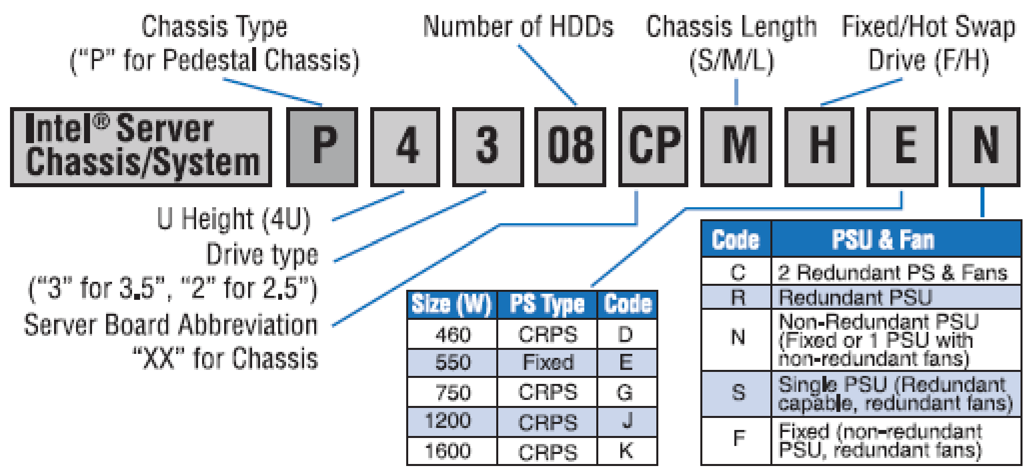


Figure 1. Chassis/System Product Code Naming Conventions

1.1.2 Intel® Server Chassis P4000M Family Product Configurations

The Intel® Server Chassis P4000M family comes with the following configurations:

1. P4308XXMFEN – one 550W non-redundant fixed PSU, two non-redundant fixed 120x38mm system fans and up to eight 3.5" fixed hard drives.
2. P4308XXMHEN – one 550W non-redundant fixed PSU, two non-redundant fixed 120x38mm system fans and up to eight 3.5" hot-swap hard drives.
3. P4308XXMFGN – one 750W hot-swap PSU, two non-redundant fixed 120x38mm system fans and up to eight 3.5" fixed hard drives.
4. P4308XXMHGC – two 750W redundant hot-swap PSU, five redundant hot-swap 80x38mm system fans and up to eight 3.5" hot-swap hard drives.

5. P4308XXMHJC – two 1200W redundant hot-swap PSU, five redundant hot-swap 80x38mm system fans and up to eight 3.5" hot-swap hard drives.
6. P4208XXMHEN – one 550W non-redundant fixed PSU, two non-redundant fixed 120x38mm system fans and up to eight 2.5" hot-swap hard drives.
7. P4208XXMHDR – two 460W redundant hot-swap PSU, two non-redundant fixed 120x38mm system fans and up to eight 2.5" hot-swap hard drives.
8. P4208XXMHGR – two 750W redundant hot-swap PSU, two non-redundant fixed 120x38mm system fans and up to eight 2.5" hot-swap hard drives.
9. P4208XXMHGC – two 750W redundant hot-swap PSU, five redundant hot-swap 80x38mm system fans and up to eight 2.5" hot-swap hard drives.
10. P4216XXMHJC – two 1200W redundant hot-swap PSU, five redundant hot-swap 80x38mm system fans and up to sixteen 2.5" hot-swap hard drives.
11. P4216XXMHGC – two 750W redundant hot-swap PSU, five redundant hot-swap 80x38mm system fans and up to sixteen 2.5" hot-swap hard drives.
12. P4216XXMHGR – two 750W redundant hot-swap PSU, two non-redundant fixed 120x38mm system fans and up to sixteen 2.5" hot-swap hard drives.
13. P4216XXMHEN – one 550W non-redundant fixed PSU, two non-redundant fixed 120x38mm system fans and up to sixteen 2.5" hot-swap hard drives.
14. P4308XXMHGR – two 750W redundant hot-swap PSU, two non-redundant fixed 120x38mm system fans and up to eight 3.5" hot-swap hard drives.
15. P4308XXMHGN – one 750W hot-swap PSU, two non-redundant fixed 120x38mm system fans and up to eight 3.5" hot-swap hard drives.
16. P4308XXMFGR – two 750W redundant hot-swap PSU, two non-redundant fixed 120x38mm system fans and up to eight 3.5" fixed hard drives.
17. P4308XXMHDR – two 460W redundant hot-swap PSU, two non-redundant fixed 120x38mm system fans and up to eight 3.5" hot-swap hard drives.
18. P4308XXMHDN – one 460W hot-swap PSU, two non-redundant fixed 120x38mm system fans and up to eight 3.5" hot-swap hard drives.
19. P4308XXMFDR – two 460W redundant hot-swap PSU, two non-redundant fixed 120x38mm system fans and up to eight 3.5" fixed hard drives.
20. P4308XXMFDN – one 460W hot-swap PSU, two non-redundant fixed 120x38mm system fans and up to eight 3.5" fixed hard drives.
21. P4304XXMHEN – one 550W non-redundant fixed PSU, two non-redundant fixed 120x38mm system fans and up to four 3.5" hot-swap hard drives.

The following table summarizes the features for all chassis combinations:

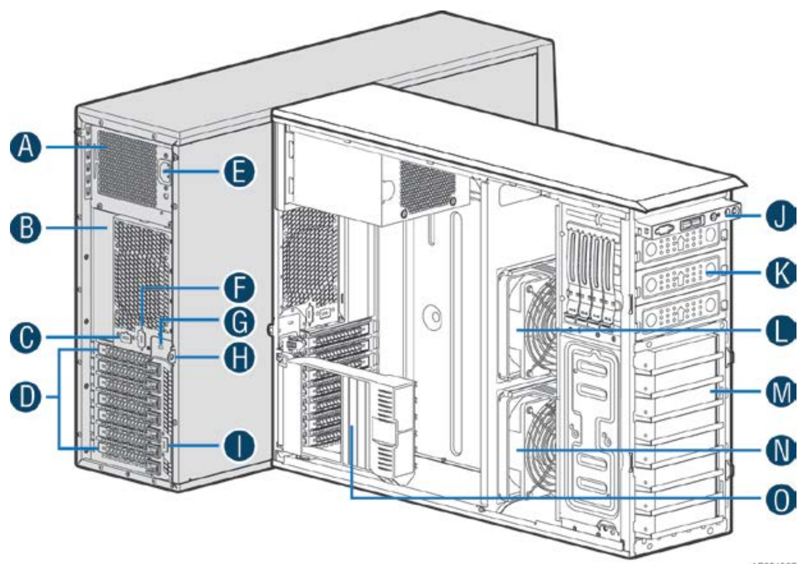
Table 1. Intel® Server Chassis P4000M family Features

Configuration	P4308XXMFEN	P4308XXMHEN	P4308XXMFGN	P4308XXMHGC	P4308XXMHJC
Intel® Server Board Support	▪ Intel® Server Board S2600CP ▪ Intel® Server Board S2600CO ▪ Intel® Server Board S2400SC ▪ Intel® Server Board S2400GP				
Power	550W non-redundant fixed power supply		One 750W hot-swap power supply with high current PDB	Two 750W redundant hot-swap power supply with high current PDB	Two 1200W redundant hot-swap power supply with high current PDB
System Cooling	Two 120x38mm non-redundant fans			Five 80x38mm redundant hot swap fans	
Peripherals Bays	Three (3) half height 5-1/4" bays for optical devices.				
Drive Bays	Includes one fixed drive bay. Supports up to eight 3.5" fixed hard drives	Includes one 8x3.5" hot-swap hard drive cage. Supports up to eight 3.5" hot-swap hard drives.	Includes one fixed drive bay. Supports up to eight 3.5" fixed hard	Includes one 8x3.5" hot-swap hard drive cage. Supports up to eight 3.5" hot-swap hard drives.	
Expansion Slots	Support up to six (6) full height, full length PCI form factor cards mechanically.				
Front Panel	Power Button with LED, Reset Button, NMI Button, ID Button with LED, Four NIC LEDs, Hard drive activity LED, System status LED, two USB ports, Optional front serial port/VGA port				
Appearance	Color: Cosmetic black (GE 701 or equivalent), service Intel blue, hot swap Intel green. Support for Intel standard front panel or LCD				
Dimensions Pedestal	17.24 in (438 mm) x 6.81 in (173mm) x 25 in (612 mm) (Height X Width X Depth)				
Optional Accessory Kits	Zephyr flash storage, RMM4-lite modules, TPM module, dedicated NIC module, Expander Card module,				
Configuration	P4208XXMHEN	P4208XXMHDR	P4208XXMHGR	P4208XXMHGC	P4216XXMHJC
Intel® Server Board Support	▪ Intel® Server Board S2600CP ▪ Intel® Server Board S2600CO ▪ Intel® Server Board S2400SC ▪ Intel® Server Board S2400GP				
Power	550W non-redundant fixed power supply	Two 460W redundant hot-swap power supply with low current PDB	Two 750W redundant hot-swap power supply with high current PDB		Two 1200W redundant hot-swap power supply with high current PDB
System Cooling	Two 120x38mm non-redundant fans			Five 80x38mm redundant hot swap fans	
Peripherals Bays	Three (3) half height 5-1/4" bays for optical devices.				
Drive Bays	Include one 8x2.5" hot-swap hard drive cage. Supports up to eight 2.5" hot-swap hard drives.				Include two 8x2.5" hot-swap hard drive cage. Supports up to

Configuration	P4308XXMFEN	P4308XXMHEN	P4308XXMFGN	P4308XXMHGC	P4308XXMHJC	
					sixteen 2.5" hot-swap hard drives.	
Expansion Slots	Support up to six (6) full height, full length PCI form factor cards mechanically.					
Front Panel	Power Button with LED, Reset Button, NMI Button, ID Button with LED, Four NIC LEDs, Hard drive activity LED, System status LED, two USB ports, Optional front serial port/VGA port					
Appearance	Color: Cosmetic black (GE 701 or equivalent), service Intel blue, hot swap Intel green. Support for Intel standard front panel or LCD					
Dimensions Pedestal	17.24 in (438 mm) x 6.81 in (173mm) x 25 in (612 mm) (Height X Width X Depth)					
Optional Accessory Kits	Zephyr flash storage, RMM4-lite modules, TPM module, dedicated NIC module, Expander Card module,					
Configuration	P4216XXMHGC	P4216XXMHGR	P4308XXMHGR	P4308XXMFGR	P4308XXMHGN	
Intel® Server Board Support	▪ Intel® Server Board S2600CP ▪ Intel® Server Board S2600CO ▪ Intel® Server Board S2400SC ▪ Intel® Server Board S2400GP					
Power	Two 750W redundant hot-swap power supply with high current PDB				One 750W hot-swap power supply with high current PDB	
System Cooling	Five 80x38mm redundant hot swap fans	Two 120x38mm non-redundant fans				
Peripherals Bays	Three (3) half height 5-1/4" bays for optical devices.					
Drive Bays	Include two 8x2.5" hot-swap hard drive cage. Supports up to sixteen 2.5" hot-swap hard drives.		Include one 8x3.5" hot-swap hard drive cage. Supports up to eight 3.5" hot-swap hard drives.	Includes one fixed drive bay. Supports up to eight 3.5" fixed hard	Include one 8x3.5" hot-swap hard drive cage. Supports up to eight 3.5" hot-swap hard drives.	
Expansion Slots	Support up to six (6) full height, full length PCI form factor cards mechanically.					
Front Panel	Power Button with LED, Reset Button, NMI Button, ID Button with LED, Four NIC LEDs, Hard drive activity LED, System status LED, two USB ports, Optional front serial port/VGA port					
Appearance	Color: Cosmetic black (GE 701 or equivalent), service Intel blue, hot swap Intel green. Support for Intel standard front panel or LCD					
Dimensions Pedestal	17.24 in (438 mm) x 6.81 in (173mm) x 25 in (612 mm) (Height X Width X Depth)					
Optional Accessory Kits	Zephyr flash storage, RMM4-lite modules, TPM module, dedicated NIC module, Expander Card module,					
Configuration	P4216XXMHEN	P4308XXMHDR	P4308XXMHDN	P4308XXMFDR	P4308XXMFDN	P4304XXMHEN
Intel® Server Board Support	▪ Intel® Server Board S2600CP ▪ Intel® Server Board S2600CO ▪ Intel® Server Board S2400SC ▪ Intel® Server Board S2400GP					
Power	550W non-redundant fixed power supply	Two 460W redundant hot-swap power supply with low current	One 460W hot-swap power supply with low current	Two 460W redundant hot-swap power supply with low current PDB	One 460W hot-swap power supply with low current PDB	550W non-redundant fixed power supply

Configuration	P4308XXMFEN	P4308XXMHEN	P4308XXMFGN	P4308XXMHGC	P4308XXMHJC
		PDB	PDB		
System Cooling	Two 120x38mm non-redundant fans				
Peripherals Bays	Three (3) half height 5-1/4" bays for optical devices.				
Drive Bays	Include two 8x2.5" hot-swap hard drive cage. Supports up to sixteen 2.5" hot-swap hard drives.	Include one 8x3.5" hot-swap hard drive cage. Supports up to eight 3.5" hot-swap hard drives.		Includes one fixed drive bay. Supports up to eight 3.5" fixed hard	Include one 4x3.5" hot-swap hard drive cage. Supports up to four 3.5" hot-swap hard drives.
Expansion Slots	Support up to six (6) full height, full length PCI form factor cards mechanically.				
Front Panel	Power Button with LED, Reset Button, NMI Button, ID Button with LED, Four NIC LEDs, Hard drive activity LED, System status LED, two USB ports, Optional front serial port/VGA port				
Appearance	Color: Cosmetic black (GE 701 or equivalent), service Intel blue, hot swap Intel green. Support for Intel standard front panel or LCD				
Dimensions Pedestal	17.24 in (438 mm) x 6.81 in (173mm) x 25 in (612 mm) (Height X Width X Depth)				
Optional Accessory Kits	Zephyr flash storage, RMM4-lite modules, TPM module, dedicated NIC module, Expander Card module,				

1.2 Intel® Server Chassis P4308XXMFEN View

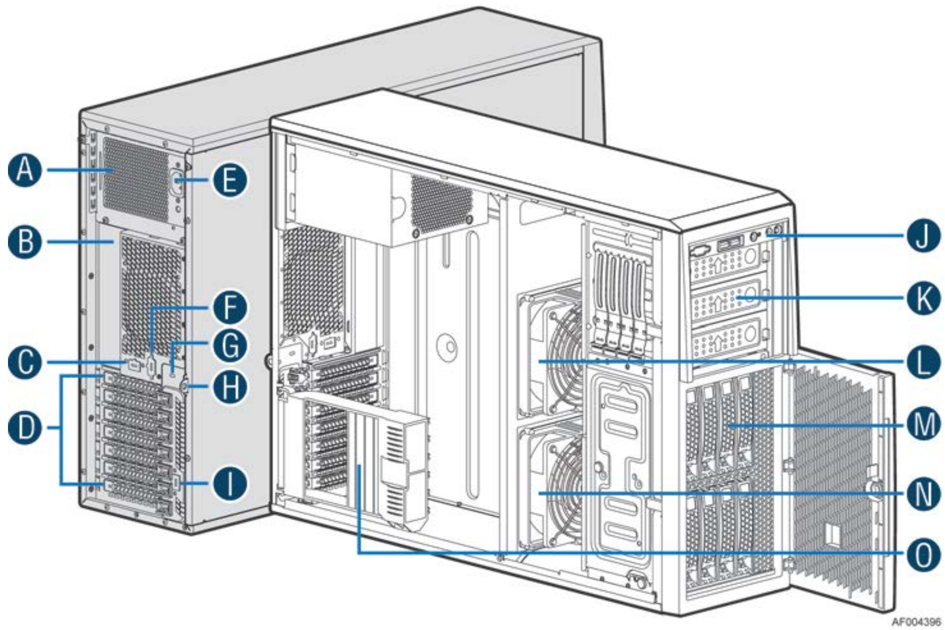


A. 550-W Fixed Power supply
B. I/O Ports
C. Alternate RMM4 Knockout
D. PCI Add-in Board Slot Covers
E. AC Input Power Connector
F. Serial Port Knockout
G. A Kensington* Cable Lock Mounting Hole

H. Padlock Loop
I. Alternate RMM4 Knockout
J. Front Control Panel
K. 5.25” Peripheral Bays
L. CPU Zone System Fan (Fixed System Fan 2)
M. Fixed Hard Drive Carrier Tray
N. PCI Zone System Fan (Fixed System Fan 1)
O. PCI Card Retainer

Figure 2. Internal Chassis View of Intel® Server Chassis P4308XXMFEN

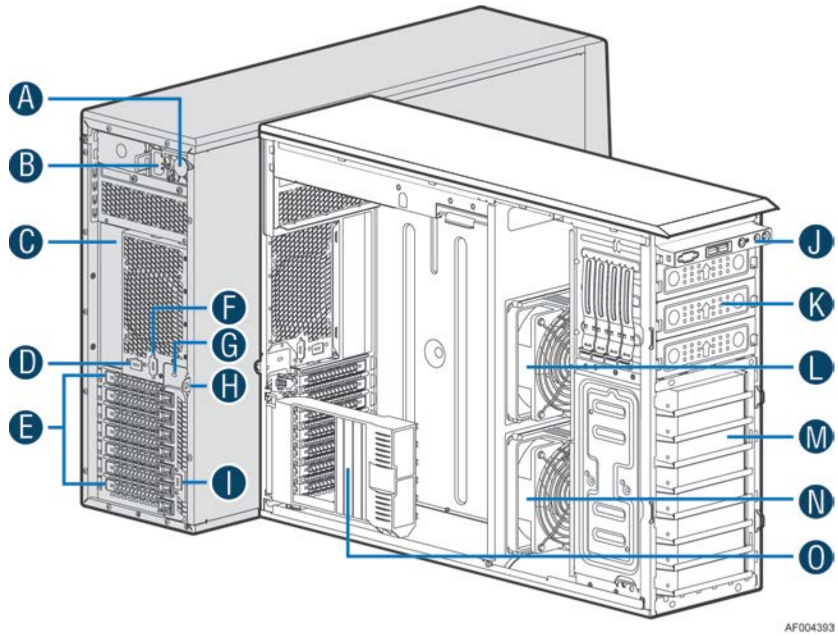
1.3 Intel® Server Chassis P4308XXMHEN View



A. 550-W Fixed Power Supply
B. I/O Ports
C. Alternate RMM4 Knockout
D. PCI Add-in Board Slot Covers
E. AC Input Power Connector
F. Serial Port Knockout
G. A Kensington* Cable Lock Mounting Hole
H. Padlock Loop
I. Alternate RMM4 Knockout
J. Front Control Panel
K. 5.25” Peripheral Bays
L. CPU Zone System Fan (Fixed System Fan 2)
M. 8x3.5” Hot-swap HDD Cage
N. PCI Zone System Fan (Fixed System Fan 1)
O. PCI Card Retainer

Figure 3. Internal Chassis View of Intel® Server Chassis P4308XXMHEN

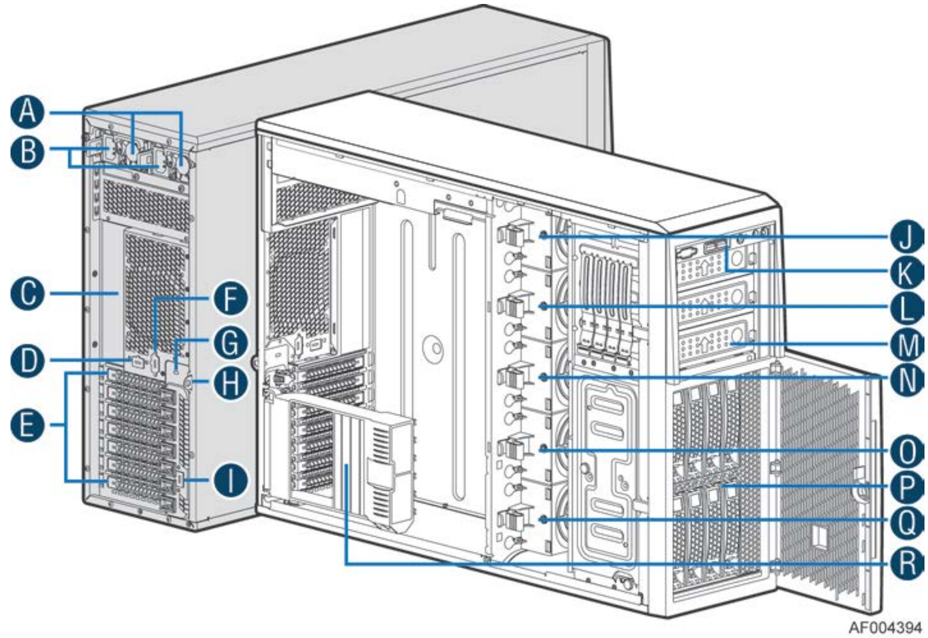
1.4 Intel® Server Chassis P4308XXMFGN View



A. 750-W Hot Swap Power Supply (One)
B. AC Input Power Connector
C. I/O Ports
D. Alternate RMM4 Knockout
E. PCI Add-in Board Slot Covers
F. Serial Port Knockout
G. A Kensington* Cable Lock Mounting Hole
H. Padlock Loop
I. Alternate RMM4 Knockout
J. Front Control Panel
K. 5.25" Peripheral Bays
L. CPU Zone System Fan (Fixed System Fan 2)
M. Fixed Hard Drive Carrier Tray
N. PCI Zone System Fan (Fixed System Fan 1)
O. PCI Card Retainer

Figure 4. Internal Chassis View of Intel® Server Chassis P4308XXMFGN

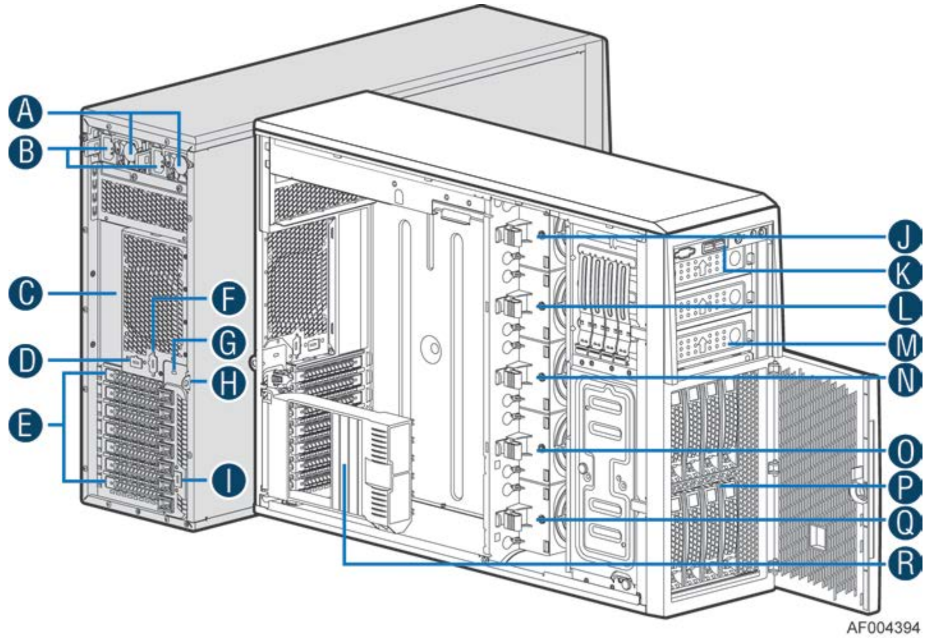
1.5 Intel® Server Chassis P4308XXMHGC View



A. 750-W Hot Swap Power Supply (Two)
B. AC Input Power Connector (Two)
C. I/O Ports
D. Alternate RMM4 Knockout
E. PCI Add-in Board Slot Covers
F. Serial Port Knockout
G. A Kensington* Cable Lock Mounting Hole
H. Padlock Loop
I. Alternate RMM4 Knockout
J. Hot-swap System Fan 5
K. Front Control Panel
L. Hot-swap System Fan 4
M. 5.25" Peripheral Bays
N. Hot-swap System Fan 3
O. Hot-swap System Fan 2
P. 8x3.5" Hot-swap HDD Cage
Q. Hot-swap System Fan 1
R. PCI Card Retainer

Figure 5. Internal Chassis View of Intel® Server Chassis P4308XXMHGC

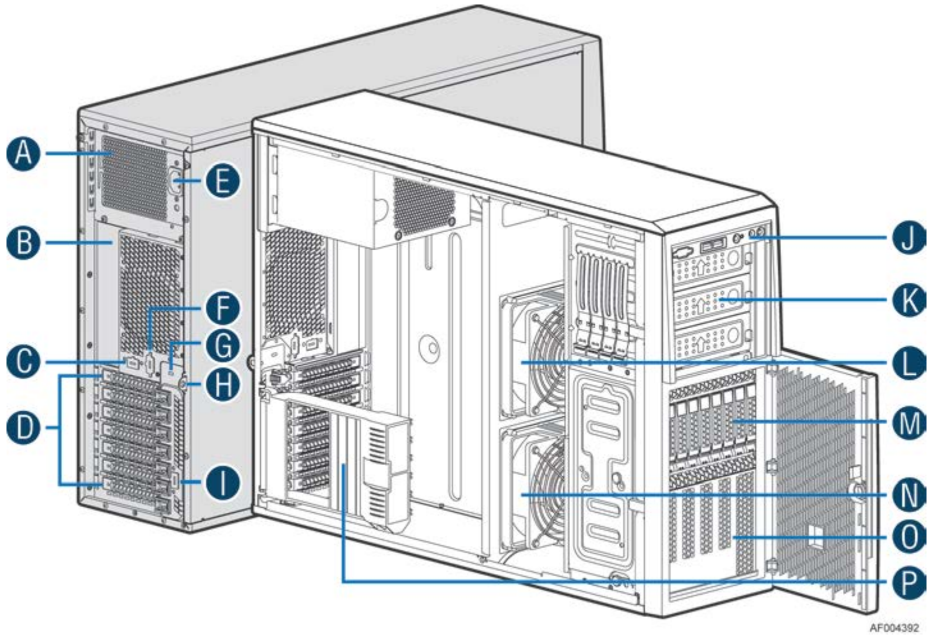
1.6 Intel® Server Chassis P4308XXMHJC View



A. 1200- W Hot Swap Power Supply (Two)
B. AC Input Power Connector (Two)
C. I/O Ports
D. Alternate RMM4 Knockout
E. PCI Add-in Board Slot Covers
F. Serial Port Knockout
G. A Kensington* Cable Lock Mounting Hole
H. Padlock Loop
I. Alternate RMM4 Knockout
J. Hot-swap System Fan 5
K. Front Control Panel
L. Hot-swap System Fan 4
M. 5.25” Peripheral Bays
N. Hot-swap System Fan 3
O. Hot-swap System Fan 2
P. 8x3.5” Hot-swap HDD Cage
Q. Hot-swap System Fan 1
R. PCI Card Retainer

Figure 6. Internal Chassis View of Intel® Server Chassis P4308XXMHJC

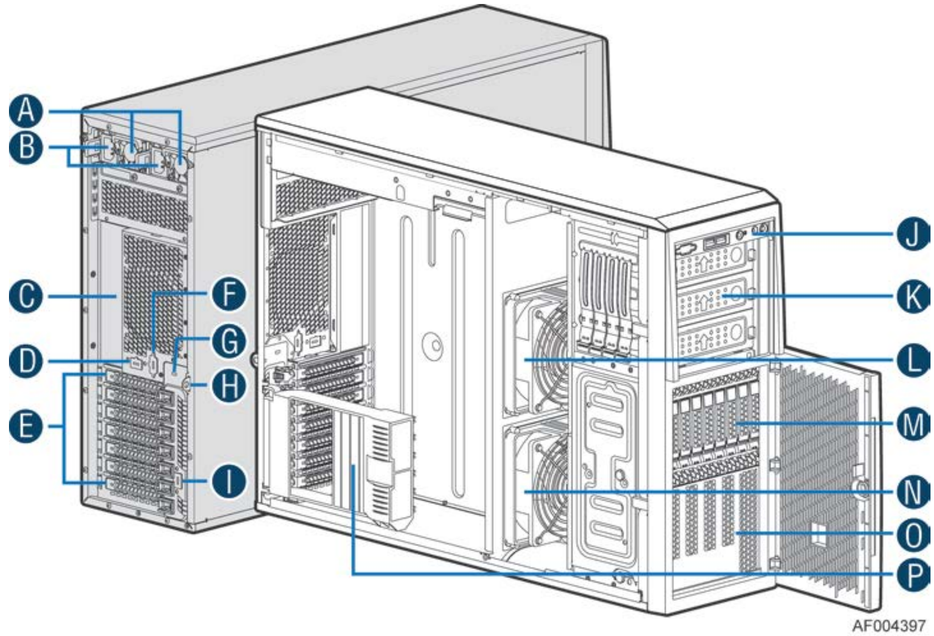
1.7 Intel® Server Chassis P4208XXMHEN View



A. 550- W Fixed Power Supply
B. I/O Ports
C. Alternate RMM4 Knockout
D. PCI Add-in Board Slot Covers
E. AC Input Power Connector
F. Serial Port Knockout
G. A Kensington* Cable Lock Mounting Hole
H. Padlock Loop
I. Alternate RMM4 Knockout
J. Front Control Panel
K. 5.25” Peripheral Bays
L. CPU Zone System Fan (Fixed System Fan 2)
M. 8x2.5” Hot-swap HDD Cage
N. PCI Zone System Fan (Fixed System Fan 1)
O. HS HDD EMI Cover
P. PCI Card Retainer

Figure 7. Internal Chassis View of Intel® Server Chassis P4208XXMHEN

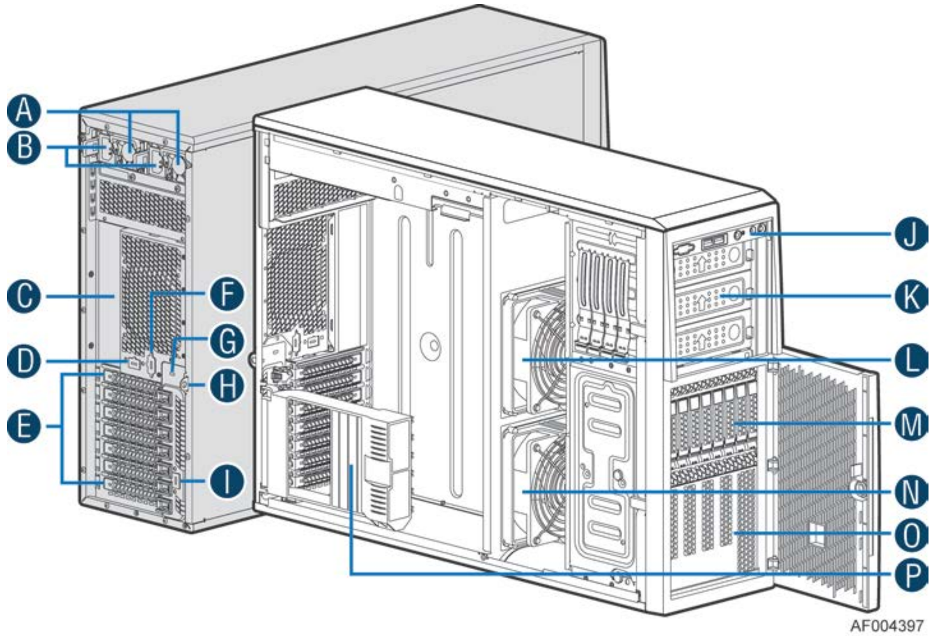
1.8 Intel® Server Chassis P4208XXMHDR View



A. 460- W Hot Swap Power Supply (Two)
B. AC Input Power Connector (Two)
C. I/O Ports
D. Alternate RMM4 Knockout
E. PCI Add-in Board Slot Covers
F. Serial Port Knockout
G. A Kensington* Cable Lock Mounting Hole
H. Padlock Loop
I. Alternate RMM4 Knockout
J. Front Control Panel
K. 5.25" Peripheral Bays
L. CPU Zone System Fan (Fixed System Fan 2)
M. 8x2.5" Hot-swap HDD Cage
N. PCI Zone System Fan (Fixed System Fan 1)
O. HS HDD EMI Cover
P. PCI Card Retainer

Figure 8. Internal Chassis View of Intel® Server Chassis P4208XXMHDR

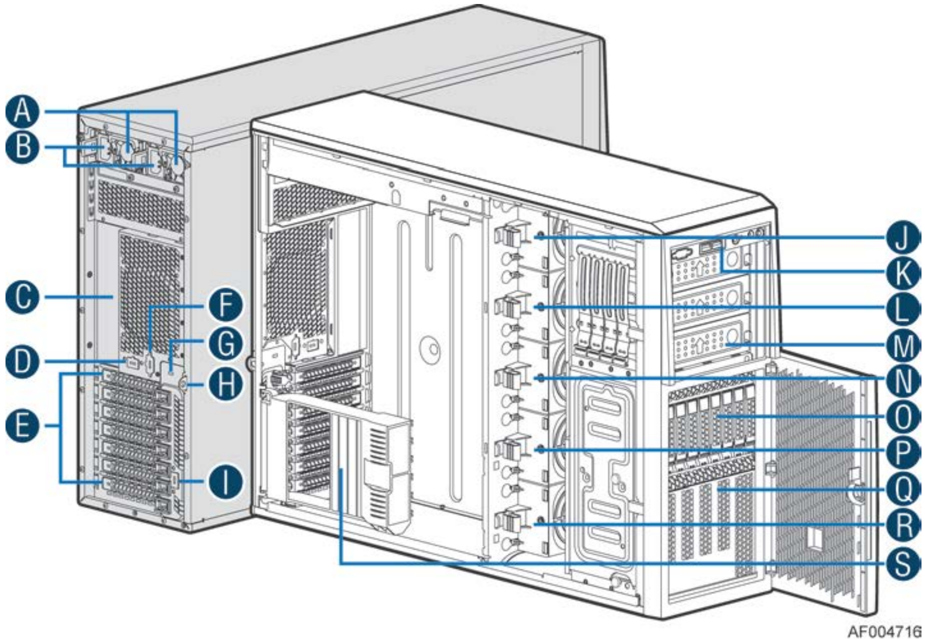
1.9 Intel® Server Chassis P4208XXMHGR View



A. 750- W Hot Swap Power Supply (Two)
B. AC Input Power Connector (Two)
C. I/O Ports
D. Alternate RMM4 Knockout
E. PCI Add-in Board Slot Covers
F. Serial Port Knockout
G. A Kensington* Cable Lock Mounting Hole
H. Padlock Loop
I. Alternate RMM4 Knockout
J. Front Control Panel
K. 5.25” Peripheral Bays
L. CPU Zone System Fan (Fixed System Fan 2)
M. 8x2.5” Hot-swap HDD Cage
N. PCI Zone System Fan (Fixed System Fan 1)
O. HS HDD EMI Cover
P. PCI Card Retainer

Figure 9. Internal Chassis View of Intel® Server Chassis P4208XXMHGR

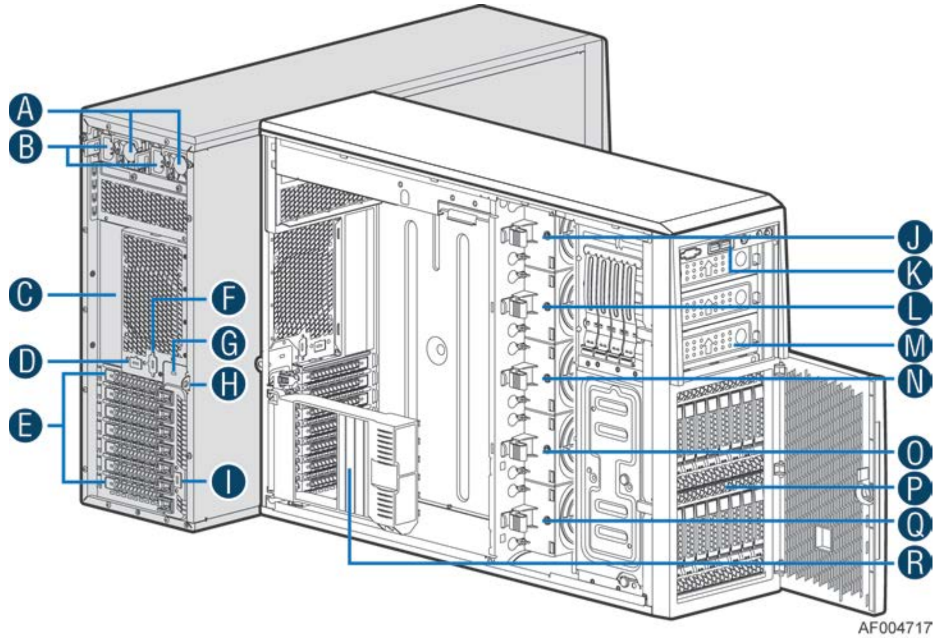
1.10 Intel® Server Chassis P4208XXMHGC View



A. 750- W Hot Swap Power Supply (Two)
B. AC Input Power Connector (Two)
C. I/O Ports
D. Alternate RMM4 Knockout
E. PCI Add-in Board Slot Covers
F. Serial Port Knockout
G. A Kensington* Cable Lock Mounting Hole
H. Padlock Loop
I. Alternate RMM4 Knockout
J. Hot-swap System Fan 5
K. Front Control Panel
L. Hot-swap System Fan 4
M. 5.25" Peripheral Bays
N. Hot-swap System Fan 3
O. 8x2.5" Hot-swap HDD Cage
P. Hot-swap System Fan 2
Q. HS HDD EMI Cover
R. Hot-swap System Fan 1
S. PCI Card Retainer

Figure 10. Internal Chassis View of Intel® Server Chassis P4208XXMHGC

1.11 Intel® Server Chassis P4216XXMHGJC View



A. 1200- W Hot Swap Power Supply (Two)
B. AC Input Power Connector (Two)
C. I/O Ports
D. Alternate RMM4 Knockout
E. PCI Add-in Board Slot Covers
F. Serial Port Knockout
G. A Kensington* Cable Lock Mounting Hole
H. Padlock Loop
I. Alternate RMM4 Knockout
J. Hot-swap System Fan 5
K. Front Control Panel
L. Hot-swap System Fan 4
M. 5.25" Peripheral Bays
N. Hot-swap System Fan 3
O. Hot-swap System Fan 2
P. 16x2.5" Hot-swap HDD Cage
Q. Hot-swap System Fan 1
R. PCI Card Retainer

Figure 11. Internal Chassis View of Intel® Server Chassis P4216XXMHJC

1.12 Chassis Security

A variety of chassis security options are provided at the system level:

- A removable padlock loop at the rear of the system access cover can be used to prevent access to the microprocessors, memory, and add-in cards. A variety of lock sizes can be accommodated by the 0.270-inch diameter loop.
- A Kensington* cable lock mounting hole is provided on the rear chassis I/O panel.
- A chassis intrusion switch is provided, allowing server management software to detect unauthorized access to the system side cover.

- In hot-swap hard drives configuration, a door lock is provided on the front bezel assembly with the door to prevent access to the hot-swap hard drives and the interior of the chassis.

Note: See the Technical Product Specification appropriate to the server board for a description of BIOS and management security features for each specific supported platform. Technical product specifications can be found at http://www.intel.com/support.

1.13 I/O Panel

All input/output (I/O) connectors are accessible from the rear of the chassis. The SSI E-bay 3.61-compliant chassis provides an ATX 2.2-compatible cutout for I/O shield installation. Boxed Intel® server boards provide the required I/O shield for installation in the cutout. The I/O cutout dimensions are shown in the following figure for reference.

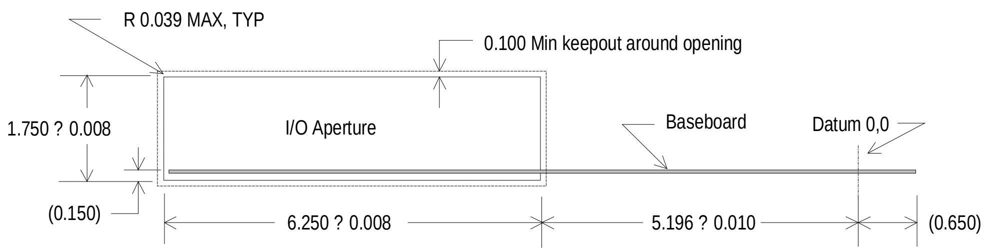


Figure 12. ATX 2.2 I/O Aperture

1.14 Front Bezel Features

There are two type of front bezel assembly in Intel® Server Chassis P4000M family.

1. Front bezel assembly for fixed hard drives configuration.

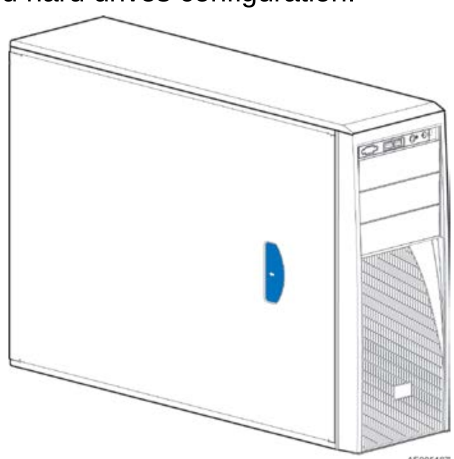
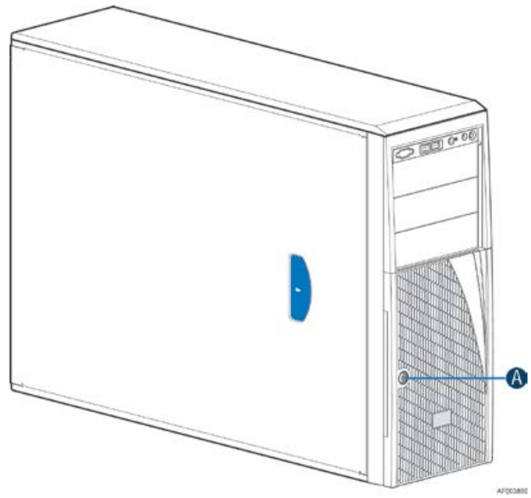


Figure 13. Front Closed Chassis View for Fixed Hard Drives Configuration

2. Front bezel assembly with the door for hot-swap hard drives configuration.



A. Security Lock

Figure 14. Front Closed Chassis View for Hot-swap Hard Drives Configuration

Both two pedestal front bezel are constructed of molded plastic and attaches to the front of the chassis with three clips on the right side and two snaps on the left. The snaps at the left attach behind the access cover, thereby preventing accidental removal of the bezel. The bezel can only be removed by first removing the server access cover. This provides additional security to the hard drive and peripheral bay area.

For the front bezel assembly for fixed hard drives configuration, removing the bezel, there is an EMI shield covering the fixed hard drives bay area.

For the front bezel assembly for hot-swap hard drives configuration, the bezel includes a key-locking door that covers the drive cage area and allows access to hot swap drives when a hot swap drive cage is installed.

The peripheral bays are covered with plastic snap-in cosmetic pieces that must be removed to add peripherals to the system. Front panel buttons and lights are located above the peripheral bays.

1.15 Front Panel Overview

The following figure shows the layout of the Front Control Panel of Intel® Server Chassis P4000M:

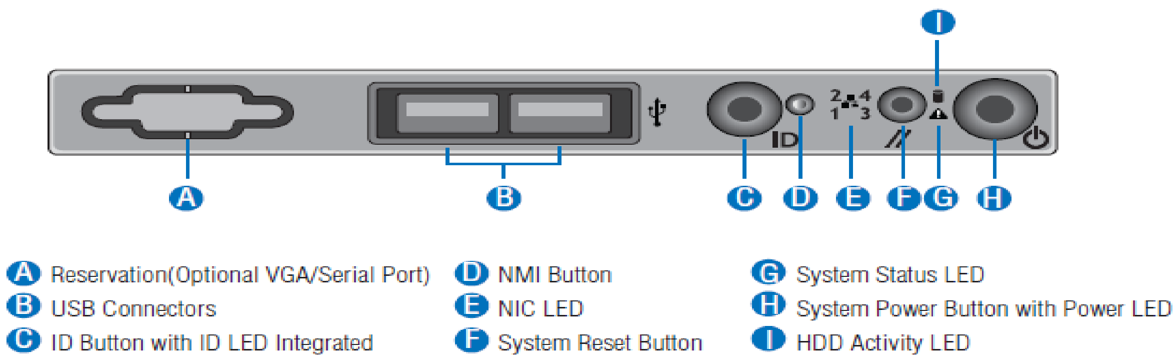
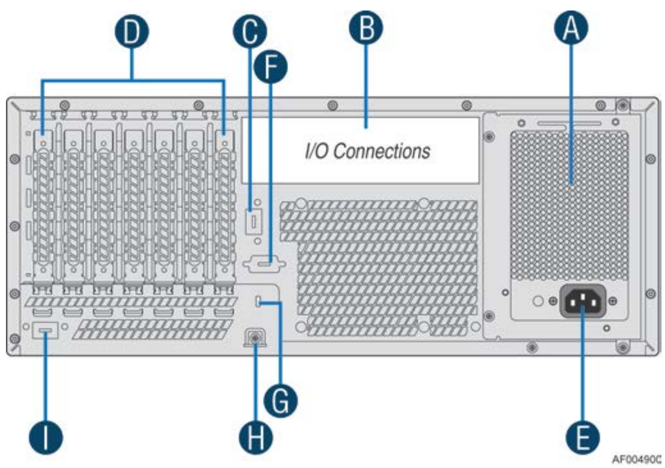


Figure 15. Front Panel Controls and Indicators

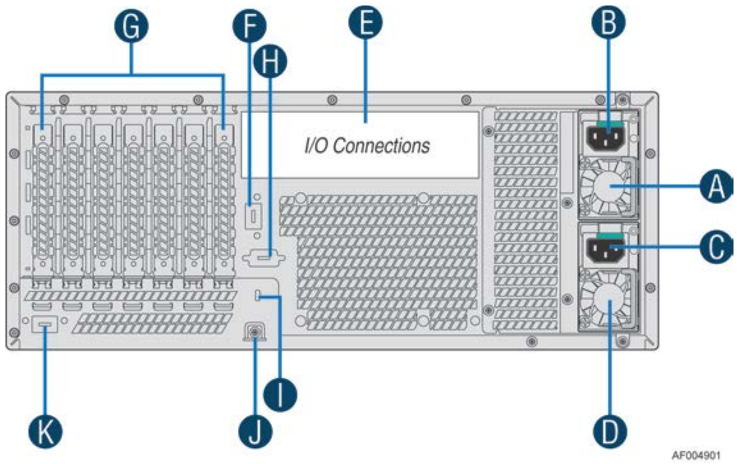
1.16 Back Panel Overview

The following figure shows the layout of Back Panel with fixed power supply and hot-swap redundant power supplies:



A	Fixed Power Supply	F	Serial-B Port (Optional)
B	IO Connectors	G	Kensington* Cable Lock Mounting Hole
C	RMM4 NIC/1394B Port (Optional)	H	Padlock Loop
D	Add in PCI-e cards	I	RMM4 NIC Port (Optional)
E	Power Connector		

Figure 16. Back Panel Layout (with Fixed Power Supply)



A	Hot-swap Power Supply	G	Add in PCI-e cards
B	Power Connector	H	Serial-B Port (Optional)
C	Power Connector	I	Kensington* Cable Lock Mounting Hole
D	Hot-swap Power Supply	J	Padlock Loop
E	IO Connectors	K	RMM4 NIC Port (Optional)
F	RMM4 NIC/1394B Port/(Optional)		

Figure 17. Back Panel Layout (with Hot-swap Power Supply)

1.17 Standard Fixed Drive Trays

Intel® Server Chassis P4000M supports up to eight 3.5" fixed Hard Disk Drive trays. You can secure each of the eight drives on the drive trays with screws, and install the drive trays in the chassis without a tool.

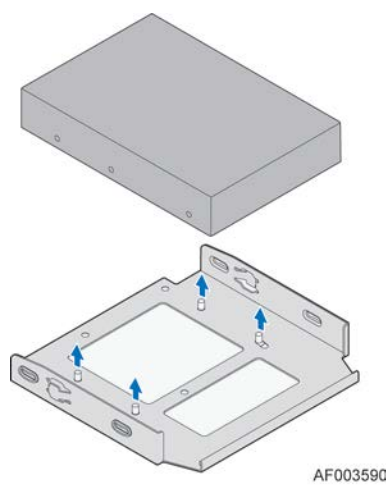


Figure 18. Fixed Drive Tray

1.18 Hot-Swap Hard Disk Drive Cage

1.18.1 4x3.5" Hot-Swap Hard Disk Drive Cage

Intel® Server Chassis P4000M family supports 4x3.5" hot-swap hard drive cage, which can support up to four hot-swap hard drives.

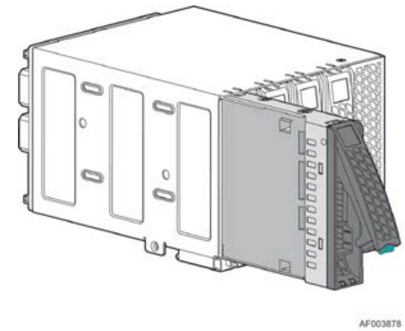


Figure 19. 4x3.5" Hot-Swap Hard Disk Drive Cage

1.18.2 8x3.5" Hot-Swap Hard Disk Drive Cage

Intel® Server Chassis P4000M family supports 8x3.5" hot-swap hard drive cage, which can support up to eight hot-swap hard drives.

Figure 20. 8x3.5" Hot-Swap Hard Disk Drive Cage

1.18.3 8x2.5" Hot-Swap Hard Disk Drive Cage

Intel® Server Chassis P4000M family supports 8x2.5" hot-swap hard drive cage that can support up to eight hot-swap hard drives.

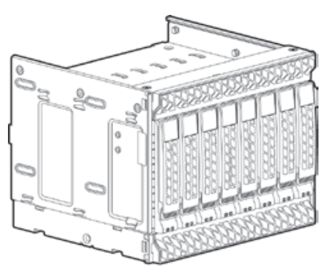


Figure 21. 8x2.5" Hot-Swap Hard Disk Drive Cage

1.18.4 Hot-swap Hard Drive Carrier

Each hard drive must be mounted to a hot-swap drive carrier, making insertion and extraction of the drive from the chassis very simple. Each drive carrier has its own dual-purpose latching mechanism used to both insert and extract drives from the chassis and lock the carrier in place. Each drive carrier supports a light pipe providing a drive status indicator, located on the backplane, to be viewable from the front of the chassis.

1.18.4.1 3.5" Hot-swap Hard Drive Carrier

The 3.5" hot-swap hard drive carrier has a 2.5" HDD interface bracket pre-installed. The 2.5" HDD interface bracket is used for install the 2.5" hard drive on the 3.5" hot-swap hard drive carrier. When a 3.5" hard drive is to be installed, the 2.5" HDD interface bracket should be removed.

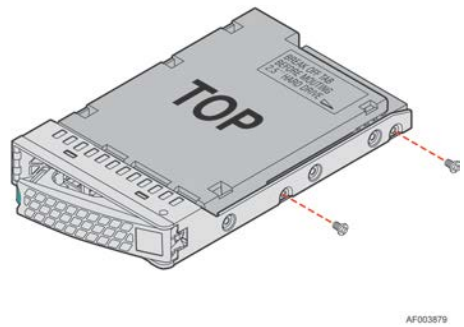


Figure 21. 3.5" Hot-Swap Hard Drive Carrier with 2.5" HDD Interface Bracket

1.18.4.2 2.5" Hot-swap Hard Drive Carrier

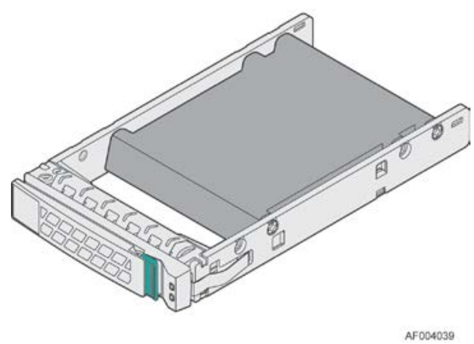


Figure22. 2.5" Hot-Swap Hard Drive Carrier

1.19 Peripheral Bays

Three 5.25-in half-height drive bays are available for CD/DVD-ROM or tape drives as well as one 3.5-inch removable media drive bay. Drive installation is tool-less and requires no screws.

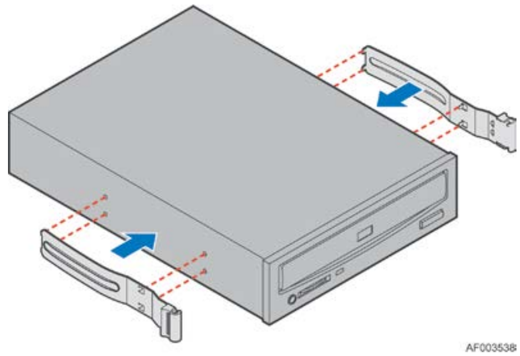


Figure 22. Tool-less Rails Mounting 5.25" CD-ROM Drive

1.20 Rack Options

Intel® Server System P4000M family can be converted to rack system with the rack bezel and rack rail options.

AUPBEZEL4UF: Rack bezel kit for converting P4000 pedestal server chassis to rack chassis, including bezel frame and two rack handles.

AUPBEZEL4UD: Rack bezel accessory for P4000 chassis in rack configuration, including security door only.

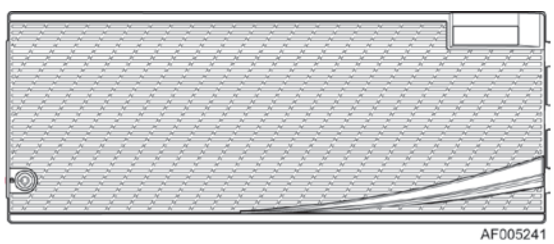


Figure 23. Optional Rack Bezel

Rack rail options include AXXELVRAIL and AXX3U5UPRAIL.

Table 2. AXXELVRAIL and AXX3U5UPRAIL Rack Options

AXXELVRAIL	AXX3U5UPRAIL
▪ 3U to 5U compatible ▪ Tool-less chassis attachment (optional screws) ▪ Tools required to attach rails to rack ▪ 1/2 extension from rack	▪ 3U to 5U compatible ▪ Tool-less installation ▪ Full extension from rack ▪ Stab in system installation ▪ Optional cable management arm support

AXX3U5UCMA

- Cable Management Arm support AXX3U5UPRAIL

Caution: THE MAXIMUM RECOMMENDED SERVER WEIGHT FOR THE RACK RAILS CAN BE FOUND at http://www.intel.com/support/motherboards/server/sb/CS-033655.htm. EXCEEDING THE MAXIMUM RECOMMENDED WEIGHT OR MISALIGNMENT OF THE SERVER MAY RESULT IN FAILURE OF THE RACK RAILS HOLDING THE SERVER. Use of a mechanical assist to install and align server into the rack rails is recommended.

2. Chassis Power Sub-system

2.1 550-W Power Supply

This 550-W power supply specification defines a non-redundant power supply that supports pedestal entry server systems. The 550-W power supply has 7 outputs; 3.3V, 5V, 12V1, 12V2, 12V3, -12V and 5Vsb, with no less than 550W. The power supply has an AC input and be power factor corrected.

2.1.1 Mechanical Overview

The power supply size is 98mm x 150mm x 160mm (H x W x D) and has a wire harness for the DC outputs. The AC plugs directly into the external face of the power supply.

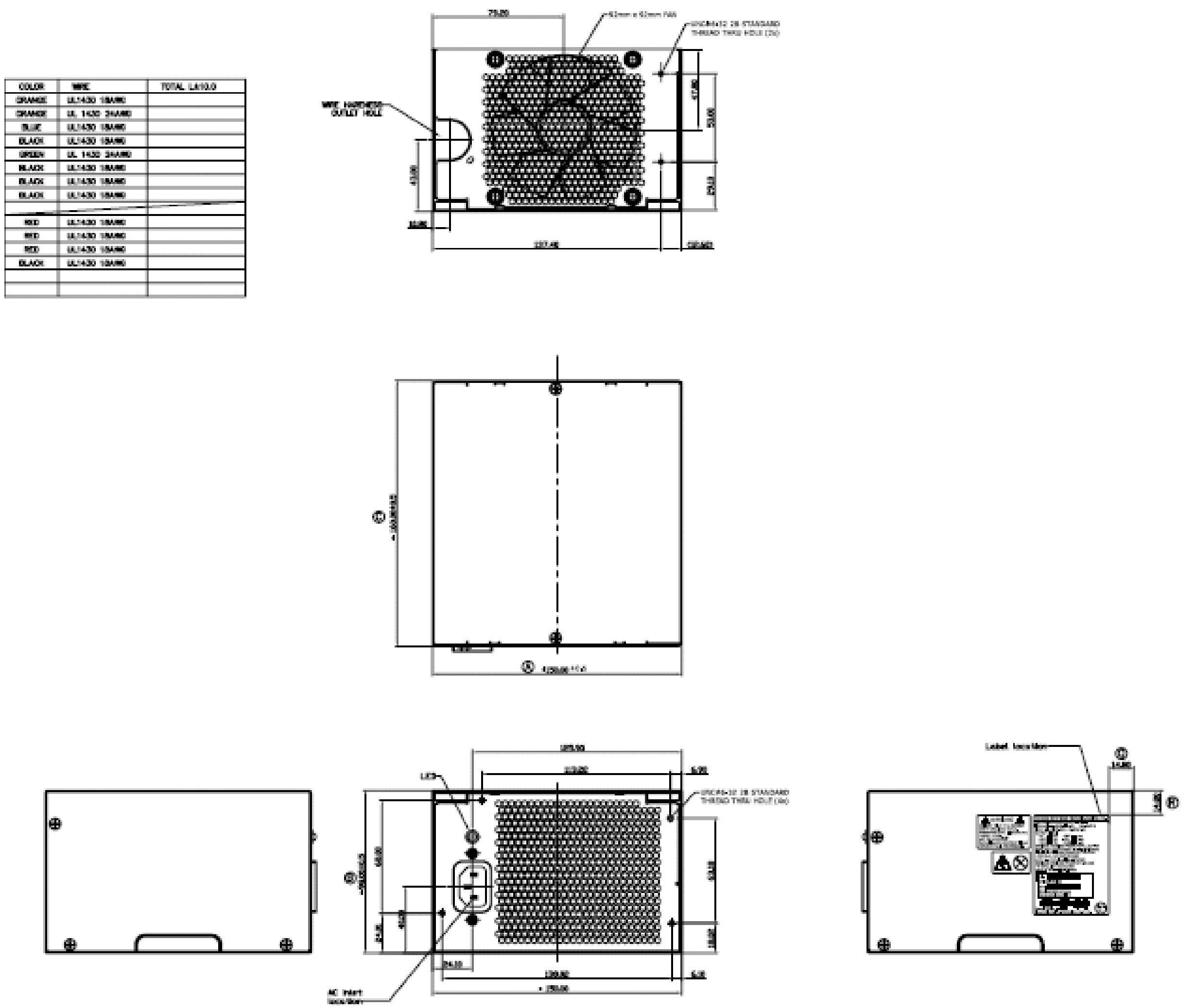


Figure 24. Mechanical Drawing for 550-W Power Supply Enclosure

2.1.1.1 550-W Power Supply Output Wire Harness

Listed or recognized component appliance wiring material (AVLV2), CN, rated min 85°C shall be used for all output wiring.

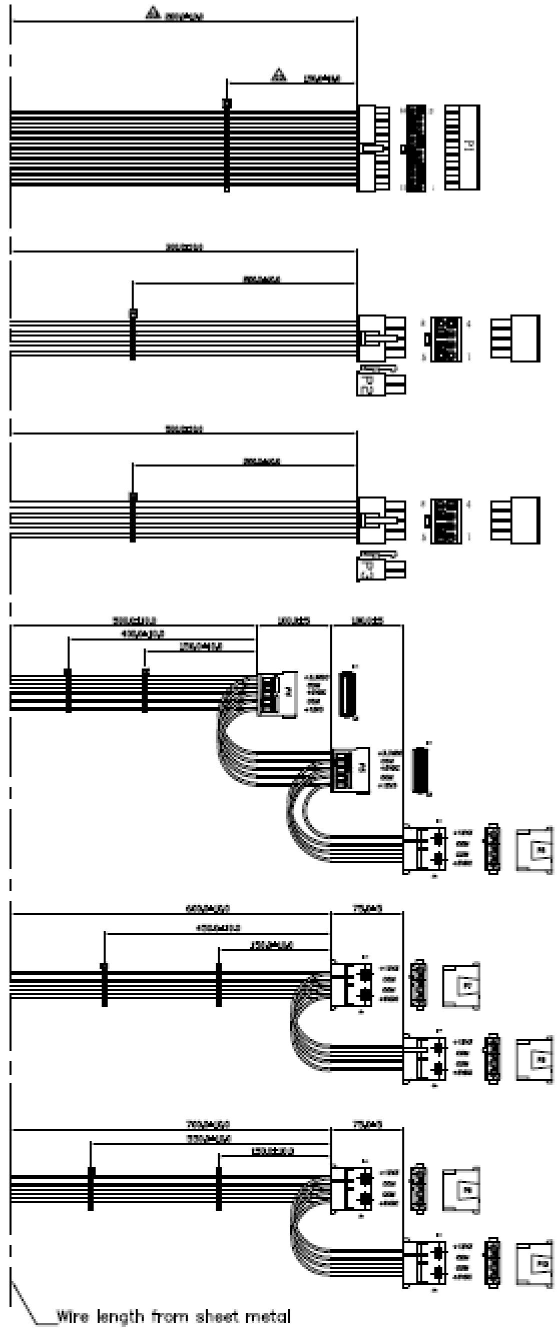


Figure 25. Output Cable Harness for 550-W Power Supply

Table 3. Power Supply Cable Lengths

From	Length (mm)	To connector #	No of pins	Description
Power Supply cover exit hole	280	P1	24	Baseboard Power Connector

From	Length (mm)	To connector #	No of pins	Description
Power Supply cover exit hole	300	P2	8	Processor 0 connector
Power Supply cover exit hole	500	P3	8	Processor 1 connector
Power Supply cover exit hole	500	P4	5	SATA Peripheral Power Connector for 5.25"
Extension from P4	100	P5	5	SATA Peripheral Power Connector for 5.25"
Extension from P5	100	P6	4	Peripheral Power Connector for 5.25"
Power Supply cover exit hole	600	P7	4	1x4 Legacy HSBP Power Connector
Extension from P7	75	P8	4	1x4 Legacy HSBP Power Connector
Power Supply cover exit hole	700	P9	4	1x4 Legacy HSBP Power/Fixed HDD Adapter Connection
Extension from P9	75	P10	4	1x4 Legacy HSBP Power/Fixed HDD Adapter Connection

2.1.1.1.1 Main power connector (P1)

Connector housing: 24- Pin Molex Mini-Fit Jr 39-01-2245 (94V2) or equivalent
Contact: Molex Minifit Jr, Crimp 5556 or equivalent

Table 4. P1 Main Power Connector

Pin	Signal	18 awg color	Pin	Signal	18 awg color
1	+3.3 VDC	Orange	13	+3.3 VDC	Orange
2	+3.3 VDC	Orange	14	-12 VDC	Blue
3	COM	Black	15	COM	Black
4	+5 VDC*	Red	16	PSON#	Green
5	COM	Black	17	COM	Black
6	+5 VDC	Red	18	COM	Black
7	COM	Black	19	COM	Black
8	PWR OK	Gray	20	Reserved	N.C.
9	5VSB	Purple	21	+5 VDC	Red
10	+12V3	Yellow/Black	22	+5 VDC	Red
11	+12V3	Yellow/Black	23	+5 VDC	Red
12	+3.3 VDC	Orange	24	COM	Black

Note: 3.3V remote sense shall be double crimped into pin 13 if needed to meet regulation limits.

2.1.1.1.2 Processor/Memory Power Connector (P2)

Connector housing: 8- Pin Molex 39-01-2085 (94V2) or equivalent
Contact: Molex, Mini-Fit Jr, HCS, 44476-1111 or equivalent

Table 5. P2 Processor#1 Power Connector

Pin	Signal	18 awg color	Pin	Signal	18 awg color
1	COM	Black	5	+12V1	Yellow
2	COM	Black	6	+12V1	Yellow
3	COM	Black	7	+12V1	Yellow
4	COM	Black	8	+12V1	Yellow

2.1.1.1.3 Processor/Memory Power Connector (P3)

Connector housing: 8- Pin Molex 39-01-2085 (94V2) or equivalent
Contact: Molex, Mini-Fit Jr, HCS, 44476-1111 or equivalent

Table 6. P3 Processor#1 Power Connector

Pin	Signal	18 awg color	Pin	Signal	18 awg color
1	COM	Black	5	+12V2	Yellow
2	COM	Black	6	+12V2	Yellow
3	COM	Black	7	+12V2	Yellow
4	COM	Black	8	+12V2	Yellow

2.1.1.1.4 Peripheral Power Connectors (P6,7,8,9,10)

Connector housing: Amp 1-480424-0 or equivalent
Contact: Amp 61314-1 contact or equivalent

Table 7. Peripheral Power Connectors

Pin	Signal	18 AWG Color
1	+12V3	Yellow/Black
2	COM	Black
3	COM	Black
4	+5 VDC	Red

2.1.1.1.5 SATA Hard Drive Power Connectors (P4, P5)

Connector housing: JWT A3811H00-5P (94V2) or equivalent;
Contact: JWT A3811TOP-0D or equivalent

Table 8. SATA Power Connector

Pin	Signal	18 AWG Color
1	+3.3V	Orange
2	COM	Black
3	+5VDC	Red
4	COM	Black
5	+12V3	Yellow/Black

2.1.2 Temperature Requirements

The power supply shall operate within all specified limits over the T_{op} temperature range.

Table 9. Thermal Requirements

Item	Description	Min	Max	Units
T_{op}	Operating temperature range.	0	50	ºC
T_{non-op}	Non-operating temperature range.	-40	70	º C
Altitude	Maximum operating altitude.		3000	meters

2.1.3 AC Input Requirements

2.1.3.1 Power Factor

The power supply meets the power factor requirements stated in the Energy Star® Program Requirements for Computer Servers. These requirements are stated below.

Table 10. Power Factor Requirements for Computer Servers

Output power	20% load	50% load	100% load
Power factor	0.8	0.9	0.95

Tested at 230Vac, 50Hz and 60Hz and 115VAC, 60Hz.
Tested according to Generalized Internal Power Supply Efficiency Testing Protocol Rev 6.4.3. This is posted at http://efficientpowersupplies.epri.com/methods.asp.

2.1.3.2 AC Inlet Connector

The AC input connector is an *IEC 320 C-14* power inlet. This inlet is rated for 10A/250VAC.

2.1.3.3 AC Input Voltage Specification

The power supply operates within all specified limits over the following input voltage range. Harmonic distortion of up to 10% of the rated line voltage does not cause the power supply to go out of specified limits. Application of an input voltage below 85VAC does not cause damage to the power supply, including a blown fuse.

Table 11. AC Input Voltage Range

Parameter	Min	Rated	Vmax	Start up vac	Power off vac
Voltage (110)	90 V_{rms}	100-127 V_{rms}	140 V_{rms}	85VAC +/- 4VAC	70VAC +/- 5VAC
Voltage (220)	180 V_{rms}	200-240 V_{rms}	264 V_{rms}		
Frequency	47 Hz	50/60	63 Hz		

Notes:
1. Maximum input current at low input voltage range shall be measured at 90VAC, at max load.
2. Maximum input current at high input voltage range shall be measured at 180VAC, at max load.
3. This requirement is not to be used for determining agency input current markings.

2.1.3.4 AC Line Dropout/Holdup

An AC line dropout is defined to be when the AC input drops to 0VAC at any phase of the AC line for any length of time. During an AC dropout the power supply meets dynamic voltage regulation requirements. An AC line dropout of any duration does not cause tripping of control signals or protection circuits. If the AC dropout lasts longer than the holdup time the power supply recovers and meets all turn on requirements. The power supply meets the AC dropout requirement over rated AC voltages and frequencies. A dropout of the AC line for any duration does not cause damage to the power supply.

Table 12. AC Line Holdup time

Loading	Holdup time
75%	12msec

2.1.3.5 AC Line Fuse

The power supply has one line fused in the **single line fuse** on the line (Hot) wire of the AC input. The line fusing is acceptable for all safety agency requirements. The input fuse is a slow blow type. AC inrush current does not cause the AC line fuse to blow under any conditions. All protection circuits in the power supply do not cause the AC fuse to blow unless a component in the power supply has failed. This includes DC output load short conditions

2.1.3.6 AC Line Leakage Current

The maximum leakage current to ground for each power supply is 3.5mA when tested at 240VAC.

2.1.3.7 AC Line Transient Specification

AC line transient conditions are defined as “sag” and “surge” conditions. “Sag” conditions are also commonly referred to as “brownout”, these conditions is defined as the AC line voltage dropping below nominal voltage conditions. “Surge” is defined to refer to conditions when the AC line voltage rises above nominal voltage.
The power supply meets the requirements under the following AC line sag and surge conditions.

Table 13. AC Line Sag Transient Performance

AC Line Sag (10sec interval between each sagging)				
Duration	Sag	Operating AC Voltage	Line Frequency	Performance Criteria
0 to 1/2 AC cycle	95%	Nominal AC Voltage ranges	50/60Hz	No loss of function or performance
> 1 AC cycle	>30 %	Nominal AC Voltage ranges	50/60Hz	Loss of function acceptable, self recoverable

Table 14. AC Line Surge Transient Performance

AC Line Surge				
Duration	Surge	Operating AC Voltage	Line Frequency	Performance Criteria
Continuous	10%	Nominal AC Voltages	50/60Hz	No loss of function or performance
0 to ½ AC cycle	30%	Mid-point of nominal AC Voltages	50/60Hz	No loss of function or performance

2.1.3.8 Power Recovery

The power supply recovers automatically after an AC power failure. AC power failure is defined to be any loss of AC power that exceeds the dropout criteria.

2.1.4 Efficiency

The following table provides the required minimum efficiency level at various loading conditions. These are provided at three different load levels; 100%, 50% and 20%. Output shall be load according to the proportional loading method defined by 80 Plus in Generalized Internal Power Supply Efficiency Testing Protocol Rev 6.4.3. This is posted at http://efficientpowersupplies.epri.com/methods.asp.

Table 15. Silver Efficiency Requirement

Loading	100% of maximum	50% of maximum	20% of maximum
Minimum Efficiency	85%	88%	85%

The power supply passes with enough margins to make sure in production all power supplies meet these efficiency requirements.

2.1.4.1 Standby Efficiency

When in standby mode; the power supply draws less than 1W AC power with 100mA of 5Vstandby load. This is tested at 115VAC/60Hz and 230VAC/50Hz.

2.1.5 DC Output Specification

2.1.5.1 Output Power/Currents

The following tables define the minimum power and current ratings. The power supply meets both static and dynamic voltage regulation requirements for all conditions.

Table 16. Over Voltage Protection Limits

Parameter	Min	Max.	Peak	Unit
3.3V	0.5	18.0		A
5V	0.3	15.0		A
12V1	0.7	24.0	28.0	A
12V2	0.7	24.0	28.0	A
12V3	1.5	18.0		
– 12V	0.0	0.5		A
5Vstby	0.0	3.0	3.5	A

Notes:

1. Max combined power for all output shall not exceed 550W.
2. Peak combined power for all outputs shall not exceed 630W for 20 seconds.
3. Max combined power of 12V1, 12V2 and 12V3 shall not exceed 530W.
4. Max combined power on 3.3V and 5V shall not exceed 120W.

2.1.5.2 Cross Loading

The power supply maintains voltage regulation limit when operated over the following cross loading conditions.

Table 17. Loading Conditions

	3.3V	5.0V	12V1	12V2	12V3	-12V	5.0Vstby	Total Power	12V Power	3.3V/5V Power
Load1	18	12.1	12	12	11.7	0	0.3	550	428	120
Load2	13.5	15	12	12	11.2	0.5	0.3	549	422	120
Load3	2.5	2	20	20	4.2	0	0.3	550	530	18
Load4	2.5	2	13.1	13.1	18	0	0.3	550	530	18
Load5	0.5	0.3	15	15	6.5	0.5	3	462	438	3
Load6	16	4	1	1	3.5	0	0.3	140	66	73
Load7	16	13	1	1	9	0.5	3	271	132	118

2.1.5.3 Standby Output

The 5VSB output is present when an AC input greater than the power supply turn on voltage is applied.

2.1.5.4 Voltage Regulation

The power supply output voltages stay within the following voltage limits when operating at steady state and dynamic loading conditions. These limits include the peak-peak ripple/noise. These shall be measured at the output connectors.

Table 18. Voltage Regulation Limits

Parameter	Tolerance	Min	Nom	Max	Units
+3.3V	- 3%/+5%	+3.20	+3.30	+3.46	Vrms
+5V	- 4%/+5%	+4.80	+5.00	+5.25	Vrms
+12V1	- 4%/+5%	+11.52	+12.00	+12.60	Vrms
+12V2	- 4%/+5%	+11.52	+12.00	+12.60	Vrms
+12V3	- 4%/+5%	+11.52	+12.00	+12.60	Vrms
- 12V	- 10%/+10%	- 13.20	-12.00	-10.80	Vrms
+5VSB	- 4%/+5%	+4.80	+5.00	+5.25	Vrms

2.1.5.5 Dynamic Loading

The output voltages remain within limits specified for the step loading and capacitive loading specified in the table below. The load transient repetition rate is tested between 50Hz and 5kHz at duty cycles ranging from 10%-90%. The load transient repetition rate is only a test specification. The Δ step load may occur anywhere within the MIN load to the MAX load conditions.

Table 19. Transient Load Requirements

Output	Δ Step Load Size (See note 2)	Load Slew Rate	Test capacitive Load
+3.3V	6.0A	0.5 A/µsec	970 µF
+5V	4.0A	0.5 A/µsec	400 µF
12V1+12V2 +12V3	23.0A	0.5 A/µsec	2200 µF [1,2]
+5VSB	0.5A	0.5 A/µsec	20 µF

Notes:

1. Step loads on each 12V output may happen simultaneously.

2. The +12V should be tested with 2200µF evenly split between the four +12V rails
3. This will be tested over the range of load conditions in section 2.1.5.2.

2.1.5.6 Capacitive Loading

The power supply is stable and meets all requirements with the following capacitive loading ranges.

Table 20. Capacitive Loading Conditions

Output	Min	Max	Units
+3.3V	250	5000	µF
+5V	400	5000	µF
+12V	500	8000	µF
-12V	1	350	µF
+5VSB	20	350	µF

2.1.5.7 Grounding

The output ground of the pins of the power supply provides the output power return path. The output connector ground pins are connected to the safety ground (power supply enclosure). This grounding is well designed to ensure passing the max allowed Common Mode Noise levels.

The power supply is provided with a reliable protective earth ground. All secondary circuits are connected to protective earth ground. Resistance of the ground returns to chassis does not exceed 1.0 mΩ. This path may be used to carry DC current.

2.1.5.8 Residual Voltage Immunity in Standby mode

The power supply is immune to any residual voltage placed on its outputs (Typically a leakage voltage through the system from standby output) up to **500mV**. There is neither additional heat generated, nor stressing of any internal components with this voltage applied to any individual or all outputs simultaneously. It also does not trip the protection circuits during turn on.

The residual voltage at the power supply outputs for no load condition does not exceed **100mV** when AC voltage is applied and the PSON# signal is de-asserted.

2.1.5.9 Common Mode Noise

The Common Mode noise on any output does not exceed **350mV pk-pk** over the frequency band of 10Hz to 20MHz.

The measurement is made across a 100Ω resistor between each of DC outputs, including ground at the DC power connector and chassis ground (power subsystem enclosure).
The test set-up shall use a FET probe such as Tektronix model P6046 or equivalent.

2.1.5.10 Ripple/Noise

The maximum allowed ripple/noise output of the power supply is defined in below table 20. This is measured over a bandwidth of 10Hz to 20MHz at the power supply output connectors. A 10µF tantalum capacitor in parallel with a 0.1µF ceramic capacitor is placed at the point of measurement.

Table 21. Ripples and Noise

+3.3V	+5V	+12V 1, 2, 3	-12V	+5VSB
50mVp-p	50mVp-p	120mVp-p	200mVp-p	50mVp-p

The test set-up shall be as shown below.

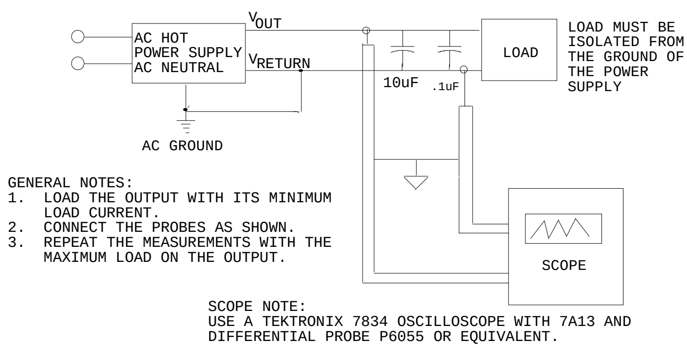


Figure 26. Differential Noise test setup

Note: When performing this test, the probe clips and capacitors should be located close to the load.

2.1.5.11 Timing Requirements

These are the timing requirements for the power supply operation. The output voltages rise from 10% to within regulation limits (T_{vout_rise}) within 2 to 50ms, except for 5VSB - it is allowed to rise from 1 to 25ms. The +3.3V, +5V and +12V1, +12V2, +12V3 output voltages start to rise approximately at the same time**. All outputs rise monotonically**. Each output voltage reach regulation within 50ms (T_{vout_on}) of each other during turn on the power supply. Each output voltage fall out of regulation within 400ms (T_{vout_off}) of each other during turn off. Table 22 shows the timing requirements for the power supply being turned on and off by the AC input, with PSON held low and the PSON signal, with the AC input applied. All timing requirements are met for the cross loading condition in Table 17.

Table 22. Output Voltage Timing

Item	Description	MIN	MAX	UNITS
T_{vout_rise}	Output voltage rise time from each main output.	2	50	ms
	Output rise time for the 5Vstby output.	1	25	ms
T_{vout_on}	All main outputs must be within regulation of each other within this time.		50	ms
T_{vout_off}	All main outputs must leave regulation within this time.		400	ms

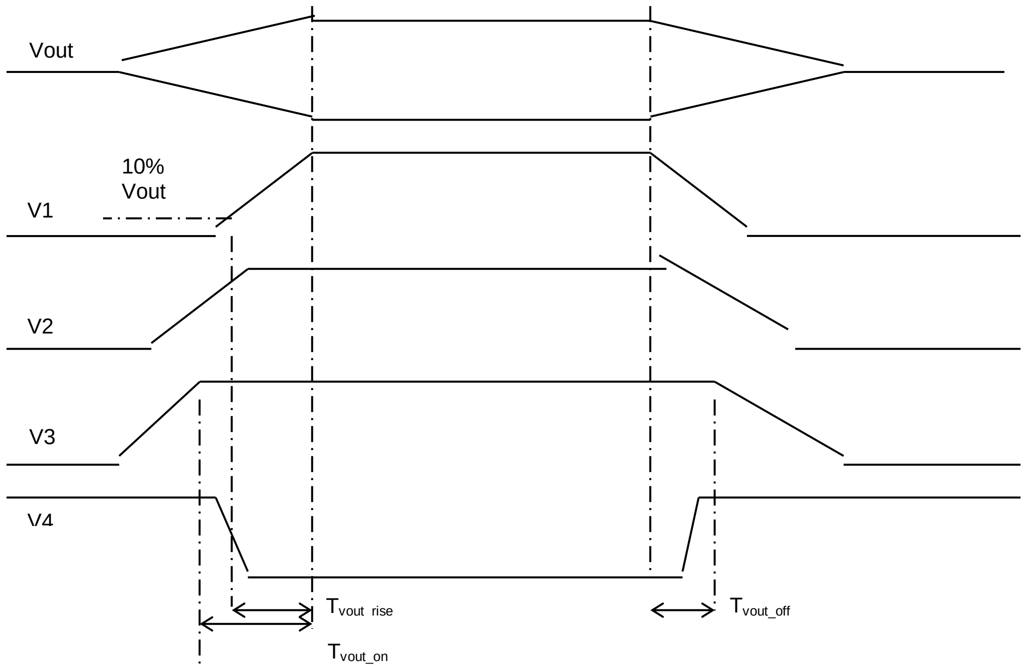


Figure 27. Output Voltage Timing

Table 23. Turn On/Off Timing

Item	Description	MIN	MAX	UNITS
$T_{sb\_on\_delay}$	Delay from AC being applied to 5VSB being within regulation.		1500	ms
$T_{ac\_on\_delay}$	Delay from AC being applied to all output voltages being within regulation.		2500	ms
T_{vout_holdup}	Time all output voltages stay within regulation after loss of AC. Tested at 75% of maximum load.	13		ms
T_{pwok_holdup}	Delay from loss of AC to de-assertion of PWOK. Tested at 75% of maximum load.	12		ms
$T_{pson\_on\_delay}$	Delay from PSON# active to output voltages within regulation limits.	5	400	ms
T_{pson_pwok}	Delay from PSON# deactivate to PWOK being de-asserted.		50	ms
T_{pwok_on}	Delay from output voltages within regulation limits to PWOK asserted at turn on.	100	500	ms
T_{pwok_off}	Delay from PWOK de-asserted to output voltages (3.3V, 5V, 12V, -12V) dropping out of regulation limits.	1		ms
T_{pwok_low}	Duration of PWOK being in the de-asserted state during an off/on cycle using AC or the PSON signal.	100		ms
T_{sb_vout}	Delay from 5VSB being in regulation to O/Ps	10	1000	ms

Item	Description	MIN	MAX	UNITS
	being in regulation at AC turn on.			
T_{5VSB_holdup}	Time the 5VSB output voltage stays within regulation after loss of AC.	70		ms

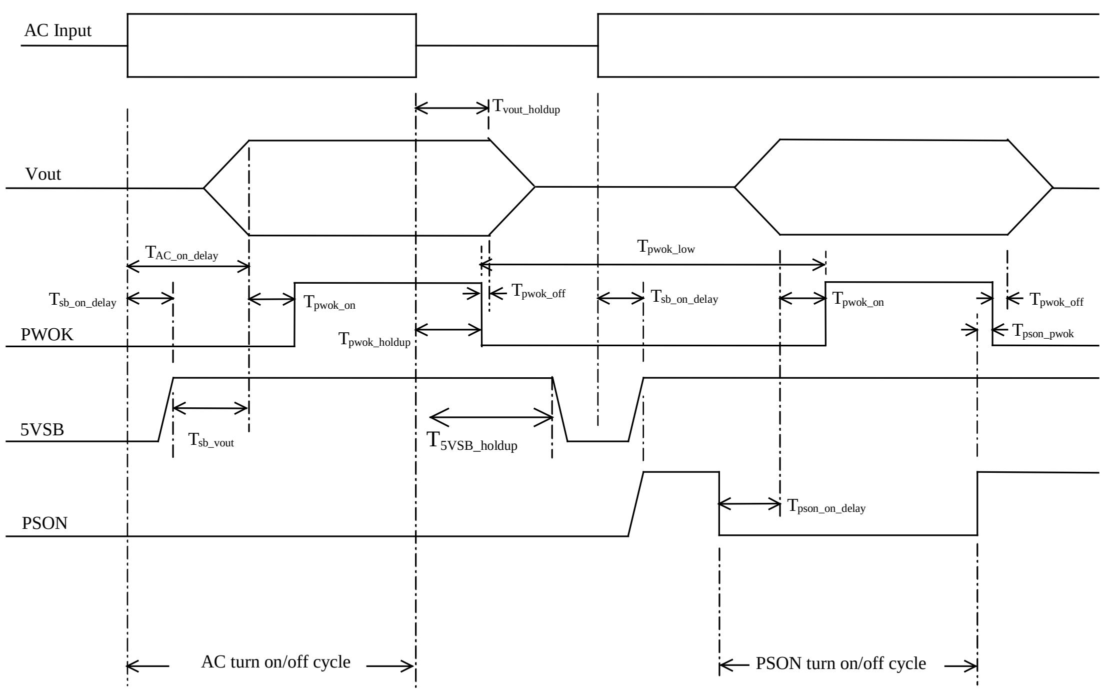


Figure 28. Turn On/Off Timing (Power Supply Signals)

2.1.6 Protection Circuits

Protection circuits inside the power supply causes only the power supply's main outputs to shut down. If the power supply latches off due to a protection circuit tripping, an AC cycle OFF for 15sec and a PSON# cycle HIGH for 1sec able to reset the power supply.

2.1.6.1 Current Limit (OCP)

Below are over current protection limits for each output. If the current limits are exceeded the power supply shuts down and latch off. The latch will be cleared by toggling the PSON# signal or by an AC power interruption. The power supply does not be damaged from repeated power cycling in this condition. -12V and 5VSB is protected under over current or shorted conditions so that no damage can occur to the power supply. 5Vsb will be auto-recovered after removing OCP limit.

Table 24. Over Current Limits

Output	Min OCP	Max OCP
+3.3V	22 A	Meet 240VA
+5V	16 A	30 A
+12V1,2	29 A	36 A
+12V3 (240VA limited)	18.5 A	20 A

Output	Min OCP	Max OCP
-12V	No damage	
5Vstby	No damage	

2.1.6.2 Over Voltage Protection (OVP)

The power supply over voltage protection is locally sensed. The power supply shuts down and latch off after an over voltage condition occurs. This latch is cleared by toggling the PSON# signal or by an AC power interruption. The table below contains the over voltage limits. The values are measured at the output of the power supply's pins. The voltage shall never exceed the maximum levels when measured at the power pins of the power supply connector during any single point of fail. The voltage shall never trip any lower than the minimum levels when measured at the power pins of the power supply connector. 5VSB will be auto-recovered after removing OVP limit.

Table 24. Over Voltage Protection (OVP) Limits

Output Voltage	MAX (V)
+3.3V	4.5
+5V	6.5
+12V1,2,3	14.5
+5VSB	6.5

2.1.6.3 Over Temperature Protection (OTP)

The power supply will be protected against over temperature conditions caused by loss of fan cooling or excessive ambient temperature. In an OTP condition the PSU will shut down.

2.1.7 Control and Indicator Functions

The following sections define the input and output signals from the power supply.
Signals that can be defined as low true use the following convention: Signal# = low true

2.1.7.1 PSON# Input Signal

The PSON# signal is required to remotely turn on/off the power supply. PSON# is an active low signal that turns on the +3.3V, +5V, +12V1, +12V2,+12V3 and -12V power rails. When this signal is not pulled low by the system, or left open, the outputs (except the +5VSB) turn off. This signal is pulled to a standby voltage by a pull-up resistor internal to the power supply. Refer to Figure 27 for the timing diagram.

Table 25. PSON# Signal Characteristic

Signal Type	Accepts an open collector/drain input from the system. Pull-up to VSB located in power supply.	
PSON# = Low	ON	
PSON# = High or Open	OFF	
	MIN	MAX
Logic level low (power supply ON)	0V	1.0V
Logic level high (power supply OFF)	2.0V	5.25V
Source current, Vpson = low		4mA
Power up delay: Tpson_on_delay	5msec	400msec

Signal Type	Accepts an open collector/drain input from the system. Pull-up to VSB located in power supply.	
PWOK delay: T pson_pwok		50msec

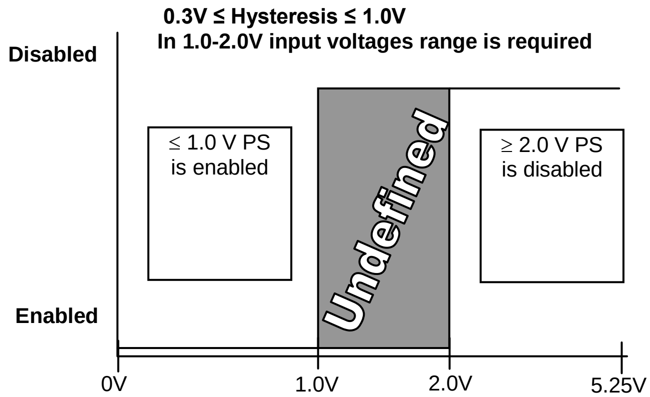


Figure 29. PSON# Required Signal Characteristic

2.1.7.2 PWOK (Power OK) Output Signal

PWOK is a power OK signal and will be pulled HIGH by the power supply to indicate that all the outputs are within the regulation limits of the power supply. When any output voltage falls below regulation limits or when AC power has been removed for a time sufficiently long so that power supply operation is no longer guaranteed, PWOK will be de-asserted to a LOW state. Refer to Figure 27 for a representation of the timing characteristics of PWOK. The start of the PWOK delay time shall inhibited as long as any power supply output is in current limit.

Table 26. PWOK Signal Characteristics

Signal Type	Open collector/drain output from power supply. Pull-up to VSB located in system.	
PWOK = High	Power OK	
PWOK = Low	Power Not OK	
	MIN	MAX
Logic level low voltage, Isink=4mA	0V	0.4V
Logic level high voltage, Isource=200µA	2.4V	5.25V
Sink current, PWOK = low		4mA
Source current, PWOK = high		2mA
PWOK delay: Tpwok_on	100ms	500ms
PWOK rise and fall time		100µsec
Power down delay: T pwok_off	1ms	

2.2 750-W Power Supply

This specification defines a 750W redundant power supply that supports server systems. This power supply has 2 outputs; 12V and 12V standby. The AC input is auto ranging and power factor corrected.

2.2.1 Mechanical Overview

The physical size of the power supply enclosure is 39/40mm x 74mm x 185mm. The power supply contains a single 40mm fan. The power supply has a card edge output that interfaces with a 2x25 card edge connector in the system. The AC plugs directly into the external face of the power supply. Refer to the following Figure. All dimensions are nominal.

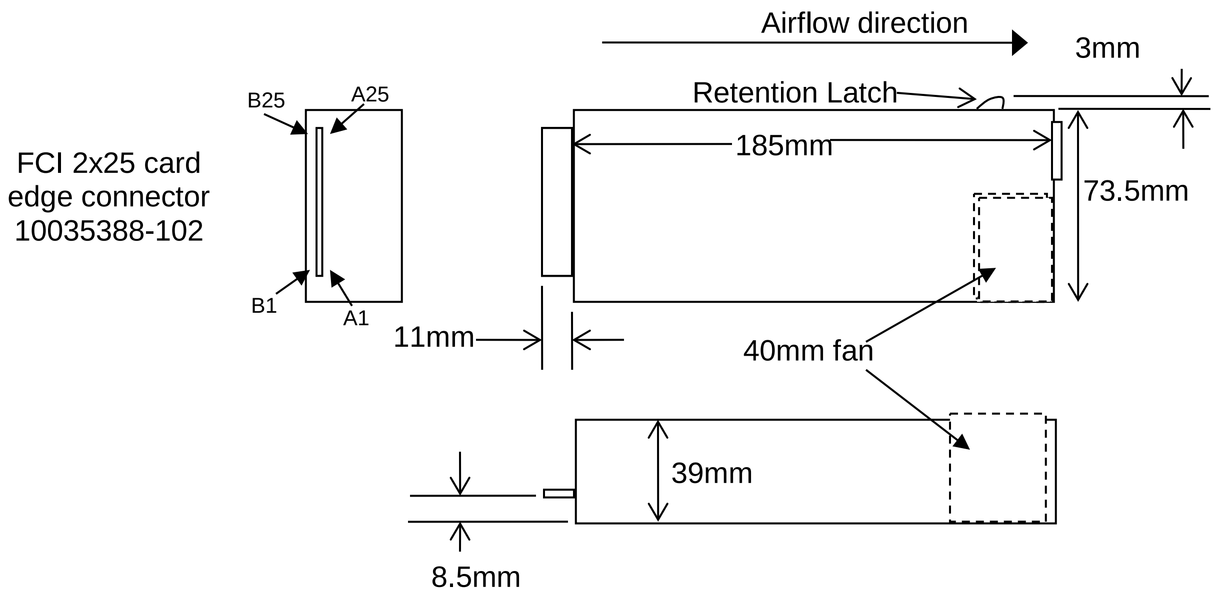


Figure 30. 750-W Power Supply Outline Drawing

2.2.1.1 DC Output Connector

The power supply uses a card edge output connection for power and signal that is compatible with a 2x25 Power Card Edge connector (equivalent to 2x25 pin configuration of the FCI power card connector 10035388-102LF).

Table 27. DC Output Connector

Pin	Name	Pin	Name
A1	GND	B1	GND
A2	GND	B2	GND
A3	GND	B3	GND
A4	GND	B4	GND
A5	GND	B5	GND
A6	GND	B6	GND
A7	GND	B7	GND
A8	GND	B8	GND
A9	GND	B9	GND
A10	+12V	B10	+12V
A11	+12V	B11	+12V
A12	+12V	B12	+12V

Pin	Name	Pin	Name
A13	+12V	B13	+12V
A14	+12V	B14	+12V
A15	+12V	B15	+12V
A16	+12V	B16	+12V
A17	+12V	B17	+12V
A18	+12V	B18	+12V
A19	PMBus* SDA	B19	A0 (SMBus* address)
A20	PMBus* SCL	B20	A1 (SMBus* address)
A21	PSON	B21	12V stby
A22	SMBAlert#	B22	Cold Redundancy Bus
A23	Return Sense	B23	12V load share bus
A24	+12V remote Sense	B24	No Connect
A25	PWOK	B25	Compatibility Check pin

2.2.1.2 Handle Retention

The power supply has a handle to assist extraction. The module is able to be inserted and extracted without the assistance of tools. The power supply has a latch which retains the power supply into the system and prevents the power supply from being inserted or extracted from the system when the AC power cord is pulled into the power supply.

The handle protects the operator from any burn hazard.

2.2.1.3 LED Marking and Identification

The power supply uses a bi-color LED: Amber & Green. Below are table showing the LED states for each power supply operating state and the LED's wavelength characteristics. Refer to the Intel LED Wavelength and Intensity specification for more details.

Table 28. LED Characteristics

	Min λd Wavelength	Nominal λd Wavelength	Max λd Wavelength	Units
Green	562	565	568	nm
Amber	607	610	613	nm

Table 29. Power Supply LED Functionality

Power Supply Condition	LED State
Output ON and OK	GREEN
No AC power to all power supplies	OFF
AC present/Only 12VSB on (PS off) or PS in Cold redundant state	1Hz Blink GREEN
AC cord unplugged or AC power lost; with a second power supply in parallel still with AC input power.	AMBER
Power supply warning events where the power supply continues to operate; high temp, high power, high current, slow fan.	1Hz Blink Amber

Power Supply Condition	LED State
Power supply critical event causing a shutdown; failure, OCP, OVP, Fan Fail	AMBER
Power supply FW updating	2Hz Blink GREEN

2.2.1.4 Temperature Requirements

The power supply operates within all specified limits over the T_{op} temperature range. All airflow passes through the power supply and not over the exterior surfaces of the power supply.

Table 30. Environmental Requirements

Item	Description	Min	Max	Units
$T_{op\_sc\_red}$	Operating temperature range; spreadcore redundant (60% load, 3000m, spreadcore system flow impedance2)	0	60	°C
$T_{op\_sc\_nr}$	Operating temperature range; spreadcore non-redundant (100% load, 3000m, spreadcore system flow impedance2)	0	50	°C
$T_{op\_rackped\_900}$	Operating temperature range; rack/pedestal 900m (100% load, 900m, rack/pedestal system flow impedance2)	0	45	°C
$T_{op\_rackped\_3000}$	Operating temperature range; rack/pedestal 3000m (100% load, 3000m, rack/pedestal system flow impedance2)	0	40	°C
Texit	Maximum exit air temperature		68	°C
T_{non-op}	Non-operating temperature range.	-40	70	°C
Altitude	Maximum operating altitude 3		3050	m

Notes:

1. Under normal conditions, the exit air temperature shall be less than 65C. 68C is provided for absolute worst case conditions and is expected only to exist when the inlet ambient reaches 60C.
2. $T_{op\_rackped\_900}$ condition only requires max altitude of 900m.

The power supply meets UL enclosure requirements for temperature rise limits. All sides of the power supply with exception to the air exhaust side are classified as “Handle, knobs, grips, and so on, held for short periods of time only”.

2.2.2 AC Input Requirements

2.2.2.1 Power Factor

The power supply meets the power factor requirements stated in the Energy Star® Program Requirements for Computer Servers. These requirements are stated below.

Table 31. Power Factor Requirements for Computer Servers

Output power	10% load	20% load	50% load	100% load
Power factor	> 0.65	> 0.80	> 0.90	> 0.95

Tested at 230Vac, 50Hz and 60Hz and 115VAC, 60Hz
Tested according to Generalized Internal Power Supply Efficiency Testing Protocol Rev 6.4.3. This is posted at http://efficientpowersupplies.epri.com/methods.asp.

2.2.2.2 AC Inlet Connector

The AC input connector is an *IEC 320 C-14* power inlet. This inlet is rated for 10A/250VAC.

2.2.2.3 AC Input Voltage Specification

The power supply operates within all specified limits over the following input voltage range. Harmonic distortion of up to 10% of the rated line voltage does not cause the power supply to go out of specified limits. Application of an input voltage below 85VAC does not cause damage to the power supply, including a blown fuse.

Table 32. AC Input Voltage Range

PARAMETER	MIN	RATED	V_{MAX}	Start up VAC	Power Off VAC
Voltage (110)	90 V_{rms}	100-127 V_{rms}	140 V_{rms}	85VAC +/- 4VAC	74VAC +/- 5VAC
Voltage (220)	180 V_{rms}	200-240 V_{rms}	264 V_{rms}		
Frequency	47 Hz	50/60	63 Hz		

Notes:

1. Maximum input current at low input voltage range shall be measured at 90VAC, at max load.
2. Maximum input current at high input voltage range shall be measured at 180VAC, at max load.
3. This requirement is not to be used for determining agency input current markings.

2.2.2.4 AC Line Dropout/Holdup

An AC line dropout is defined to be when the AC input drops to 0VAC at any phase of the AC line for any length of time. During an AC dropout the power supply meets dynamic voltage regulation requirements. An AC line dropout of any duration does not cause tripping of control signals or protection circuits. If the AC dropout lasts longer than the holdup time the power supply recovers and meets all turn on requirements. The power supply meets the AC dropout requirement over rated AC voltages and frequencies. A dropout of the AC line for any duration does not cause damage to the power supply.

Table 33. AC Line Holdup Time

Loading	Holdup time
70%	12msec

2.2.2.5 AC Line 12VSBHoldup

The 12VSB output voltage stays in regulation under its full load (static or dynamic) during an AC dropout of **70ms min** (=12VSB holdup time) whether the power supply is in ON or OFF state (PSON asserted or de-asserted).

2.2.2.6 AC Line Fuse

The power supply has one line fused in the **single line fuse** on the line (Hot) wire of the AC input. The line fusing is acceptable for all safety agency requirements. The input is a slow blow type. AC inrush current does not cause the AC line fuse to blow under any conditions. All protection circuits in the power supply does not cause the AC fuse to blow unless a component in the power supply has failed. This includes DC output load short conditions.

2.2.2.7 AC Line Transient Specification

AC line transient conditions are defined as “sag” and “surge” conditions. “Sag” conditions are also commonly referred to as “brownout”, these conditions is defined as the AC line voltage dropping below nominal voltage conditions. “Surge” is defined to refer to conditions when the AC line voltage rises above nominal voltage.

The power supply meets the requirements under the following AC line sag and surge conditions.

Table 34. AC Line Sag Transient Performance

AC Line Sag (10sec interval between each sagging)				
Duration	Sag	Operating AC Voltage	Line Frequency	Performance Criteria
0 to 1/2 AC cycle	95%	Nominal AC Voltage ranges	50/60Hz	No loss of function or performance
> 1 AC cycle	>30%	Nominal AC Voltage ranges	50/60Hz	Loss of function acceptable, self recoverable

Table 35. AC Line Surge Transient Performance

AC Line Surge				
Duration	Surge	Operating AC Voltage	Line Frequency	Performance Criteria
Continuous	10%	Nominal AC Voltages	50/60Hz	No loss of function or performance
0 to ½ AC cycle	30%	Mid-point of nominal AC Voltages	50/60Hz	No loss of function or performance

2.2.2.8 Power Recovery

The power supply shall recover automatically after an AC power failure. AC power failure is defined to be any loss of AC power that exceeds the dropout criteria.

2.2.3 Efficiency

The following table provides the required minimum efficiency level at various loading conditions. These are provided at three different load levels; 100%, 50%, 20%, and 10%. Output shall be load according to the proportional loading method defined by 80 Plus in Generalized Internal Power Supply Efficiency Testing Protocol Rev. 6.4.3. This is posted at http://efficientpowersupplies.epri.com/methods.asp.

Table 36. Silver Efficiency Requirement

Loading	100% of maximum	50% of maximum	20% of maximum	10% of maximum
Minimum Efficiency	91%	94%	90%	82%

The power supply passes with enough margins to make sure in production all power supplies meet these efficiency requirements.

2.2.4 DC Output Specification

2.2.4.1 Output Power/Currents

The following table defines the minimum power and current ratings. The power supply meets both static and dynamic voltage regulation requirements for all conditions.

Table 37. Minimum Load Ratings

Parameter	Min	Max.	Peak 2, 3	Unit
12V main	0.0	62.0	70.0	A
12Vstby 1	0.0	2.1	2.4	A

Notes:

1. 12Vstby must provide 4.0A with two power supplies in parallel. The Fan may work when stby current >1.5A.
2. Length of time peak power can be supported is based on thermal sensor and assertion of the SMBAlert# signal. Minimum peak power duration shall be 20 seconds without asserting the SMBAlert# signal at maximum operating temperature.

2.2.4.2 Standby Output

The 12VSB output is present when an AC input greater than the power supply turn on voltage is applied.

2.2.4.3 Voltage Regulation

The power supply output voltages stay within the following voltage limits when operating at steady state and dynamic loading conditions. These limits include the peak-peak ripple/noise. These shall be measured at the output connectors.

Table 38. Voltage Regulation Limits

Parameter	Tolerance	Min	Nom	Max	Units
+12V	- 5%/+5%	+11.40	+12.00	+12.60	V_{rms}
+12V stby	- 5%/+5%	+11.40	+12.00	+12.60	V_{rms}

2.2.4.4 Dynamic Loading

The output voltages remains within limits specified for the step loading and capacitive loading specified in the table below. The load transient repetition rate is tested between 50Hz and 5kHz at duty cycles ranging from 10%-90%. The load transient repetition rate is only a test specification. The Δ step load may occur anywhere within the MIN load to the MAX load conditions.

Table 39. Transient Load Requirements

Output	Δ Step Load Size (See note 2)	Load Slew Rate	Test capacitive Load
+12VSB	1.0A	0.25 A/μsec	20 μF
+12V	60% of max load	0.25 A/μsec	2000 μF

Note:

For dynamic condition +12V min loading is 1A.

2.2.4.5 Capacitive Loading

The power supply is stable and meets all requirements with the following capacitive loading ranges.

Table 40. Capacitive Loading Conditions

Output	Min	Max	Units
+12VSB	20	3100	μF
+12V	500	25000	μF

2.2.4.6 Grounding

The output ground of the pins of the power supply provides the output power return path. The output connector ground pins are connected to the safety ground (power supply enclosure). This grounding is well designed to ensure passing the max allowed Common Mode Noise levels.

The power supply is provided with a reliable protective earth ground. All secondary circuits is connected to protective earth ground. Resistance of the ground returns to chassis does not exceed 1.0 mΩ. This path may be used to carry DC current.

2.2.4.7 Residual Voltage Immunity in Standby mode

The power supply is immune to any residual voltage placed on its outputs (Typically a leakage voltage through the system from standby output) up to 500mV. There is neither additional heat generated, nor stressing of any internal components with this voltage applied to any individual or all outputs simultaneously. It also does not trip the protection circuits during turn on.

The residual voltage at the power supply outputs for no load condition does not exceed 100mV when AC voltage is applied and the PSON# signal is de-asserted.

2.2.4.8 Common Mode Noise

The Common Mode noise on any output does not exceed 350mV pk-pk over the frequency band of 10Hz to 20MHz.

The measurement is made across a 100Ω resistor between each of DC outputs, including ground at the DC power connector and chassis ground (power subsystem enclosure).

The test set-up shall use a FET probe such as Tektronix model P6046 or equivalent.

2.2.4.9 Hot Swap Requirements

Hot swapping a power supply is the process of inserting and extracting a power supply from an operating power system. During this process the output voltages remains within the limits with the capacitive load specified. The hot swap test is conducted when the system is operating under static, dynamic, and zero loading conditions. The power supply uses a latching mechanism to prevent insertion and extraction of the power supply when the AC power cord is inserted into the power supply.

2.2.4.10 Forced Load Sharing

The +12V output will have active load sharing. The output will share within 10% at full load. The failure of a power supply does not affect the load sharing or output voltages of the other supplies still operating. The supplies are able to load share in parallel and operate in a hot-swap/redundant **1+1** configurations. The 12VSB output is not required to actively share current between power supplies (passive sharing). The 12VSB output of the power supplies are connected together in the system so that a failure or hot swap of a redundant power supply does not cause these outputs to go out of regulation in the system.

2.2.4.11 Ripple/Noise

The maximum allowed ripple/noise output of the power supply is defined in below table. This is measured over a bandwidth of 10Hz to 20MHz at the power supply output connectors. A 10μF tantalum capacitor in parallel with a 0.1μF ceramic capacitor is placed at the point of measurement.

Table 41. Ripples and Noise

+12V main	+12VSB
120mVp-p	120mVp-p

The test set-up shall be as shown below.

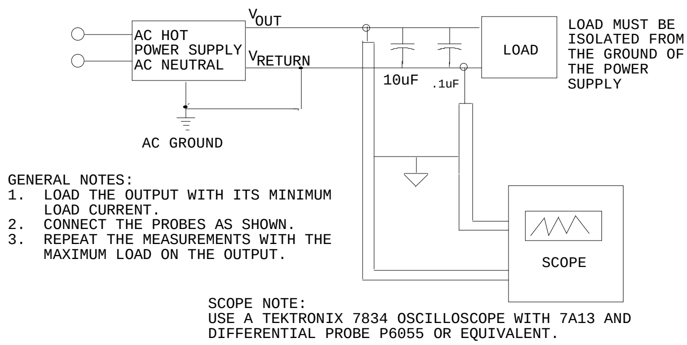


Figure 31. Differential Noise test setup

Note: When performing this test, the probe clips and capacitors should be located close to the load.

2.2.4.12 Timing Requirements

These are the timing requirements for the power supply operation. The output voltages must rise from 10% to within regulation limits (T_{vout_rise}) within 5 to 70ms. For 12VSB, it is allowed to rise from 1.0 to 25ms. **All outputs must rise monotonically**. Table below shows the timing requirements for the power supply being turned on and off by the AC input, with PSON held low and the PSON signal, with the AC input applied.

Table 42. Timing Requirements

Item	Description	Min	Max	Units
T^{vout_rise}	Output voltage rise time	5.0 *	70 *	ms
$T_{sb\_on\_delay}$	Delay from AC being applied to 12VSBbeing within regulation.		1500	ms
$T_{ac\_on\_delay}$	Delay from AC being applied to all output voltages being within regulation.		3000	ms
T_{vout_holdup}	Time 12Vl output voltage stay within regulation after loss of AC.	13		ms
T_{pwok_holdup}	Delay from loss of AC to de-assertion of PWOK	12		ms
$T_{pson\_on\_delay}$	Delay from PSON# active to output voltages within regulation limits.	5	400	ms
T_{pson_pwok}	Delay from PSON# deactivate to PWOK being de-asserted.		5	ms
T_{pwok_on}	Delay from output voltages within regulation limits to PWOK asserted at turn on.	100	500	ms
T_{pwok_off}	Delay from PWOK de-asserted to output voltages dropping out of regulation limits.	1		ms

Item	Description	Min	Max	Units
T_{pwok_low}	Duration of PWOK being in the de-asserted state during an off/on cycle using AC or the PSON signal.	100		ms
T_{sb_vout}	Delay from 12VSBbeing in regulation to O/Ps being in regulation at AC turn on.	50	1000	ms
T_{12VSB_holdup}	Time the 12VSBoutput voltage stays within regulation after loss of AC.	70		ms

* The 12VSBoutput voltage rise time shall be from 1.0ms to 25ms.

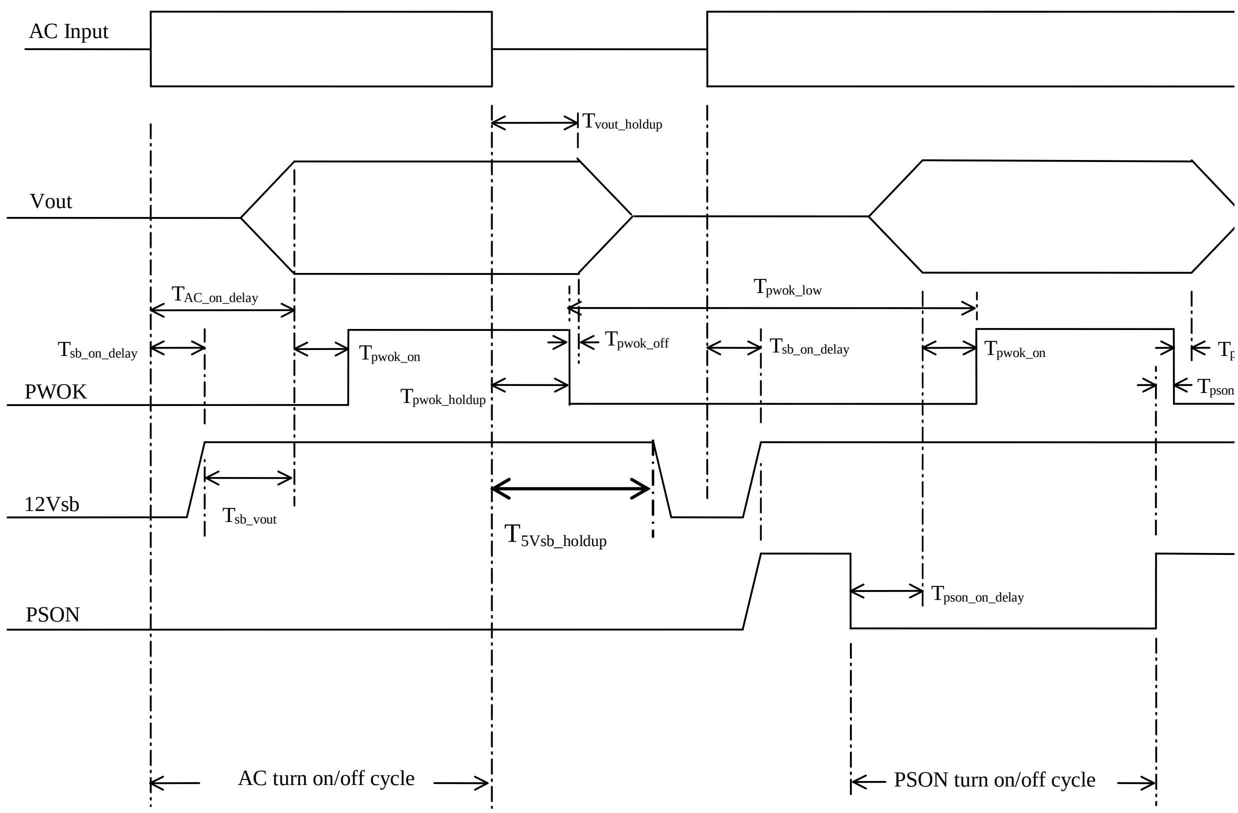


Figure 32. Turn On/Off Timing (Power Supply Signals)

2.2.5 Protection Circuits

Protection circuits inside the power supply causes only the power supply's main outputs to shutdown. If the power supply latches off due to a protection circuit tripping, an AC cycle OFF for 15sec and a PSON# cycle HIGH for 1sec is able to reset the power supply.

2.2.5.1 Current Limit (OCP)

The power supply has current limit to prevent the outputs from exceeding the values shown in table below. If the current limits are exceeded the power supply shuts down and latches off. The latch will be cleared by toggling the PSON# signal or by an AC power interruption. The power supply does not be damaged from repeated power cycling in this condition. 12VSB will be auto-recovered after removing OCP limit.

Table 43. Over Current Protection

Output VOLTAGE	Input voltage range	Over Current Limits
+12V	90 – 264VAC	72A min; 78A max
12VSB	90 – 264VAC	2.5A min; 3.5A max

2.2.5.2 Over Voltage Protection (OVP)

The power supply over voltage protection is locally sensed. The power supply shuts down and latches off after an over voltage condition occurs. This latch is cleared by toggling the PSON# signal or by an AC power interruption. The values are measured at the output of the power supply's connectors. The voltage does not exceed the maximum levels when measured at the power connectors of the power supply connector during any single point of fail. The voltage doesn't trip any lower than the minimum levels when measured at the power connector. 12VSBwill be auto-recovered after removing OVP limit.

Table 44. Over Voltage Protection (OVP) Limits

Output voltage	Min (v)	Max (v)
+12V	13.0	14.5
+12VSB	13.3	14.5

2.2.5.3 Over Temperature Protection (OTP)

The power supply will be protected against over temperature conditions caused by loss of fan cooling or excessive ambient temperature. In an OTP condition the PSU will shut down. When the power supply temperature drops to within specified limits, the power supply shall restore power automatically, while the 12VSB remains always on. The OTP circuit must have built in margin such that the power supply will not oscillate on and off due to temperature recovering condition. The OTP trip level shall have a minimum of 4°C of ambient temperature margin.

2.2.6 Control and Indicator Functions

The following sections define the input and output signals from the power supply.

Signals that can be defined as low true use the following convention: Signal# = low true.

2.2.6.1 PSON# Input Signal

The PSON# signal is required to remotely turn on/off the power supply. PSON# is an active low signal that turns on the +12V power rail. When this signal is not pulled low by the system, or left open, the outputs (except the +12VSB) turn off. This signal is pulled to a standby voltage by a pull-up resistor internal to the power supply. Refer to Table 41 for the timing diagram.

Table 45. PSON# Signal Characteristic

Signal Type	Accepts an open collector/drain input from the system. Pull-up to VSB located in power supply.	
PSON# = Low	ON	
PSON# = High or Open	OFF	
	MIN	MAX
Logic level low (power supply ON)	0V	1.0V
Logic level high (power supply OFF)	2.0V	3.46V
Source current, Vpson = low		4mA
Power up delay: $T_{pson\_on\_delay}$	5msec	400msec
PWOK delay: T_{pson_pwok}		50msec

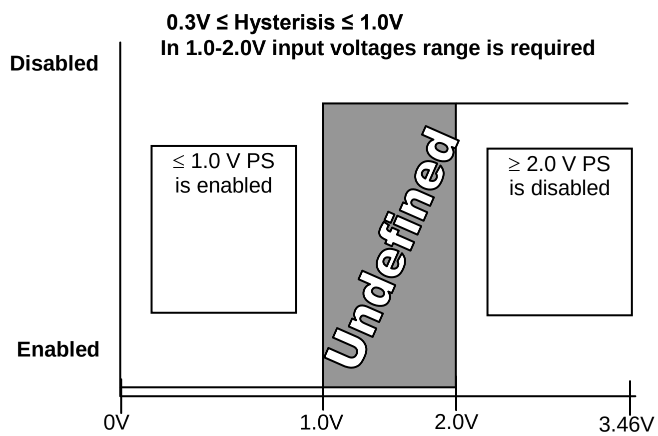


Figure 33. PSON# Required Signal Characteristic

2.2.6.2 PWOK (Power OK) Output Signal

PWOK is a power OK signal and will be pulled HIGH by the power supply to indicate that all the outputs are within the regulation limits of the power supply. When any output voltage falls below regulation limits or when AC power has been removed for a time sufficiently long so that power supply operation is no longer guaranteed, PWOK will be de-asserted to a LOW state. See Table 45for a representation of the timing characteristics of PWOK. The start of the PWOK delay time shall inhibited as long as any power supply output is in current limit.

Table 46. PWOK Signal Characteristics

Signal Type	Open collector/drain output from power supply. Pull-up to VSB located in the power supply.	
PWOK = High	Power OK	
PWOK = Low	Power Not OK	
	MIN	MAX
Logic level low voltage, Isink=400uA	0V	0.4V
Logic level high voltage, Isource=200µA	2.4V	3.46V

Signal Type	Open collector/drain output from power supply. Pull-up to VSB located in the power supply.	
Sink current, PWOK = low		400uA
Source current, PWOK = high		2mA
PWOK delay: T_{pwok_on}	100ms	1000ms
PWOK rise and fall time		100μsec
Power down delay: T_{pwok_off}	1ms	200msec

A recommended implementation of the Power Ok circuits is shown below.

Note: The Power Ok circuits should be compatible with 5V pull up resistor (>10k) and 3.3V pull up resistor (>6.8k).

2.2.6.3 SMBAlert# Signal

This signal indicates that the power supply is experiencing a problem that the user should investigate. This shall be asserted due to Critical events or Warning events. The signal shall activate in the case of critical component temperature reached a warning threshold, general failure, over-current, over-voltage, under-voltage, failed fan. This signal may also indicate the power supply is reaching its end of life or is operating in an environment exceeding the specified limits.

This signal is to be asserted in parallel with LED turning solid Amber or blink Amber.

Table 47. SMBAlert# Signal Characteristics

Signal Type (Active Low)	Open collector/drain output from power supply. Pull-up to VSB located in system.	
Alert# = High	OK	
Alert# = Low	Power Alert to system	
	MIN	MAX
Logic level low voltage, Isink=4 mA	0 V	0.4 V
Logic level high voltage, Isink=50 μA		3.46 V
Sink current, Alert# = low		4 mA
Sink current, Alert# = high		50 μA
Alert# rise and fall time		100 μs

2.2.7 Thermal CLST

The power supply shall assert the SMBAlert signal when a temperature sensor crosses a warning threshold. Refer to the Intel “Common Hardware & Firmware Requirements for CRPS Power Supplier” for detailed requirements.

2.2.8 Power Supply Diagnostic “Black Box”

The power supply saves the latest PMBus* data and other pertinent data into nonvolatile memory when a critical event shuts down the power supply. This data is accessible from the SMBus* interface with an external source providing power to the 12Vstby output.

Refer to the Intel "Common Hardware & Firmware Requirements for CRPS Power Supplier" for detailed requirements.

2.2.9 Firmware Uploader

The power supply has the capability to update its firmware from the PMBus* interface while it is in standby mode. This FW can be updated when in the system and in standby mode and outside the system with power applied to the 12Vstby pins.

Refer to the Intel "Common Hardware & Firmware Requirements for CRPS Power Supplier" for detailed requirements.

2.3 460-W Power Supply

This specification defines a 460W redundant power supply that supports server systems. The parameters of this power supply are defined in this specification. This specification defines a power supply with 2 outputs; 12V and 12V standby. The AC input shall be auto ranging and power factor corrected.

2.3.1 Mechanical Overview

The physical size of the power supply enclosure is 39/40mm x 73.5mm x 185mm. The power supply contains a single 40mm fan. The power supply has a card edge output that interfaces with a 2x25 card edge connector in the system. The AC plugs directly into the external face of the power supply. Refer to the following figure. All dimensions are nominal.

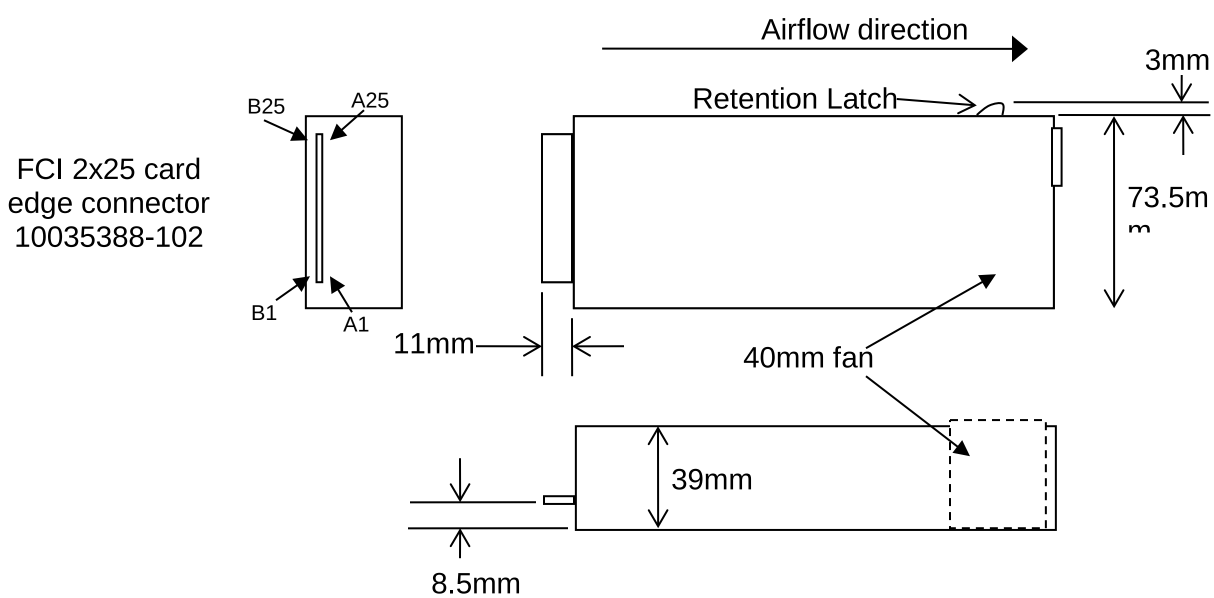


Figure 34. Power Supply Outline Drawing

2.3.1.1 DC Output Connector

The power supply shall use a card edge output connection for power and signal that is compatible with a 2x25 Power Card Edge connector (equivalent to 2x25 pin configuration of the FCI power card connector 10035388-102LF).

Table 48. DC Output Selector

Pin	Name	Pin	Name
A1	GND	B1	GND
A2	GND	B2	GND
A3	GND	B3	GND
A4	GND	B4	GND
A5	GND	B5	GND
A6	GND	B6	GND
A7	GND	B7	GND
A8	GND	B8	GND
A9	GND	B9	GND
A10	+12V	B10	+12V
A11	+12V	B11	+12V
A12	+12V	B12	+12V
A13	+12V	B13	+12V
A14	+12V	B14	+12V
A15	+12V	B15	+12V
A16	+12V	B16	+12V
A17	+12V	B17	+12V
A18	+12V	B18	+12V
A19	PMBus* SDA	B19	A0 (SMBus* address)
A20	PMBus* SCL	B20	A1 (SMBus* address)
A21	PSON	B21	12V stby
A22	SMBAlert#	B22	Cold Redundancy Bus
A23	Return Sense	B23	12V load share bus
A24	+12V remote Sense	B24	No Connect
A25	PWOK	B25	Compatibility **Check** pin*

Note: Refer to the *Common Hardware & Firmware Requirements for CRPS Power Supplies Specification*.

2.3.1.2 Handle Retention

The power supply shall have a handle to assist extraction. The module shall be able to be inserted and extracted without the assistance of tools. The power supply shall have a latch which retains the power supply into the system and prevents the power supply from being inserted or extracted from the system when the AC power cord is pulled into the power supply.

The handle shall protect the operator from any burn hazard through the use of the Intel Corporation Industrial designed plastic handle or equivalent Intel approved material.

2.3.1.3 LED Marking and Identification

The power supply shall use a bi-color LED; Amber & Green. Below are table showing the LED states for each power supply operating state and the LED's wavelength characteristics.

Refer to the Intel LED Wavelength and Intensity specification for more details.

Table 49. LED Characteristics

	Min λd Wavelength	Nominal λd Wavelength	Max λd Wavelength	Units
Green	562	565	568	nm
Amber	607	610	613	nm

Table 50. LED Indicator States

Power Supply Condition	LED State
Output ON and OK	GREEN
No AC power to all power supplies	OFF
AC present/Only 12VSB on (PS off) or PS in Cold redundant state	1Hz Blink GREEN
AC cord unplugged or AC power lost; with a second power supply in parallel still with AC input power.	AMBER
Power supply warning events where the power supply continues to operate; high temp, high power, high current, slow fan.	1Hz Blink Amber
Power supply critical event causing a shutdown; failure, OCP, OVP, Fan Fail	AMBER
Power supply FW updating	2Hz Blink GREEN

2.3.1.4 Temperature Requirements

The power supply shall operate within all specified limits over the T_{op} temperature range. All airflow shall pass through the power supply and not over the exterior surfaces of the power supply.

Table 51. Environmental Requirements

Item	Description	MIN	MAX	UNITS
$T_{op\_sc\_red}$	Operating temperature range; spreadcore redundant (60% load, 3000m, spreadcore system flow impedance)	0	60	°C
$T_{op\_sc\_nr}$	Operating temperature range; spreadcore non-redundant (100% load, 3000m, spreadcore system flow impedance)	0	50	°C
$T_{op\_rackped\_900}$	Operating temperature range; rack/pedestal 900m (100% load, 900m, rack/pedestal system flow impedance)	0	45	°C
$T_{op\_rackped\_3000}$	Operating temperature range; rack/pedestal 3000m (100% load, 3000m, rack/pedestal	0	40	°C

Item	Description	MIN	MAX	UNITS
	system flow impedance)			
Texit	Maximum exit air temperature		68[1]	°C
T_{non-op}	Non-operating temperature range.	-40	70	°C
Altitude	Maximum operating altitude		3050	m

2.3.2 AC Input Requirements

2.3.2.1 Power Factor

The power supply must meet the power factor requirements stated in the Energy Star® Program Requirements for Computer Servers. These requirements are stated below:

Output power	10% load	20% load	50% load	100% load
Power factor	> 0.65	> 0.80	> 0.90	> 0.95

Tested at 230Vac, 50Hz and 60Hz and 115VAC, 60Hz
Tested according to Generalized Internal Power Supply Efficiency Testing Protocol Rev 6.4.3. This is posted at http://efficientpowersupplies.epri.com/methods.asp

2.3.2.2 AC Inlet Connector

The AC input connector shall be an *IEC 320 C-14* power inlet. This inlet is rated for 10A/250VAC.

2.3.2.3 AC Input Voltage Specification

The power supply must operate within all specified limits over the following input voltage range. Harmonic distortion of up to 10% of the rated line voltage must not cause the power supply to go out of specified limits. Application of an input voltage below 85VAC shall not cause damage to the power supply, including a blown fuse.

Table 52. AC Input Voltage Range

Parameter	MIN	Rated	V_{MAX}	Startup VAC	Power Off VAC
Voltage (110)	90 V_{rms}	100-127 V_{rms}	140 V_{rms}	85VAC +/- 4VAC	74VAC +/- 5VAC
Voltage (220)	180 V_{rms}	200-240 V_{rms}	264 V_{rms}		
Frequency	47 Hz	50/60	63 Hz		

Notes:
1. Maximum input current at low input voltage range shall be measured at 90VAC, at max load.
2. Maximum input current at high input voltage range shall be measured at 180VAC, at max load.
3. This requirement is not to be used for determining agency input current markings.

2.3.2.4 AC Line Dropout/Holdup

An AC line dropout is defined to be when the AC input drops to 0VAC at any phase of the AC line for any length of time. During an AC dropout the power supply must meet dynamic voltage regulation requirements. An AC line dropout of any duration shall not cause tripping of control signals or protection circuits. If the AC dropout lasts longer than the holdup time the power supply should recover and meet all turn on requirements. The power supply shall meet the AC dropout requirement over rated AC voltages and frequencies. A dropout of the AC line for any duration shall not cause damage to the power supply.

Loading	Holdup time
70%	12msec

2.3.2.5 AC Line 12VSBHoldup

The 12VSB output voltage should stay in regulation under its full load (static or dynamic) during an AC dropout of **70ms min** (=12VSB holdup time) whether the power supply is in ON or OFF state (PSON asserted or de-asserted).

2.3.2.6 AC Line Fuse

The power supply shall have one line fused in the **single line fuse** on the line (Hot) wire of the AC input. The line fusing shall be acceptable for all safety agency requirements. The input fuse shall be a slow blow type. AC inrush current shall not cause the AC line fuse to blow under any conditions. All protection circuits in the power supply shall not cause the AC fuse to blow unless a component in the power supply has failed. This includes DC output load short conditions.

2.3.2.7 AC Line Transient Specification

AC line transient conditions shall be defined as “sag” and “surge” conditions. “Sag” conditions are also commonly referred to as “brownout”; these conditions will be defined as the AC line voltage dropping below nominal voltage conditions. “Surge” will be defined to refer to conditions when the AC line voltage rises above nominal voltage.
The power supply shall meet the requirements under the following AC line sag and surge conditions.

Table 53 AC Line Sag Transient Performance

AC Line Sag (10sec interval between each sagging)				
Duration	Sag	Operating AC Voltage	Line Frequency	Performance Criteria
0 to 1/2 AC cycle	95%	Nominal AC Voltage ranges	50/60Hz	No loss of function or performance
> 1 AC cycle	>30 %	Nominal AC Voltage ranges	50/60Hz	Loss of function acceptable, self-recoverable

Table 54. AC Line Surge Transient Performance

AC Line Surge				
Duration	Surge	Operating AC Voltage	Line Frequency	Performance Criteria
Continuous	10%	Nominal AC Voltages	50/60Hz	No loss of function or performance
0 to ½ AC cycle	30%	Mid-point of nominal AC Voltages	50/60Hz	No loss of function or performance

2.3.2.8 Power Recovery

The power supply shall recover automatically after an AC power failure. AC power failure is defined to be any loss of AC power that exceeds the dropout criteria.

2.3.3 Efficiency

The following table provides the required minimum efficiency level at various loading conditions. These are provided at three different load levels; 100%, 50%, 20%, and 10%. Output shall be load according to the proportional loading method defined by 80 Plus in Generalized Internal Power Supply Efficiency Testing Protocol Rev 6.4.3. This is posted at http://efficientpowersupplies.epri.com/methods.asp

Table 55. Gold Efficiency Requirement

Loading	100% of maximum	50% of maximum	20% of maximum	10% of maximum
Minimum Efficiency	88%	92%	88%	80%

The power supply must pass with enough margins to make sure in production all power supplies meet these efficiency requirements.

2.3.4 DC Output Specification

2.3.4.1 Output Power/Currents

The following table defines the minimum power and current ratings. The power supply must meet both static and dynamic voltage regulation requirements for all conditions.

Table 56. Minimum Load Ratings

Parameter	Min	Max.	Peak [2,3]	Unit
12V main	0.0	38.0	45.0	A
12Vstby [1]	0.0	2.1	2.4	A

Notes:

1. 12Vstby must provide 4.0A with two power supplies in parallel. The Fan may start to work when stby current >1.5A
2. Peak combined power for all outputs shall not exceed 575W.
3. Length of time peak power can be supported is based on thermal sensor and assertion of the SMBAlert# signal. Minimum peak power duration shall be 20 seconds without asserting the SMBAlert# signal at maximum operating temperature.

2.3.4.2 Standby Output

The 12VSB output shall be present when an AC input greater than the power supply turn on voltage is applied. There should be load sharing in the standby rail. And two PSU modules should be able to support 4A standby current.

2.3.4.3 Voltage Regulation

The power supply output voltages must stay within the following voltage limits when operating at steady state and dynamic loading conditions. These limits include the peak-peak ripple/noise. These shall be measured at the output connectors.

Table 57. Voltage Regulation Limits

Parameter	Tolerance	MIN	NOM	MAX	UNITS
+12V	- 5%/+5%	+11.40	+12.00	+12.60	V_{rms}
+12V stby	- 5%/+5%	+11.40	+12.00	+12.60	V_{rms}

2.3.4.4 Dynamic Loading

The output voltages shall remain within limits specified for the step loading and capacitive loading specified in the table below. The load transient repetition rate shall be tested between 50Hz and 5kHz at duty cycles ranging from 10%-90%. The load transient repetition rate is only a test specification. The Δ step load may occur anywhere within the MIN load to the MAX load conditions.

Table 58. Transient Load Requirements

Output	Δ Step Load Size(See note)	Load Slew Rate	Test capacitive Load
+12VSB	1.0A	0.25 A/µsec	20 µF
+12V	60% of max load	0.25 A/µsec	2000 µF

Note: For dynamic condition +12V min loading is 1A.

2.3.4.5 Capacitive Loading

The power supply shall be stable and meet all requirements with the following capacitive loading ranges.

Table 59. Capacitive Loading Conditions

Output	MIN	MAX	Units
+12VSB	20	3100	µF
+12V	500	25000	µF

2.3.4.6 Grounding

The output ground of the pins of the power supply provides the output power return path. The output connector ground pins shall be connected to the safety ground (power supply enclosure). This grounding should be well designed to ensure passing the max allowed Common Mode Noise levels.

The power supply shall be provided with a reliable protective earth ground. All secondary circuits shall be connected to protective earth ground. Resistance of the ground returns to chassis shall not exceed 1.0 mΩ. This path may be used to carry DC current.

2.3.4.7 Residual Voltage Immunity in Standby mode

The power supply should be immune to any residual voltage placed on its outputs (Typically a leakage voltage through the system from standby output) up to **500mV**. There shall be no additional heat generated, nor stressing of any internal components with this voltage applied to any individual or all outputs simultaneously. It also should not trip the protection circuits during turn on.
The residual voltage at the power supply outputs for no load condition shall not exceed **100mV** when AC voltage is applied and the PSON# signal is de-asserted.

2.3.4.8 Common Mode Noise

The Common Mode noise on any output shall not exceed **350mV pk-pk** over the frequency band of 10Hz to 20MHz.

1. The measurement shall be made across a 100Ω resistor between each of DC outputs, including ground at the DC power connector and chassis ground (power subsystem enclosure).

2. The test set-up shall use a FET probe such as Tektronix model P6046 or equivalent.

2.3.4.9 Hot Swap Requirements

Hot swapping a power supply is the process of inserting and extracting a power supply from an operating power system. During this process the output voltages shall remain within the limits with the capacitive load specified. The hot swap test must be conducted when the system is operating under static, dynamic, and zero loading conditions. The power supply shall use a latching mechanism to prevent insertion and extraction of the power supply when the AC power cord is inserted into the power supply.

2.3.4.10 Forced Load Sharing

The +12V output will have active load sharing. The output will share within 10% at full load. The failure of a power supply should not affect the load sharing or output voltages of the other supplies still operating. The supplies must be able to load share in parallel and operate in a hot-swap/redundant 1+1 configurations. The 12VSBoutput is not required to actively share current between power supplies (passive sharing). The 12VSB output of the power supplies are connected together in the system so that a failure or hot swap of a redundant power supply does not cause these outputs to go out of regulation in the system.

2.3.4.11 Ripple/Noise

The maximum allowed ripple/noise output of the power supply is defined in the table below. This is measured over a bandwidth of 10Hz to 20MHz at the power supply output connectors. A 10µF tantalum capacitor in parallel with a 0.1µF ceramic capacitor is placed at the point of measurement.

Table 60. Ripples and Noise

+12V main	+12VSB
120mVp-p	120mVp-p

The test set-up shall be as shown below.

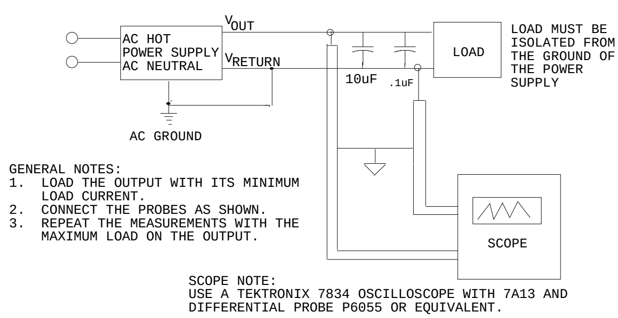


Figure 35. Differential Noise test setup

Note: When performing this test, the probe clips and capacitors should be located close to the load.

2.3.4.12 Timing Requirements

These are the timing requirements for the power supply operation. The output voltages must rise from 10% to within regulation limits (T_{vout_rise}) within 5 to 70ms. For 12VSB, it is allowed to rise from 1.0 to 25ms. **All outputs must rise monotonically**. Table below shows the timing requirements for the power supply being turned on and off by the AC input, with PSON held low and the PSON signal, with the AC input applied.

Table 61. Timing Requirements

Item	Description	MIN	MAX	UNITS
T_{vout_rise}	Output voltage rise time	5.0 *	70 *	ms
Tsb_on_delay	Delay from AC being applied to 12VSBbeing within regulation.		1500	ms
Tac_on_delay	Delay from AC being applied to all output voltages being within regulation.		3000	ms
Tvout_holdup	Time 12V output voltage stays within regulation after loss of AC at 70% load.	13		ms
Tpwok_holdup	Delay from loss of AC to de-assertion of PWOK	12		ms
Tpson_on_delay	Delay from PSON# active to output voltages within regulation limits.	5	400	ms
Tpson_pwok	Delay from PSON# deactivate to PWOK being de-asserted.		5	ms
Tpwok_on	Delay from output voltages within regulation limits to PWOK asserted at turn on.	100	500	ms
T pwok_off	Delay from PWOK de-asserted to output voltages dropping out of regulation limits.	1		ms
Tpwok_low	Duration of PWOK being in the de-asserted state during an off/on cycle using AC or the PSON signal.	100		ms
Tsb_vout	Delay from 12VSBbeing in regulation to O/Ps being in regulation at AC turn on.	50	1000	ms
T12VSB_holdup	Time the 12VSBoutput voltage stays within regulation after loss of AC.	70		ms

* The 12VSBoutput voltage rise time shall be from 1.0ms to 25ms

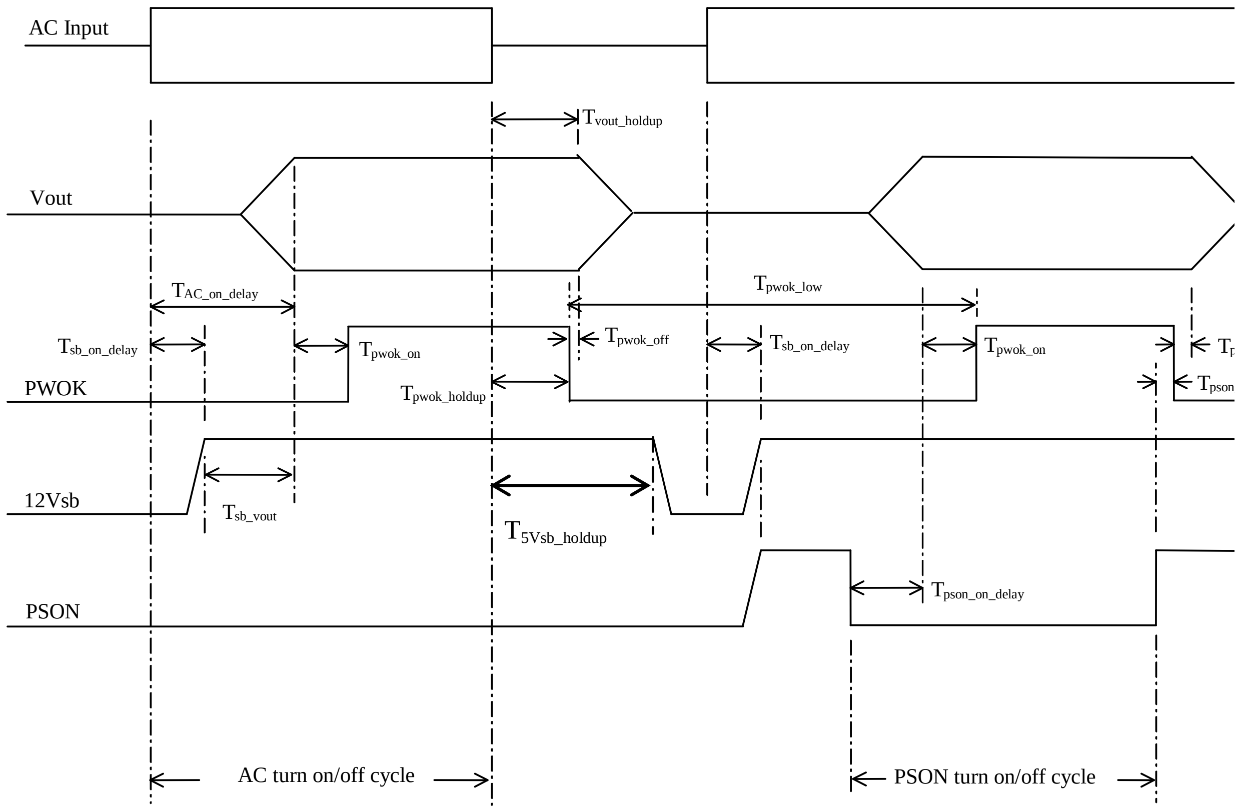


Figure 36. Turn On/Off Timing (Power Supply Signals)

2.3.5 Protection Circuits

Protection circuits inside the power supply shall cause only the power supply's main outputs to shut down. If the power supply latches off due to a protection circuit tripping, an AC cycle OFF for 15sec and a PSON# cycle HIGH for 1sec shall be able to reset the power supply.

2.3.5.1 Current Limit (OCP)

The power supply shall have current limit to prevent the outputs from exceeding the values shown in table below. If the current limits are exceeded the power supply shall shutdown and latch off. The latch will be cleared by toggling the PSON# signal or by an AC power interruption. The power supply shall not be damaged from repeated power cycling in this condition. 12VSB will be auto-recovered after removing OCP limit.

Table 62. Over Current Protection

Output VOLTAGE	Input voltage range	Over Current Limits
+12V	90 – 264VAC	47A min; 55A max
12VSB	90 – 264VAC	2A min; 2.5A max

2.3.5.2 Over Voltage Protection (OVP)

The power supply over voltage protection shall be locally sensed. The power supply shall shutdown and latch off after an over voltage condition occurs. This latch shall be cleared by toggling the PSON# signal or by an AC power interruption. The values are measured at the output of the power supply's connectors. The voltage shall never exceed the maximum levels when measured at the power connectors of the power supply connector during any single point of fail. The voltage shall never trip any lower than the minimum levels when measured at the power connector. 12VSBwill be auto-recovered after removing OVP limit.

Table 63. Over Voltage Protection (OVP) Limits

Output Voltage	MIN (V)	MAX (V)
+12V	13.3	14.5
+12VSB	13.3	14.5

2.3.5.3 Over Temperature Protection (OTP)

The power supply will be protected against over temperature conditions caused by loss of fan cooling or excessive ambient temperature. In an OTP condition the PSU will shut down. When the power supply temperature drops to within specified limits, the power supply shall restore power automatically, while the 12VSB remains always on. The OTP circuit must have built in margin such that the power supply will not oscillate on and off due to temperature recovering condition. The OTP trip level shall have a minimum of 4°C of ambient temperature margin.

2.3.6 Control and Indicator Functions

The following sections define the input and output signals from the power supply.
Signals that can be defined as low true use the following convention: *Signal*# = low true

2.3.6.1 PSON# Input Signal

The PSON# signal is required to remotely turn on/off the power supply. PSON# is an active low signal that turns on the +12V power rail. When this signal is not pulled low by the system, or left open, the outputs (except the +5VSB) turn off. This signal is pulled to a standby voltage by a pull-up resistor internal to the power supply. Refer Table 60 for the timing diagram.

Table 64. PSON# Signal Characteristic

Signal Type	Accepts an open collector/drain input from the system. Pull-up to VSB located in power supply.	
PSON# = Low	ON	
PSON# = High or Open	OFF	
	MIN	MAX
Logic level low (power supply ON)	0V	1.0V
Logic level high (power supply OFF)	2.0V	3.46V
Source current, Vpson = low		4mA
Power up delay: $T_{pson\_on\_delay}$	5msec	400msec
PWOK delay: T_{pson_pwok}		50msec

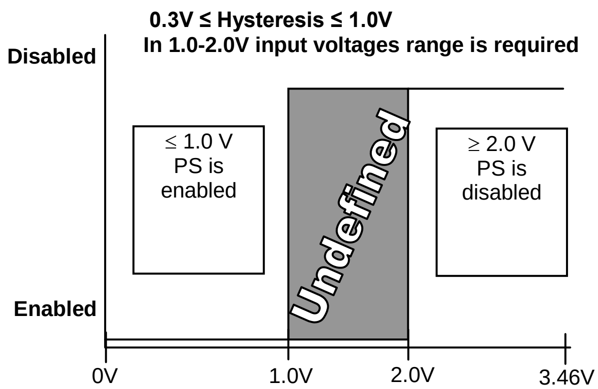


Figure 37. PSON# Required Signal Characteristic

2.3.6.2 PWOK (Power OK) Output Signal

PWOK is a power OK signal and will be pulled HIGH by the power supply to indicate that all the outputs are within the regulation limits of the power supply. When any output voltage falls below regulation limits or when AC power has been removed for a time sufficiently long so that power supply operation is no longer guaranteed, PWOK will be de-asserted to a LOW state. See the table below for a representation of the timing characteristics of PWOK. The start of the PWOK delay time shall inhibited as long as any power supply output is in current limit.

Table 65. PWOK Signal Characteristics

Signal Type	Open collector/drain output from power supply. Pull-up to VSB located in the power supply.	
PWOK = High	Power OK	
PWOK = Low	Power Not OK	
	MIN	MAX
Logic level low voltage, Isink=400uA	0V	0.4V
Logic level high voltage, Isource=200µA	2.4V	3.46V
Sink current, PWOK = low		400uA
Source current, PWOK = high		2mA
PWOK delay: T_{pwok_on}	100ms	1000ms
PWOK rise and fall time		100µsec
Power down delay: T_{pwok_off}	1ms	200msec

A recommended implementation of the Power Ok circuits is shown below.

Note: The Power Ok circuits should be compatible with 5V pull up resistor (>10k) and 3.3V pull up resistor (>6.8k).

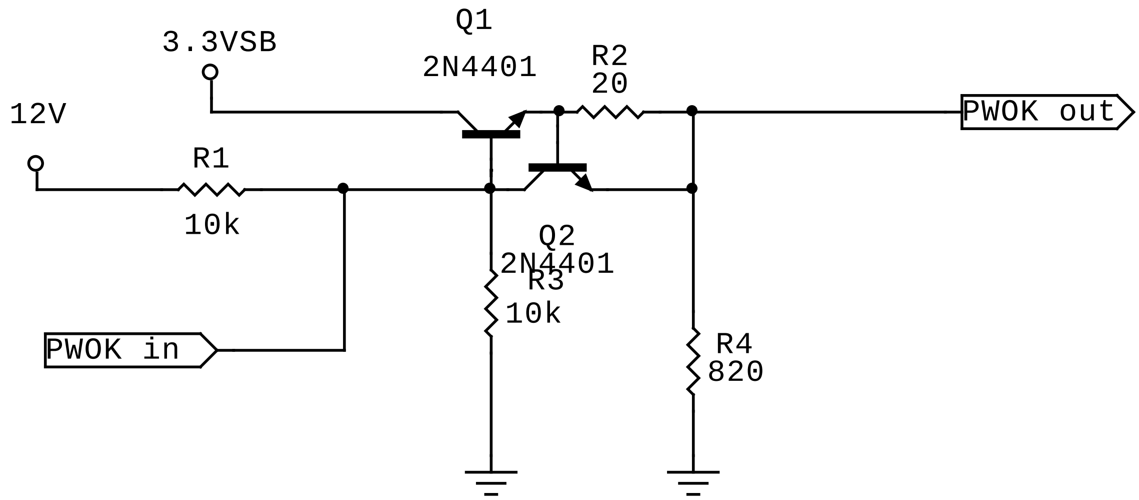


Figure 38. Implementation of the Power Ok Circuits

2.3.6.3 SMBAlert# Signal

This signal indicates that the power supply is experiencing a problem that the user should investigate. This shall be asserted due to Critical events or Warning events. The signal shall activate in the case of critical component temperature reached a warning threshold, general failure, over-current, over-voltage, under-voltage, failed fan. This signal may also indicate the power supply is reaching its end of life or is operating in an environment exceeding the specified limits.

This signal is to be asserted in parallel with LED turning solid Amber or blink Amber.

Table 66. SMBAlert# Signal Characteristics

Signal Type (Active Low)	Open collector/drain output from power supply. Pull-up to VSB located in system.	
Alert# = High	OK	
Alert# = Low	Power Alert to system	
	MIN	MAX
Logic level low voltage, Isink=4 mA	0 V	0.4 V
Logic level high voltage, Isink=50 µA		3.46 V
Sink current, Alert# = low		4 mA
Sink current, Alert# = high		50 µA
Alert# rise and fall time		100 µs

2.3.7 Thermal CLST

The power supply shall assert the SMBAlert signal when a temperature sensor crosses a warning threshold. Refer to the *Intel® Common Hardware & Firmware Requirements for CRPS Power Supplier* for detailed requirements.

2.3.8 Power Supply Diagnostic "Black Box"

The power supply shall save the latest PMBus* data and other pertinent data into nonvolatile memory when a critical event shuts down the power supply. This data shall be accessible from the SMBus* interface with an external source providing power to the 12Vstby output.

Refer to *Intel® Common Hardware & Firmware Requirements for CRPS Power Supplier* for detailed requirements.

2.3.9 Firmware Uploader

The power supply shall have the capability to update its firmware from the PMBus* interface while it is in standby mode. This FW can be updated when in the system and in standby mode and outside the system with power applied to the 12Vstby pins.
Refer to the *Intel® Common Hardware & Firmware Requirements for CRPS Power Supplier* for detailed requirements.

2.4 1200-W Power Supply

This specification defines a 1200W redundant power supply that supports server systems. The parameters of this power supply are defined in this specification. This specification defines a power supply with 2 outputs; 12V and 12V standby. The AC input shall be auto ranging and power factor corrected.

2.4.1 Mechanical Overview

The physical size of the power supply enclosure is 39/40mm x 73.5mm x 265mm. The power supply contains a single 40mm fan. The power supply has a card edge output that interfaces with a 2x25 card edge connector in the system. The AC plugs directly into the external face of the power supply. Refer to the following figure. All dimensions are nominal.

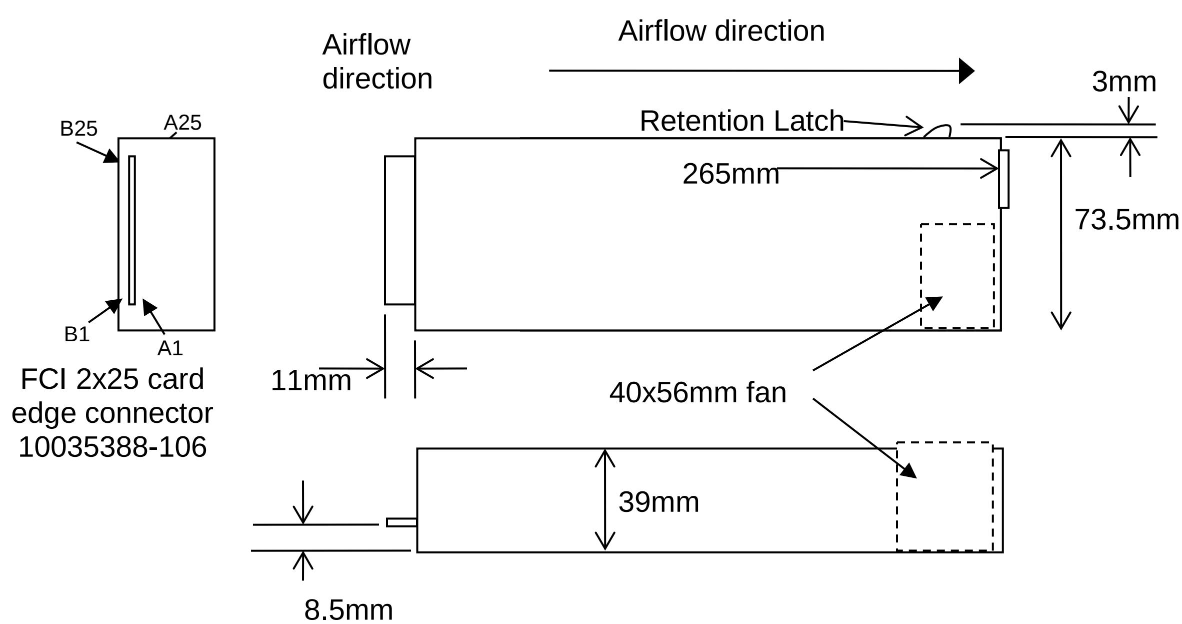


Figure 39. Power Supply Outline Drawing

2.4.1.1 DC Output Connector

The power supply shall use a card edge output connection for power and signal that is compatible with a 2x25 Power Card Edge connector (equivalent to 2x25 pin configuration of the FCI power card connector 10035388-102LF).

Table 67. DC Output Connector

Pin	Name	Pin	Name
A1	GND	B1	GND
A2	GND	B2	GND
A3	GND	B3	GND
A4	GND	B4	GND
A5	GND	B5	GND
A6	GND	B6	GND
A7	GND	B7	GND
A8	GND	B8	GND
A9	GND	B9	GND
A10	+12V	B10	+12V
A11	+12V	B11	+12V
A12	+12V	B12	+12V
A13	+12V	B13	+12V
A14	+12V	B14	+12V
A15	+12V	B15	+12V
A16	+12V	B16	+12V
A17	+12V	B17	+12V
A18	+12V	B18	+12V
A19	PMBus* SDA	B19	A0 (SMBus* address)
A20	PMBus* SCL	B20	A1 (SMBus* address)
A21	PSON	B21	12V stby
A22	SMBAlert#	B22	Cold Redundancy Bus
A23	Return Sense	B23	12V load share bus
A24	+12V remote Sense	B24	No Connect
A25	PWOK	B25	Compatibility Check pin*

Note: Refer the specifications mentioned in the *Intel® Common Hardware & Firmware Requirements for CRPS Power Supplier.*

2.4.1.2 Handle Retention

The power supply shall have a handle to assist extraction. The module shall be able to be inserted and extracted without the assistance of tools. The power supply shall have a latch which retains the power supply into the system and prevents the power supply from being inserted or extracted from the system when the AC power cord is pulled into the power supply.

The handle shall protect the operator from any burn hazard through the use of the Intel Corporation Industrial designed plastic handle or equivalent Intel approved material.

2.4.1.3 LED Marking and Identification

The power supply shall use a bi-color LED; Amber & Green. Below are table showing the LED states for each power supply operating state and the LED's wavelength characteristics.
Refer to the *Intel® LED Wavelength and Intensity Specification* for more details.

Table 68. LED Characteristics

	Min λd Wavelength	Nominal λd Wavelength	Max λd Wavelength	Units
Green	562	565	568	nm
Amber	607	610	613	nm

Table 69. LED Status

Power Supply Condition	LED State
Output ON and OK	GREEN
No AC power to all power supplies	OFF
AC present/Only 12VSB on (PS off) or PS in Cold redundant state	1Hz Blink GREEN
AC cord unplugged or AC power lost; with a second power supply in parallel still with AC input power.	AMBER
Power supply warning events where the power supply continues to operate; high temp, high power, high current, slow fan.	1Hz Blink Amber
Power supply critical event causing a shutdown; failure, OCP, OVP, Fan Fail	AMBER
Power supply FW updating	2Hz Blink GREEN

2.4.1.4 Temperature Requirements

The power supply shall operate within all specified limits over the T_{op} temperature range. All airflow shall pass through the power supply and not over the exterior surfaces of the power supply.

Table 70. Environmental Requirements

Item	Description	MIN	MAX	UNITS
$T_{op\_rackped\_900}$	Operating temperature range; rack/pedestal 900m (100% load, 900m, rack/pedestal system flow impedance)	0	50	°C
$T_{op\_rackped\_3000}$	Operating temperature range; rack/pedestal 3000m (100% load, 3000m, rack/pedestal system flow impedance)	0	45	°C
Texit	Maximum exit air temperature		68[1]	°C
$T_{non\text{-}op}$	Non-operating temperature range.	-40	70	°C
Altitude	Maximum operating altitude [3]		3050	m

Notes:
1. Under normal conditions, the exit air temperature shall be less than 65C. 68C is provided for absolute worst case conditions and is expected only to exist when the inlet ambient reaches 60C.
2. $T_{op\_rackped\_900}$ condition only requires max altitude of 900m.

The power supply must meet UL enclosure requirements for temperature rise limits. All sides of the power supply with exception to the air exhaust side must be classified as “Handle, knobs, grips, and so on, held for short periods of time only”.

2.4.2 AC Input Requirements

2.4.2.1 Power Factor

The power supply must meet the power factor requirements stated in the Energy Star® Program Requirements for Computer Servers. These requirements are stated below:

Output power	10% load	20% load	50% load	100% load
Power factor	> 0.80	> 0.90	> 0.90	> 0.95

Tested at 230Vac, 50Hz and 60Hz and 115VAC, 60Hz.
Tested according to Generalized Internal Power Supply Efficiency Testing Protocol Rev 6.4.3. This is posted at http://efficientpowersupplies.epri.com/methods.asp

2.4.2.2 AC Inlet Connector

The AC input connector shall be an *IEC 320 C-14* power inlet. This inlet is rated for 10A/250VAC.

2.4.2.3 AC Input Voltage Specification

The power supply must operate within all specified limits over the following input voltage range. Harmonic distortion of up to 10% of the rated line voltage must not cause the power supply to go out of specified limits. Application of an input voltage below 85VAC shall not cause damage to the power supply, including a blown fuse.

Table 71. AC Input Voltage Range

Parameter	MIN	Rated	V_{MAX}	Startup VAC	Power Off VAC
Voltage (110)	90 V_{rms}	100-127 V_{rms}	140 V_{rms}	85VAC +/- 4VAC	74VAC +/- 5VAC
Voltage (220)	180 V_{rms}	200-240 V_{rms}	264 V_{rms}		
Frequency	47 Hz	50/60	63 Hz		

Notes:
1. Maximum input current at low input voltage range shall be measured at 90VAC, at max load.
2. Maximum input current at high input voltage range shall be measured at 180VAC, at max load.
3. This requirement is not to be used for determining agency input current markings.

2.4.2.4 AC Line Dropout/Holdup

An AC line dropout is defined to be when the AC input drops to 0VAC at any phase of the AC line for any length of time. During an AC dropout the power supply must meet dynamic voltage regulation requirements. An AC line dropout of any duration shall not cause tripping of control signals or protection circuits. If the AC dropout lasts longer than the holdup time the power supply should recover and meet all turn on requirements. The power supply shall meet the AC dropout requirement over rated AC voltages and frequencies. A dropout of the AC line for any duration shall not cause damage to the power supply.

Loading	Holdup time
70%	10.6msec

2.4.2.5 AC Line 12VSBHoldup

The 12VSB output voltage should stay in regulation under its full load (static or dynamic) during an AC dropout of **70ms min** (=12VSB holdup time) whether the power supply is in ON or OFF state (PSON asserted or de-asserted).

2.4.2.6 AC Line Fuse

The power supply shall have one line fused in the **single line fuse** on the line (Hot) wire of the AC input. The line fusing shall be acceptable for all safety agency requirements. The input fuse shall be a slow blow type. AC inrush current shall not cause the AC line fuse to blow under any conditions. All protection circuits in the power supply shall not cause the AC fuse to blow unless a component in the power supply has failed. This includes DC output load short conditions.

2.4.2.7 AC Line Transient Specification

AC line transient conditions shall be defined as "sag" and "surge" conditions. "Sag" conditions are also commonly referred to as "brownout", these conditions will be defined as the AC line voltage dropping below nominal voltage conditions. "Surge" will be defined to refer to conditions when the AC line voltage rises above nominal voltage.
The power supply shall meet the requirements under the following AC line sag and surge conditions.

Table 72. AC Line Sag Transient Performance

AC Line Sag (10sec interval between each sagging)				
Duration	Sag	Operating AC Voltage	Line Frequency	Performance Criteria
0 to 1/2 AC cycle	95%	Nominal AC Voltage ranges	50/60Hz	No loss of function or performance.
> 1 AC cycle	>30 %	Nominal AC Voltage ranges	50/60Hz	Loss of function acceptable, self-recoverable.

Table 73. AC Line Surge Transient Performance

AC Line Surge				
Duration	Surge	Operating AC Voltage	Line Frequency	Performance Criteria
Continuous	10%	Nominal AC Voltages	50/60Hz	No loss of function or performance
0 to ½ AC cycle	30%	Mid-point of nominal AC Voltages	50/60Hz	No loss of function or performance.

2.4.2.8 Power Recovery

The power supply shall recover automatically after an AC power failure. AC power failure is defined to be any loss of AC power that exceeds the dropout criteria.

2.4.3 Efficiency

The following table provides the required minimum efficiency level at various loading conditions. These are provided at three different load levels; 100%, 50%, 20%, and 10%. Output shall be load according to the proportional loading method defined by 80 Plus in Generalized Internal Power Supply Efficiency Testing Protocol Rev 6.4.3. This is posted at http://efficientpowersupplies.epri.com/methods.asp.

Table 74. Platinum Efficiency Requirement

Loading	100% of maximum	50% of maximum	20% of maximum	10% of maximum
Minimum Efficiency	91%	94%	90%	82%

The power supply must pass with enough margins to make sure in production all power supplies meet these efficiency requirements.

2.4.4 DC Output Specification

2.4.4.1 Output Power/Currents

The following table defines the minimum power and current ratings. The power supply must meet both static and dynamic voltage regulation requirements for all conditions.

Table 75. Minimum Load Ratings

Parameter	Min	Max.	Peak [2,3]	Unit
12V main (200-240VAC)	0.0	100	133	A
12V main (100-127VAC)	0.0	83	110	A
12Vstby [1]	0.0	3	3.5	A

Notes:

1. 12V standby must provide 6A with two power supplies in parallel. The power supply fan is allowed to run in standby mode for loads > 1.5A.
2. Peak combined power for all outputs shall not exceed 1600W.
3. Length of time peak power can be supported is based on thermal sensor and assertion of the SMBAlert# signal. Minimum peak power duration shall be 20 seconds without asserting the SMBAlert# signal.

2.4.4.2 Standby Output

The 12VSB output shall be present when an AC input greater than the power supply turn on voltage is applied.

2.4.4.3 Voltage Regulation

The power supply output voltages must stay within the following voltage limits when operating at steady state and dynamic loading conditions. These limits include the peak-peak ripple/noise. These shall be measured at the output connectors.

Table 76. Voltage Regulation Limits

Parameter	Tolerance	MIN	NOM	MAX	UNITS
+12V	- 5%/+5%	+11.40	+12.00	+12.60	V_{rms}
+12V stby	- 5%/+5%	+11.40	+12.00	+12.60	V_{rms}

2.4.4.4 Dynamic Loading

The output voltages shall remain within limits specified for the step loading and capacitive loading specified in the table below. The load transient repetition rate shall be tested between 50Hz and 5kHz at duty cycles ranging from 10%-90%. The load transient repetition rate is only a test specification. The Δ step load may occur anywhere within the MIN load to the MAX load conditions.

Table 77. Transient Load Requirements

Output	Δ Step Load Size (See note)	Load Slew Rate	Test capacitive Load
+12VSB	1.0A	0.25 A/µsec	20 µF
+12V	60% of max load	0.25 A/µsec	2000 µF

Note: For dynamic condition +12V min loading is 1A.

2.4.4.5 Capacitive Loading

The power supply shall be stable and meet all requirements with the following capacitive loading ranges.

Table 78 Capacitive Loading Conditions

Output	MIN	MAX	Units
+12VSB	20	3100	μF
+12V	500	25000	μF

2.4.4.6 Grounding

The output ground of the pins of the power supply provides the output power return path. The output connector ground pins shall be connected to the safety ground (power supply enclosure). This grounding should be well designed to ensure passing the max allowed Common Mode Noise levels.

2.4.4.7 Residual Voltage Immunity in Standby mode

The power supply should be immune to any residual voltage placed on its outputs (Typically a leakage voltage through the system from standby output) up to **500mV**. There shall be no additional heat generated, nor stressing of any internal components with this voltage applied to any individual or all outputs simultaneously. It also should not trip the protection circuits during turn on.
The residual voltage at the power supply outputs for no load condition shall not exceed **100mV** when AC voltage is applied and the PSON# signal is de-asserted.

2.4.4.8 Common Mode Noise

The Common Mode noise on any output shall not exceed **350mV pk-pk** over the frequency band of 10Hz to 20MHz.

1. The measurement shall be made across a 100Ω resistor between each of DC outputs, including ground at the DC power connector and chassis ground (power subsystem enclosure).
2. The test set-up shall use a FET probe such as Tektronix model P6046 or equivalent.

2.4.4.9 Hot Swap Requirements

Hot swapping a power supply is the process of inserting and extracting a power supply from an operating power system. During this process the output voltages shall remain within the limits with the capacitive load specified. The hot swap test must be conducted when the system is operating under static, dynamic, and zero loading conditions. The power supply shall use a latching mechanism to prevent insertion and extraction of the power supply when the AC power cord is inserted into the power supply.

2.4.4.10 Forced Load Sharing

The +12V output will have active load sharing. The output will share within 10% at full load. The failure of a power supply should not affect the load sharing or output voltages of the other supplies still operating. The supplies must be able to load share in parallel and operate in a hot-swap/redundant **1+1** configurations. The 12VSBoutput is not required to actively share current between power supplies (passive sharing). The 12VSBoutput of the power supplies are connected together in the system so that a failure or hot swap of a redundant power supply does not cause these outputs to go out of regulation in the system.

2.4.4.11 Ripple/Noise

The maximum allowed ripple/noise output of the power supply is defined in the table below. This is measured over a bandwidth of 10Hz to 20MHz at the power supply output connectors. A 10μF tantalum capacitor in parallel with a 0.1μF ceramic capacitor is placed at the point of measurement.

Table 79. Ripples and Noise

+12V main	+12VSB
120mVp-p	120mVp-p

The test set-up shall be as shown below:

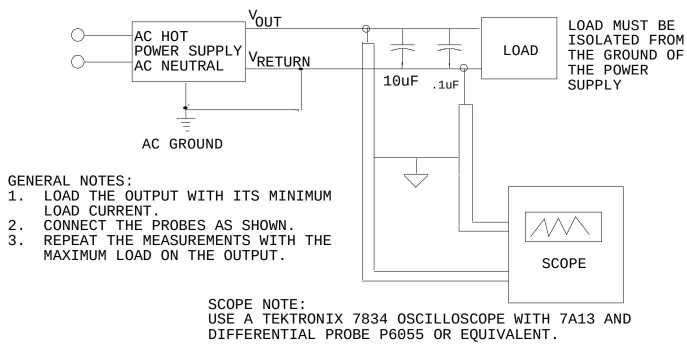


Figure 40. Differential Noise test setup

Note: When performing this test, the probe clips and capacitors should be located close to the load.

2.4.4.12 Timing Requirements

These are the timing requirements for the power supply operation. The output voltages must rise from 10% to within regulation limits (T_{vout_rise}) within 5 to 70ms. For 12VSB, it is allowed to rise from 1.0 to 25ms. **All outputs must rise monotonically**. Table below shows the timing requirements for the power supply being turned on and off by the AC input, with PSON held low and the PSON signal, with the AC input applied.

Table 80. Timing Requirements

Item	Description	MIN	MAX	UNITS
T_{vout_rise}	Output voltage rise time	5.0 *	70 *	ms
Tsb_on_delay	Delay from AC being applied to 12VSBbeing within regulation.		1500	ms
T ac_on_delay	Delay from AC being applied to all output voltages being within regulation.		3000	ms
Tvout_holdup	Time 12Vl output voltage stay within regulation after loss of AC.	13		ms
Tpwok_holdup	Delay from loss of AC to de-assertion of PWOK	10.6		ms
Tpson_on_delay	Delay from PSON# active to output voltages within regulation limits.	5	400	ms
T pson_pwok	Delay from PSON# deactivate to PWOK being de-asserted.		5	ms
Tpwok_on	Delay from output voltages within regulation limits to PWOK asserted at turn on.	100	500	ms

Item	Description	MIN	MAX	UNITS
T pwok_off	Delay from PWOK de-asserted to output voltages dropping out of regulation limits.	1		ms
Tpwok_low	Duration of PWOK being in the de-asserted state during an off/on cycle using AC or the PSON signal.	100		ms
Tsb_vout	Delay from 12VSBbeing in regulation to O/Ps being in regulation at AC turn on.	50	1000	ms
T12VSB_holdup	Time the 12VSBoutput voltage stays within regulation after loss of AC.	70		ms

* The 12VSBoutput voltage rise time shall be from 1.0ms to 25ms

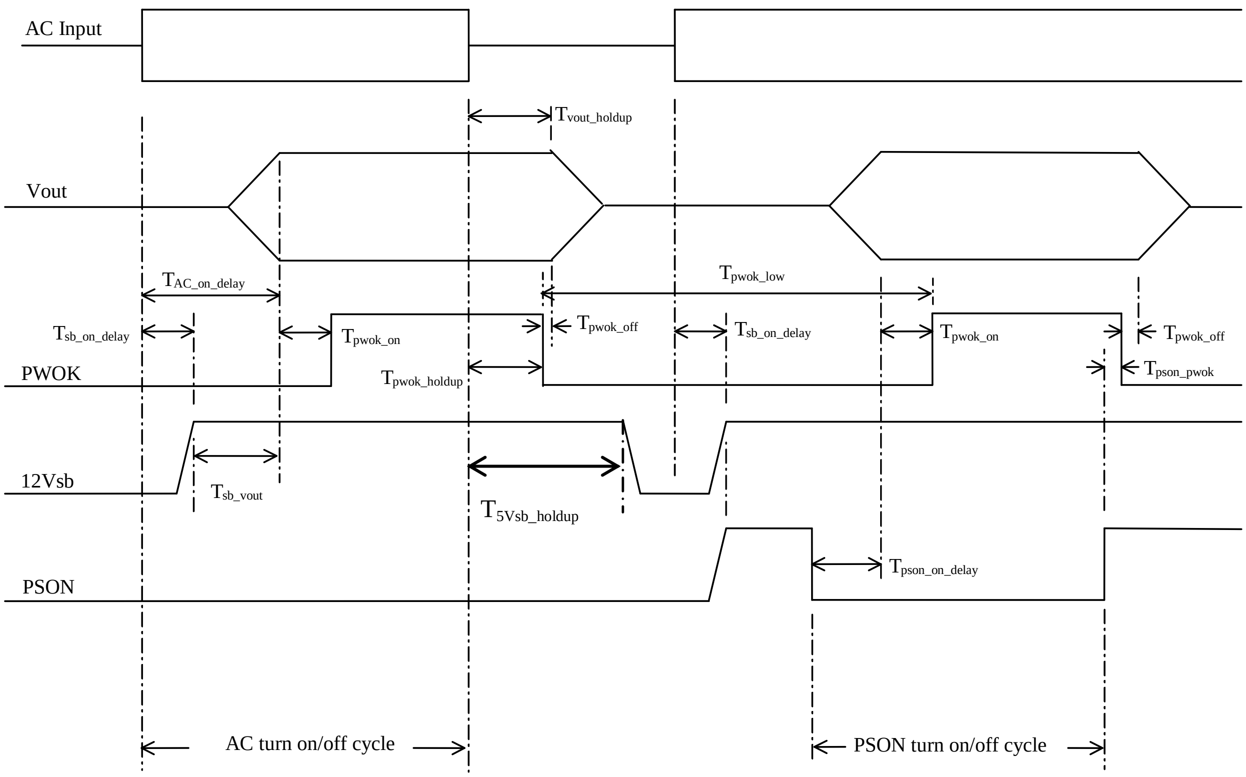


Figure 41. Turn On/Off Timing (Power Supply Signals)

2.4.5 Protection Circuits

Protection circuits inside the power supply shall cause only the power supply's main outputs to shut down. If the power supply latches off due to a protection circuit tripping, an AC cycle OFF for 15sec and a PSON# cycle HIGH for 1sec shall be able to reset the power supply.

2.4.5.1 Current Limit (OCP)

The power supply shall have current limit to prevent the outputs from exceeding the values shown in table below. If the current limits are exceeded the power supply shall shutdown and latch off. The latch will be cleared by toggling the PSON# signal or by an AC power interruption. The power supply shall not be damaged from repeated power cycling in this condition. 12VSB will be auto-recovered after removing OCP limit.

Table 81. Over Current Protection

Output Voltage	Input voltage range	Over Current Limits
+12V	90 – 264VAC	140A min; 170A max
12VSB	90 – 264VAC	2.5A min; 3A max

2.4.5.2 Over Voltage Protection (OVP)

The power supply over voltage protection shall be locally sensed. The power supply shall shutdown and latch off after an over voltage condition occurs. This latch shall be cleared by toggling the PSON# signal or by an AC power interruption. The values are measured at the output of the power supply's connectors. The voltage shall never exceed the maximum levels when measured at the power connectors of the power supply connector during any single point of fail. The voltage shall never trip any lower than the minimum levels when measured at the power connector. 12VSBwill be auto-recovered after removing OVP limit.

Table 82. Over Voltage Protection (OVP) Limits

Output Voltage	MIN (V)	MAX (V)
+12V	13.3	14.5
+12VSB	13.3	14.5

2.4.5.3 Over Temperature Protection (OTP)

The power supply will be protected against over temperature conditions caused by loss of fan cooling or excessive ambient temperature. In an OTP condition the PSU will shut down. When the power supply temperature drops to within specified limits, the power supply shall restore power automatically, while the 12VSB remains always on. The OTP circuit must have built in margin such that the power supply will not oscillate on and off due to temperature recovering condition. The OTP trip level shall have a minimum of 4°C of ambient temperature margin.

2.4.6 Control and Indicator Functions

The following sections define the input and output signals from the power supply.
Signals that can be defined as low true use the following convention: *Signal#* = low true

2.4.6.1 PSON# Input Signal

The PSON# signal is required to remotely turn on/off the power supply. PSON# is an active low signal that turns on the +12V power rail. When this signal is not pulled low by the system, or left open, the outputs (except the +12VSB) turn off. This signal is pulled to a standby voltage by a pull-up resistor internal to the power supply. Refer to Table 79 for the timing diagram.

Table 83. PSON# Signal Characteristic

Signal Type	Accepts an open collector/drain input from the system. Pull-up to VSB located in power supply.	
PSON# = Low	ON	
PSON# = High or Open	OFF	
	MIN	MAX
Logic level low (power supply ON)	0V	1.0V

Signal Type	Accepts an open collector/drain input from the system. Pull-up to VSB located in power supply.	
Logic level high (power supply OFF)	2.0V	3.46V
Source current, Vpson = low		4mA
Power up delay: $T_{pson\_on\_delay}$	5msec	400msec
PWOK delay: T pson_pwok		50msec

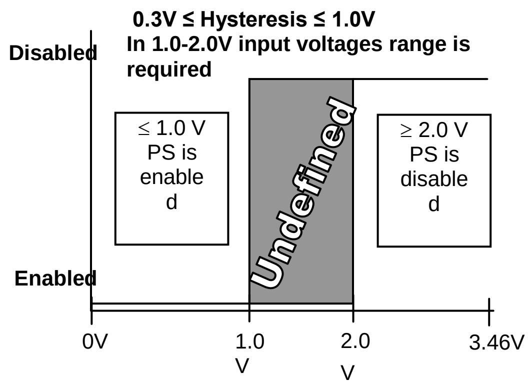


Figure 42. PSON# Required Signal Characteristic

2.4.6.2 PWOK (Power OK) Output Signal

PWOK is a power OK signal and will be pulled HIGH by the power supply to indicate that all the outputs are within the regulation limits of the power supply. When any output voltage falls below regulation limits or when AC power has been removed for a time sufficiently long so that power supply operation is no longer guaranteed, PWOK will be de-asserted to a LOW state. See the table below for a representation of the timing characteristics of PWOK. The start of the PWOK delay time shall inhibited as long as any power supply output is in current limit.

Table 84. PWOK Signal Characteristics

Signal Type		
PWOK = High	Power OK	
PWOK = Low	Power Not OK	
	MIN	MAX
Logic level low voltage, Isink=400uA	0V	0.4V
Logic level high voltage, Isource=200µA	2.4V	3.46V
Sink current, PWOK = low		400uA
Source current, PWOK = high		2mA
PWOK delay: T_{pwok_on}	100ms	1000ms
PWOK rise and fall time		100µsec
Power down delay: T_{pwok_off}	1ms	200msec

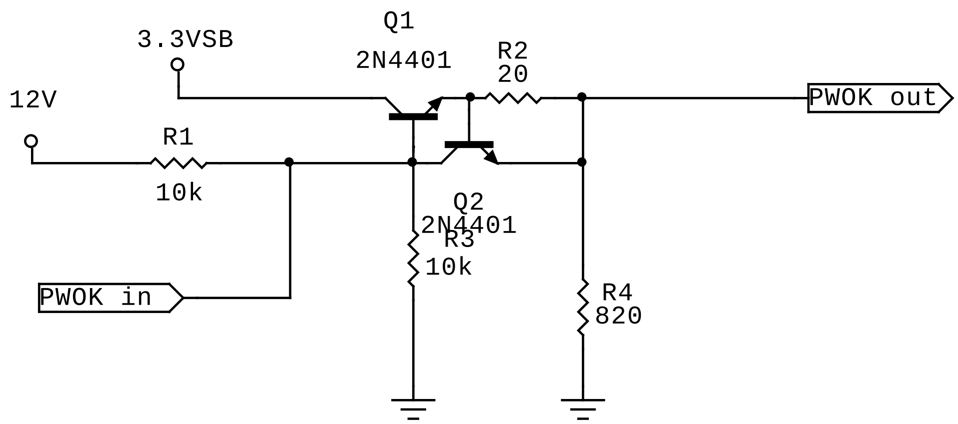


Figure 43. PWOK Circuit Requirement

2.4.6.3 SMBAlert# Signal

This signal indicates that the power supply is experiencing a problem that the user should investigate. This shall be asserted due to Critical events or Warning events. The signal shall activate in the case of critical component temperature reached a warning threshold, general failure, over-current, over-voltage, under-voltage, failed fan. This signal may also indicate the power supply is reaching its end of life or is operating in an environment exceeding the specified limits.

This signal is to be asserted in parallel with LED turning solid Amber or blink Amber.

Table 85. SMBAlert# Signal Characteristics

Signal Type (Active Low)	Open collector/drain output from power supply. Pull-up to VSB located in system.	
Alert# = High	OK	
Alert# = Low	Power Alert to system	
	MIN	MAX
Logic level low voltage, Isink=4 mA	0 V	0.4 V
Logic level high voltage, Isink=50 µA		3.46 V
Sink current, Alert# = low		4 mA
Sink current, Alert# = high		50 µA
Alert# rise and fall time		100 µs

2.4.7 Thermal CLST

The power supply shall assert the SMBAlert signal when a temperature sensor crosses a warning threshold. Refer to the *Intel® Common Hardware & Firmware Requirements for CRPS Power Supplier* for detailed requirements.

2.4.8 Power Supply Diagnostic "Black Box"

The power supply shall save the latest PMBus* data and other pertinent data into nonvolatile memory when a critical event shuts down the power supply. This data shall be accessible from the SMBus* interface with an external source providing power to the 12Vstby output.

Refer to *Intel® Common Hardware & Firmware Requirements for CRPS Power Supplier* for detailed requirements.

2.4.9 Firmware Update

The power supply shall have the capability to update its firmware from the PMBus* interface while it is in standby mode. This FW can be updated when in the system and in standby mode and outside the system with power applied to the 12Vstby pins.
Refer to the *Intel® Common Hardware & Firmware Requirements for CRPS Power Supplier* for detailed requirements.

2.5 Lower Current Common Redundant Power Distribution Board (PDB)

The Power Distribution Board (PDB) for Intel® Server Chassis P4000M supports the Common Redundant power supply in a 1+1 redundant configuration. The PDB is designed to plug directly to the output connector of the PS and it contains 4 DC/DC power converters to produce other required voltages: -12V, +3.3VDC, +5VDC and 5V standby along with additional over current protection circuit for the 12V rails.

This power distribution board is intended to be used in the Intel® Server Chassis P4000M Family with various common redundant power supplies: 460W, 750W and DC input 750W.

2.5.1 Mechanical Overview

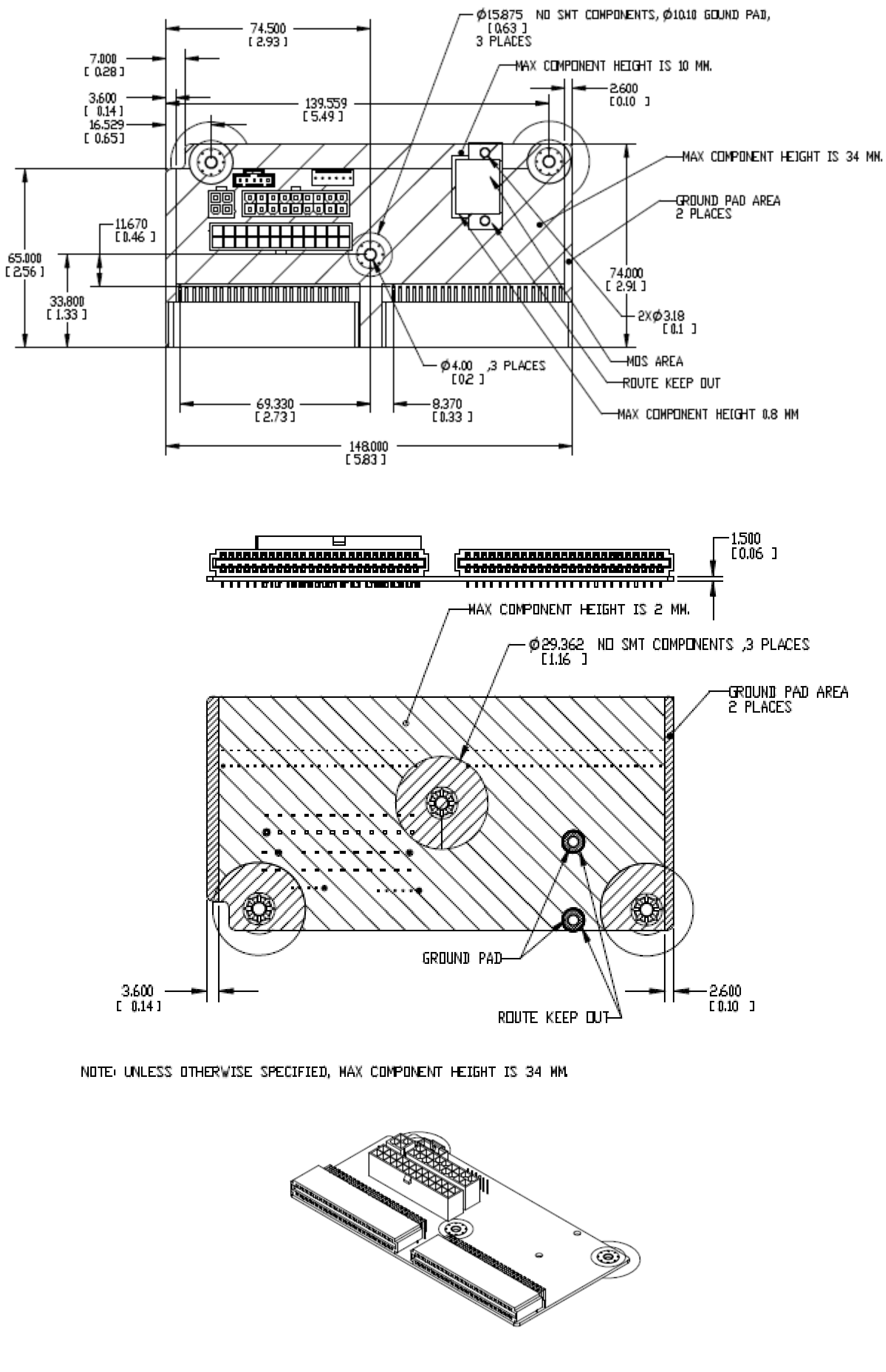


Figure 44. Outline Drawing

2.5.1.1 Airflow Requirements

The power distribution board shall get enough airflow for cooling DC/DC converters from the fans located in the Power Supply modules. Below is a basic drawing showing airflow direction.

The amount of cooling airflow that will be available to the DC/DC converters is to be no less than 1.2M/s.

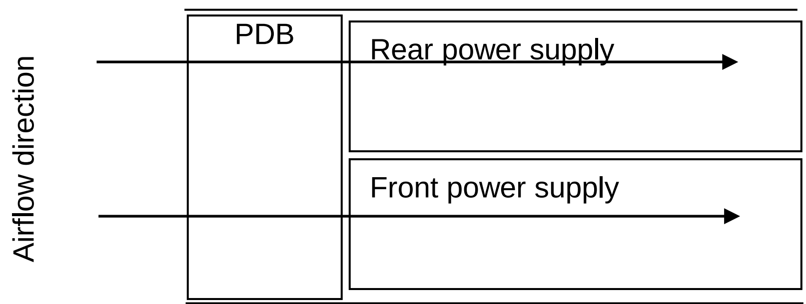


Figure 45. Airflow Diagram

2.5.1.2 DC/DC Converter Cooling

The dc/dc converters on the power distribution board are in series airflow path with the power supplies.

2.5.1.3 Temperature Requirements

The PDB operates within all specified limits over the Top temperature range. Some amount of airflow shall pass over the PDB.

Tabel 86. Thermal Requirements

Item	Description	Min	Max	Units
T_{op}	Operating temperature range.	0	50	°C
$T_{non\text{-}op}$	Non-operating temperature range.	-40	70	°C

2.5.1.4 Efficiency

Each DC/DC converter shall have a **minimum** efficiency of **85%** at 50% ~ 100% loads and over +12V line voltage range and over temperature and humidity range.

2.5.2 DC Output Specification

2.5.2.1 Input Connector (power distribution mating connector)

The power distribution provides 2 power pin, a card edge output connection for power and signal that is compatible with a 2x25 Power Card Edge connector (equivalent to 2x25 pin configuration of the FCI power card connector 10035388-102LF). The FCI power card edge connector is a new version of the PCE from FCI used to raise the card edge by 0.031” to allow for future 0.093” PCBs in the system. The card edge connector has no keying features; the keying method is accomplished by the system sheet metal.

Table 87. Input Connector and Pin Assignment Diagrams

Pin	Name	Pin	Name
A1	GND	B1	GND
A2	GND	B2	GND
A3	GND	B3	GND
A4	GND	B4	GND
A5	GND	B5	GND
A6	GND	B6	GND
A7	GND	B7	GND
A8	GND	B8	GND
A9	GND	B9	GND
A10	+12V	B10	+12V
A11	+12V	B11	+12V
A12	+12V	B12	+12V
A13	+12V	B13	+12V
A14	+12V	B14	+12V
A15	+12V	B15	+12V
A16	+12V	B16	+12V
A17	+12V	B17	+12V
A18	+12V	B18	+12V
A19	PMBus* SDA	B19	A0 (SMBus* address)
A20	PMBus* SCL	B20	A1 (SMBus* address)
A21	PSON	B21	12V stby
A22	SMBAlert#	B22	Cold Redundancy Bus
A23	Return Sense	B23	12V load share
A24	+12V remote Sense	B24	No Connect
A25	PWOK	B25	Compatibility Pin

2.5.2.2 Output Wire Harness

The power distribution board has a wire harness output with the following connectors.

Listed or recognized component appliance wiring material (AVLV2), CN, rated min 85°C shall be used for all output wiring.

Table 88. PDB Cable Length

From	Length, mm	To connector #	No. of pins	Description
Power Supply cover exit hole	470	P1	24	Baseboard Power Connector
Power Supply cover exit hole	320	P2	8	Processor 0 connector
Power Supply cover exit hole	450	P3	8	Processor 1 connector
Power Supply cover exit hole	800	P4	5	Power FRU/PMBus* connector
Power Supply cover exit hole	350	P5	5	SATA peripheral power connector for 5.25”
Extension from P5	100	P6	5	SATA peripheral power connector for 5.25”
Extension from P6	100	P7	4	Peripheral Power Connector for 5.25”/HSBP Power
Power Supply cover exit hole	400	P8	4	1x4 legacy HSBP Power Connector
Extension from P8	75	P9	4	1x4 legacy HSBP Power Connector
Power supply cover exit hole	500	P10	4	1x4 legacy HSBP Power/Fixed HDD adaptor Connection

From	Length, mm	To connector #	No. of pins	Description
Extension from P10	75	P11	4	1x4 legacy HSBP Power/Fixed HDD adaptor Connection
Connetor only (no cable)		P12	4	2x2 Legacy PCI Power Connector for PCIe slots

2.5.2.2.1 Baseboard power connector (P1)

- Connector housing: 24-Pin Molex Mini-Fit Jr. 39-01-2245 or equivalent
- Contact: Molex Mini-Fit, HCS Plus, Female, Crimp 44476 or equivalent

Table 89. P1 Baseboard Power Connector

Pin	Signal	18 AWG Color	Pin	Signal	18 AWG Color
1	+3.3VDC	Orange	13	+3.3VDC	Orange
	3.3V RS	Orange (24AWG)			
2	+3.3VDC	Orange	14	-12VDC	Blue
3	COM	Black	15	COM	Black
4	+5VDC	Red	16	PSON#	Green (24AWG)
5	COM	Black	17	COM	Black
6	+5VDC	Red	18	COM	Black
7	COM	Black	19	COM	Black
8	PWR OK	Gray (24AWG)	20	Reserved	N.C.
9	5 VSB	Purple	21	+5VDC	Red
10	+12V1	Yellow	22	+5VDC	Red
11	+12V1	Yellow	23	+5VDC	Red
12	+3.3VDC	Orange	24	COM	Black

2.5.2.2.2 Processor#0 Power Connector (P2)

- Connector housing: 8-Pin Molex 39-01-2080 or equivalent
- Contact: Molex Mini-Fit, HCS Plus, Female, Crimp 44476 or equivalent

Table 90. P0 Processor Power Connector

Pin	Signal	18 AWG color	Pin	Signal	18 AWG Color
1	COM	Black	5*	+12V1	Yellow
2	COM	Black	6	+12V1	Yellow
3	COM	Black	7	+12V1	Yellow
4	COM	Black	8	+12V1	Yellow

2.5.2.2.3 Processor#1 Power Connector (P3)

- Connector housing: 8-Pin Molex 39-01-2080 or equivalent
- Contact: Molex Mini-Fit, HCS Plus, Female, Crimp 44476 or equivalent

Table 91. P1 Processor Power Connector

Pin	Signal	18 AWG color	Pin	Signal	18 AWG Color
1	COM	Black	5	+12V1	Yellow
2	COM	Black	6	+12V1	Yellow
3	COM	Black	7	+12V1	Yellow
4	COM	Black	8	+12V1	Yellow

2.5.2.2.4 Power Signal Connector (P4)

- Connector housing: 5-pin Molex 50-57-9405 or equivalent
- Contacts: Molex 16-02-0087 or equivalent

Table 92. Power Signal Connector

Pin	Signal	24 AWG Color
1	I2C Clock	White
2	I2C Data	Yellow
3	SMBAlert#	Red
4	COM	Black
5	3.3RS	Orange

2.5.2.2.5 Aux baseboard power connector (P12)

Connector header: Foxconn p/n HM3502E-P1 or equivalent

Table 93. Aux baseboard power connector

Pin	Signal	18 AWG color	Pin	Signal	18 AWG Color
1	COM	Black	3	+12V1	Yellow
2	COM	Black	4	+12V1	Yellow

2.5.2.2.6 Legacy 1x4 Peripheral Power Connectors (P7, P8, P9, P10, P11)

- Connector housing: Molex 0015-24-4048 or equivalent;
- Contact: Molex 0002-08-1201 or equivalent

Table 94. P8, P9, P10, P11 Legacy Peripheral Power Connectors

Pin	Signal	18 AWG Color
1	+12V3	White
2	COM	Black
3	COM	Black
4	+5 VDC	Red

Table 95. P7 Legacy Peripheral Power Connectors

Pin	Signal	18 AWG Color
1	+12V2	Brown
2	COM	Black
3	COM	Black
4	+5 VDC	Red

2.5.2.2.7 SATA 1x5 Peripheral Power Connectors (P5, P6)

- Connector housing: Molex 0675-82-0000 or equivalent;
- Contact: Molex 0675-81-0000 or equivalent

Table 96. SATA Peripheral Power Connectors

Pin	Signal	18 AWG Color
1	+3.3VDC	Orange
2	COM	Black
3	+5VDC	Red
4	COM	Black
5	+12V2	Brown

2.5.2.3 Grounding

The ground of the pins of the PDB output connectors provides the power return path. The output connector ground pins is connected to safety ground (PDB enclosure). This grounding is well designed to ensure passing the max allowed Common Mode Noise levels.

2.5.2.4 Remote Sense

Below is listed the remote sense requirements and connection points for all the converters on the PDB and the main 12V output of the power supply.

Table 97. Remote Sense Connection Points

Converter	+ sense location	- sense location
Power supply main 12V	On PDB	On PDB
12V/3.3V	P20 (1x5 signal connector)	P20 (1x5 signal connector)
12V/5V	On PDB	On PDB
12V/-12V	none	none
12Vstby/5Vstby	none	none

Table 98. Remote Sense Requirements

Characteristic	Requirement
+3.3V remote sense input impedance	200Ω (measure from +3.3V on P1 2x12 connector to +3.3V sense on P20 1x5 signal connector)
+3.3V remote sense drop	200mV (remote sense must be able to regulate out 200mV drop on the +3.3V and return path; from the 2x12 connector to the remote sense points)
Max remote sense current draw	< 5mA

2.5.2.5 12V Rail Distribution

The below table shows the configuration of the 12V rails and what connectors and components in the system they are powering.

Table 99. 12V Rail Distribution

	P2		P3		P12	P1	P8	P9	P10	P11	P5,6,7				
			2x4		2x2	2x12	1x4	1x4	1x4	1x4	(2) 1x5, 1x4		OCP		
	CPU1	Memory1	CPU2	Memory2	PCIe	Fans	Misc	HDD & peripherals				Total Current	Min	Nominal	Max
12V1	17.8 A	10.5 A	17.8	10.5	21.7	10.0 A	3.0 A					91 A	50	55	60
12V2								18.0 A (P8, 9, 10, 11)				18 A	18	19	20
12V3								18a (P5, 6, 7)				18 A	18	19	20

Note:

+12V current to PCIe slots may be supplied from four different connectors. 12V1 on P2, 12V2 on P3, 12V3 on P1, and 12V3 on P12. P12 is reserved for board that needs 4 x GPU cards powered. P1 is the main 12V power for PCIe slot; but additional 12V power can be connected to P2 and/or P3. The motherboard MUST NOT short any of the 12V rails or connectors together.

2.5.2.6 Hard Drive 12V rail configuration options

The below table shows the hard drive configuration options using the defined power connectors. In some cases additional converter or 'Y' cables are needed.

Table 100. Hard Drive 12V rail configuration options

	P8	P9	P10	P11	P5	P6	P7
	1x4	1x4	1x4	1x4	1x5	1x5	1x4
	18						
3 x 2.5" 8xHDD BP	HDD1 8 x 2.5	HDD2 8 x 2.5	na	na	na	na	HDD3 8 x 2.5
2 x 3.5" 4xHDD BP	HDD1 4x3.5		HDD1 4x3.5		peripheral bay		
1 x 3.5" 8xHDD BP	HDD1 8x3.5		na	na	peripheral bay		
8 x 3.5" fixed SATA	2xfixed	2xfixed	2xfixed	2xfixed	peripheral bay		
8 x 3.5" fixed SAS	2xfixed	2xfixed	2xfixed	2xfixed	peripheral bay		

2.5.2.7 DC/DC Converters Loading

The following table defines power and current ratings of three DC/DC converters located on the PDB, each powered from +12V rail. The 3 converters meet both static and dynamic voltage regulation requirements for the minimum and maximum loading conditions.

Table 101. DC/DC Converters Load Ratings

	+12VDC Input DC/DC Converters		
	+3.3V Converter	+5V Converter	-12V Converter
MAX Load	15A	15A	0.5A
MIN Static/Dynamic Load	0A	0A	0A
Max Output Power	3.3V x15A =49.5W	5V x15A =75W	12V x0.5A =6W

2.5.2.8 5VSB Loading

There is also one DC/DC converter that converts the 12V standby into 5V standby.

Table 102. 5VSB Loading

	12V stby/5V stby DC/DC Converters
MAX Load	5A
MIN Static/Dynamic Load	0.1
Max Output Power	5V x5A =25W

2.5.2.9 DC/DC Converters Voltage Regulation

The DC/DC converters' output voltages stay within the following voltage limits when operating at steady state and dynamic loading conditions. These limits include the peak-peak ripple/noise specified in Table 105. The 3.3V and 5V outputs are measured at the remote sense point, all other voltages measured at the output harness connectors.

Table 103. Voltage Regulation Limits

Converter output	Tolerance	Min	Nom	Max	Units
+ 3.3VDC	-5%/+5%	+3.14	+3.30	+3.46	VDC
+ 5VDC	-5%/+5%	+4.75	+5.00	+5.25	VDC
- 12VDC	- 5%/+9%	-13.08	-12.00	-11.40	VDC
5Vstby	-5%/+5%	+4.75	+5.00	+5.25	VDC

2.5.2.10 DC/DC Converters Dynamic Loading

The output voltages remains within limits specified in table above for the step loading and capacitive loading specified in Table 103 below. The load transient repetition rate is only a test specification. The Δ step load may occur anywhere within the MIN load to the MAX load shown in Tables 100 and 101.

Table 104. Transient Load Requirements

Output	Max Δ Step Load Size	Max Load Slew Rate	Test capacitive Load
+ 3.3VDC	5A	0.25 A/µs	250 µF
+ 5VDC	5A	0.25 A/µs	400 µF
+5Vsb	0.5A	0.25A/µs	20 µF

2.5.2.11 DC/DC Converter Capacitive Loading

The DC/DC converters are stable and meet all requirements with the following capacitive loading ranges.

Min capacitive loading applies to static load only.

Table 105. Capacitive Loading Conditions

Converter output	Min	Max	Units
+3.3VDC	250	6800	μF
+5VDC	400	4700	μF
-12VDC	1	350	μF
5Vstby	20	350	μF

2.5.2.12 DC/DC Converters Closed Loop stability

Each DC/DC converter is unconditionally stable under all line/load/transient load conditions including capacitive load ranges specified in Section 2.5.2.11. A minimum of: **45 degrees phase margin** and -**10dB-gain margin** is required. The PDB provides proof of the unit's closed-loop stability with local sensing through the submission of Bode plots. Closed-loop stability must be ensured at the maximum and minimum loads as applicable.

2.5.2.13 Common Mode Noise

The Common Mode noise on any output does not exceed 350mV pk-pk over the frequency band of 10Hz to 20MHz.

- The measurement shall be made across a 100Ω resistor between each of DC outputs, including ground, at the DC power connector and chassis ground (power subsystem enclosure).
- The test set-up shall use a FET probe such as Tektronix model P6046 or equivalent.

2.5.2.14 Ripple/Noise

The maximum allowed ripple/noise output of each DC/DC Converter is defined in below Table 105. This is measured over a bandwidth of 0Hz to 20MHz at the PDB output connectors. A 10μF tantalum capacitor in parallel with a 0.1μF ceramic capacitor are placed at the point of measurement.

Table 106. Ripple and Noise

+3.3V	+5V	-12V	+5VSB
50mVp-p	50mVp-p	120mVp-p	50mVp-p

The test set-up shall be as shown below.

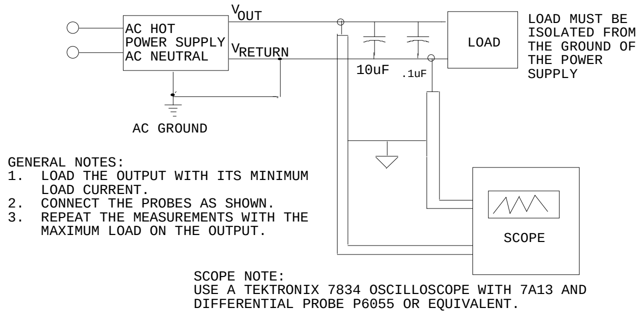


Figure 46. Differential Noise test setup

Note: When performing this test, the probe clips and capacitors should be located close to the load.

2.5.2.15 Timing Requirements

Below are timing requirements for the power on/off of the PDB DC/DC converters. The +3.3V, +5V and +12V output voltages should start to rise approximately at the same time. All outputs must rise monotonically.

Table 107. Output Voltage Timing

Description	Min	Max	Units
Output voltage rise time for each main output; 3.3V, 5V, and -12V.	5.0	70	msec
Output voltage rise time for the 5Vstby	1.0	25	msec
The main DC/DC converters (3.3V, 5V, -12V) shall be in regulation limits within this time after the 12V input has reached 11.4V.		50	msec
The main DC/DC converters (3.3V, 5V, -12V) must power off within this time after the 12V input has dropped below 11.4V.		100	msec
The 5Vstby converter shall be in regulation limits within this time after the 12Vstby has reach 11.4V.		10	msec
The 5Vstby converter must power off within this time after the 12Vstby input has dropped below 11.4V.		100	msec

2.5.2.16 Residual Voltage Immunity in Standby Mode

Each DC/DC converter is immune to any residual voltage placed on its respective output (typically a leakage voltage through the system from standby output) up to 500mV. This residual voltage does not have any adverse effect on each DC/DC converter, such as: no additional power dissipation or over-stressing/over-heating any internal components or adversely affecting the turn-on performance (no protection circuits tripping during turn on).

While in Stand-by mode, at no load condition, the residual voltage on each DC/DC converter output does not exceed 100mV.

2.5.3 Protection Circuits

The PDB shall shut down all the DC/DC converters on the PDB and the power supply (from PSON) if there is a fault condition on the PDB (OVP or OCP). If the PDB DC/DC converter latches off due to a protection circuit tripping, an AC cycle OFF for 15sec min or a PSON# cycle HIGH for 1sec shall be able to reset the power supply and the PDB.

2.5.3.1 Over-Current Protection (OCP)/240VA Protection

Each DC/DC converter output on PDB has individual OCP protection circuits. The PS+PDB combo shall shutdown and latch off after an over current condition occurs. This latch shall be cleared by toggling the PSON# signal or by an AC power interruption. The values are measured at the PDB harness connectors. The DC/DC converters shall not be damaged from repeated power cycling in this condition. Also, the +12V output from the power supply is divided on the PDB into 4 channels and +12V4 is limited to 240VA of power. There are current sensors and limit circuits to shut down the entire PS+PDB combo if the limit is exceeded. The limits are listed in below table. -12V and 5VSB is protected under over current or shorted conditions so that no damage can occur to the power supply. Auto-recovery feature is a requirement on 5VSB rail.

Table 108. PDB Over Current Protection Limits/240VA Protection

Output Voltage	Min OCP Trip Limits	Max OCP Trip Limits	Usage	Connectors
+3.3V	18A	240VA	PCIe, Misc	P1
+5V	18A	240VA	PCIe, HDD, Misc	P1, P5-11
+12V1	91A	100A	CPU1 + memory Fans, Misc	P2
+12V2	18A	20A	HDD & peripherals	P8, 9, 10, 11
+12V3	18A	20A	HDD & peripherals	P5, 6, 7

2.5.3.2 Over Voltage Protection (OVP)

Each DC/DC converter output on PDB have individual OVP protection circuits built in and it shall be locally sensed. The PS+PDB combo shall shutdown and latch off after an over voltage condition occurs. This latch shall be cleared by toggling the PSON# signal or by an AC power interruption. Table 108 contains the over voltage limits. The values are measured at the PDB harness connectors. The voltage shall never exceed the maximum levels when measured at the power pins of the output harness connector during any single point of fail. The voltage shall never trip any lower than the minimum levels when measured at the power pins of the PDB connector.

Table 109. Over Voltage Protection (OVP) Limits

Output voltage	OVP min (v)	OVP max (v)
+3.3V	3.9	4.8
+5V	5.7	6.5
-12V	-13.3	-15.5
+5VSB	5.7	6.5

2.5.4 PWOK (Power OK) Signal

The PDB connects the PWOK signals from the power supply modules and the DC/DC converters to a common PWOK signal. This common PWOK signal connects to the PWOK pin on P1. The DC/DC convert PWOK signals have open collector outputs.

2.5.4.1 System PWOK requirements

The system will connect the PWOK signal to 3.3V or 5V from a pull-up resistor. The maximum sink current of the power supplies are 0.5mA. The minimum resistance of the pull-up resistor is stated below depending upon the motherboard's pull-up voltage. Refer to the CRPS power supply specification for signal details.

Table 110. System PWOK Requirements

Motherboard pull-up voltage	MIN resistance value (ohms)
5V	10K
3.3V	6.8K

2.5.5 PSON Signal

The PDB connects the power supplies PSON signals together and connect them to the PSON signal on P1.
Refer to the CRPS power supply specification for signal details.

2.5.6 PMBus*

The PDB has no components on it to support PMBus*. It only needs to connect the power supply PMBus* signals (clock, data, SMBAlert#) and pass them to the 1x5 signal connector.

2.5.6.1 Addressing

The PDB address the power supply as follows on the PDB.
0 = open, 1 = grounded

Table 111. PDB addressing

	Power Supply Position 1	Power Supply Position 2
PDB addressing Address0/Address1	0/0	0/1
Power supply PMBus* device address	B0h	B2h

2.6 Higher Current Common Redundant Power Distribution Board (PDB)

The Power Distribution Board (PDB) for Intel® Server Chassis P4000M supports the Common Redundant power supply in a 1+1 redundant configuration. The PDB is designed to plug directly to the output connector of the PS and it contains 3 DC/DC power converters to produce other required voltages: +3.3VDC, +5VDC and 5V standby along with additional over current protection circuit for the 12V rails.

This power distribution board is intended to be used in the Intel® Server Chassis P4000M with various common redundant power supplies; 460W, 750W, 1200W, 1600W and DC input 750W.

2.6.1 Mechanical Overview

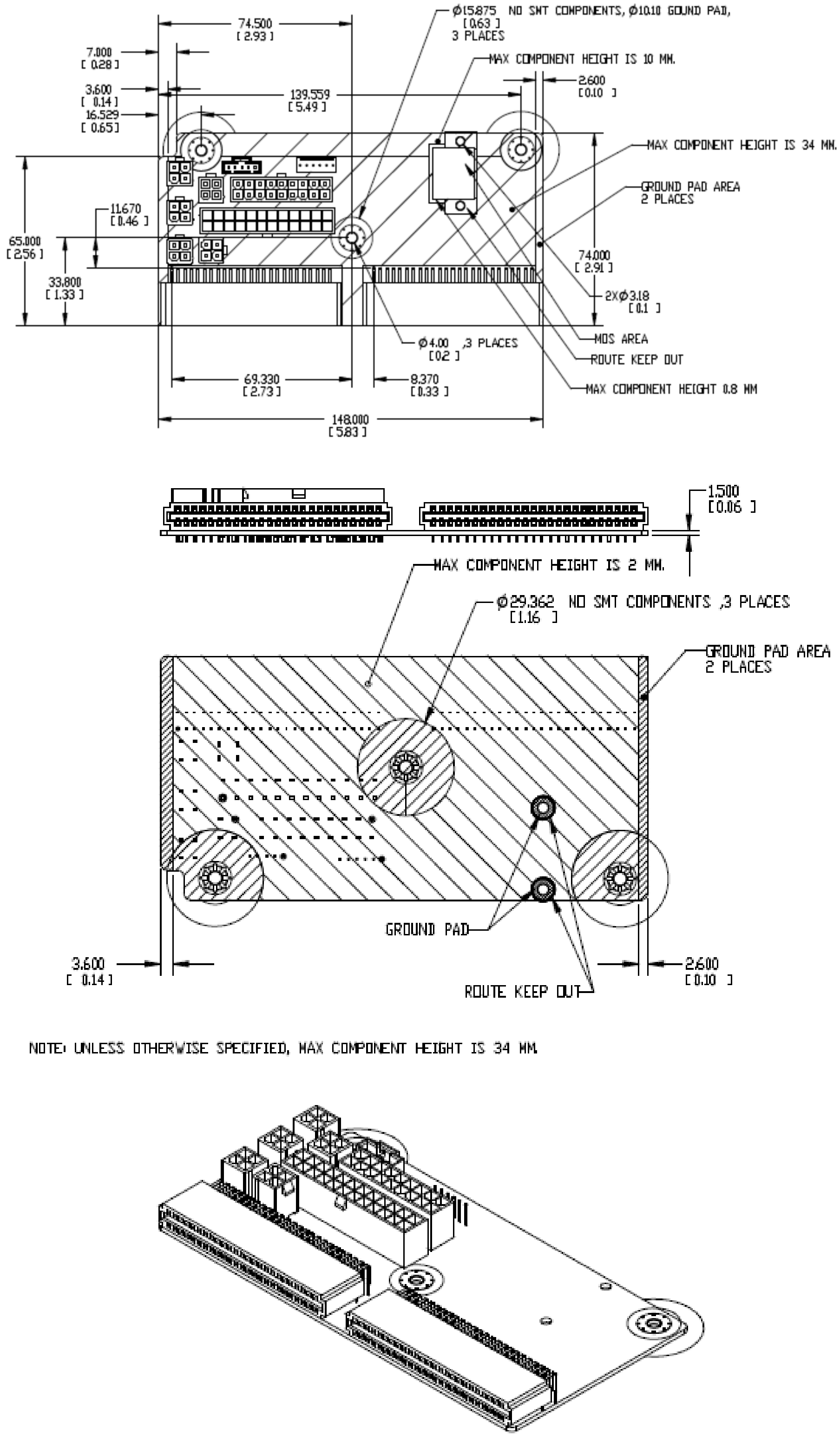


Figure 47. Outline Drawing

2.6.1.1 Airflow Requirements

The power distribution board shall get enough airflow for cooling DC/DC converters from the fans located in the Power Supply modules. Below is a basic drawing showing airflow direction.

The amount of cooling airflow that will be available to the DC/DC converters is to be no less than 1.2M/s.

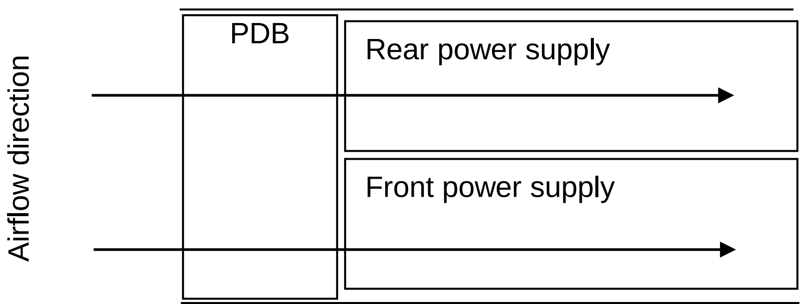


Figure 48. Airflow Diagram

2.6.1.2 DC/DC converter cooling

The dc/dc converters on the power distribution board are in series airflow path with the power supplies.

2.6.1.3 Temperature Requirements

The PDB operates within all specified limits over the Top temperature range. Some amount of airflow shall pass over the PDB.

Table 112. Thermal Requirements

Item	Description	Min	Max	Units
T_{op}	Operating temperature range.	0	50	°C
$T_{non\text{-}op}$	Non-operating temperature range.	-40	70	°C

2.6.1.4 Efficiency

Each DC/DC converter shall have a **minimum** efficiency of **85%** at 50% ~ 100% loads and over +12V line voltage range and over temperature and humidity range.

2.6.2 DC Output Specification

2.6.2.1 Input Connector (power distribution mating connector)

The power distribution provides 2 power pin, a card edge output connection for power and signal that is compatible with a 2x25 Power Card Edge connector (equivalent to 2x25 pin configuration of the FCI power card connector 10035388-102LF). The FCI power card edge connector is a new version of the PCE from FCI used to raise the card edge by 0.031" to allow for future 0.093" PCBs in the system. The card edge connector has no keying features; the keying method is accomplished by the system sheet metal.

Table 113. Input Connector and Pin Assignment Diagrams

Pin	Name	Pin	Name
A1	GND	B1	GND
A2	GND	B2	GND
A3	GND	B3	GND
A4	GND	B4	GND
A5	GND	B5	GND
A6	GND	B6	GND
A7	GND	B7	GND
A8	GND	B8	GND
A9	GND	B9	GND
A10	+12V	B10	+12V
A11	+12V	B11	+12V
A12	+12V	B12	+12V
A13	+12V	B13	+12V
A14	+12V	B14	+12V
A15	+12V	B15	+12V
A16	+12V	B16	+12V
A17	+12V	B17	+12V
A18	+12V	B18	+12V
A19	PMBus* SDA	B19	A0 (SMBus* address)
A20	PMBus* SCL	B20	A1 (SMBus* address)
A21	PSON	B21	12V stby
A22	SMBAlert#	B22	Cold Redundancy Bus
A23	Return Sense	B23	12V load share
A24	+12V remote Sense	B24	No Connect
A25	PWOK	B25	Compatibility Pin*

*The compatibility Pin is used for soft compatibility check. The two compatibility pins are connected directly.

2.6.2.2 Output Wire Harness

The power distribution board has a wire harness output with the following connectors.

Listed or recognized component appliance wiring material (AVLV2), CN, rated min 85°C shall be used for all output wiring.

Table 114. PDB Cable Length

From	Length, mm	To connector #	No of pins	Description
Power Supply cover exit hole	470	P1	24	Baseboard Power Connector
Power Supply cover exit hole	320	P2	8	Processor 0 connector
Power Supply cover exit hole	450	P3	8	Processor 1 connector
Power Supply cover exit hole	800	P4	5	Power FRU/PMBus* connector
Power Supply cover exit hole	350	P5	5	SATA peripheral power connector for 5.25"
Extension from P5	100	P6	5	SATA peripheral power connector for 5.25"
Extension from P6	100	P7	4	Peripheral Power Connector for 5.25"/HSBP

From	Length, mm	To connector #	No of pins	Description
				Power
Power Supply cover exit hole	400	P8	4	1x4 legacy HSBP Power Connector
Extension from P8	75	P9	4	1x4 legacy HSBP Power Connector
Power supply cover exit hole	500	P10	4	1x4 legacy HSBP Power/Fixed HDD adaptor Connection
Extension from P10	75	P11	4	1x4 legacy HSBP Power/Fixed HDD adaptor Connection
PCI power connector	800	P12	4	2z2 Legacy PCI Power Connector
Connector only (no cable)	na	P13	4	GFX card aux connectors
Connector only (no cable)	na	P14	4	
Connector only (no cable)	na	P15	4	
Connector only (no cable)	na	P16	4	

2.6.2.2.1 Baseboard power connector (P1)

- Connector housing: 24-Pin Molex Mini-Fit Jr. 39-01-2245 or equivalent
- Contact: Molex Mini-Fit, HCS Plus, Female, Crimp 44476 or equivalent

Table 115. P1 Baseboard Power Connector

Pin	Signal	18 AWG Color	Pin	Signal	18 AWG Color
1	+3.3VDC	Orange	13	+3.3VDC	Orange
	3.3V RS	Orange (24AWG)			
2	+3.3VDC	Orange	14	-12VDC	Blue
3	COM	Black	15	COM	Black
4	+5VDC	Red	16	PSON#	Green (24AWG)
5	COM	Black	17	COM	Black
6	+5VDC	Red	18	COM	Black
7	COM	Black	19	COM	Black
8	PWR OK	Gray (24AWG)	20	Reserved	N.C.
9	5 VSB	Purple	21	+5VDC	Red
10	+12V1	Yellow	22	+5VDC	Red
11	+12V1	Yellow	23	+5VDC	Red
12	+3.3VDC	Orange	24	COM	Black

2.6.2.2.2 Processor#0 Power Connector (P2)

- Connector housing: 8-Pin Molex 39-01-2080 or equivalent
- Contact: Molex Mini-Fit, HCS Plus, Female, Crimp 44476 or equivalent

Table 116. P0 Processor Power Connector

Pin	Signal	18 AWG color	Pin	Signal	18 AWG Color
1	COM	Black	5*	+12V1	Yellow
2	COM	Black	6	+12V1	Yellow
3	COM	Black	7	+12V1	Yellow
4	COM	Black	8	+12V1	Yellow

2.6.2.2.3 Processor#1 Power Connector (P3)

- Connector housing: 8-Pin Molex 39-01-2080 or equivalent
- Contact: Molex Mini-Fit, HCS Plus, Female, Crimp 44476 or equivalent

Table 117. P1 Processor Power Connector

Pin	Signal	18 AWG color	Pin	Signal	18 AWG Color
1	COM	Black	5	+12V1	Yellow
2	COM	Black	6	+12V1	Yellow
3	COM	Black	7	+12V1	Yellow
4	COM	Black	8	+12V1	Yellow

2.6.2.2.4 Power Signal Connector (P4)

- Connector housing: 5-pin Molex 50-57-9405 or equivalent
- Contacts: Molex 16-02-0087 or equivalent

Table 118. Power Signal Connector

Pin	Signal	24 AWG Color
1	I2C Clock	White
2	I2C Data	Yellow
3	SMBAlert#	Red
4	COM	Black
5	3.3RS	Orange

2.6.2.2.5 2x2 12V connector (P12-P16)

Connector header: Foxconn p/n HM3502E-P1 or equivalent

Table 119. P12 12V connectors

Pin	Signal	18 AWG color	Pin	Signal	18 AWG Color
1	COM	Black	5	+12V1	Yellow
2	COM	Black	6	+12V1	Yellow

Table 120. P13 - P16 12V connectors

Pin	Signal	18 AWG color	Pin	Signal	18 AWG Color
1	COM	Black	5	+12V2	Green
2	COM	Black	6	+12V2	Green

2.6.2.2.6 *Legacy 1x4 Peripheral Power Connectors (P7, P8, P9, P10, P11)*

- Connector housing: Molex 0015-24-4048 or equivalent;
- Contact: Molex 0002-08-1201 or equivalent

Table 121. P8, P9, P10, P11 Legacy Peripheral Power Connectors

Pin	Signal	18 AWG Color
1	+12V4	White
2	COM	Black
3	COM	Black
4	+5 VDC	Red

Table 122. P7Legacy Peripheral Power Connectors

Pin	Signal	18 AWG Color
1	+12V3	Brown
2	COM	Black
3	COM	Black
4	+5 VDC	Red

2.6.2.2.7 *SATA 1x5 Peripheral Power Connectors (P5, P6)*

- Connector housing: Molex 0675-82-0000 or equivalent;
- Contact: Molex 0675-81-0000 or equivalent

Table 123. SATA Peripheral Power Connectors

Pin	Signal	18 AWG Color
1	+3.3VDC	Orange
2	COM	Black
3	+5VDC	Red
4	COM	Black
5	+12V3	Yellow

2.6.2.3 Grounding

The ground of the pins of the PDB output connectors provides the power return path. The output connector ground pins is connected to safety ground (PDB enclosure). This grounding is well designed to ensure passing the max allowed Common Mode Noise levels.

2.6.2.4 Remote Sense

Below is listed the remote sense requirements and connection points for all the converters on the PDB and the main 12V output of the power supply.

Table 124. Remote Sense Connection Points

Converter	+ sense location	- sense location
Power supply main 12V	On PDB	On PDB
12V/3.3V	P20 (1x5 signal connector)	P20 (1x5 signal connector)
12V/5V	On PDB	On PDB
12V/-12V	none	none
12Vstby/5Vstby	none	none

Table 125. Remote Sense Requirements

Characteristic	Requirement
+3.3V remote sense input impedance	200Ω (measure from +3.3V on P1 2x12 connector to +3.3V sense on P20 1x5 signal connector)
+3.3V remote sense drop	200mV (remote sense must be able to regulate out 200mV drop on the +3.3V and return path; from the 2x12 connector to the remote sense points)
Max remote sense current draw	< 5mA

2.6.2.5 12V Rail Distribution

The below table shows the configuration of the 12V rails and what connectors and components in the system they are powering.

Table 126. 12V Rail Distribution

	P2		P3		P12	P1		P8	P9	P10	P11	P5,6,7	P13	P14	P15	P16	P17	P18	P19	P20				
	2x4		2x4		2x2	2x12		1x4	1x4	1x4	1x4	(2) 1x5, 1x4	GPU1		GPU2		GPU3		GPU4			OCP		
	CPU 1	Memory 1	CPU 2	Memory 2	PCIe	Fans	Misc	HDD & peripherals					2x3	2x4	2x3	2x4	2x3	2x4	2x3	2x4	Total Current	Min	Nominal	Max
12V 1	17.8 A	10.5 A	17.8 A	10.5 A	21.7 A	10.0 A	3.0 A														91 A	91	95.5	100
12V 2													6.3 A	12.5 A	6.3 A	12.5 A	6.3 A	12.5 A	6.3 A	12.5 A	76 A	76	88	100
12V 3												18.0A									18 A	18	19	20
12V 4								18.0 A													18 A	18	19	20

Note:

P12 is reserved for board that needs 4 x GPU cards powered. P1 is the main 12V power for PCIe slot; but additional 12V power can be connected to P2 and/or P3. The motherboard MUST NOT short any of the 12V rails or connectors together.

2.6.2.6 Hard Drive 12V rail configuration options

The below table shows the hard drive configuration options using the defined power connectors. In some cases additional converter or 'Y' cables are needed.

Table 127. Hard Drive 12V rail configuration options

	P8	P9	P10	P11	P5	P6	P7
	1x4	1x4	1x4	1x4	1x5	1x5	1x4
	18						
3 x 2.5" 8xHDD BP	HDD1 8 x 2.5	na	HDD2 8 x 2.5	na	na	na	HDD3 8 x 2.5
2 x 3.5" 4xHDD BP	HDD1 4x3.5		HDD1 4x3.5		peripheral bay		
1 x 3.5" 8xHDD BP	HDD1 8x3.5		na	na	peripheral bay		
8 x 3.5" fixed SATA	2xfixed	2xfixed	2xfixed	2xfixed	peripheral bay		
8 x 3.5" fixed SAS	2xfixed	2xfixed	2xfixed	2xfixed	peripheral bay		

2.6.2.7 DC/DC Converters Loading

The following table defines power and current ratings of three DC/DC converters located on the PDB, each powered from +12V rail. The 3 converters meet both static and dynamic voltage regulation requirements for the minimum and maximum loading conditions.

Table 128. DC/DC Converters Load Ratings

	+12VDC Input DC/DC Converters		
	+3.3V Converter	+5V Converter	-12V Converter
MAX Load	25A	15A	0.5A
MIN Static/Dynamic Load	0A	0A	0A
Max Output Power	3.3V x25A =82.5W	5V x15A =75W	12V x0.5A =6W

2.6.2.8 5VSB Loading

There is also one DC/DC converter that converts the 12V standby into 5V standby.

Table 129. 5VSB Loading

	12V stby/5V stby DC/DC Converters
MAX Load	8A
MIN Static/Dynamic Load	0.1
Max Output Power	5V x8A =40W

2.6.2.9 DC/DC Converters Voltage Regulation

The DC/DC converters' output voltages stay within the following voltage limits when operating at steady state and dynamic loading conditions. These limits include the peak-peak ripple/noise specified in Table 132. The 3.3V and 5V outputs are measured at the remote sense point, all other voltages measured at the output harness connectors.

Table 130. Voltage Regulation Limits

Converter output	Tolerance	Min	Nom	Max	Units
+ 3.3VDC	-4%/+5%	+3.20	+3.30	+3.46	VDC
+ 5VDC	-4%/+5%	+4.80	+5.00	+5.25	VDC
5Vstby	-4%/+5%	+4.80	+5.00	+5.25	VDC

2.6.2.10 DC/DC Converters Dynamic Loading

The output voltages remains within limits specified in table above for the step loading and capacitive loading specified in Table 130 below. The load transient repetition rate is only a test specification. The Δ step load may occur anywhere within the MIN load to the MAX load shown in Tables 127 and 128.

Table 131. Transient Load Requirements

Output	Max Δ Step Load Size	Max Load Slew Rate	Test capacitive Load
+ 3.3VDC	5A	0.25 A/µs	250 µF
+ 5VDC	5A	0.25 A/µs	400 µF
+5Vsb	0.5A	0.25A/µs	20 µF

2.6.2.11 DC/DC Converter Capacitive Loading

The DC/DC converters are stable and meet all requirements with the following capacitive loading ranges. Minimum capacitive loading applies to static load only.

Table 132. Capacitive Loading Conditions

Converter output	Min	Max	Units
+3.3VDC	250	6800	µF
+5VDC	400	4700	µF
5Vstby	20	350	µF

2.6.2.12 DC/DC Converters Closed Loop stability

Each DC/DC converter is unconditionally stable under all line/load/transient load conditions including capacitive load ranges specified in Section 2.4.2.11. A minimum of: **45 degrees phase margin** and -**10dB-gain margin** is required. The PDB provides proof of the unit's closed-loop stability with local sensing through the submission of Bode plots. Closed-loop stability must be ensured at the maximum and minimum loads as applicable.

2.6.2.13 Common Mode Noise

The Common Mode noise on any output does not exceed 350mV pk-pk over the frequency band of 10Hz to 20MHz.

- The measurement shall be made across a 100Ω resistor between each of DC outputs, including ground, at the DC power connector and chassis ground (power subsystem enclosure).
- The test set-up shall use a FET probe such as Tektronix model P6046 or equivalent.

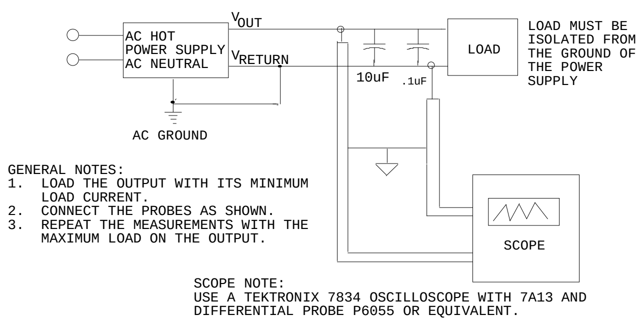
2.6.2.14 Ripple/Noise

The maximum allowed ripple/noise output of each DC/DC Converter is defined in below Table 132. This is measured over a bandwidth of 0Hz to 20MHz at the PDB output connectors. A 10μF tantalum capacitor in parallel with a 0.1μF ceramic capacitor are placed at the point of measurement.

Table 133. Ripple and Noise

+3.3V	+5V	-12V	+5VSB
50mVp-p	50mVp-p	120mVp-p	50mVp-p

The test set-up shall be as shown below.



Note:

When performing this test, the probe clips and capacitors should be located close to the load.

Figure 49. Differential Noise test setup

2.6.2.15 Timing Requirements

Below are timing requirements for the power on/off of the PDB DC/DC converters. The +3.3V, +5V and +12V output voltages should start to rise approximately at the same time. All outputs must rise monotonically.

Table 134. Output Voltage Timing

Description	Min	Max	Units
Output voltage rise time for each main output; 3.3V, 5V, -12V and 5Vstby.	1.0	20	msec
The main DC/DC converters (3.3V, 5V, -12V) shall be in regulation limits within this time after the 12V input has reached 11.4V.		20	msec
The main DC/DC converters (3.3V, 5V, -12V) must drop below regulation limits within this time after the 12V input has dropped below 11.4V.		20	msec
The 5Vstby converter shall be in regulation limits within this time after the 12Vstby has reach 11.4V.		20	msec

Description	Min	Max	Units
The 5Vstby converter must power off within this time after the 12Vstby input has dropped below 11.4V.		100	msec

2.6.2.16 Residual Voltage Immunity in Standby Mode

Each DC/DC converter is immune to any residual voltage placed on its respective output (typically a leakage voltage through the system from standby output) up to 500mV. This residual voltage does not have any adverse effect on each DC/DC converter, such as: no additional power dissipation or over-stressing/over-heating any internal components or adversely affecting the turn-on performance (no protection circuits tripping during turn on).

While in Stand-by mode, at no load condition, the residual voltage on each DC/DC converter output does not exceed 100mV.

2.6.3 Protection Circuits

The PDB shall shut down all the DC/DC converters on the PDB and the power supply (from PSON) if there is a fault condition on the PDB (OVP or OCP). If the PDB DC/DC converter latches off due to a protection circuit tripping, an AC cycle OFF for 15sec min or a PSON# cycle HIGH for 1sec shall be able to reset the power supply and the PDB.

2.6.3.1 Over-Current Protection (OCP)/240VA Protection

Each DC/DC converter output on PDB has individual OCP protection circuits. The PS+PDB combo shall shutdown and latch off after an over current condition occurs. This latch shall be cleared by toggling the PSON# signal or by an AC power interruption. The values are measured at the PDB harness connectors. The DC/DC converters shall not be damaged from repeated power cycling in this condition. Also, the +12V output from the power supply is divided on the PDB into 3 channels and +12V3 is limited to 240VA of power. There are current sensors and limit circuits to shut down the entire PS+PDB combo if the limit is exceeded. The limits are listed in below table. -12V and 5VSB is protected under over current or shorted conditions so that no damage can occur to the power supply. Auto-recovery feature is a requirement on 5VSB rail.

Table 135. PDB Over Current Protection Limits/240VA Protection

Output Voltage	Min OCP Trip Limits	Max OCP Trip Limits	Usage
+3.3V	27A	Meet 240VA	PCIe, Misc
+5V	27A		PCIe, HDD, Misc
+12V1	91A	100A	CPU & memory
+12V2	76A	100A	GPU cards
+12V3	18A	20A	HDD & peripherals
+12V4	18A	20A	HDD & peripherals

2.6.3.2 Over Voltage Protection (OVP)

Each DC/DC converter output on PDB have individual OVP protection circuits built in and it shall be locally sensed. The PS+PDB combo shall shutdown and latch off after an over voltage condition occurs. This latch shall be cleared by toggling the PSON# signal or by an AC power interruption. Table 135 contains the over voltage limits. The values are measured at the PDB harness connectors. The voltage shall never exceed the maximum levels when measured at the power pins of the output harness connector during any single point of fail. The voltage shall never trip any lower than the minimum levels when measured at the power pins of the PDB connector.

Table 136. Over Voltage Protection (OVP) Limits

Output voltage	OVP min (v)	OVP max (v)
+3.3V	3.9	4.8
+5V	5.7	6.5
+5VSB	5.7	6.5

2.6.4 PWOK (Power OK) Signal

The PDB connects the PWOK signals from the power supply modules and the DC/DC converters to a common PWOK signal. This common PWOK signal connects to the PWOK pin on P1. The DC/DC convert PWOK signals have open collector outputs.

2.6.4.1 System PWOK requirements

The system will connect the PWOK signal to 3.3V or 5V from a pull-up resistor. The maximum sink current of the power supplies are 0.5mA. The minimum resistance of the pull-up resistor is stated below depending upon the motherboard's pull-up voltage. Refer to the CRPS power supply specification for signal details.

Table 137. System PWOK Requirements

Motherboard pull-up voltage	MIN resistance value (ohms)
5V	10K
3.3V	6.8K

2.6.5 PSON Signal

The PDB connects the power supplies PSON signals together and connect them to the PSON signal on P1.
Refer to the CRPS power supply specification for signal details.

2.6.6 PMBus*

The PDB has no components on it to support PMBus*. It only needs to connect the power supply PMBus* signals (clock, data, SMBAlert#) and pass them to the 1x5 signal connector.

2.6.6.1 Addressing

The PDB address the power supply as follows on the PDB.
0 = open, 1 = grounded

Table 138. PDB Addressing

	Power Supply Position 1	Power Supply Position 2
PDB addressing Address0/Address1	0/0	0/1
Power supply PMBus* device address	B0h	B2h

3. Chassis Cooling

Two cooling solutions are used in the Intel® Server Chassis P4000M series. The base non-redundant solution consists of two 120 x 38mm fixed fans to provide sufficient system cooling. The second redundant solution is designed for maximum up time by providing five 80 x 38 mm replaceable hot-swap fans. The fans can maintain proper system cooling, even with a single failed fan. Corresponding air ducts are needed in both configurations for supported boards.

3.1 Non-Redundant Cooling Solution

Two 120 x 38 mm fans provide cooling for the processors, memory, hard drives and add-in cards. The two fans draw air through the rear of each hard drive bay to provide drive, processors, and memory cooling. All system fans provide a signal for RPM detection the server board can make available for server management functions.

In addition, the power supply fan provides cooling for the power supply.

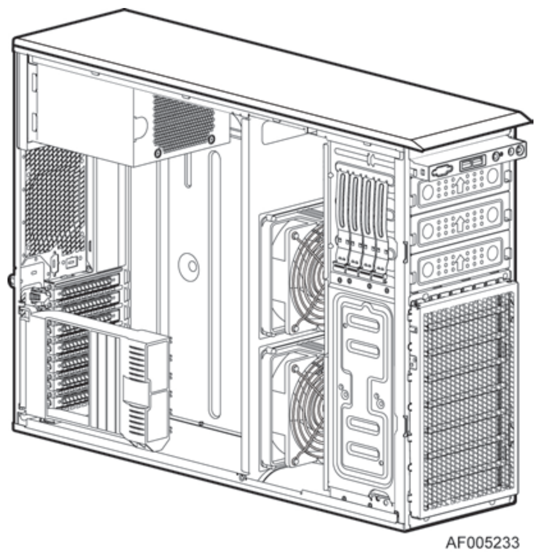


Figure 50. Fixed Fans in Intel® Server Chassis P4308XXMFEN

3.2 Redundant Cooling Solution

Five hot-swap 80x38mm fans provide cooling for the processors, hard drives, and add-in cards. When any single fan fails, the remaining fans increase in speed and maintain cooling until the failed unit is replaced. All system fans provide a signal for RPM detection that the server board can make available for server management functions.

In addition, the power supply fan provides cooling for the power supply.

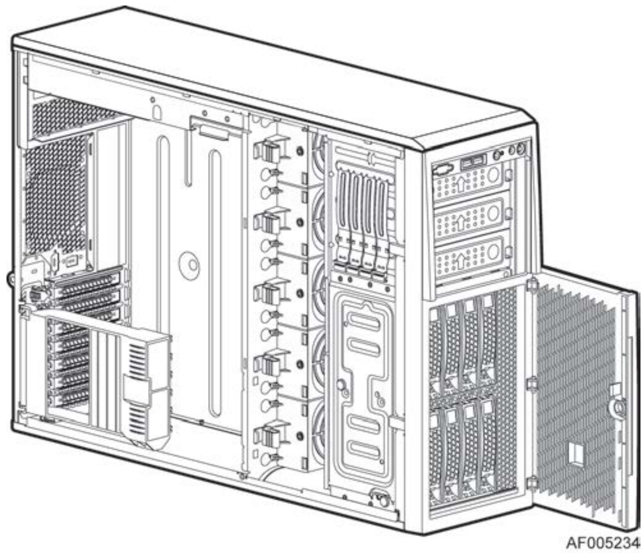


Figure 51. Hot-swap Fans in Intel® Server Chassis P4308XXMHGC

3.3 Fan Control

The fans provided in the Intel® Server Chassis P4000M Family contains a tachometer signal that can be monitored by the server management subsystem of the Intel® Server Boards for RPM (Revolutions per Minute) detection.

The server board monitors several temperature sensors and adjusts the PWM (Pulse Width Modulated) signal to drive the fan at the appropriate speed.

The front panel of the chassis has a digital temperature sensor connected to the server board through the front panel's bus. The server board firmware adjusts the fan speed based on the front panel intake temperature and processor temperatures.

Refer to the baseboard documentation for additional details on how fan control is implementation.

3.4 Fan Header Connector Descriptions

All system fan headers support pulse width modulated (PWM) fans for cooling the processors in the chassis. PWM fans have an improved RPM range (20% to 100% rated fan speed) when compared to voltage controlled fans.

Fixed chassis fans are a 4-wire/4-pin style designed to plug into 4-pin or 6-pin SSI Fan headers. When plugged into a 6-pin header, only the first four signals are used (Pwr, Gnd, Tach,PWM).

Hot-swap chassis fans are a 6-wire/6-pin style designed to plug into 6-pin headers. The extra signals provide for fan redundancy and failure indications (Pwr, Gnd, Tach, PWM, Presence, and Failure).

4. Standard Front Panel

4.1 Front Panel Overview

The Front Panel board is a common front panel across different sever boards and systems.

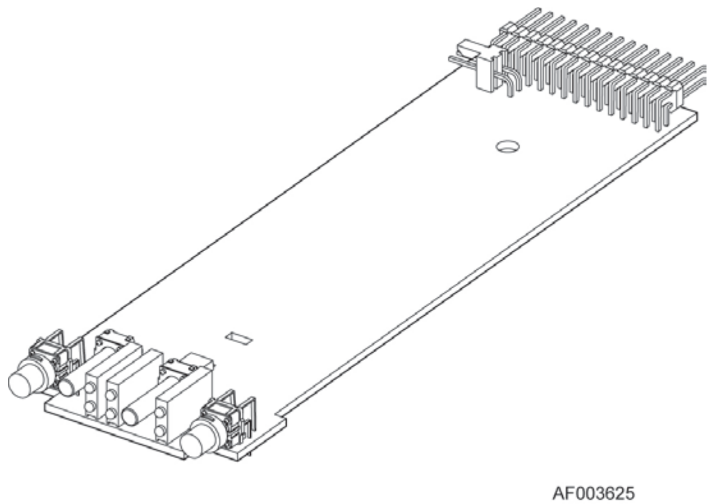


Figure 52. Front Panel overview

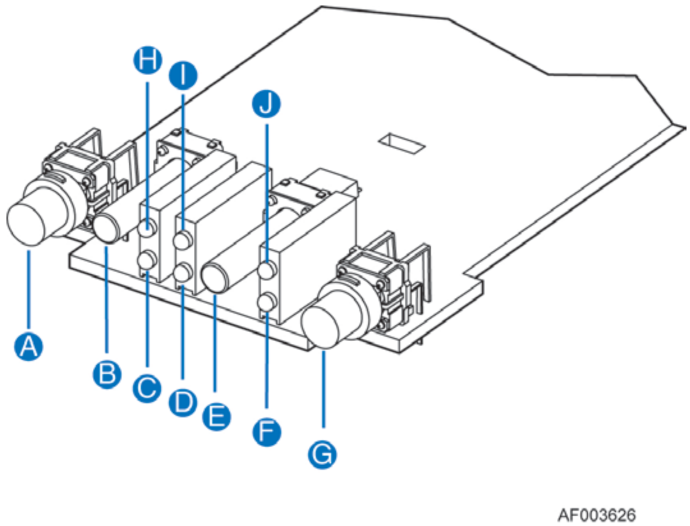
This front panel conforms to SSI specification with one exception that up to 4 LAN act/link LEDs are supported. The common front panel can support either the standard SSI 2x12 cable interconnect (2 LAN ports) or an Intel customized 2x15 cable interconnect (4 LAN ports). With Intel® Server Board S1200BT, the front panel supports standard SSI specification by using the standard SSI 2X 12 cables.

4.2 Front Panel Features

The Front panel has the following features:

- Power button with integrated power LED (green).
- Chassis ID button with integrated ID LED (blue).
- Status/Fault LED (green/amber) (Conform to the BT board).
- Reset button.
- Global HDD activity LED (One HDD action).
- 4 LAN activity/link LEDs (Intel® Server Board S1200BT is using 2 LAN LEDs, such as NIC_1_LED and NIC_2_LED).
- NMI button.
- Connectors: RA 2x15pin signal connector (supports 2x12pin SSI FP connections) and SSI 1x2pin chassis intrusion.

4.3 Common Front Panel Placement



A	Unstuffable ID Button with ID LED	F	Status/Fault LED
B	NMI Button	G	Power Button with power LED
C	LAN1 LED	H	LAN2 LED
D	LAN3 LED	I	LAN4 LED
E	Reset Button	J	HDD activity LED

Figure 53. Common Front Panel LED/Button Arragement

4.3.1 Common Front Panel LED Functionality

Table 139. Front Panel LED Functionality

LED	Color	Condition	What It Means
Power/Sleep	Green	On	Power on or S0 sleep.
	Green	Blink	S1 sleep or S3 standby only for workstation baseboards.
		Off	Off (also sleep S4/S5 modes).
Status	Green	On	System ready/No alarm.
	Green	Blink	System ready, but degraded: redundancy lost such as PS or fan failure; non-critical temp/voltage threshold; battery failure; or predictive PS failure.
	Amber	On	Critical alarm: Voltage, thermal, or power fault; CPU missing; insufficient power unit redundancy resource offset asserted.
	Amber	Blink	Non-Critical failure: Critical temp/voltage threshold; VDR hot asserted; min number fans not present or failed.
		Off	AC power off: System unplugged. AC power on: System powered off and in standby, no prior degraded\non-critical\critical state.
Global HDD Activity	Green	Blink	HDD access.
		Off	No access and no fault.
LAN 1-4 Activity/Link	Green	On	LAN link/no access.
	Green	Blink	LAN access.

LED	Color	Condition	What It Means
(LAN 1-2 for Intel® Server Board S1200BT)		Off	Idle.
Chassis Identification	Blue	On	Front panel chassis ID button pressed.
	Blue	Blink	Unit selected for identification from software.
		Off	No identification.

Note: This is dependent on server board support. Not all server boards support all features. For additional details about control panel functions supported for a specific board, refer to the individual server board specifications.

4.4 Common Front Panel Connector List & Pinouts

Below is a list of the connectors needed for this board.

Table 140. Connectors for Boards

Function	Qty
RA 2x15 FP	1
RA 1x2 Chassis Intrusion	1

4.4.1 Pinouts

The following table describes the pinouts.

Table 141. Pinouts Signal Description

Pin	Signal Description	Pin	Signal Description
1	Power LED Anode	2	Front Plane Power (P3V3_STBY)
3	Key Pin	4	System ID LED Anode
5	Power LED Cathode	6	System ID LED Cathode
7	HDD Activity LED Anode	8	System status LED1 Cathode (Green)
9	HDD Activity LED Cathode	10	System status LED2 Cathode (Amber)
11	Power Switch	12	NIC_1 Activity LED Anode
13	Power Switch (GND)	14	NIC_1 Activity LED Cathode
15	Reset Switch	16	SMBus* SDA
17	Reset Switch (GND)	18	SMBus* SCL
19	System ID Switch	20	Chassis Intrusion
21	1-wire Temp Sensor (unused)	22	NIC_2 Activity LED Anode
23	NMI to CPU Switch	24	NIC_2 Activity LED Cathode
25	Key Pin	26	Key Pin
27	NIC_3 Activity LED Anode	28	NIC_4 Activity LED Anode
29	NIC_3 Activity LED Cathode	30	NIC_4 Activity LED Cathode

Note: Pin 1~24 is compatible with SSI spec.

Table 142. Chassis Intrusion Pin-out

	Description
	RA 1x2 Chassis Intrusion
Pin	Signal Name
1	FP_CHASSIS_INTRU
2	GND

5. Hot-Swap Back Plane (HSBP)

5.1 4U 4x3.5" Hot-Swap Back Plane (HSBP)

5.1.1 Overview

The Chassis supports 4x3.5" SAS/SATA backplane. The backplane provide the platform support for up to four hot-swap SAS or SATA hard drives.

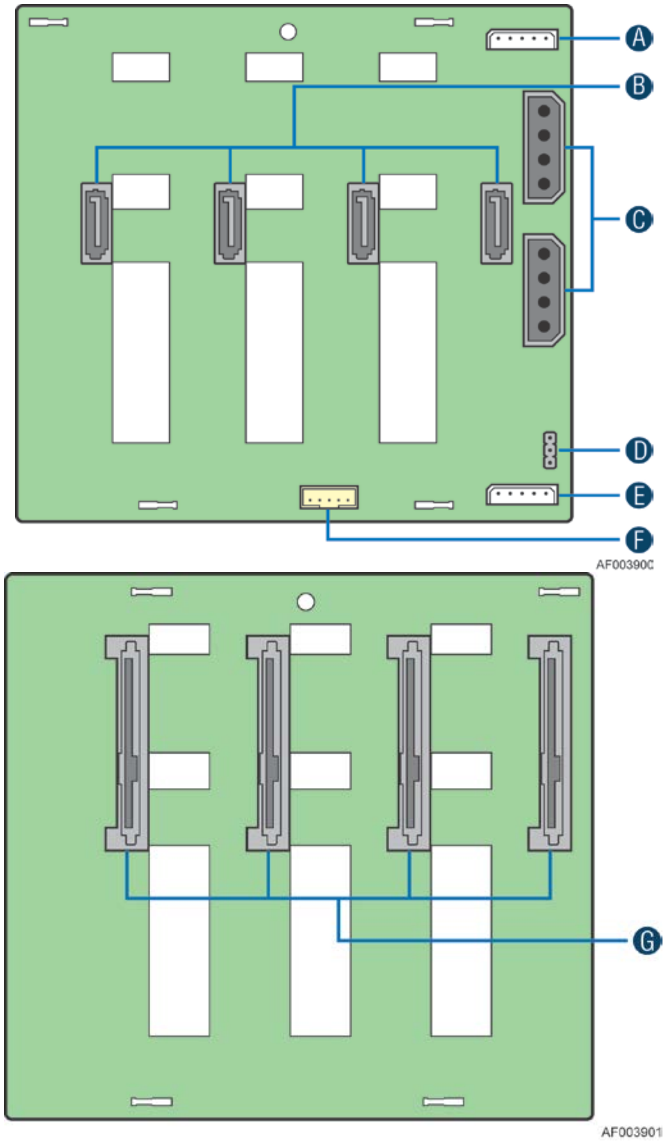
5.1.1.1 Key Features

The 4HDD 3.5" SAS/SATA HSBP supports the following feature set:

- 4x SAS/SATA 3.5" hot swap hard drives.
- One SGPIO SFF-8485 interface from a 5pin connector. This 5pin connector will be common with all other HSBPs
- One I2C interface from a 5pin connector for HDD status communication to BMC over slave SMB bus.
- Temperature sensor and FRU support
- In-application FW updateable over I2C interface by BMC. No special hardware needed for field FW upgrade with BMC onboard baseboard
- 4 HDD status LEDs and 4 HDD activity LEDs
- 4 HDD presence detect inputs to the microcontroller
- 3.3V linear regulator for to power microcontroller and various other components
- Four 7pin shrouded latching THMT SAS/SATA input connectors
- 29pin SAS/SATA 'hybrid' docking hot-swap connectors
- Mount board using one loose screw

5.1.1.2 Board Layout

The following figure shows the board layout and connectors placement of the 4HDD SAS/SATA hot-swap backplane:



A. I2C_In Connectors
B. SATA/SAS Cable Connectors
C. Power Connectors
D. SATA 6X Mode
E. I2C_Out Connector
F. SGPIO Connector
G. SATA/SAS Hot-swap Drive Connectors

Figure 54. 4x3.5" HSBP Board Layout

5.1.2 4x 3.5" HSBP Functional Description

5.1.2.1 4x3.5" HSBP Microcontroller

The microcontroller Cypress PSoC (CY8C22545-24AXI) is sized for 4x and 8x HSBP. It includes I2C interface hardware for in application updating of FW operational code from I2C interface.

The following table displays the microcontroller signal names and pin numbers:

Table 143. 4x3.5" HSBP Microcontroller Pinouts

Pin	Pin Name	Signal Name
1	P2[5]	FM_HDD_PRSNT1
2	P2[3]	SGPIO_DATAOUT_0
3	P2[1]	SGPIO_DATAIN_0
4	Vdd	P3V3
5	P4[5]	TP_SATA_6X_MODE
6	P4[3]	LED_HDD_FAULT3_N
7	P4[1]	LED_HDD_FAULT1_N
8	Vss	GND
9	P3[7]	TP_SGPIO_DATAOUT_1
10	P3[5]	TP_SGPIO_DATAIN_1
11	P3[3]	TP_HDD_PRSNT_7
12	P3[1]	TP_HDD_PRSNT_5
13	P1[7]	SMB_P3V3_CLK
14	P1[5]	SMB_P3V3_DAT
15	P1[3]	TP_P1_3
16	P1[1]	SMB_ISSP_CLK
17	Vss	GND
18	P1[0]	SMB_ISSP_DAT
19	P1[2]	TP_P1_2
20	P1[4]	SMB_ADD0
21	P1[6]	SMB_ADD1
22	P3[0]	TP_HDD_PRSNT_4
23	P3[2]	TP_HDD_PRSNT_6
24	P3[4]	TP_SGPIO_CLK_1
25	P3[6]	TP_SGPIO_LOAD_1
26	XRES	FM_ISSP_XRES
27	P4[0]	LED_HDD_FAULT0_N
28	P4[2]	LED_HDD_FAULT2_N
29	P4[4]	TP_P4_4
30	Vss	GND
31	P2[0]	SGPIO_CLOCK_0
32	P2[2]	SGPIO_LOAD_0
33	P2[4]	FM_HDD_PRSNT0
34	P2[6]	FM_HDD_PRSNT2
35	P0[0]	Therm_P0
36	P0[2]	TP_THERM_N
37	P0[4]	TP_LED_HDD_FAULT4_N
38	P0[6]	TP_LED_HDD_FAULT6_N
39	Vdd	P3V3
40	P0[7]	TP_LED_HDD_FAULT7_N
41	P0[5]	TP_LED_HDD_FAULT5_N
42	P0[3]	TP_P0_3

Pin	Pin Name	Signal Name
43	P0[1]	TP_P0_1
44	P2[7]	FM_HDD_PRSNT3

5.1.2.2 SGPIO Functionality

The 4x 3.5" HSBP supports a SFF-8485 compliant SGPIO interface. It is used to activate the HDD status LED as well is monitored by the microcontroller for generating fault, identify, & rebuild registers that in turn are monitored by the baseboard BMC for generating corresponding SEL events.

SGPIO uses a 5pin header; this is to incorporate a ground conductor as an SI improvement over previous generation products and based on measurement data indicating add the ground is strongly recommended. The 5pin connector will be consistent with other HSBPs, in this way cable commonality is improved.

5.1.2.3 I2C Functionality

The microcontroller has a master/slave I2C connection to the baseboard BMC. The microcontroller is not an IPMB compliant device. The BMC will generate SEL events by monitoring registers on the HSBP microcontroller for drive presence, fault, and RAID rebuild in progress.

I2C uses a 5pin connector; this is to add two additional address bits. This connector is keyed differently than the 5pin SGPIO connector. The 4x3.5” HSBP architecture is setup to support up to 3 HSBPs even though the 4x 3.5" HSBP is currently only indented to support up to two of them in the Intel® Server Chassis P4000S, P4000M and P4000L family. Two pins on the I2C header are used to indicate HSBP address. Below is a figure on how the addressing is recommended for up to three HSBPs.

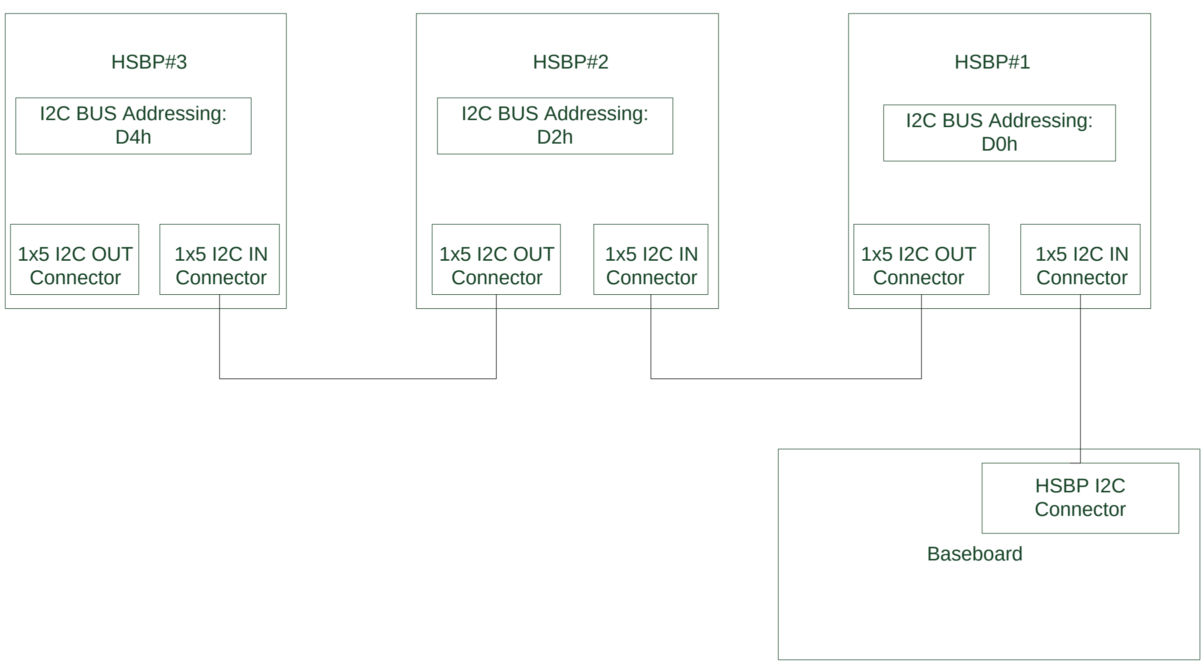


Figure 55. 4x 3.5" HSBP I2C Connectivity

5.1.2.4 SATA 6X Mode Jumper Functionality

The SATA 6X Mode jumper is used for enable baseboard AHCI SATA ports SGPIO function. Only when SATA 6X Mode jumper is set enabled, and the SGPIO on backplane is connected to the SGPIO connector for the AHCI SATA ports on the baseboard, the AHCI SATA ports SGPIO function will be enabled.

Below table is the SATA 6X Mode Jumper Block function:

Table 144. 4x3.5" HSBP SATA 6X Mode Host Jumper Block

Function	Pins	Operation
SATA 6X Mode	1-2	Enable SATA 6x Mode
	2-3	Disable SATA 6x Mode

5.1.2.5 HSBP LED Functionality

Below is a table for LED functionality for HSBP board.

Table 145. Romley LED Functionality

HDD	Green	Blink	HDD access or spin up/down (see note below)
	Amber	On	HDD fault
	Amber	Blink	RAID rebuild in progress (1Hz), identify (2Hz)
		Off	No access and no fault

The HSBP does not route HDD activity signal to the front panel so is not subject to the LED being continuously on when running SAS HDDs. Any HDD activity (really bus activity) driven from SATA/SAS host on baseboard or HBA card hosts that cable HDD activity to baseboard 2pin header would still result in the FP LED blinking. Below is a table showing HDD activity LED differences between with SATA and SAS HDDs.

Table 146. HDD Activity LED Functionality

Condition	Drive Type	Behavior
Power on with no drive activity	SAS	Ready LED stays on
	SATA	Ready LED stays off
Power on with drive activity	SAS	Ready LED blinks off when processing a command
	SATA	Ready LED blinks on when processing a command
Power on and drive spun down	SAS	Ready LED stays off
	SATA	Ready LED stays off
Power on and drive spinning up	SAS	Ready LED blinks*
	SATA	Ready LED stays off

HSBP does not need to route HDD fault LED function to front panel fan board. This function is already lumped with system fault LED already on the FP.

5.1.3 4x3.5" HSBP Connector List and Pinouts

Below is a list of the connectors needed for this board.

Table 147: 4x3.5" HSBP Connector List

Function	Color	Qty
29Pin Hot Swap Docking Connector	Black	4
7Pin Input SAS/SATA Connector	Black	4
1x4Pin Power Connector	Black	2
1x5Pin I2C Connector (In)	White	1
1x5Pin I2C Connector (Out)	White	1
1x5Pin SGPIO Connector	White	1

5.1.3.1 Pinouts

Table 148. 4x3.5" HSBP SGPIO Connector Pinouts

	Description
	1x5pin SATA SGPIO
Pin	Signal Name
1	SGPIO_CLOCK_0
2	SGPIO_LOAD_0
3	GND
4	SGPIO_DATAOUT_0
5	SGPIO_DATAIN_0

Table 149. 4x3.5" HSBP I2C (In) Connector Pinouts

	Description
	1x5Pin I2C Connector (In)
Pin	Signal Name
1	SMB_3V3SB_DAT
2	GND
3	SMB_3V3SB_CLK
4	SMB_ADD0
5	SMB_ADD1

Table 150. 4x3.5" HSBP I2C (Out) Connector Pinouts

	Description
-	1x5Pin I2C Connector (Out)
Pin	Signal Name
1	SMB_3V3SB_DAT
2	GND
3	SMB_3V3SB_CLK
4	SMB_ADD0
5	SMB_ADD1

Table 151. 4x3.5" HSBP Power Connector Pinouts

	Description
	1x4Pin Power Connector
Pin	Signal Name
1	P12V
2	GND
3	GND
4	P5V

Note: See SAS/SATA specs for pinout of 29pin and 7pin connectors.

5.1.4 4x3.5" HSBP Cabling Requirements

The 4x 3.5" HSBP requires the following cables:

- Ganged 4x SATA/SAS data cable.
- I2C cable - 5pin on HSBP side to 3pin on baseboard side
- SGPIO cable - 5pin on HSBP side to 5pin on host controller side.

5.2 4U 8x3.5" Hot-Swap Back Plane (HSBP)

5.2.1 Overview

The chassis supports 8x3.5" SAS/SATA backplane. The backplane provide the platform support for up to eight hot-swap SAS or SATA hard drives.

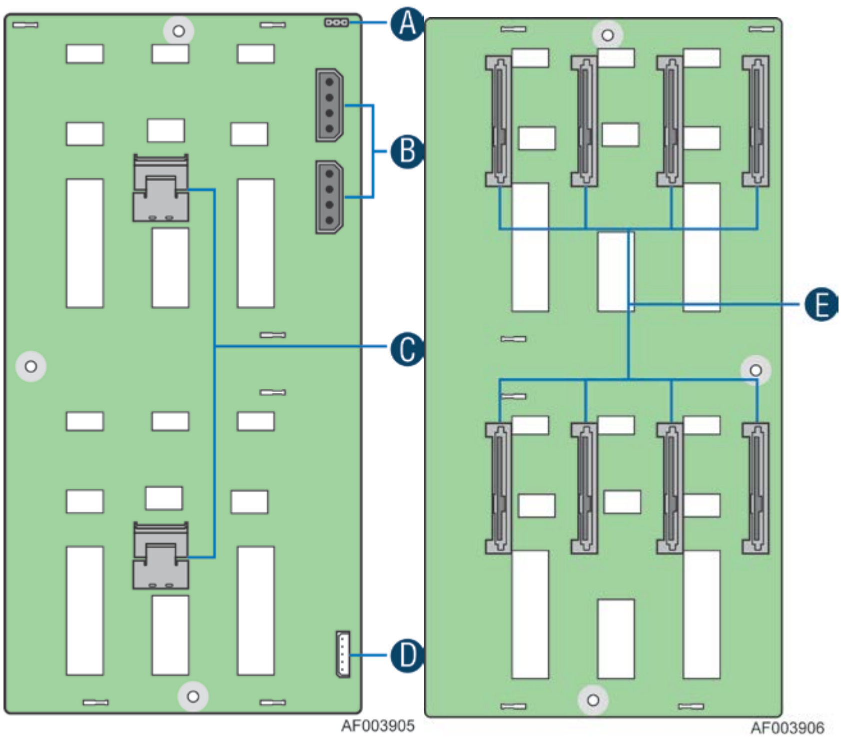
5.2.1.1 Key Features

The 8HDD 3.5" SAS/SATA HSBP supports the following feature set:

- 8x SAS/SATA 3.5" hot swap hard drives.
- Two SGPIO SFF-8485 interfaces in sideband of mini-SAS connectors.
- One I2C interface from a 5pin connector for HDD status communication to BMC over slave SMB bus.
- Temperature sensor and FRU support
- In-application FW updateable over I2C interface from BMC. No special hardware needed for field FW upgrade with BMC onboard baseboard
- 8 HDD status LEDs and 8 HDD activity LEDs
- 8 HDD presence detect inputs to the microcontroller
- 3.3V linear regulator for to power microcontroller and various other components
- Two mini-SAS SAS/SATA input connectors
- Eight 29pin SAS/SATA 'hybrid' docking hot-swap connectors
- Mount board using one loose screw

5.2.1.2 Board Layout

The following figure shows the board layout and connectors placement of the 8HDD SAS/SATA hot-swap backplane.



A. SATA 6X Mode
B. Power Connectors
C. MINI_SAS Connectors
D. I2C Connector
E. SATA/SAS Hot-swap Drive Connectors

Figure 56. 8x3.5" HSBP Board Layout

5.2.2 8x 3.5" HSBP Functional Description

5.2.2.1 8x3.5" HSBP Microcontroller

The microcontroller Cypress PSoC (CY8C22545-24AXI) is sized for 4x and 8x HSBP. It includes I2C interface hardware for in application updating of FW operational code from I2C interface. The following table displays the microcontroller signal names and pin numbers:

Table 152. 8x3.5" HSBP Microcontroller Pinouts

Pin	Pin Name	Signal Name
1	P2[5]	FM_HDD_PRSNT1
2	P2[3]	SGPIO_DATAOUT_0
3	P2[1]	SGPIO_DATAIN_0
4	Vdd	P3V3
5	P4[5]	TP_SATA_6X_MODE
6	P4[3]	LED_HDD_FAULT3_N
7	P4[1]	LED_HDD_FAULT1_N
8	Vss	GND
9	P3[7]	TP_SGPIO_DATAOUT_1
10	P3[5]	TP_SGPIO_DATAIN_1

Pin	Pin Name	Signal Name
11	P3[3]	TP_HDD_PRSNT_7
12	P3[1]	TP_HDD_PRSNT_5
13	P1[7]	SMB_P3V3_CLK
14	P1[5]	SMB_P3V3_DAT
15	P1[3]	TP_P1_3
16	P1[1]	SMB_ISSP_CLK
17	Vss	GND
18	P1[0]	SMB_ISSP_DAT
19	P1[2]	TP_P1_2
20	P1[4]	SMB_ADD0
21	P1[6]	SMB_ADD1
22	P3[0]	TP_HDD_PRSNT_4
23	P3[2]	TP_HDD_PRSNT_6
24	P3[4]	TP_SGPIO_CLK_1
25	P3[6]	TP_SGPIO_LOAD_1
26	XRES	FM_ISSP_XRES
27	P4[0]	LED_HDD_FAULT0_N
28	P4[2]	LED_HDD_FAULT2_N
29	P4[4]	TP_P4_4
30	Vss	GND
31	P2[0]	SGPIO_CLOCK_0
32	P2[2]	SGPIO_LOAD_0
33	P2[4]	FM_HDD_PRSNT0
34	P2[6]	FM_HDD_PRSNT2
35	P0[0]	Therm_P0
36	P0[2]	TP_THERM_N
37	P0[4]	TP_LED_HDD_FAULT4_N
38	P0[6]	TP_LED_HDD_FAULT6_N
39	Vdd	P3V3
40	P0[7]	TP_LED_HDD_FAULT7_N
41	P0[5]	TP_LED_HDD_FAULT5_N
42	P0[3]	TP_P0_3
43	P0[1]	TP_P0_1
44	P2[7]	FM_HDD_PRSNT3

5.2.2.2 SGPIO Functionality

The 8x 3.5" HSBP supports two SFF-8485 compliant SGPIO interfaces. The two SGPIO interfaces are included in sideband of mini-SAS connectors. They are used to activate the HDD status LED as well is monitored by the microcontroller for generating fault, identify, & rebuild registers that in turn are monitored by the baseboard BMC for generating corresponding SEL events.

5.2.2.3 I2C Functionality

The microcontroller has a master/slave I2C connection to the baseboard BMC. The microcontroller is not an IPMB compliant device. The BMC will generate SEL events by monitoring registers on the HSBP microcontroller for drive presence, fault, and RAID rebuild in progress.

I2C uses a 5pin connector; this is to add two additional address bits. The 4U 8x 3.5" HSBP doesn't really need these extra two address bits, they should be hardwired. However 5pin will make it consistent with other HSBPs, in this way cable commonality is improved.

5.2.2.4 SATA 6X Mode Jumper Functionality

The SATA 6X Mode jumper is used for enable baseboard AHCI SATA ports SGPIO function. Only when SATA 6X Mode jumper is set enabled, and the SGPIO on backplane is connected to the SGPIO connector for the AHCI SATA ports on the baseboard, the AHCI SATA ports SGPIO function will be enabled.

The table below displays the SATA 6X Mode Jumper Block function:

Table 153. 4x3.5" HSBP SATA 6X Mode Host Jumper Block

Function	Pins	Operation
SATA 6X Mode	1-2	Enable SATA 6x Mode
	2-3	Disable SATA 6x Mode

5.2.2.5 HSBP LED Functionality

Below is a table for LED functionality for HSBP board.

Table 154. LED Functionality

HDD	Green	Blink	HDD access or spin up/down (see note below)
	Amber	On	HDD fault
	Amber	Blink	RAID rebuild in progress (1Hz), identify (2Hz)
		Off	No access and no fault

The HSBP does not route HDD activity signal to the front panel so is not subject to the LED being continuously on when running SAS HDDs. Any HDD activity (really bus activity) driven from SATA/SAS host on baseboard or HBA card hosts that cable HDD activity to baseboard 2pin header would still result in the FP LED blinking. Below is a table showing HDD activity LED differences between with SATA and SAS HDDs.

Table 155. BP HDD Activity LED Functionality

Condition	Drive Type	Behavior
Power on with no drive activity	SAS	Ready LED stays on
	SATA	Ready LED stays off
Power on with drive activity	SAS	Ready LED blinks off when processing a command
	SATA	Ready LED blinks on when processing a command
Power on and drive spun down	SAS	Ready LED stays off
	SATA	Ready LED stays off
Power on and drive spinning up	SAS	Ready LED blinks*
	SATA	Ready LED stays off

HSBP does not need to route HDD fault LED function to front panel fan board. This function is already lumped with system fault LED already on the FP.

5.2.3 8x3.5" HSBP Connector List and Pinouts

Below is a list of the connectors needed for this board.

Table 156. 8x3.5" HSBP Connector List and Pinouts

Function	Color	Qty
29Pin Hot Swap Docking Connector	Black	8
36Pin Input RA Mini-SAS Connector	Metal	2
1x4Pin Power Connector	Black	2
1x5Pin I2C Connector (In)	White	1
1x3 SATA 6X Host Jumper Header	Black	1

5.2.3.1 Pinouts

Table 157. 1x5 Pin I2C Connector (In)

	Description
-	1x5Pin I2C Connector (In)
Pin	Signal Name
1	SMB_3V3SB_DAT
2	GND
3	SMB_3V3SB_CLK
4	SMB_ADD0
5	SMB_ADD1

Table 158.1x4 Pin Power Connector

	Description
	1x4Pin Power Connector
Pin	Signal Name
1	P12V
2	GND
3	GND

	Description
4	P5V

Table 159. 36Pin Input RA Mini-SAS Connector

	Description	
	36Pin Input RA Mini-SAS Connector	
Pin	Signal Name	
A1	GND1	GND
A2	RX0_P	SAS_P0_TX_P
A3	RX0_N	SAS_P0_TX_N
A4	GND2	GND
A5	RX1_P	SAS_P1_TX_P
A6	RX1_N	SAS_P1_TX_N
A7	GND3	GND
A8	SIDEBAND7	SGPIO_CLOCK_0_R
A9	SIDEBAND3	SGPIO_LOAD_0_R
A10	SIDEBAND4	GND
A11	SIDEBAND5	TP_PORTA_SIDEBAND6
A12	GND4	GND
A13	RX2_P	SAS_P2_TX_P
A14	RX2_N	SAS_P2_TX_N
A15	GND5	GND
A16	RX3_P	SAS_P3_TX_P
A17	RX3_N	SAS_PE_TX_N
A18	GND6	GND
B1	GND7	GND
B2	TX0_P	SAS_P0_RX_P
B3	TX0_N	SAS_P0_RX_N
B4	GND8	GND
B5	TX1_P	SAS_P1_RX_P
B6	TX1_N	SAS_P1_RX_N
B7	GND9	GND
B8	SIDEBAND0	PD_PORTA_SIDEBAND7
B9	SIDEBAND1	TP_PORTA_B9
B10	SIDEBAND2	SGPIO_DATAOUT_0_R
B11	SIDEBAND6	SGPIO_DATAIN_0_R
B12	GND10	GND
B13	TX2_P	SAS_P2_RX_P
B14	TX2_N	SAS_P2_RX_N
B15	GND11	GND
B16	TX3_P	SAS_P3_RX_P
B17	TX3_N	SAS_P3_RX_N
B18	GND12	GND
MTH1	GND13	GND
MTH2	GND14	GND
MTH3	GND15	GND

	Description	
MTH4	GND16	GND
MTH5	GND17	GND
MTH6	GND18	GND

Table 160.1x3 SATA 6X Host Jumper

	Description
-	1x3 SATA 6X Host Jumper Header
Pin	Signal Name
1	P3V3
2	SATA_6X_MODE
3	TP_PIN3

5.2.4 8x3.5" HSBP Cabling Requirements

The 8x 3.5" HSBP requires the following cables:

1. Up to two Ganged Mini SAS to 4pcs 7Pin SATA cable with SGPIO Cable.
2. I2C cable - 5pin on HSBP side to 3pin on baseboard side.

5.3 4U 8x2.5" Hot-Swap Back Plane (HSBP)

5.3.1 Overview

The chassis supports 8x2.5" SAS/SATA backplane. The backplane provide the platform support for up to eight hot-swap SAS or SATA hard drives.

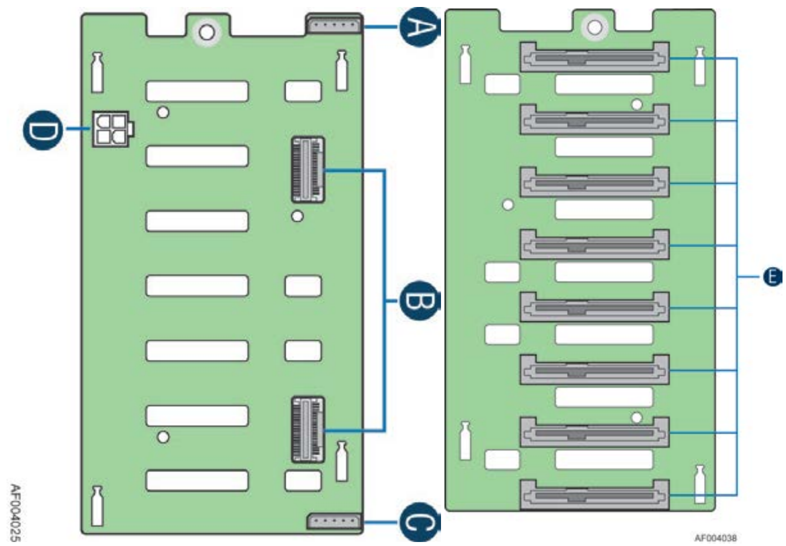
5.3.1.1 Key Features

The 8HDD 2.5" SAS/SATA HSBP supports the following feature set:

- 8x SAS/SATA 2.5" hot swap hard drives.
- Two SGPIO SFF-8485 interfaces in sideband of mini-SAS connectors.
- One I2C interface from a 5pin connector for HDD status communication to BMC over slave SMB bus.
- Temperature sensor and FRU support.
- In-application FW updateable over I2C interface from BMC. No special hardware needed for field FW upgrade with BMC onboard baseboard.
- 8 HDD status LEDs and 8 HDD activity LEDs.
- 8 HDD presence detect inputs to the microcontroller.
- 3.3V linear regulator for to power microcontroller and various other components
- Two mini-SAS SAS/SATA input connectors.
- Eight 29pin SAS/SATA 'hybrid' docking hot-swap connectors.
- Mount board using one loose screw.

5.3.1.2 Board Layout

The following figure shows the board layout and connectors placement of the 8HDD SAS/SATA hot-swap backplane:



A. I2C_OUT Connector
B. MINI_SAS Connectors
C I2C_IN Connector
D. Power Connectors
E. SATA/SAS Hot-swap Drive Connectors

Figure 57. 8x2.5” HSBP Board Layout

5.3.2 8x 2.5” HSBP Functional Description

5.3.2.1 8x2.5” HSBP Microcontroller

The microcontroller Cypress PSoC (CY8C22545-24AXI) is sized for 4x and 8 HSBP. It includes I2C interface hardware for in application updating of FW operational code by I2C interface.

The following table shows the microcontroller signal names and pin numbers:

Table 161. 8x2.5" HSBP Microcontroller Pinouts

Pin	Pin Name	Signal Name
1	P2[5]	FM_HDD_PRSNT1
2	P2[3]	SGPIO_DATAOUT_0
3	P2[1]	SGPIO_DATAIN_0
4	Vdd	P3V3
5	P4[5]	SATA_6X_MODE
6	P4[3]	LED_HDD_FAULT3_N
7	P4[1]	LED_HDD_FAULT1_N
8	Vss	GND
9	P3[7]	SGPIO_DATAOUT_1
10	P3[5]	SGPIO_DATAIN_1

Pin	Pin Name	Signal Name
11	P3[3]	HDD_PRSNT_7
12	P3[1]	HDD_PRSNT_5
13	P1[7]	SMB_P3V3_CLK
14	P1[5]	SMB_P3V3_DAT
15	P1[3]	TP_P1_3
16	P1[1]	ISSP_CLK
17	Vss	GND
18	P1[0]	ISSP_DAT
19	P1[2]	TP_P1_2
20	P1[4]	SMB_ADD0
21	P1[6]	SMB_ADD1
22	P3[0]	HDD_PRSNT_4
23	P3[2]	HDD_PRSNT_6
24	P3[4]	SGPIO_CLK_1
25	P3[6]	SGPIO_LOAD_1
26	XRES	ISSP_XRES
27	P4[0]	LED_HDD_FAULT0_N
28	P4[2]	LED_HDD_FAULT2_N
29	P4[4]	SPI_WP_N
30	Vss	GND
31	P2[0]	SGPIO_CLOCK_0
32	P2[2]	SGPIO_LOAD_0
33	P2[4]	FM_HDD_PRSNT0
34	P2[6]	FM_HDD_PRSNT2
35	P0[0]	FM_THERM_P5V
36	P0[2]	TP_THERM_N
37	P0[4]	LED_HDD_FAULT4_N
38	P0[6]	LED_HDD_FAULT6_N
39	Vdd	P3V3
40	P0[7]	LED_HDD_FAULT7_N
41	P0[5]	LED_HDD_FAULT5_N
42	P0[3]	TP_P0_3
43	P0[1]	TP_P0_1
44	P2[7]	FM_HDD_PRSNT3

5.3.2.2 SGPIO Functionality

The 8x 2.5" HSBP supports two SFF-8485 compliant SGPIO interfaces. The two SGPIO interfaces are included in sideband of mini-SAS connectors. They are used to activate the HDD status LED as well is monitored by the microcontroller for generating fault, identify, & rebuild registers that in turn are monitored by the baseboard BMC for generating corresponding SEL events.

5.3.2.3 I2C Functionality

The microcontroller has a master/slave I2C connection to the baseboard BMC. The microcontroller is not an IPMB compliant device. The BMC will generate SEL events by monitoring registers on the HSBP microcontroller for drive presence, fault, and RAID rebuild in progress.

I2C uses a 5pin connector; this is to add two additional address bits. Adding the extra 2 pins allows the HSBP are setup to support up to 3 HSBP.

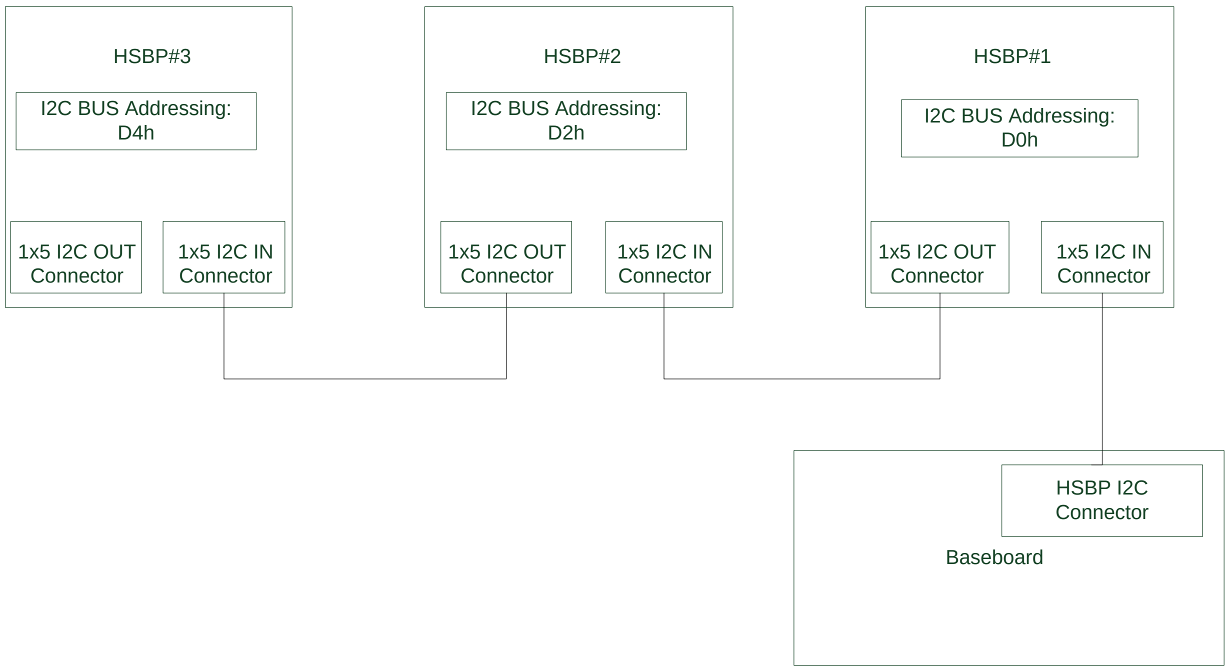


Figure 58. 8x 2.5" HSBP I2C Connectivity

5.3.2.4 HSBP LED Functionality

Below is a table for LED functionality for HSBP board.

Table 162. LED Functionality

HDD	Green	Blink	HDD access or spin up/down (see note below)
	Amber	On	HDD fault
	Amber	Blink	RAID rebuild in progress (1Hz), identify (2Hz)
		Off	No access and no fault

The HSBP does not route OR'd HDD activity signal to the front panel so is not subject to the LED being continuously on when running SAS HDDs. Any HDD activity (really bus activity) driven from SATA/SAS host on baseboard or HBA card hosts that cable HDD activity to baseboard 2pin header would still result in the FP LED blinking. Below is a table showing HDD activity LED differences between with SATA and SAS HDDs.

Table 163. 8xBP HDD Activity LED Functionality

Condition	Drive Type	Behavior
Power on with no drive activity	SAS	Ready LED stays on
	SATA	Ready LED stays off
Power on with drive activity	SAS	Ready LED blinks off when processing a command
	SATA	Ready LED blinks on when processing a command
Power on and drive spun down	SAS	Ready LED stays off
	SATA	Ready LED stays off
Power on and drive spinning up	SAS	Ready LED blinks*
	SATA	Ready LED stays off

HSBP does not need to route HDD fault LED function to front panel fan board. This function is already lumped with system fault LED already on the FP.

5.3.3 8x2.5" HSBP Connector List and Pinouts

Below is a list of the connectors needed for this board.

Table 164. 8x2.5" HSBP Connector List and Pinouts

Function	Color	Qty
29Pin Hot Swap Docking Connector	Black	8
36Pin Input VT Mini-SAS Connector	Metal	2
2x2Pin Power Connector	White	1
1x5Pin I2C Connector (In)	White	1
1x5Pin I2C Connector (Out)	Blue	1

5.3.3.1 Pinouts

Table 165. 1x5 Pin I2C Connector (In)

	Description
-	1x5Pin I2C Connector (In)
Pin	Signal Name
1	SMB_3V3SB_DAT
2	GND
3	SMB_3V3SB_CLK
4	SMB_ADD0
5	SMB_ADD1

Table 166. 1x5 Pin I2C Connector (Out)

	Description
	1x5Pin I2C Connector (Out)
Pin	Signal Name
1	SMB_3V3SB_DAT
2	GND
3	SMB_3V3SB_CLK
4	SMB_ADD0
5	SMB_ADD1

Table 167.2x2 Pin Power Connector

	Description
	1x4Pin Power Connector
Pin	Signal Name
1	GND
2	GND
3	P12V
4	P12V

5.3.4 8x2.5" HSBP Cabling Requirements

The 8x 2.5" HSBP requires the following cables:

1. Up To Two Ganged 4x SATA/SAS mini-SAS data cable - RA 36pin mini-SAS on HSBP end, other end can be either mini-SAS or 7pin depending on what host controller the data cable is plugged into. The possible host controller options are onboard SATA or SAS, SAS modules, or HBA. SGPIO sideband signals are included within the mini-SAS cable.
2. I2C cable - 5pin on HSBP side to 3pin on baseboard side.
3. 2x2power adapter cable.
4. HSBP I2C cable -5pin to 5 pin for two 8x2.5" HSBP cascade.

6. System Interconnection

6.1 Chassis Internal Cables

Note: This section provides the chassis internal cables specification descriptions. Different chassis configuration may come with different cables setting.

6.1.1 Front Panel Cable

A 24-conductor ribbon cable with 24-pin IDC connectors links the front panel to the SSI EEB Revision 3.61-compliant server board.

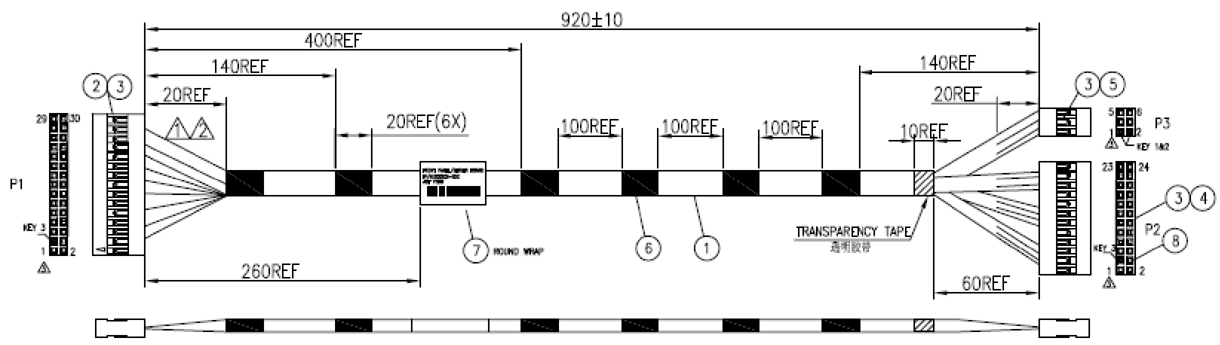


Figure 59. Chassis Front Panel Cable

6.1.2 Intrusion Switch cable

The intrusion switch cable acts as a switch installed on the chassis for chassis intrusion detection, allowing server management software to detect unauthorized access to the system side cover. The cable is connected to the front panel through a 2-pin chassis intrusion header on the front panel board.

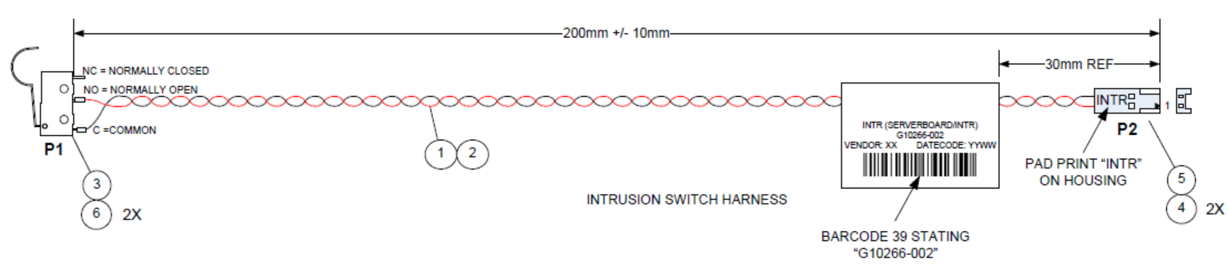


Figure 60. Intrusion Switch Cable

6.1.3 USB Cable

A 10-conductor USB cable with 10-pin connectors at one end and two 4-pin external USB connectors at the other end is used for connecting the front panel- mounted USB connector to the server board.

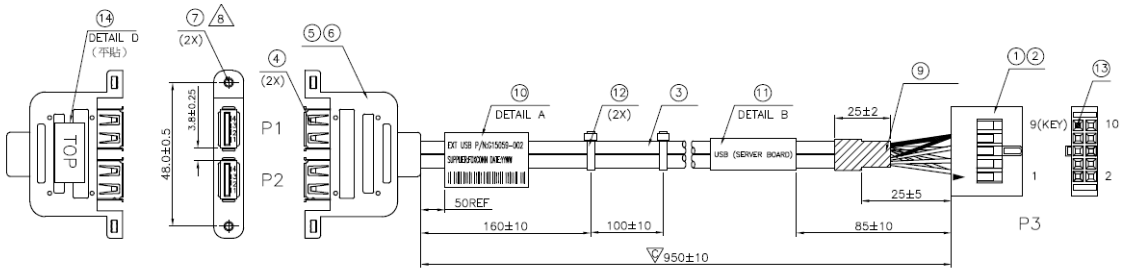


Figure 61. USB Cable Drawing

6.1.4 SATA Power Adapter Cable

The SATA Power Adapter Cable has a 4-pin LP4 connector at one end, two 15-pins SATA power connector at the other end. The cable is used for connecting the SATA Hard Drive to a standard 4-pin LP4 power connector.

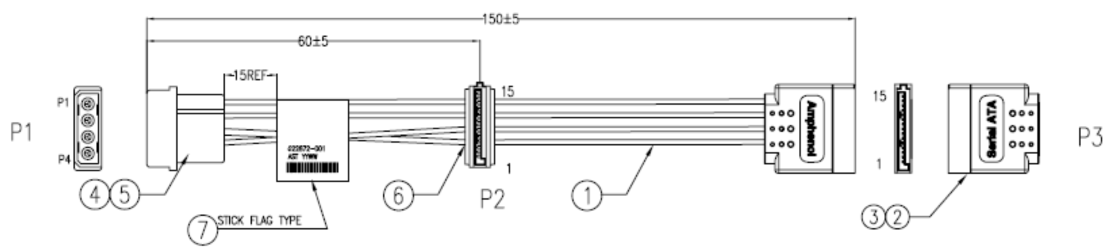


Figure 62. SATA Power Adapter Cable

6.1.5 SAS/SATA Cable Kit for ODD/HDD

The SATA cables with two 7-pin SATA connectors are used for connecting the SATA HDDs/ODDs to the server board.

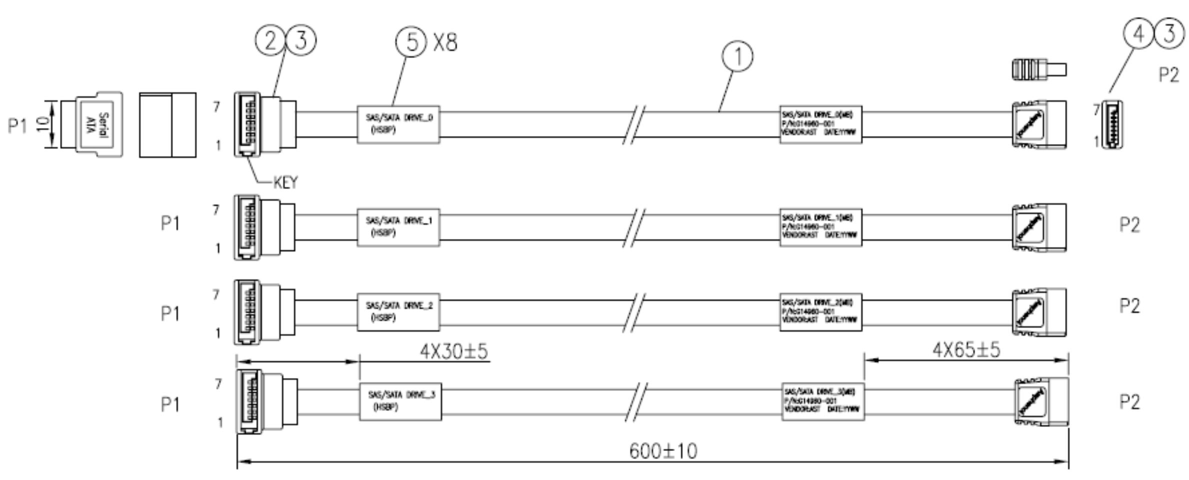


Figure 63. SATA cable for HDDs

6.1.6 Mini SAS (HSBP) to 4pcs 7Pin SATA Cable with SGPIO Cable

The cable has a 36-pin connector at one end, four 7-pin SATA connectors and a 5-pin SGPIO connector at the other end. The cable is used for connecting the HSBP Mini SAS connector to server base board SATA connectors and SGPIO connector.

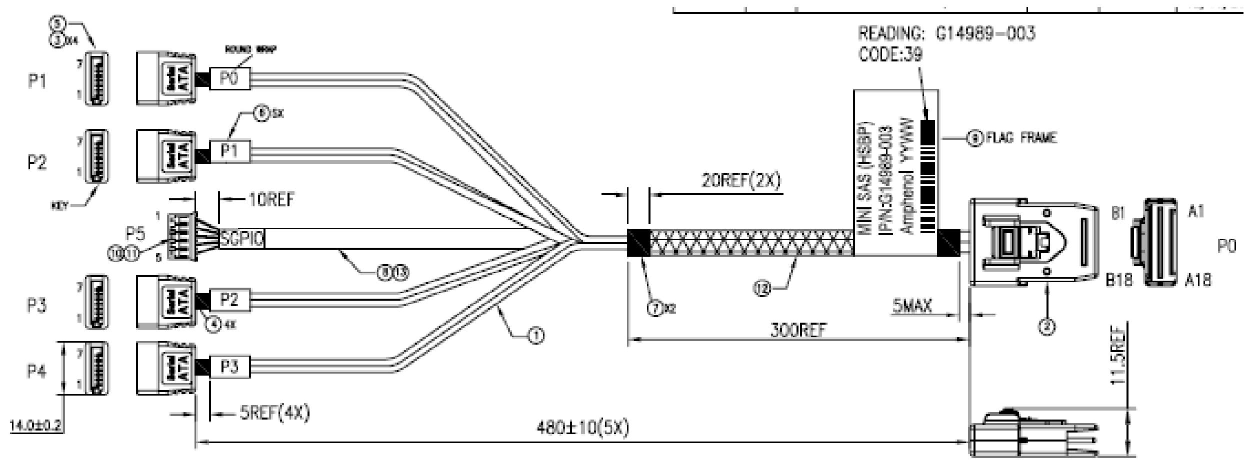


Figure 64. Mini SAS to 4pcs 7Pin SATA cable with SGPIO Cable

6.1.7 I2C Cable (5pin(HSBP) – 3pin(MB))

The I2C cable is used for enclosure management communication between I/O controller (RAID) and backplane.

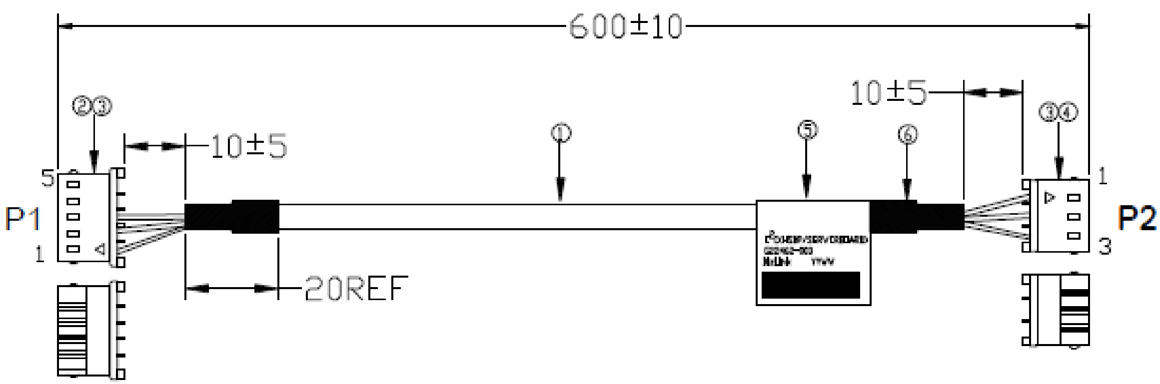


Figure 65. I2C Cable (5pin to 3pin)

6.1.8 HSBP I2C Cable (5pin(HSBP) – 5pin(HSBP))

The HSBP I2C cable is used for two 8x2.5" HSBP cascade in the chassis with 16x2.5" HDD configuration.

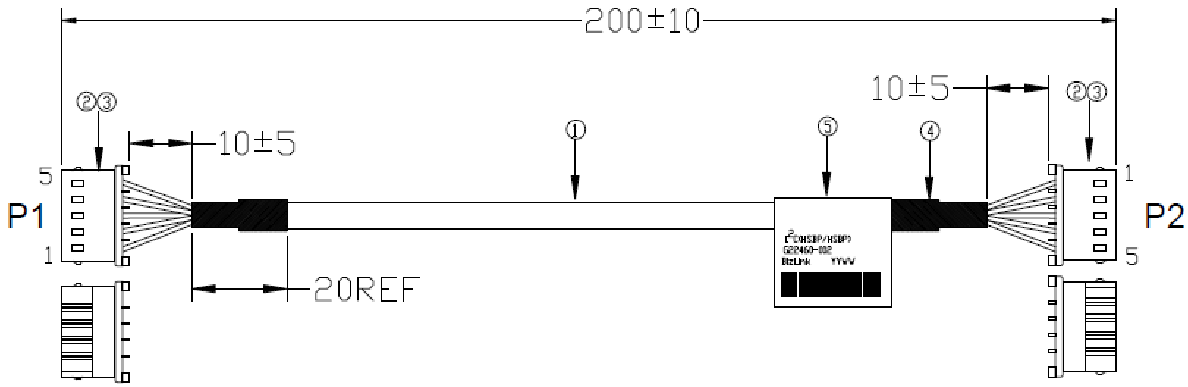


Figure 66. HSBP I2C Cable (5pin to 5pin)

7. System-Compatible Intel® Server Boards

The Intel® Server Chassis P4000M family supports the following Intel® server boards:

- Intel® Server Board S2600CP
- Intel® Server Board S2600CO
- Intel® Server Board S2400SC
- Intel® Server Board S2400GP

8. Reliability, Serviceability, and Availability

8.1 Mean Time between Failure

The following is the calculated Mean Time Between Failures (MTBF) at maximum configuration at 40°C (ambient air). These values are derived using a historical failure rate and multiplied by factors for application, electrical and/or thermal stress and for device maturity. MTBF estimates should be viewed as "reference numbers" only.

- Telcordia* SR_332 Issue II: Reliability Prediction Procedure
- Method 1: Parts Count Prediction
- Case III: Generic Value + Quality + Stress + Temperature
- Confidence Level: 90%
- Quality Level: II
- Temperature: Customer Specified (default 40 °C)
- Duty Cycle: Continuous, 100%
- Operating Environment: Ground Benign, Fixed, Controlled

Table 168. Calculated Mean Time Between Failure – P4308XXMFEN

Subassembly (Server in 40°C ambient air)	Intel® Server Chassis P4308XXMFEN	
	MTBF	FIT
	(Hours)	(Failures/10^ 9 hrs)
S2600CP Baseboard	216,557	4,618
Power Supply (550 W)	474,910	2,106
Non-redundant Cooling Fan – CPU Zone Fan	157,350	6,355
Non-redundant Cooling Fan – PCI Zone Fan	490,000	2,041
Front Panel board	8,272,282	121
RMM4	10,960,687	91
Totals withoutmotherboard=	55600	17,976
Totals with motherboard =	44200	22,594

Table 169. Calculated Mean Time Between Failure – P4308XXMHEN

Subassembly (Server in 40°C ambient air)	Intel® Server Chassis P4308XXMHEN	
	MTBF	FIT
	(Hours)	(Failures/10^ 9 hrs)
S2600CP Baseboard	216,557	4,618
Power Supply (550 W)	474,910	2,106
Non-redundant Cooling Fan – CPU Zone Fan	157,350	6,355
Non-redundant Cooling Fan – PCI Zone Fan	490,000	2,041
8x.3.5" HSBP	712,161	1,404
Front Panel board	8,272,282	121
RMM4	10,960,687	91
Totals withoutmotherboard=	51500	19,380
Totals with motherboard =	41600	23,998

Table 170. Calculated Mean Time Between Failure – P4308XXMFGN

Subassembly (Server in 40°C ambient air)	Intel® Server Chassis P4308XXMFGN	
	MTBF	FIT
	(Hours)	(Failures/10^ 9 hrs)
S2600CP Baseboard	216,557	4,618
Power Supply (One 750 W)	537,582	1,860
High Current PDB	1,726,969	579
Non-redundant Cooling Fan – CPU Zone Fan	157,350	6,355
Non-redundant Cooling Fan – PCI Zone Fan	490,000	2,041
Front Panel board	8,272,282	121
RMM4	10,960,687	91
Totals withoutmotherboard=	54600	18,309
Totals with motherboard =	43600	22,927

Table 171. Calculated Mean Time Between Failure – P4308XXMHGC

Subassembly (Server in 40°C ambient air)	Intel® Server Chassis P4308XXMHGC	
	MTBF	FIT
	(Hours)	(Failures/10^ 9 hrs)
S2600CP Baseboard	216,557	4,618
Power Supply (Two 750 W)	806,373	1,240
High Current PDB	1,726,969	579
Redundant Cooling Fan (x5)	108,708	9,199
8x3.5" HSBP	712,161	1,404
Front Panel board	8,272,282	121
RMM4	10,960,687	91
Totals withoutmotherboard=	79100	12,634
Totals with motherboard =	57900	17,252

Table 172. Calculated Mean Time Between Failure – P4208XXMHGC

Subassembly (Server in 40°C ambient air)	Intel® Server Chassis P4208XXMHGC	
	MTBF	FIT
	(Hours)	(Failures/10^ 9 hrs)
S2600CP Baseboard	216,557	4,618
Power Supply (Two 750 W)	806,373	1,240
High Current PDB	1,726,969	579
Redundant Cooling Fan (x5)	108,708	9,199
8x2.5" HSBP	2,750,894	364
Front Panel board	8,272,282	121
RMM4	10,960,687	91
Totals withoutmotherboard=	86200	11,594
Totals with motherboard =	61600	16,211

Table 173. Calculated Mean Time Between Failure –P4208XXMHGR

Subassembly (Server in 40°C ambient air)	Intel® Server Chassis P4208XXMHGR	
	MTBF	FIT
	(Hours)	(Failures/10^ 9 hrs)
S2600CP Baseboard	216,557	4,618
Power Supply (Two 750 W)	806,373	1,240
High Current PDB	1,726,969	579
Non-redundant Cooling Fan – CPU Zone Fan	157,350	6,355
Non-redundant Cooling Fan – PCI Zone Fan	490,000	2,041
8x2.5” HSBP	2,750,894	364
Front Panel board	8,272,282	121
RMM4	10,960,687	91
Totals withoutmotherboard=	55300	18,053
Totals with motherboard =	44100	22,671

Table 174. Calculated Mean Time Between Failure – P4208XXMHDR

Subassembly (Server in 40°C ambient air)	Intel® Server Chassis P4208XXMHDR	
	MTBF	FIT
	(Hours)	(Failures/10^ 9 hrs)
S2600CP Baseboard	216,557	4,618
Power Supply (Two 460 W)	1,186,122	843
Low Current PDB	1,726,969	579
Non-redundant Cooling Fan – CPU Zone Fan	157,350	6,355
Non-redundant Cooling Fan – PCI Zone Fan	490,000	2,041
8x2.5” HSBP	2,750,894	364
Front Panel board	8,272,282	121
RMM4	10,960,687	91
Totals withoutmotherboard=	56600	17,656
Totals with motherboard =	44800	22,274

Table 175. Calculated Mean Time Between Failure – P4208XXMHEN

Subassembly (Server in 40°C ambient air)	Intel® Server Chassis P4208XXMHEN	
	MTBF	FIT
	(Hours)	(Failures/10^ 9 hrs)
S2600CP Baseboard	216,557	4,618
Power Supply (550 W)	474,910	2,106
Non-redundant Cooling Fan – CPU Zone Fan	157,350	6,355
Non-redundant Cooling Fan – PCI Zone Fan	490,000	2,041
8x2.5" HSBP	2,750,894	364
Front Panel board	8,272,282	121
RMM4	10,960,687	91
Totals withoutmotherboard=	54500	18,339
Totals with motherboard =	43500	22,957

Table 176. Calculated Mean Time Between Failure – P4216XXMHJC

Subassembly (Server in 40°C ambient air)	Intel® Server Chassis P4216XXMHJC	
	MTBF	FIT
	(Hours)	(Failures/10^ 9 hrs)
S2600CP Baseboard	216,557	4,618
Power Supply (Two 1200 W)	888,444	1,126
High Current PDB	1,726,969	579
Redundant Cooling Fan (X5)	108,708	9,199
8x2.5" HSBP	1,375,447	727
Front Panel board	8,272,282	121
RMM4	10,960,687	91
Totals withoutmotherboard=	84400	11,843
Totals with motherboard =	60700	16,460

Table 177. Calculated Mean Time Between Failure – P4308XXMHJC

Subassembly (Server in 40°C ambient air)	Intel® Server Chassis P4308XXMHJC	
	MTBF (Hours)	FIT (Failures/10^ 9 hrs)
S2600CP Baseboard	216,557	4,618
Power Supply (Two 1200 W)	888,444	1,126
High Current PDB	1,726,969	579
Redundant Cooling Fan (X5)	108,708	9,199
8x3.5” HSBP	712,161	1,404
Front Panel board	8,272,282	121
RMM4	10,960,687	91
Totals withoutmotherboard=	79800	12,520
Totals with motherboard =	58300	17,138

8.2 Serviceability

The system is designed for service by qualified technical personnel only.

The desired Mean Time to Repair (MTTR) of the system is 30 minutes including the diagnosis of the system problem. To meet this goal, the system enclosure and hardware were designed to minimize the mean time to repair.

The following are the maximum times a trained field service technician should take to perform the listed system maintenance procedures after diagnosis of the system.

Table 178. Maximum Maintenance Procedure Times

Activity	Time Estimate
Remove cover	< 1 minute
Remove and replace fixed hard disk drive	<3 minutes
Remove and replace hot-swap hard disk drive	< 2 minutes
Remove and replace 5.25-inch peripheral device	< 1 minute
Remove and replace fixed power supply module	<5 minutes
Remove and replcae hot-swap power supply module	15 second
Remove and replace hot-swap power supply cage	<5 minutes
Remove and replace fixed fan	<2 minute
Remove and replace hot-swap fan	< 1 minute
Remove and replace expansion board (PCI Adaptor Card)	<2 minutes
Remove and replace backplane board	<5 minutes
Remove and replace front panel board	<3 minutes
Remove and replace server board (with no expansion boards)	<7 minutes
Overall Mean Time To Repair (MTTR)	<30 minutes

9. Environmental Limits

9.1 System Office Environment

The following table displays the System Office Environment summary:

Table 179. System Office Environment Summary

Parameter	Limits
Operating temperature	+10°C to +35°C with the maximum rate of change not to exceed 10°C per hour.
Non-operating temperature	-40°C to +70°C
Non-operating humidity	50% to 90%, non-condensing with a maximum wet bulb of 28° C (at temperatures from 25° C to 35° C)
Acoustic noise	7.0 BA LWA in a typical office ambient temperature (18-25°C)
Shock Operating	Half sine, 2 g, 11 milliseconds
Shock Unpackaged	Trapezoidal, 25 g, velocity change 136 inches/second (≧40 lbs to < 80 lbs)
Shock Packaged	Operational after a free fall of 9 – 36-inches depending on the weight
Vibration unpackaged	5 Hz to 500 Hz 2.20 g RMS random
Vibration packaged	5 Hz to 500 Hz 1.09 g RMS random
Packaged shock	Operational after a free fall of 9 – 36-inches depending on the weight
ESD	Air discharge: 0 to 15.0kV; Contact Discharge: 0 to 8.0kV

9.2 System Environmental Testing

The system will be tested per the *Environmental Standards Handbook*, Intel Doc 25-GS0009. These tests shall include:

- Acoustic Sound Power
- Temperature operating and non-operating
- Humidity non-operating
- Shock Operating, Shock Packaged and Shock unpackaged
- Vibration Packaged and Vibration Unpackaged
- AC, DC, and I/O Surge
- AC voltage, frequency, and source interrupt
- Conducted Immunity
- DC Voltage and Source Interrupt
- Electrical Fast Transient (EFT)
- Electrostatic discharge (ESD)
- Flicker and Voltage Fluctuation
- Power Frequency Magnetic Fields
- Power Line Harmonics
- Radiated Emissions
- Radiated Immunity
- Telecom Power Line Conducted Emissions

- Voltage Dip and Dropout
- Reliability Test

9.3 Intel® Server Chassis P4000M Family Acoustic Level

The following tables detail the declared acoustic data of Intel® Server Chassis P4000M family for reference.

9.3.1 Intel® Server Chassis P4000M Family with Intel® Server Board S2600CP

9.3.1.1 Test Conditions at Acoustic Lab

Table 180. Test Conditions at Acoustic Lab

Function	Conditions/Stress Software
Idle Mode	Windows-2k8R2 Idling
Stress Mode_TO1	IO meter + PTU_1.5 (Core 50%)
Stress Mode_TO2	IO meter + PTU_1.5 (Core & Memory 50%)

9.3.1.2 Test Environment

The room temperature shall be 23°C+/-2°C, recommend related humidity is 40% ~70% based on ISO-7779 standard.

9.3.1.3 Declared Acoustic Data

Table 181. System Configurations

	Configuration 1	Configuration 2	Configuration 3
Chassis	P4308XXMHEN	P4308XXMHGR	P4208XXMHGC
Motherboard	S2600CP	S2600CP	S2600CP
CPU TDP	130W	130W	130W
Memory	2GB 2RX8 fully populated	2GB 2RX8 fully populated	2GB 2RX8 fully populated
PCI card	3 PCI cards	3 PCI cards	3 PCI cards
HDD	Half quantity populated (4x3.5" HDDs)	Half quantity populated (4x3.5" HDDs)	Half quantity populated (4x2.5" HDDs)
Stress mode	Idle Mode/TO1/TO2	Idle Mode/TO1/TO2	Idle Mode/TO1/TO2

Table 182. Declared Acoustic Data of Intel® Server Chassis P4000M family with Intel® Server Board S2600CP

Conditions	Declared A-weighted Sound Power Level per ISO9296, LwAd (BA)		
	Configuration 1	Configuration 2	Configuration 3
Idle Mode	4.77	4.89	4.28
Stress Mode_TO1	4.79	5.08	4.39
Stress Mode_TO2	4.79	5.07	4.61

9.3.2 Intel® Server Chassis P4000M Family with Intel® Server Board S2600CO

9.3.2.1 Test Conditions at Acoustic Lab

Table 183. Test Conditions at Acoustic Lab

Function	Conditions/Stress Software
Idle Mode	Windows-2k8R2 Idling
Stress Mode_TO1	IO meter + PTU_1.5 (Core 50%)
Stress Mode_TO2	IO meter + PTU_1.5 (Core & Memory 50%)
Stress Mode_TO3	IO meter + GPGPU CV utility

9.3.2.2 Test Environment

The room temperature shall be 23°C+/-2°C, recommend related humidity is 40% ~70% based on ISO-7779 standard.

9.3.2.3 Declared Acoustic Data

Table 184. System Configurations

	Configuration 1	Configuration 2	Configuration 3
Chassis	P4308XXMHEN	P4308XXMHGC	P4208XXMHGR
Motherboard	S2600CO	S2600CO	S2600CO
CPU TDP	130W	130W	150W
Memory	2GB 2RX8 fully populated	2GB 2RX8 fully populated	2GB 2RX8 fully populated
PCI card	3 PCI cards	1 GPU Card	1 GPU Card
HDD	Half quantity populated (4x3.5" HDDs)	Half quantity populated (4x3.5" HDDs)	Half quantity populated (4x2.5" HDDs)
Stress mode	Idle Mode/TO1/TO2	Idle Mode/TO1/TO2/TO3	Idle Mode/TO1/TO2/TO3

Table 185. Declared Acoustic Data of Intel® Server Chassis P4000M family with Intel® Server Board S2600CO

Conditions	Declared A-weighted Sound Power Level per ISO9296, LwAd (BA)		
	Configuration 1	Configuration 2	Configuration 3
Idle Mode	4.79	4.44	4.71
Stress Mode_TO1	4.82	4.44	5.43
Stress Mode_TO2	4.96	4.50	5.48
Stress Mode_TO3	NA	4.59	5.31

9.3.3 Intel® Server Chassis P4000M Family with Intel® Server Board S2600GP

9.3.3.1 Test Conditions at Acoustic Lab

Table 186. Test Conditions at Acoustic Lab

Function	Conditions/Stress Software
Idle Mode	OS Idling
Stress Mode_TO1	IO meter + PTU_1.5 (Core 50%)
Stress Mode_TO2	IO meter + PTU_1.5 (Core & Memory 50%)

9.3.3.2 Test Environment

The room temperature shall be 23°C+/-2°C, recommend related humidity is 40% ~70% based on ISO-7779 standard.

9.3.3.3 Declared Acoustic Data

Table 187. System Configurations

	Configuration 1	Configuration 2
Chassis	P4308XXMHGR	P4308XXMHGC
Motherboard	S2600GP	S2600GP
CPU TDP	95W	95W
Memory	R/C DRX8 fully populated	R/C DRX8 fully populated
GPGPU/card	3 PCI cards	1 GPU Card
HDD	Half quantity populated (4x3.5" HDDs)	Half quantity populated (4x3.5" HDDs)
Stress mode	Idle Mode/TO1/TO2	Idle Mode/TO1/TO2

Table 188. Declared Acoustic Data of Intel® Server Chassis P4000M family with Intel® Server Board S2600GP

Conditions	Declared A-weighted Sound Power Level per ISO9296, LwAd (BA)	
	Configuration 1	Configuration 2
Idle Mode	4.38	4.38
Stress Mode_TO1	4.4	4.4
Stress Mode_TO2	4.57	4.57

9.3.4 Intel® Server Chassis P4000M Family with Intel® Server Board S2600SC

9.3.4.1 Test Conditions at Acoustic Lab

Table 189. Test Conditions at Acoustic Lab

Function	Conditions/Stress Software
Idle Mode	OS Idling
Stress Mode_TO	IO meter + PTU_1.5 (Core & Memory 50%)

9.3.4.2 Test Environment

The room temperature shall be 23°C+/-2°C, recommend related humidity is 40% ~70% based on ISO-7779 standard.

9.3.4.3 Declared Acoustic Data

Table 190. System Configurations

	Configuration 1	Configuration 2	Configuration 3	Configuration 4
Chassis	P4216XXMHGC	P4216XXMHDC	P4216XXMHGR	P4216XXMHEN
Motherboard	S2600SC	S2600SC	S2600SC	S2600SC
CPU TDP	95W	95W	95W	95W
Memory	4GB 2Rx4 RDIMM fully populated	4GB 2Rx4 RDIMM fully populated	4GB 2Rx4 RDIMM fully populated	4GB 2Rx4 RDIMM fully populated
PCI card	3 PCI cards	3 PCI cards	3 PCI cards	3 PCI cards
HDD	Half quantity populated (8x2.5” HDDs)	Half quantity populated (8x2.5” HDDs)	Half quantity populated (8x2.5” HDDs)	Half quantity populated (8x2.5” HDDs)
Stress mode	Idle Mode/TO	Idle Mode/TO	Idle Mode/TO	Idle Mode/TO

Table 191. Declared Acoustic Data of Intel® Server Chassis P4000M family with Intel® Server Board S2600SC

Conditions	Declared A-weighted Sound Power Level per ISO9296, LwAd (BA)			
	Configuration 1	Configuration 2	Configuration 3	Configuration 4
Idle Mode	4.9	4.8	5.0	5.2
Stress Mode_TO	5.6	5.5	5.5	5.5

Appendix A: Integration and Usage Tips

This appendix provides a list of useful information that is unique to the Intel® Server Chassis P4000M family and should be kept in mind while integrating and configuring your server.

The Intel® Local Control Panel can only be used with systems configured with an Intel® Management Module.

Make sure the latest system software is loaded on the server. This includes system BIOS, FRU/SDR, BMC firmware, and hot-swap controller firmware. The latest system software can be downloaded from http://www.intel.com/support/motherboards/server/.

Glossary

Word/Acronym	Definition
ACA	Australian Communication Authority
ANSI	American National Standards Institute
ATA	Advanced Technology Attachment
ATX	Advanced Technology Extended
Auto-Ranging	Power supply that automatically senses and adjust itself to the proper input voltage range (110 VAC or 220 VAC). No manual switches or manual adjustments are needed.
BMC	Baseboard Management Controller
CFM	Cubic Feet per Minute (airflow)
CMOS	Complementary Metal Oxide Silicon
Dropout	A condition that allows the line voltage input to the power supply to drop to below the minimum operating voltage.
EEB	Entry-level Electronics Bay
EM	Expander Management
EMC	Electromagnetic compatibility,
EMI	Electromagnetic Interference
EMP	Emergency Management Port
ESD	Electrostatic Discharge
FIT	Failures In Time
FP	Front Panel
FRB	Fault Resilient Booting
FRU	Field Replaceable Unit
GPIO	General Purpose Input and Output
HSBP	Hot-swap Backplane
I/O	Input/Output
I2C	Inter-Integrated Circuit
IPMB	Intelligent Platform Management Bus
IPMI	Intelligent Platform Management Interface
Latch Off	A power supply, after detecting a fault condition, shuts itself off. Even if the fault condition disappears, the supply does not restart unless manual or electronic intervention occurs. Manual intervention commonly includes briefly removing and then reconnecting the supply, or using a switch. Electronic intervention can be completed by electronic signals in the Server System.
LCD	Liquid Crystal Display
LCP	Local Control Panel
LPC	Low-Pin Count
LQFP	Lower Profile Quad Flat Pack
Monotonically	A waveform changes from one level to another in a steady fashion, without intermediate retrenchment or oscillation.
MTBF	Mean Time Between Failure
MTTR	Mean Time to Repair
Noise	The periodic or random signals over frequency band of 10 Hz to 20 MHz.

Word/Acronym	Definition
OCP	Over Current Protection
OTP	Over Temperature Protection
Over-current	A condition in which a supply attempts to provide more output current than the amount for which it is rated. This commonly occurs if there is a ‘short circuit’ condition in the load attached to the supply.
OVP	Over Voltage Protection
PDB	Power Distribution Board
PFC	Power Factor Correction
PMBus*	Power Management Bus
PSU	Power Supply Unit
PWM	Pulse Width Modulate
ppm	Parts per million
PWOK	A typical logic level output signal provided by the supply that signals the Server System that all DC output voltages are within their specified range
RI	Ring Indicate
Ripple	The periodic or random signals over frequency band of 10 Hz to 20 MHz.
Rise Time	The time it takes any output voltage to rise from 10% to 95% of its nominal voltage.
Sag	The condition where the AC line voltage drops below the nominal voltage conditions
SAS	Serial Attached SCSI
SATA	Serial ATA
SCA	Single Connector Attachment
SCSI	Small Computer System Interface
SDK	Software Development Kit
SDR	Sensor Data Record
SE	Single-Ended
SES	SCSI Enclosure Service
SGPIO	Serial General Purpose Input/Output
SMBUS*	System Management Bus
SSI	Server System Infrastructure
Surge	AC line voltage rises above nominal voltage
TACH	Tachometer
THD	Total Harmonic Distortion
UART	Universal Asynchronous Receiver Transmitter
USB	Universal Serial Bus
VCCI	Voluntary Control Council for Interference
VSB or Stand By	An output voltage that is present whenever AC power is applied to the AC inputs of the supply.