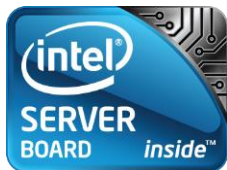


# Intel<sup>®</sup> Server Chassis P4304XXMFEN2 / P4304XXMUXX

## *Technical Product Specification*



Revision 1.2

August 2015

Intel<sup>®</sup> Server Boards and Systems

## ***Revision History***

| Date            | Revision Number | Modifications  |
|-----------------|-----------------|--|
| September, 2014 | 1.0             | Initial release                                      |
| May, 2015       | 1.1             | Update air duct, HTA table and dummy filler          |
| August, 2015    | 1.2             | Updated Chapter 8.4 CWP Thermal Configuration Matrix |

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# 1. Product Overview

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The Intel® Server Chassis P4304XXMFEN2 / P4304XXMUXX is a 4U pedestal, 25" length server chassis that is designed to support the Intel® Server Board S2600CW. 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 P4304XXMFEN2 / P4304XXMUXX Design Features

The Intel® Server Chassis P4304XXMFEN2 / P4304XXMUXX makes extensive use of tool-less hardware features and, depending on configuration and upgrade features, provides redundant power supply and redundant cooling capability. The standard chassis configuration is pedestal and it provides rackable feature.

## 1.2 Intel® Server Chassis P4304XXMFEN2 / P4304XXMUXX Product Configurations

The Intel® Server Chassis P4304XXMFEN2 / P4304XXMUXX comes with the following configurations:

- P4304XXMFEN2 – One 550W non-redundant fixed PSU, two non-redundant fixed 120mmx38mm system fans, and supports up to four 3.5" fixed hard drives. Supports the Intel® Server Board S2600CW only.
- P4304XXMUXX – No pre-installed PSU, five redundant hot-swap 80mmx38mm system fans, and supports up to four 3.5" fixed hard drives. Supports the Intel® Server Board S2600CW only. Optional 750W and 1600W PSUs are supported and available separately.

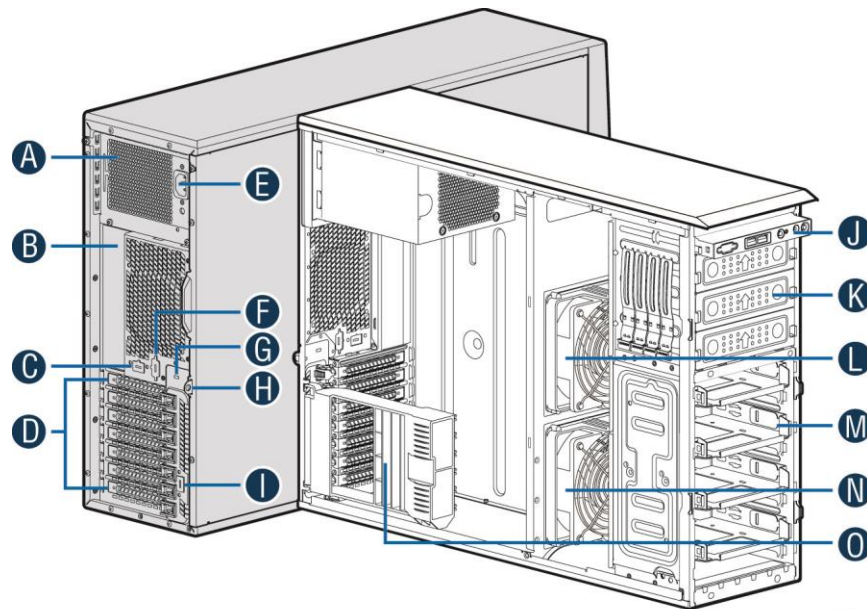
The following table summarizes the features for all chassis combinations.

Table 1. Intel® Server Chassis P4304XXMFEN2/P4304XXMUXX Family Features

| Configuration               | P4304XXMFEN2  | P4304XXMUXX   |
|-----------------------------|---|---|
| Intel® Server Board Support | Intel® Server Board S2600CW   |   |
| Power                       | 550W non-redundant fixed power supply   | High current PDB installed, no power supply installed. 750W and 1600W hot-swap power supplies are supported but need to order separately. |
| System Cooling              | Two 120mmx38mm non-redundant fans   | Five 80mmx38mm 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 four 3.5" fixed hard drives.           |   |
| Expansion Slots             | Supports 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, |   |

| Configuration       | P4304XXMFEN2   | P4304XXMUXX |
|---------------------|--|-------------|
|                     | 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.<br>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)  |             |

### 1.3 Intel® Server Chassis P4304XXMFEN2 View



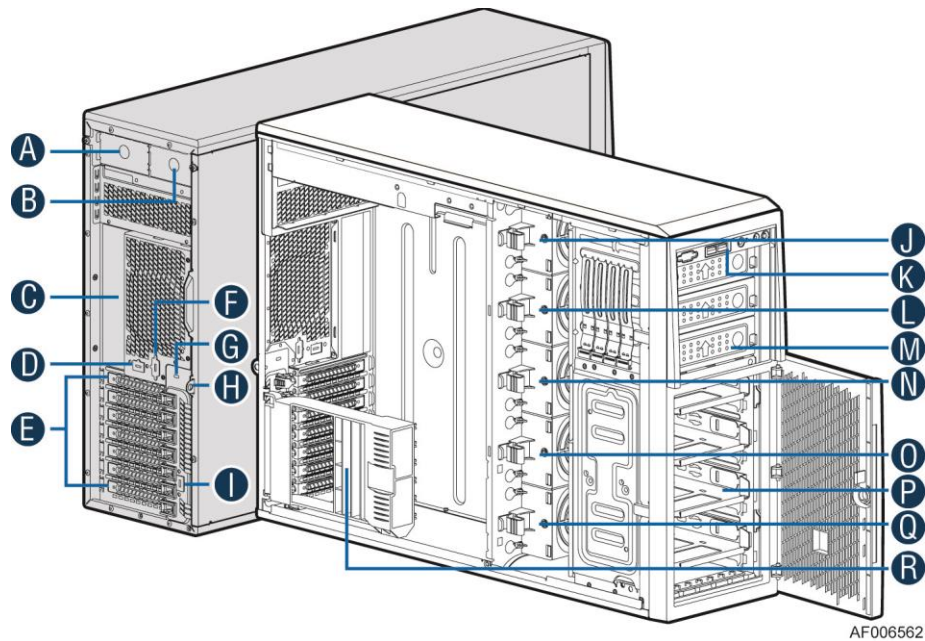
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- A. 550W Fixed Power Supply
- B. I/O Ports
- C. Alternate RMM4 Knockout
- D. PCI Add-in Board Slot Covers
- E. AC Input Power Connector
- F. Serial Port Knockout
- G. A Kensington\* Cable Lock Mounting Hole
- H. Padlock Loop
- I. Alternate RMM4 Knockout
- 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 1. Internal Chassis View of Intel® Server Chassis P4308XXMFEN2



## 1.4 Intel® Server Chassis P4304XXMUXX View



- A. Filler for Hot-swap Power Supply (only one in A or B position)
- B. Filler for Hot-swap Power Supply (only one in A or B position)
- 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. Fixed Hard Drive Carrier Tray
- Q. Hot-swap System Fan 1
- R. PCI Card Retainer

Figure 2. Internal Chassis View of Intel® Server Chassis P4308XXMUXX

## 1.5 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>.

---

## 1.6 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.

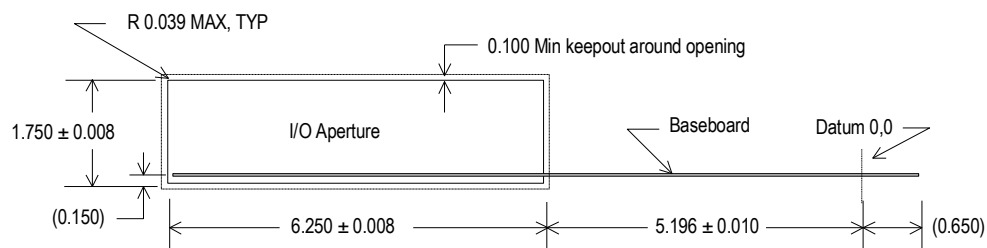


Figure 3. ATX 2.2 I/O Aperture

## 1.7 Front Bezel Features

There are two types of front bezel assembly in the Intel® Server Chassis P4304XXMFEN2 / P4304XXMUXX.

### 1. Front bezel assembly for P4304XXMFEN2

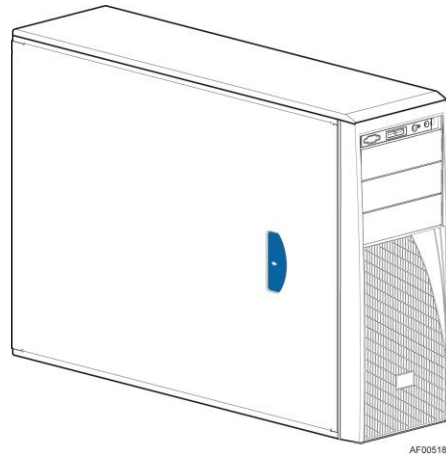
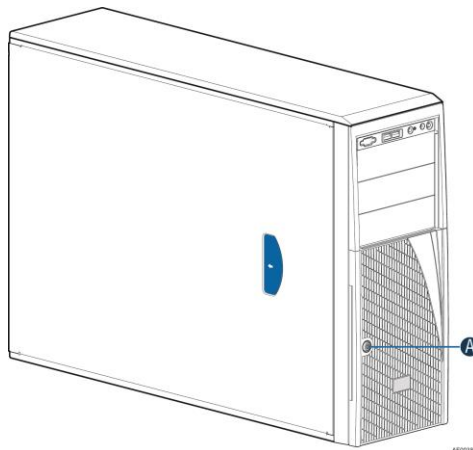


Figure 4. Front Closed Chassis View for Fixed Hard Drives Configuration

### 2. Front bezel assembly for P4304XXMUXX



A. Security Lock

Figure 5. Front Closed Chassis View for Hot-swap Hard Drives Configuration

Both pedestal front bezels are constructed of molded plastic and attach 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 drive bay area.

For the front bezel assembly for hot-swap hard drive 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.

---

**Note:** The chassis P4304XXMUXX is configured for fixed hard drive support by default, and supports hot-swap drive bay(s) as upgrade options.

---

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.

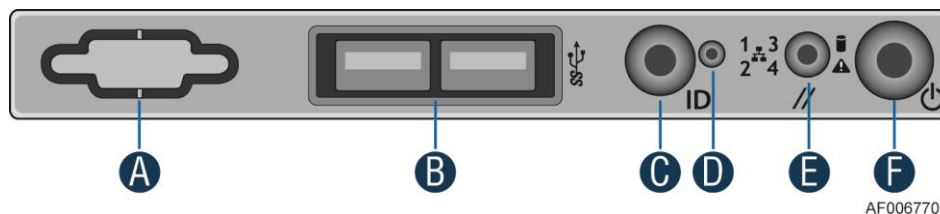
## 1.8 Front Panel Overview

This Front Control Panel conforms to SSI Specification with one exception that up to four LAN act/link LEDs are supported. The common front panel can support either the standard SSI 2x12 cable interconnect (two LAN ports) or an Intel customized 2x15 cable interconnect (four LAN ports). The Intel® Server Board S2600CW uses 2x12 pin Front Control Panel connector.

The Front Control Panel has the following features:

- Power button with integrated power LED (green)
- System ID with integrated ID LED (blue)
- System Status LED (green/amber)
- System Reset button
- HDD activity LED
- Four NIC activity/link LEDs
- NMI button
- Two USB 3.0 ports

The following figure shows the layout of the Front Control Panel of the Intel® Server Chassis P4304XXMFEN2/P4304XXMUXX.

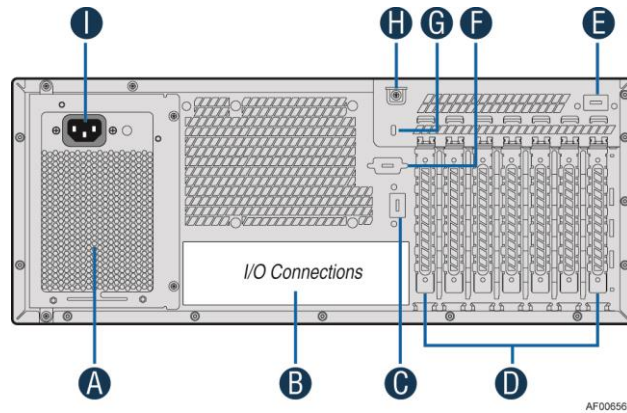


|   |                |   |                     |
|---|----------------|---|---------------------|
| A | Reserved       | D | NMI Button          |
| B | USB connectors | E | System Reset Button |
| C | ID Button      | F | Power Button        |

Figure 6. Front Panel Controls and Indicators

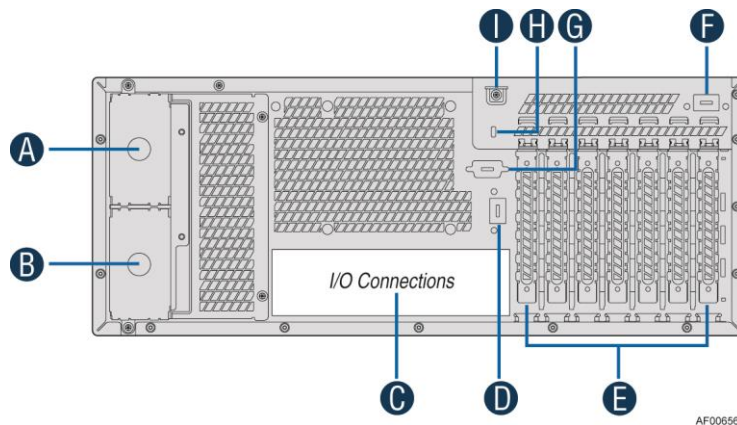
## 1.9 Back Panel Overview

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 (Optional)      | H | Padlock Loop                         |
| D | Add in PCI-e cards       | I | Power Connector                      |
| E | RMM4 NIC Port (Optional) |   |                                      |

Figure 7. Back Panel Layout (with Fixed Power Supply)



|     |  |   |                                      |
|-----|--|---|--------------------------------------|
| A/B | Hot-swap Power Supply Filler (may only have one) | F | RMM4 NIC Port (Optional)             |
| C   | IO Connectors                                    | G | Serial-B Port (Optional)             |
| D   | RMM4 NIC (Optional)                              | H | Kensington* Cable Lock Mounting Hole |
| E   | Add in PCI-e cards                               | I | Padlock Loop                         |

**Note:** There may be only one filler available at position A and B.

Figure 8. Back Panel Layout (with Hot-swap Power Supply)

## 1.10 Standard Fixed Drive Trays

The Intel® Server Chassis P4304XXMFEN2 / P4304XXMUXX supports up to eight 3.5" fixed Hard Disk Drive trays. The default configuration may include four drive trays. You can secure each of the drives on the drive trays with screws, and install the drive trays in the chassis without a tool.

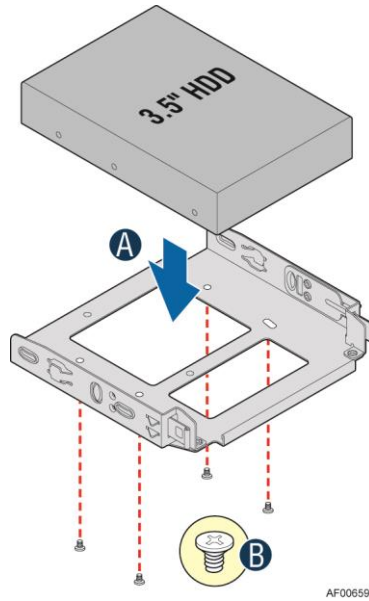


Figure 9. Fixed Drive Tray

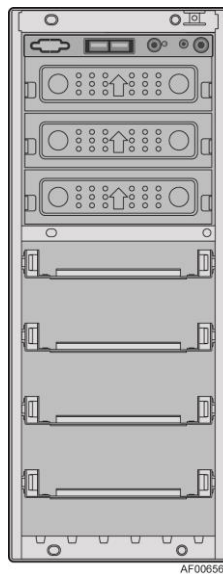


Figure 10. Four Fixed Drive Trays in P4304XXMFEN2 / P4304XXMUXX

### 1.11 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.

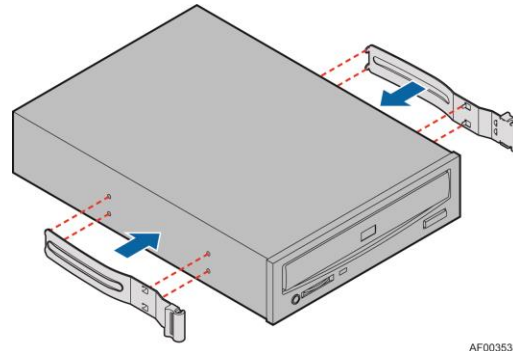


Figure 11. Tool-less Rails Mounting 5.25" CD-ROM Drive

### 1.12 Rack Options

The Intel® Server Chassis P4304XXMFEN2 / P4304XXMUXX 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.

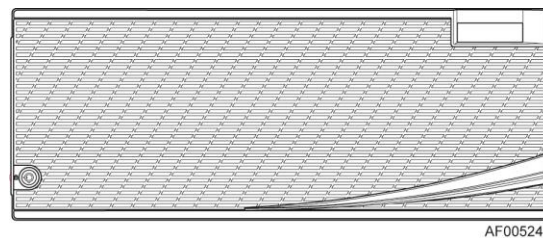


Figure 12. Optional Rack Bezel

Rack rail options include AXXELVRAIL and AXX3U5UPRAIL.

Table 2. AXXELVRAIL and AXX3U5UPRAIL Rack Options

| AXXELVRAIL   | AXX3U5UPRAIL  |
|--|---|
| <ul style="list-style-type: none"> <li>▪ 3U to 5U compatible</li> <li>▪ Tool-less chassis attachment (optional screws)</li> <li>▪ Tools required to attach rails to rack</li> <li>▪ 1/2 extension from rack</li> </ul> | <ul style="list-style-type: none"> <li>▪ 3U to 5U compatible</li> <li>▪ Tool-less installation</li> <li>▪ Full extension from rack</li> <li>▪ Stab in system installation</li> <li>▪ Optional cable management arm support</li> </ul> |

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**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.

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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                          |
| 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 Mini-Fit 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  | PSO#     | 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   | °C     |
| $T_{non-op}$ | Non-operating temperature range. | -40 | 70   | °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 <sub>rms</sub>  | 100-127 V <sub>rms</sub> | 140 V <sub>rms</sub> | 85VAC +/-4VAC | 70VAC +/-5VAC |
| Voltage (220) | 180 V <sub>rms</sub> | 200-240 V <sub>rms</sub> | 264 V <sub>rms</sub> |               |               |
| 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 1/2 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  $\Delta$  step load may occur anywhere within the MIN load to the MAX load conditions.

Table 19. Transient Load Requirements

| Output          | $\Delta$ Step Load Size<br>(See note 2) | Load Slew Rate   | Test capacitive Load        |
|-----------------|---|------------------|-----------------------------|
| +3.3V           | 6.0A                                    | 0.5 A/ $\mu$ sec | 970 $\mu$ F                 |
| +5V             | 4.0A                                    | 0.5 A/ $\mu$ sec | 400 $\mu$ F                 |
| 12V1+12V2 +12V3 | 23.0A                                   | 0.5 A/ $\mu$ sec | 2200 $\mu$ F <sup>1,2</sup> |
| +5VSB           | 0.5A                                    | 0.5 A/ $\mu$ sec | 20 $\mu$ F                  |

**Notes:**

1. Step loads on each 12V output may happen simultaneously.
2. The +12V should be tested with 2200 $\mu$ F 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 | $\mu$ F |

| Output | Min | Max  | Units |
|--------|-----|------|-------|
| +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 setup 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 setup shall be as shown below.

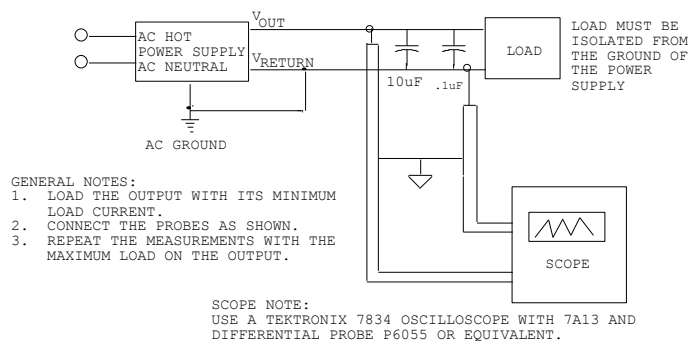


Figure 15. Differential Noise Test Setup

**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    |

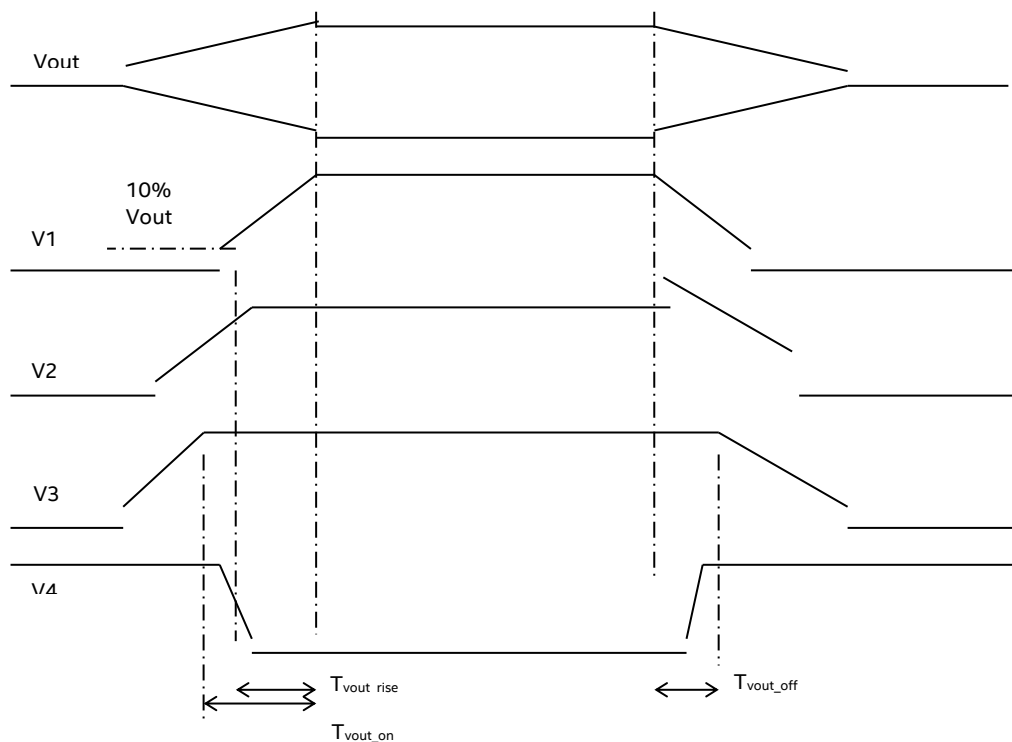


Figure 16. Output Voltage Timing

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 being in regulation at AC turn on.                          | 10  | 1000 | ms    |
| $T_{5VSB\_holdup}$    | Time the 5VSB output voltage stays within regulation after loss of AC.                                  | 70  |      | ms    |

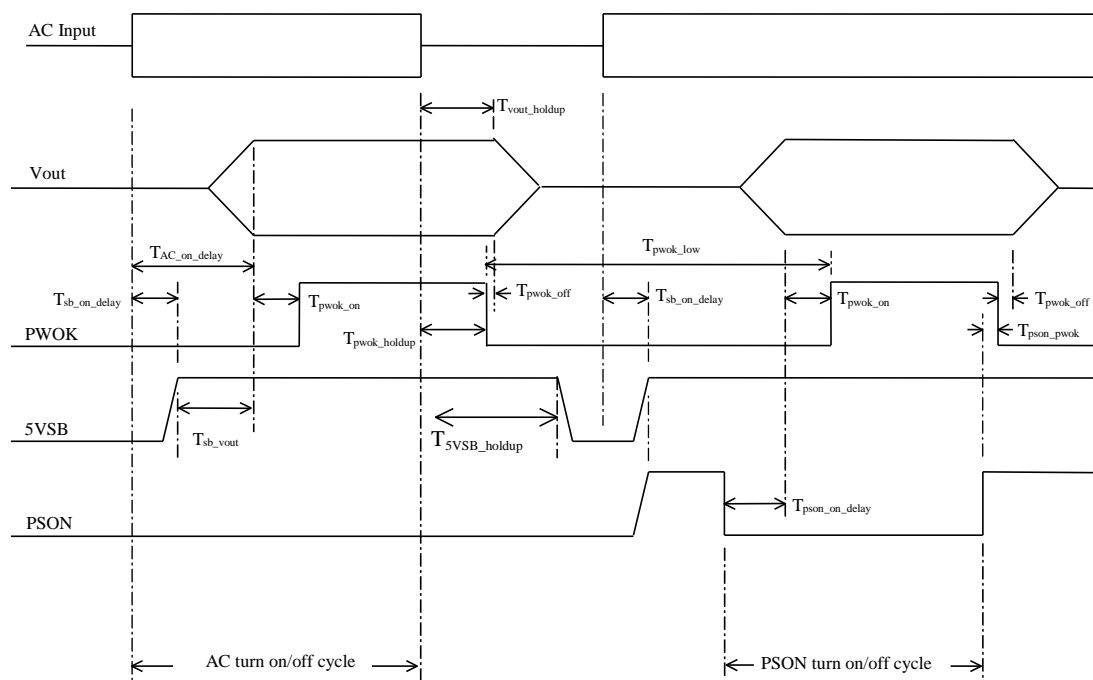


Figure 17. Turn On/Off Timing (Power Supply Signals)

## 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       |
| -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 17 for the timing diagram.

Table 25. PSON# Signal Characteristic

| Signal Type                         | Accepts an open collector/drain input from the system.<br>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   |

|  |   |         |
|--|---|---------|
| Signal Type                                | Accepts an open collector/drain input from the system.<br>Pull-up to VSB located in power supply. |         |
| Power up delay: T <sub>pson_on_delay</sub> | 5msec   | 400msec |
| PWOK delay: T <sub>pson_pwok</sub>         |   | 50msec  |

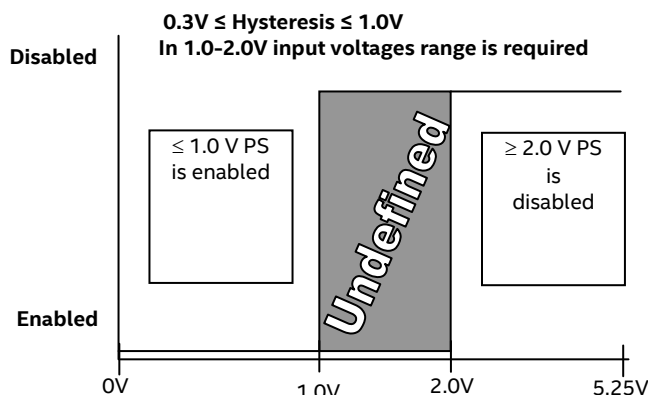


Figure 18. PSON# Required Signal Characteristic

### 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 be 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.<br>Pull-up to VSB located in system. |         |
| PWOK = High  | Power OK  |         |
| PWOK = Low   | Power Not OK  |         |
|  | MIN   | MAX     |
| Logic level low voltage, I <sub>sink</sub> =4mA      | 0V  | 0.4V    |
| Logic level high voltage, I <sub>source</sub> =200μA | 2.4V  | 5.25V   |
| Sink current, PWOK = low                             |   | 4mA     |
| Source current, PWOK = high                          |   | 2mA     |
| PWOK delay: T <sub>pwok_on</sub>                     | 100ms   | 500ms   |
| PWOK rise and fall time                              |   | 100μsec |
| Power down delay: T <sub>pwok_off</sub>              | 1ms   |         |

## 2.2 750W Power Supply (Optional)

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.

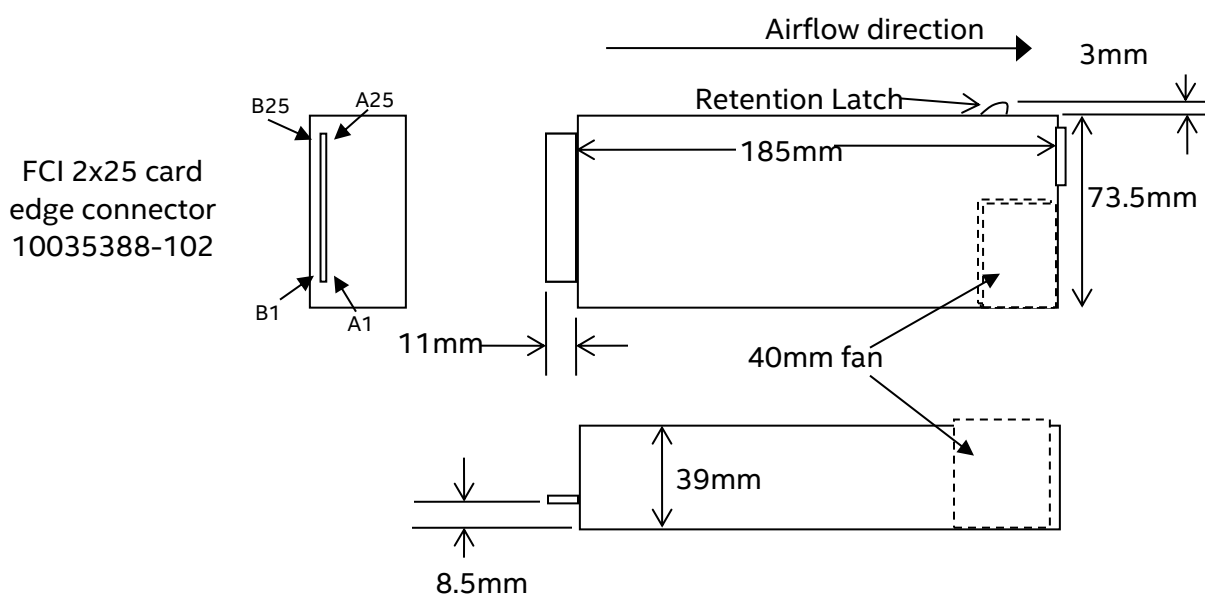


Figure 19. 750W Power Supply Outline Drawing

#### 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  |



| Pin | Name              | Pin | Name                    |
|-----|-------------------|-----|-------------------------|
| 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 |

### 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 $\lambda_d$ Wavelength | Nominal $\lambda_d$ Wavelength | Max $\lambda_d$ 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 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:

- 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.
- $T_{op\_rackped\_900}$  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 <sub>MAX</sub>     | Start up VAC  | Power Off VAC |
|---------------|----------------------|--------------------------|----------------------|---------------|---------------|
| Voltage (110) | 90 V <sub>rms</sub>  | 100-127 V <sub>rms</sub> | 140 V <sub>rms</sub> | 85VAC +/-4VAC | 74VAC +/-5VAC |
| Voltage (220) | 180 V <sub>rms</sub> | 200-240 V <sub>rms</sub> | 264 V <sub>rms</sub> |               |               |
| 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 12VSB Holdup

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 1/2 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:**

- 12Vstby must provide 4.0A with two power supplies in parallel. The Fan may work when stby current >1.5A.
- 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 <sub>rms</sub> |
| +12V stby | - 5%/+5%  | +11.40 | +12.00 | +12.60 | V <sub>rms</sub> |

#### 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  $\Delta$  step load may occur anywhere within the MIN load to the MAX load conditions.

Table 39. Transient Load Requirements

| Output | $\Delta$ Step Load Size<br>(See note 2) | Load Slew Rate    | Test capacitive Load |
|--------|---|-------------------|----------------------|
| +12VSB | 1.0A                                    | 0.25 A/ $\mu$ sec | 20 $\mu$ F           |
| +12V   | 60% of max load                         | 0.25 A/ $\mu$ sec | 2000 $\mu$ F         |

**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  | $\mu$ F |
| +12V   | 500 | 25000 | $\mu$ F |

#### 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 m $\Omega$ . 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 setup 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 setup shall be as shown below.

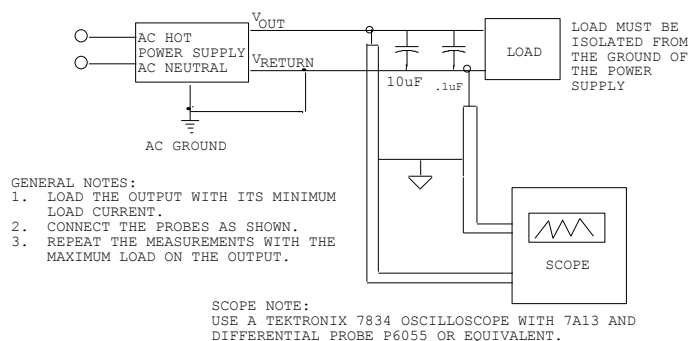


Figure 20. Differential Noise Test Setup

**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 12VSB being 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    |
| $T_{pwok\_low}$       | 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 12VSB being in regulation to O/Ps being in regulation at AC turn on.                     | 50    | 1000 | ms    |
| $T_{12VSB\_holdup}$   | Time the 12VSB output voltage stays within regulation after loss of AC.                             | 70    |      | ms    |

\* The 12VSB output voltage rise time shall be from 1.0ms to 25ms.



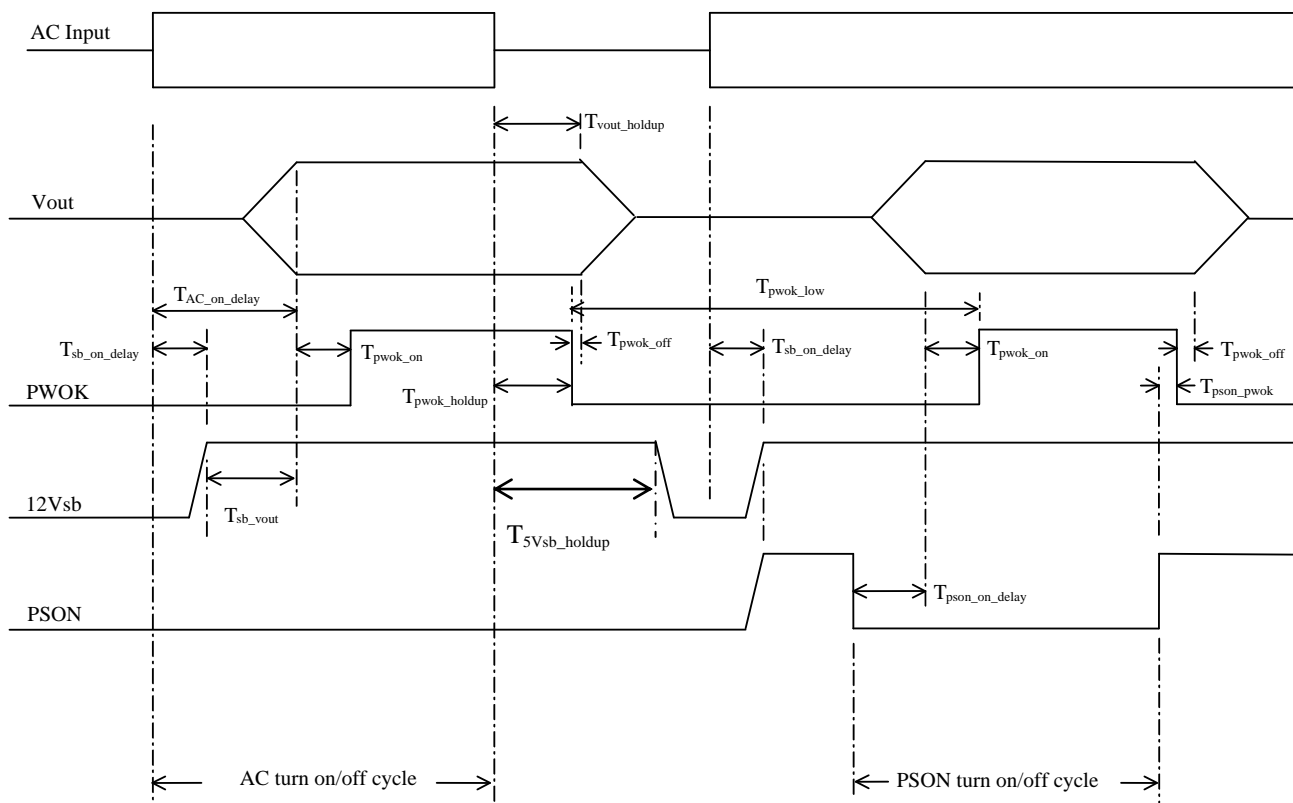


Figure 21. Turn On/Off Timing (Power Supply Signals)

## 2.2.5 Protection Circuits

Protection circuits inside the power supply causes only the power supply's main outputs to 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 are 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. 12VSB will 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 Figure 21 for the timing diagram.

Table 45. PSON# Signal Characteristic

| Signal Type                         | Accepts an open collector/drain input from the system.<br>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   |

|  |   |         |
|--|---|---------|
| Signal Type                                | Accepts an open collector/drain input from the system.<br>Pull-up to VSB located in power supply. |         |
| Power up delay: T <sub>pson_on_delay</sub> | 5msec   | 400msec |
| PWOK delay: T <sub>pson_pwok</sub>         |   | 50msec  |

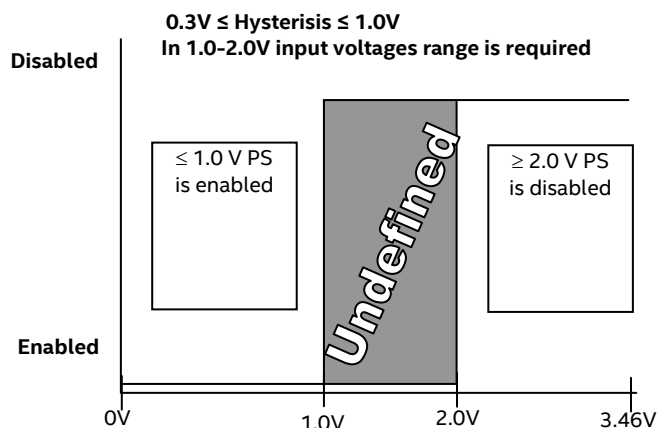


Figure 22. PS0N# Required Signal Characteristic

### 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 45 for a representation of the timing characteristics of PWOK. The start of the PWOK delay time shall be 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.<br>Pull-up to VSB located in the power supply. |         |
| PWOK = High  | Power OK  |         |
| PWOK = Low   | Power Not OK  |         |
|  | MIN   | MAX     |
| Logic level low voltage, I <sub>sink</sub> =400uA    | 0V  | 0.4V    |
| Logic level high voltage, I <sub>source</sub> =200uA | 2.4V  | 3.46V   |
| Sink current, PWOK = low                             |   | 400uA   |
| Source current, PWOK = high                          |   | 2mA     |
| PWOK delay: T <sub>pwok_on</sub>                     | 100ms   | 1000ms  |
| PWOK rise and fall time                              |   | 100uA   |
| Power down delay: T <sub>pwok_off</sub>              | 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 $\mu$ A |  | 3.46 V      |
| Sink current, Alert# = low                 |  | 4 mA        |
| Sink current, Alert# = high                |  | 50 $\mu$ A  |
| Alert# rise and fall time                  |  | 100 $\mu$ s |

### 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 1600W Power Supply (Optional)

This specification defines a 1600W redundant power supply that supports server systems. The parameters of this power supply are defined in this specification. The single power supply module has Platinum level energy efficiency.

### 2.3.1 Mechanical Overview

The power supply module has a simple retention mechanism to retain the module self once it is inserted. This mechanism shall withstand the specified mechanical shock and vibration requirements. The power distribution board will be fixed in the chassis with screws.

#### 2.3.1.1 AC Power Supply Unit Dimension Overview

The casing dimension is W 73.5mm x L 265.0mm x H 39/40mm. 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.

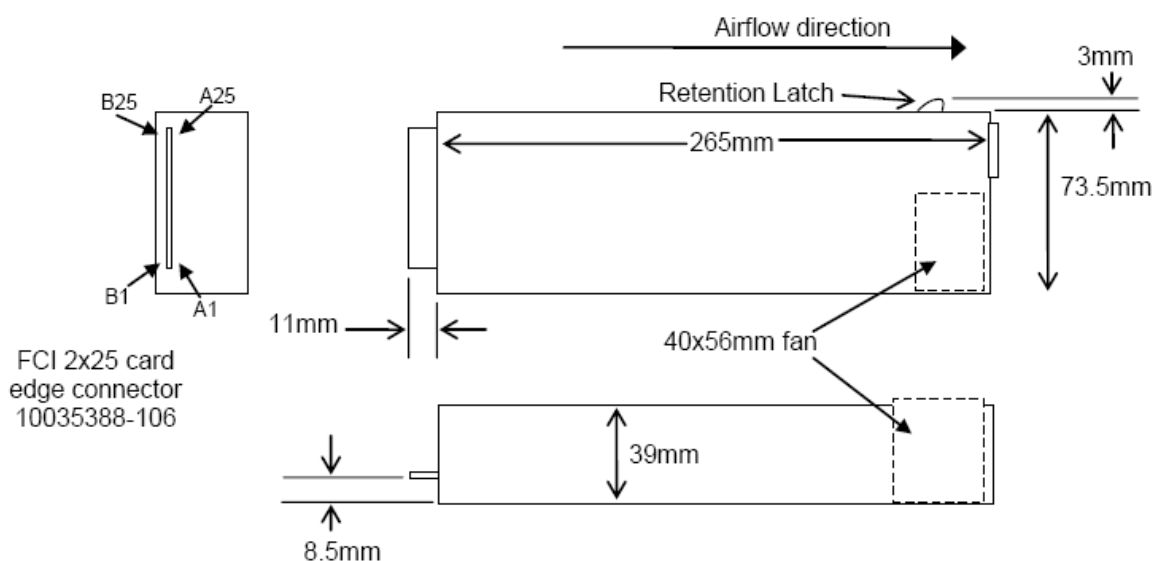


Figure 23. AC Power Supply Unit Dimension Overview

#### 2.3.1.2 AC Power Supply Unit General Data

Below is general specification data for AC Power Supply Unit.

Table 48. Specification Data for AC Power Supply Unit

|         |   |
|---------|---|
| Wattage | 1600W (Energy Smart)                    |
| Voltage | 90 – 264 VAC, auto-ranging, 47 Hz-63 Hz |

|                           |   |
|---------------------------|---|
| Heat Dissipation          | 2560 BTU/hr   |
| Maximum Inrush Current    | Under typical line conditions and over the entire system ambient operating range, the inrush current may reach 65 A per power supply for 5 ms |
| 80 Plus rating            | Platinum  |
| Climate Saver (CS) rating | Platinum  |

### 2.3.1.3 AC Input Connector

The power supply has an internal IEC320 C14 power inlet. The inlet is rated for a minimum of 10A at 250VAC.

### 2.3.1.4 AC Power Cord Specification Requirements

The AC power cord used must meet the following specification requirements.

Table 49. AC Power Cord Specification

|                    |        |
|--------------------|--------|
| Cable Type         | SJT    |
| Wire Size          | 16 AWG |
| Temperature Rating | 105°C  |
| Amperage Rating    | 13A    |
| Cable Type         | SJT    |

### 2.3.1.5 Power Supply Unit DC Output Connector

The DC output connector pin-out is defined as follows.

Table 50. DC Output Power Connector

| PSU Output Connector |      |     |      |
|----------------------|------|-----|------|
| 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 |

| PSU Output Connector |                   |     |                               |
|----------------------|-------------------|-----|-------------------------------|
| 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 | CRPS Compatibility Check pin* |

\* Refer to the spec of CRPS Common Requirements Specification.

### 2.3.1.6 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 also 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 through the use of industrial designed plastic handle or equivalent material.

### 2.3.1.7 LED Marking and Identification

The power supply is using a bi-color LED: Amber and Green for status indication. The following table shows the LED states for each power supply operating state.

Table 51. Power Supply Status LED

| Power Supply Condition  | LED State       |
|---|-----------------|
| Output ON and OK  | Solid 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.                   | Solid 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   | Solid AMBER     |
| Power supply FW updating  | 2Hz Blink GREEN |

## 2.3.2 AC Input Specification

### 2.3.2.1 Input Voltage And Frequency

The power supply must operate within all specified limits over the following input voltage range. Harmonic distortion of up to 10% THD must not cause the power supply to go out of specific limits. The power supply shall be capable of start-up (power-on) with full rated power load, at line voltage as low as 90VAC.

Table 52. AC Input Rating

| Parameter          | Min                  | Rated                    | Max                  | Start-up VAC                          | Power-off VAC                       |
|--------------------|----------------------|--------------------------|----------------------|---------------------------------------|-------------------------------------|
| 110V <sub>AC</sub> | 90 V <sub>rms</sub>  | 100-127 V <sub>rms</sub> | 140 V <sub>rms</sub> | 85 V <sub>AC</sub> ± 4V <sub>AC</sub> | 70V <sub>AC</sub> ±5V <sub>AC</sub> |
| 220V <sub>AC</sub> | 180 V <sub>rms</sub> | 200-240 V <sub>rms</sub> | 264 V <sub>rms</sub> |                                       |                                     |
| Frequency          | 47 Hz                | 50/60 Hz                 | 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.

### 2.3.2.2 AC input 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.

Table 53. Typical Power Factor

| Output Power | 10% Load | 20% Load | 50% Load | 100% Load |
|--------------|----------|----------|----------|-----------|
| Power factor | > 0.80   | > 0.90   | > 0.90   | > 0.95    |

**Note:** 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>.

### 2.3.2.3 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 54. 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.



#### 2.3.2.4 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.

#### 2.3.2.5 AC Line Inrush

AC line inrush current shall not exceed **65A peak**, for up to one-quarter of the AC cycle, after which, the input current should be no more than the specified maximum input current. The peak inrush current shall be less than the ratings of its critical components (including input fuse, bulk rectifiers, and surge limiting device).

The power supply must meet the inrush requirements for any rated AC voltage, during turn on at any phase of AC voltage, during a single cycle AC dropout condition as well as upon recovery after AC dropout of any duration, and over the specified temperature range ( $T_{op}$ ).

#### 2.3.2.6 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.

Table 55. AC Power Holdup Requirement

| Loading | Holdup Time |
|---------|-------------|
| 70%     | 10.6msec    |

The  $12V_{STB}$  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).

#### 2.3.2.7 AC Line Fast Transient (EFT) Specification

The power supply shall meet the *EN61000-4-5* directive and any additional requirements in *IEC1000-4-5: 1995* and the Level 3 requirements for surge-withstand capability, with the following conditions and exceptions:

- These input transients must not cause any out-of-regulation conditions, such as overshoot and undershoot, nor must it cause any nuisance trips of any of the power supply protection circuits.

- The surge-withstand test must not produce damage to the power supply.

The supply must meet surge-withstand test conditions under maximum and minimum DC-output load conditions.

### 2.3.2.8 Hot Plug

Power supply shall be designed to allow connection into and removal from the system without removing power to the system. During any phase of insertion, start-up, shutdown, or removal, the power supply shall not cause any other like modules in the system to deviate outside of their specifications. When AC power is applied, the auxiliary supply shall turn on providing bias power internal to the supply and the 5VSB standby output.

### 2.3.2.9 Susceptibility Requirements

The power supply shall meet the following electrical immunity requirements when connected to a cage with an external EMI filter, which meets the criteria, defined in the SSI document EPS Power Supply Specification. For further information on customer standards please request a copy of the customer Environmental Standards Handbook.

Table 56. Performance Criteria

| Level | Description  |
|-------|--|
| A     | The apparatus shall continue to operate as intended. No degradation of performance.  |
| B     | The apparatus shall continue to operate as intended. No degradation of performance beyond spec limits.                               |
| C     | Temporary loss of function is allowed provided the function is self-recoverable or can be restored by the operation of the controls. |

### 2.3.2.10 Electrostatic Discharge Susceptibility

The power supply shall comply with the limits defined in EN 55024: 1998 using the IEC 61000-4-2:1995 test standard and performance criteria B defined in Annex B of CISPR 24.

### 2.3.2.11 Fast Transient/Burst

The power supply shall comply with the limits defined in EN 55024: 1998 using the IEC 61000-4-4:1995 test standard and performance criteria B defined in Annex B of CISPR 24.

### 2.3.2.12 Radiated Immunity

The power supply shall comply with the limits defined in EN 55024: 1998 using the IEC 61000-4-3:1995 test standard and performance criteria A defined in Annex B of CISPR 24.

### 2.3.2.13 Surge Immunity

The power supply shall be tested with the system for immunity to AC Ring wave and AC Unidirectional wave, both up to 2kV, per EN 55024:1998, EN 61000-4-5:1995 and ANSI C62.45: 1992.

The pass criteria include the following:

- No unsafe operation is allowed under any condition
- All power supply output voltage levels to stay within proper spec levels
- No change in operating state or loss of data during and after the test profile
- No component damage under any condition

The power supply shall comply with the limits defined in EN 55024: 1998 using the IEC 61000-4-5:1995 test standard and performance criteria B defined in Annex B of CISPR 24.

### 2.3.2.14 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 57. AC Line Sag Transient Performance

| AC Line Sag (10 sec interval between each sagging) |      |                           |                |  |
|--|------|---------------------------|----------------|--|
| Duration   | Sag  | Operating AC Voltage      | Line Frequency | Performance Criteria.                          |
| 0 to ½ 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 58. 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 |

### 2.3.2.15 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.

### 2.3.2.16 Voltage Interruptions

The power supply shall comply with the limits defined in EN 55024: 1998/A1: 2001/A2: 2003 using the IEC 61000-4-11: Second Edition: 2004-03 test standard and performance criteria C defined in Annex B of CISPR 24.

### 2.3.2.17 AC Line Isolation

The power supply shall meet all safety agency requirements for dielectric strength. Transformers' isolation between primary and secondary windings must comply with the 3000Vac (4242Vdc) dielectric strength criteria. If the working voltage between primary and secondary dictates a higher dielectric strength test voltage the highest test voltage should be used. In addition the insulation system must comply with reinforced insulation per safety standard IEC 950. Separation between the primary and secondary circuits, and primary to ground circuits, must comply with the IEC 950 spacing requirements.

### 2.3.2.18 AC Power Inlet

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

The AC power cord must meet the following specification requirements.

|                    |        |
|--------------------|--------|
| Cable Type         | SJT    |
| Wire Size          | 16 AWG |
| Temperature Rating | 105° C |
| Amperage Rating    | 13 A   |
| Voltage Rating     | 125 V  |

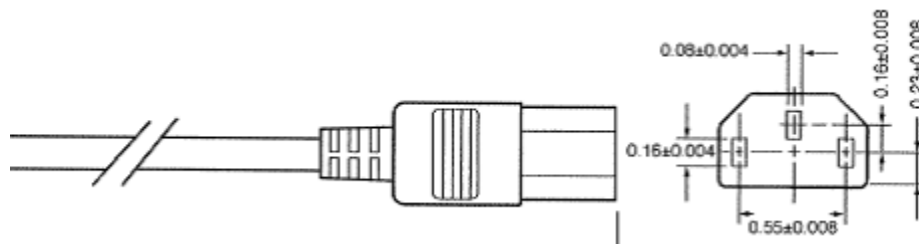


Figure 24. AC Power Cord Specification

## 2.3.3 DC Output Specification

### 2.3.3.1 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 59. Load Ratings for Single 1600W Power Supply Unit

| Parameter                        | Min | Max | Peak <sup>2,3</sup> | Unit |
|----------------------------------|-----|-----|---------------------|------|
| +12V main (200-240VAC)           | 0.0 | 133 | 175                 | A    |
| +12V main (100-127VAC)           | 0.0 | 83  | 110                 | A    |
| +12V <sub>STB</sub> <sup>1</sup> | 0.0 | 3.5 | 2.4                 | A    |

**Notes:**

1. 12V<sub>STB</sub> must provide 4.0A 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 (for 1200W PSU) and 2100W (for 1600W PSU)
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.

**2.3.3.2 Standby Output**

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

**2.3.3.3 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 60. Voltage Regulation Limits

| Parameter           | Min     | Nom      | Max     | Unit | Tolerance |
|---------------------|---------|----------|---------|------|-----------|
| +12V <sub>STB</sub> | +11.40V | +12.000V | +12.60V | Vrms | ±5%       |
| +12V                | +11.40V | +12.000V | +12.60V | Vrms | ±5%       |

The combined output continuous power of all outputs shall not exceed 3200W (1600W from each power supply unit). Each output has a maximum and minimum current rating shown in below table. The power supply shall meet both static and dynamic voltage regulation requirements for the minimum dynamic loading conditions. The power supply shall meet only the static load voltage regulation requirements for the minimum static load conditions.

**2.3.3.4 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  $\Delta$  step load may occur anywhere within the MIN load to the MAX load conditions.

Table 61. Transient Load Requirements

| Output              | $\Delta$ Step Load Size | Load Slew Rate    | Test Capacitive Load |
|---------------------|-------------------------|-------------------|----------------------|
| +12V <sub>STB</sub> | 1.0A                    | 0.25 A/ $\mu$ sec | 20 $\mu$ F           |

| Output | $\Delta$ Step Load Size | Load Slew Rate    | Test Capacitive Load |
|--------|-------------------------|-------------------|----------------------|
| +12V   | 60% of max load         | 0.25 A/ $\mu$ sec | 2000 $\mu$ F         |

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

### 2.3.3.5 Capacitive Loading

The power supply must be stable and meet all requirements, with the following capacitive loading conditions.

Table 62. Capacitive Loading Conditions

| Output              | Min | Max    | Units   |
|---------------------|-----|--------|---------|
| +12V                | 500 | 25,000 | $\mu$ F |
| +12V <sub>STB</sub> | 20  | 3100   | $\mu$ F |

### 2.3.3.6 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 10 $\mu$ F tantalum capacitor in parallel with a 0.1 $\mu$ F ceramic capacitor is placed at the point of measurement.

Table 63. Ripple and Noise

| +12V     | +12V <sub>STB</sub> |
|----------|---------------------|
| 120mVp-p | 120mVp-p            |

### 2.3.3.7 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 m $\Omega$ . This path may be used to carry DC current.

### 2.3.3.8 Closed Loop Stability

The power supply shall be unconditionally stable under all line/load/transient load conditions including capacitive load ranges specified in Section 2.3.3.5. A minimum of: **45 degrees phase margin** and **-10dB-gain margin** is required. The power supply manufacturer shall provide 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.

### 2.3.3.9 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.

### 2.3.3.10 Common Mode Noise

The Common Mode noise on any output shall not exceed **350mVp-p** 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 setup shall use a FET probe such as Tektronix model P6046 or equivalent.

### 2.3.3.11 Soft Starting

The Power Supply shall contain control circuit which provides monotonic soft start for its outputs without overstress of the AC line or any power supply components at any specified AC line or load conditions.

### 2.3.3.12 Zero Load Stability Requirement

When the power subsystem operates in a no load condition, it does not need to meet the output regulation specification, but it must operate without any tripping of over-voltage or other fault circuitry. When the power subsystem is subsequently loaded, it must begin to regulate and source current without fault.

### 2.3.3.13 Hot Swap Requirement

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.

### 2.3.3.14 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.

### 2.3.3.15 Timing Requirement

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 through the AC input, with PSON held low and the PSON signal, with the AC input applied.

Table 64. Timing Requirement

| 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 12VSB being 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 12V output voltage stay within regulation after loss of AC.                                    | 13    |      | ms    |
| $T_{pwok\_holdup}$    | Delay from loss of AC to de-assertion of PWOK   | 10.6  |      | 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    |
| $T_{pwok\_low}$       | 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 12VSB being in regulation to O/Ps being in regulation at AC turn on.                     | 50    | 1000 | ms    |
| $T_{12VSB\_holdup}$   | Time the 12VSB output voltage stays within regulation after loss of AC.                             | 70    |      | ms    |

\* The 12VSB output voltage rise time shall be from 1.0ms to 25ms.



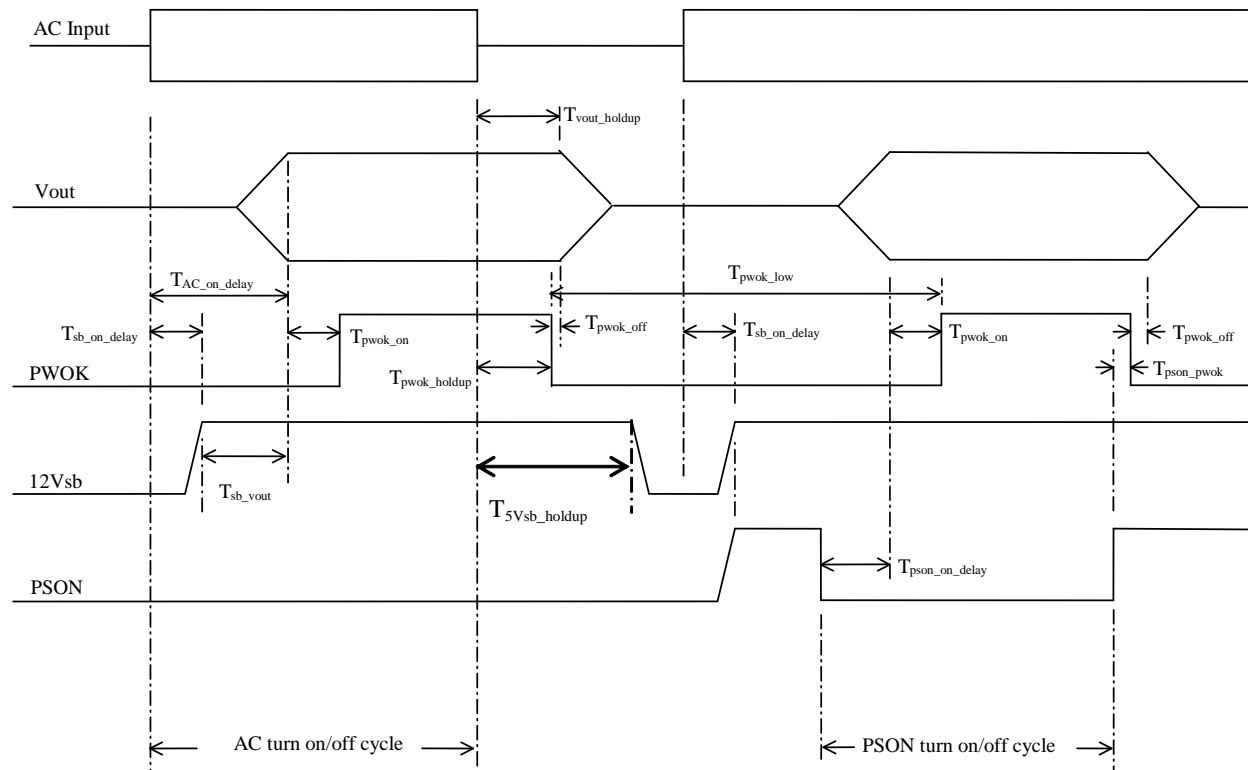


Figure 25. Turn On/Off Timing (Power Supply Signals)

### 2.3.4 Power Supply Cold Redundancy Support

Power supplies that support cold redundancy can be enabled to go into a low-power state (that is, cold redundant state) in order to provide increased power usage efficiency when system loads are such that both power supplies are not needed. When the power subsystem is in Cold Redundant mode, only the needed power supply to support the best power delivery efficiency is ON. Any additional power supplies; including the redundant power supply, is in Cold Standby state.

Each power supply has an additional signal that is dedicated to supporting Cold Redundancy; CR\_BUS. This signal is a common bus between all power supplies in the system. CR\_BUS is asserted when there is a fault in any power supply OR the power supplies output voltage falls below the  $V_{fault}$  threshold. Asserting the CR\_BUS signal causes all power supplies in Cold Standby state to power ON.

Enabling power supplies to maintain best efficiency is achieved by looking at the Load Share bus voltage and comparing it to a programmed voltage level through a PMBus command.

Whenever there is no active power supply on the Cold Redundancy bus driving a HIGH level on the bus all power supplies are ON no matter their defined Cold Redundant roll (active or Cold Standby). This guarantees that incorrect programming of the Cold Redundancy states of the power supply will never cause the power subsystem to shut down or become over loaded. The default state of the power subsystem is all power supplies ON. There needs to be at least

one power supply in Cold Redundant Active state or Standard Redundant state to allow the Cold Standby state power supplies to go into Cold Standby state.

---

**Caution:** Installing two Power Supply Units with different wattage ratings on a system is not supported. This will not provide Power Supply Redundancy and causes the system to log multiple errors.

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### 2.3.4.1 1600W CRPS Cold Redundancy

If the output power is less than 640W (40%), the Cold redundant function will be enable. Thus you will see one PSU working normal. The second PSU will be CR mode. The Power Supply LED is green blinking.

Table 65. 1600W CRPS Cold Redundancy Threshold

|                      | Enable (V) | Percent | Power (W) | Disable (V) | Percent | Power (W) |
|----------------------|------------|---------|-----------|-------------|---------|-----------|
| Cold Standby 1 (02h) | 3.2        | 40.00%  | 640(±5%)  | 1.44        | 18.00%  | 576(±5%)  |

### 2.3.5 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**.

#### 2.3.5.1 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 Figure 25 for the timing diagram.

Table 66. PSON# Signal Characteristics

| Signal Type                             | Accepts an open collector/drain input from the system.<br>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, $V_{pson} = \text{low}$ |   | 4mA     |
| Power up delay: $T_{pson\_on\_delay}$   | 5msec   | 400msec |
| PWOK delay: $T_{pson\_pwok}$            |   | 50msec  |

### 2.3.5.2 PWOK (power good) 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 be inhibited as long as any power supply output is in current limit.

Table 67. 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: Tpwok_on                    | 100ms        | 1000ms  |
| PWOK rise and fall time                 |              | 100µsec |
| Power down delay: T pwok_off            | 1ms          | 200msec |

### 2.3.5.3 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 68. SMBAlert# Signal Characteristics

| Signal Type (Active Low)              | Open collector/drain output from power supply.<br>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 |

### 2.3.6 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.

#### 2.3.6.1 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 69. Over Current Protection

| Output Voltage      | Input Voltage Range | Over Current Limits |
|---------------------|---------------------|---------------------|
| +12V                | 90 – 264VAC         | 180A min; 200A max  |
| +12V <sub>STB</sub> | 90 – 264VAC         | 2.5A min; 3A max    |

#### 2.3.6.2 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. 12VSB will be auto-recovered after removing OVP limit.

Table 70. Over Voltage Protection (OVP) Limits

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

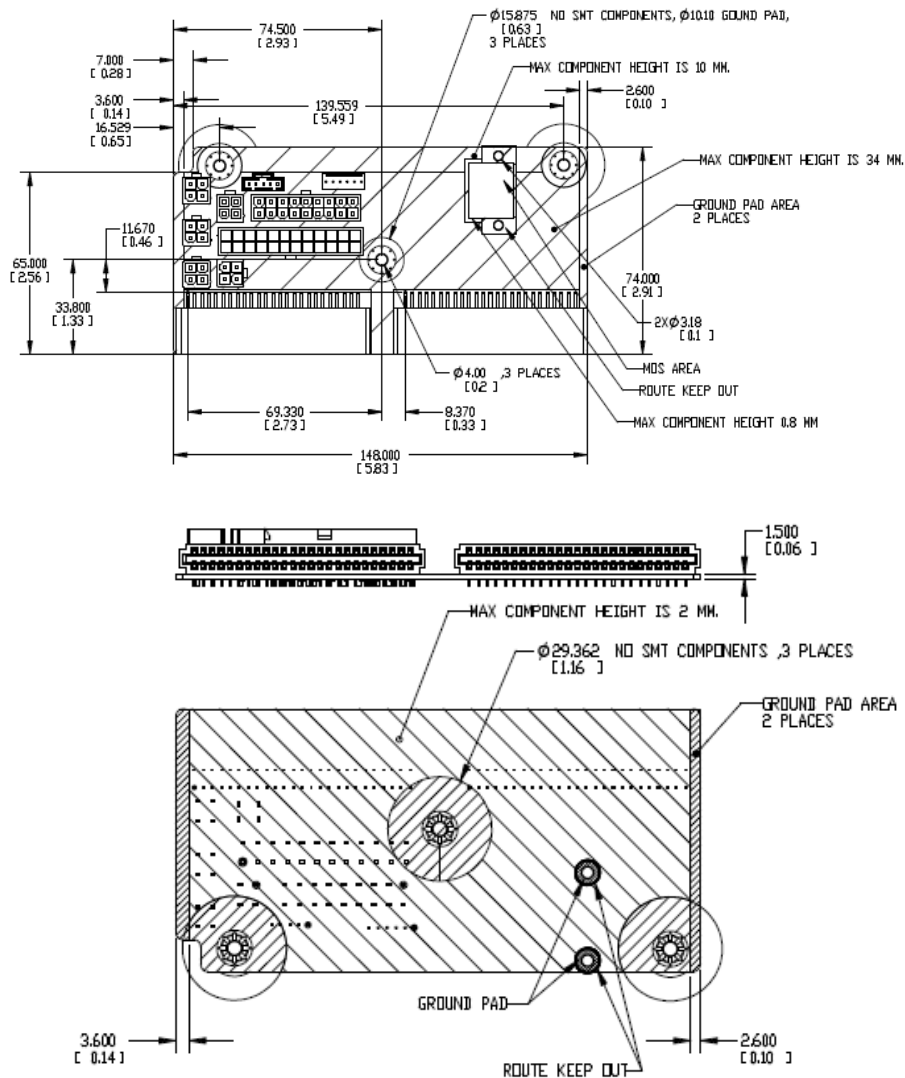
#### 2.3.6.3 Over Thermal Protection

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 Higher Current Common Redundant Power Distribution Board (PDB)

The Power Distribution Board (PDB) for Intel® Server Chassis P4304XXMFEN2/P4304XXMUXX 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.

### 2.4.1 Mechanical Overview



NOTE: UNLESS OTHERWISE SPECIFIED, MAX COMPONENT HEIGHT IS 34 MM.

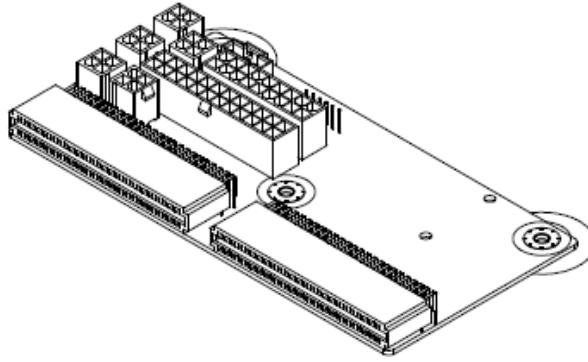


Figure 26. Outline Drawing

**2.4.1.1 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.

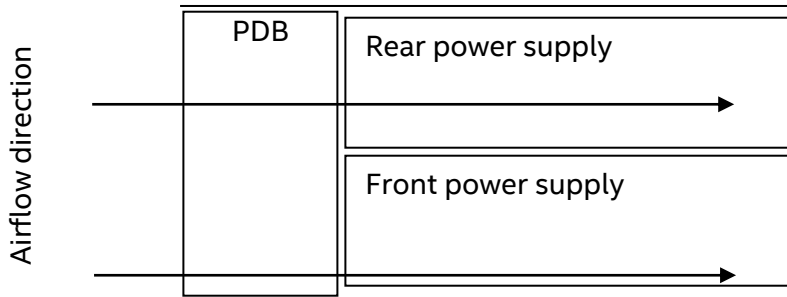


Figure 27. Airflow Diagram

**2.4.1.2 DC/DC Converter Cooling**

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

**2.4.1.3 Temperature Requirements**

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

Table 71. Thermal Requirements

| Item                | Description                      | Min | Max | Units |
|---------------------|----------------------------------|-----|-----|-------|
| T <sub>op</sub>     | Operating temperature range.     | 0   | 50  | °C    |
| T <sub>non-op</sub> | Non-operating temperature range. | -40 | 70  | °C    |

#### 2.4.1.4 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.

### 2.4.2 DC Output Specification

#### 2.4.2.1 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 72. 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.

#### 2.4.2.2 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 73. 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 |
| Extension from P10           | 75         | P11            | 4          | 1x4 legacy HSBP Power/Fixed HDD adaptor Connection |
| PCI power connector          | 800        | P12            | 4          | 2x2 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          |  |

#### 2.4.2.2.1 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 74. 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         |



| Pin | Signal  | 18 AWG Color | Pin | Signal   | 18 AWG Color |
|-----|---------|--------------|-----|----------|--------------|
| 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        |

#### 2.4.2.2.2 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 75. 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       |

#### 2.4.2.2.3 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 76. 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       |

#### 2.4.2.2.4 Power Signal Connector (P4)

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

Table 77. Power Signal Connector

| Pin | Signal    | 24 AWG Color |
|-----|-----------|--------------|
| 1   | I2C Clock | White        |
| 2   | I2C Data  | Yellow       |
| 3   | SMBAlert# | Red          |
| 4   | COM       | Black        |

| Pin | Signal | 24 AWG Color |
|-----|--------|--------------|
| 5   | 3.3RS  | Orange       |

#### 2.4.2.2.5 2x2 12V Connector (P12-P16)

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

Table 78. 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 79. 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        |

#### 2.4.2.2.6 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 80. 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 81. P7 Legacy Peripheral Power Connectors

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

### 2.4.2.2.7 SATA 1x5 Peripheral Power Connectors (P5, P6)

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

Table 82. 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       |

### 2.4.2.3 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.

### 2.4.2.4 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 83. 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 84. 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   |

### 2.4.2.5 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 85. 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 |
| 12V1 | 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 |
| 12V2 |        |          |        |          |        |        |       |                   |              | 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 |
| 12V3 |        |          |        |          |        |        |       |                   | 18.0 A       |       |        |       |        |       |        |       |        | 18 A          | 18  | 19      | 20  |
| 12V4 |        |          |        |          |        |        |       | 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.

### 2.4.2.6 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 86. 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 |     |              |

### 2.4.2.7 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 87. 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  |

### 2.4.2.8 5VSB Loading

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

Table 88. 5VSB Loading

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

### 2.4.2.9 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 89. 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   |

### 2.4.2.10 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 90 below. The load transient repetition rate is only a test specification. The  $\Delta$  step load may occur anywhere within the MIN load to the MAX load shown in Table 87 and Table 88.

Table 90. Transient Load Requirements

| Output   | Max $\Delta$ Step Load Size | Max Load Slew Rate | Test capacitive Load |
|----------|-----------------------------|--------------------|----------------------|
| + 3.3VDC | 5A                          | 0.25 A/ $\mu$ s    | 250 $\mu$ F          |
| + 5VDC   | 5A                          | 0.25 A/ $\mu$ s    | 400 $\mu$ F          |
| +5Vsb    | 0.5A                        | 0.25A/ $\mu$ s     | 20 $\mu$ F           |

#### 2.4.2.11 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 91. Capacitive Loading Conditions

| Converter output | Min | Max  | Units   |
|------------------|-----|------|---------|
| +3.3VDC          | 250 | 6800 | $\mu$ F |
| +5VDC            | 400 | 4700 | $\mu$ F |
| 5Vstby           | 20  | 350  | $\mu$ F |

#### 2.4.2.12 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.

#### 2.4.2.13 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 100 $\Omega$  resistor between each of DC outputs, including ground, at the DC power connector and chassis ground (power subsystem enclosure).
- The test setup shall use a FET probe such as Tektronix model P6046 or equivalent.

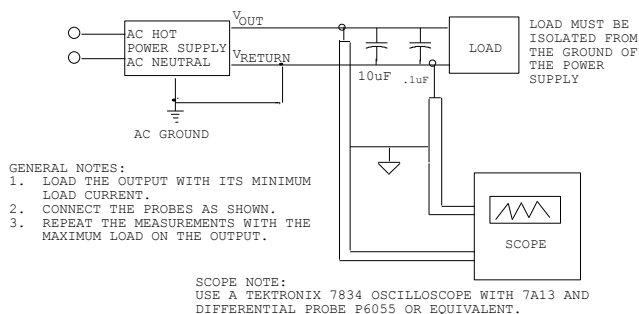
#### 2.4.2.14 Ripple/Noise

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 10 $\mu$ F tantalum capacitor in parallel with a 0.1 $\mu$ F ceramic capacitor are placed at the point of measurement.

Table 92. Ripple and Noise

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

The test setup shall be as shown below.



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

Figure 28. Differential Noise Test Setup

#### 2.4.2.15 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 93. 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  |
| The 5Vstby converter must power off within this time after the 12Vstby input has dropped below 11.4V.                                      |     | 100 | msec  |

#### 2.4.2.16 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.

### 2.4.3 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.

#### 2.4.3.1 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 94. 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 |

#### 2.4.3.2 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 95. 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         |

## 2.4.4 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.

### 2.4.4.1 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 96. System PWOK Requirements

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

## 2.4.5 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.

## 2.4.6 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.

### 2.4.6.1 Addressing

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

Table 97. 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

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The Intel® Server Chassis P4304XXMFEN2 provides a base cooling solution which includes two 120 x 38mm fixed fans to provide sufficient system cooling. The Intel® Server Chassis P4304XXMUXX provides a redundant cooling solution which 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 on P4304XXMFEN2

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.

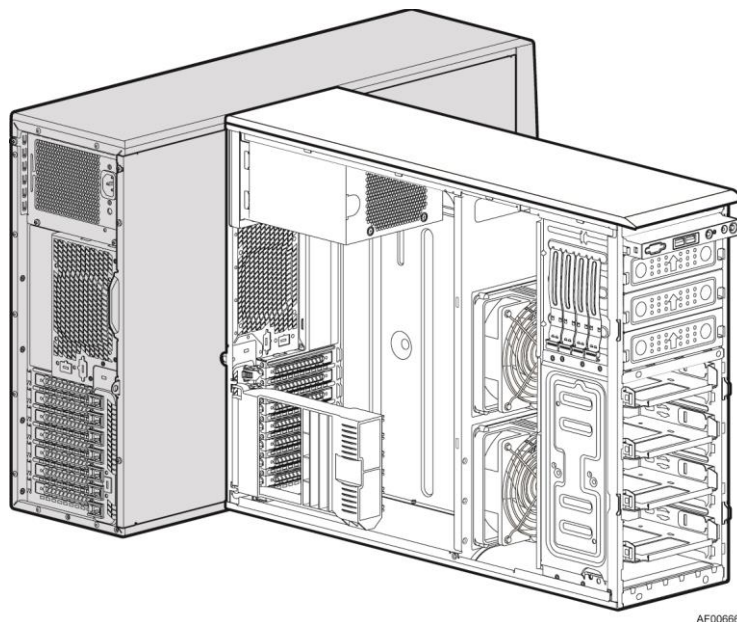


Figure 29. Fixed Fans in Intel® Server Chassis P4304XXMFEN2

### 3.2 Redundant Cooling Solution on P4304XXMUXX

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.

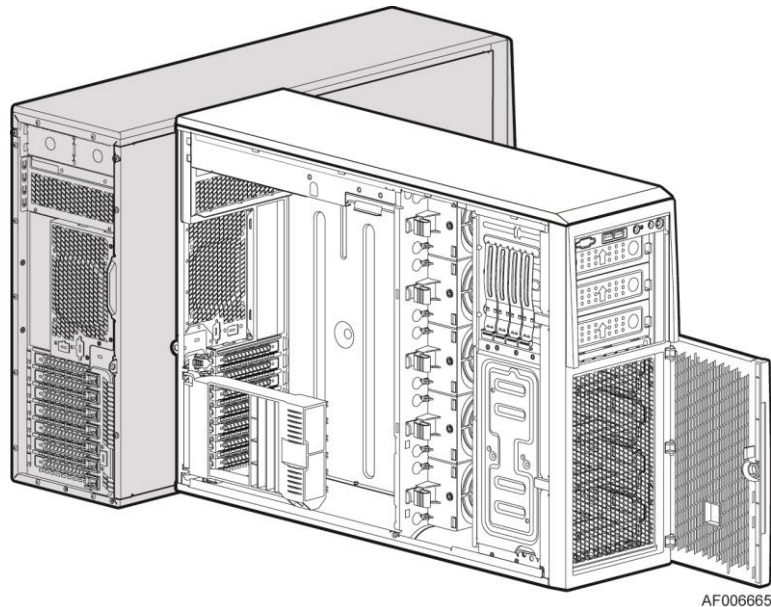


Figure 30. Hot-swap Fans in Intel® Server Chassis P4304XXMUXX

### 3.3 Fan Control

The fans provided in the Intel® Server Chassis P4304XXMFEN2 / P4304XXMUXX contain 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 implemented.

### 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 in 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, and PWM).

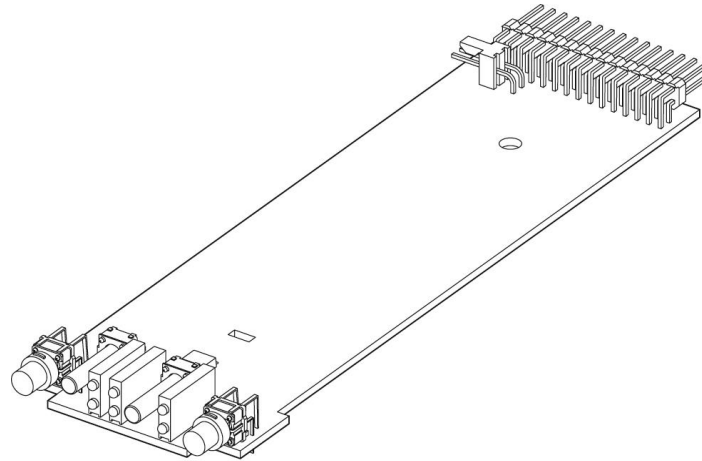
Hot-swap chassis fans are in a 6-wire/6-pin style designed to plug into 6-pin headers. The extra signals provide for fan redundancy and failure indications (Pwr, Gnd, Tach, PWM, Presence, and Failure).

## 4. Standard Front Panel

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### 4.1 Front Panel Overview

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



AF003625

Figure 31. 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 pin cable interconnect (2 LAN ports) or an Intel customized 2x15 pin cable interconnect (4 LAN ports). With the Intel® Server Board S2600CW, the front panel supports standard SSI specification by using the standard SSI 2X12 pin 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 S2600CW is using 2 LAN LEDs)
- NMI button
- Connectors: RA 2x15pin signal connector (supports 2x12 pin SSI FP connections) and SSI 1x2 pin chassis intrusion

### 4.3 Front Control Panel LED/Button Functionality

**ID Button with integrated ID LED** – Toggles the integrated ID LED and the Blue server board ID LED on and off. The ID LED is used to identify the system for maintenance when installed in a rack of similar server systems. The ID LED can also be toggled on and off remotely using the IPMI *Chassis Identify* command which will cause the LED to blink for 15 seconds.

**NMI Button** – When the NMI button is pressed, it puts the server in a halt state and issues a non-maskable interrupt (NMI). This can be useful when performing diagnostics for a given issue where a memory download is necessary to help determine the cause of the problem. To prevent an inadvertent system halt, the actual NMI button is located behind the Front Control Panel faceplate where it is only accessible with the use of a small tipped tool like a pin or paper clip.

**Network Activity LEDs (NIC LED)** – The Front Control Panel includes an activity LED indicator for each on-board Network Interface Controller (NIC). When a network link is detected, the LED will turn on solid. The LED will blink once network activity occurs at a rate that is consistent with the amount of network activity that is occurring.

**System Reset Button** – When pressed, this button will reboot and re-initialize the system.

**System Status LED** – The System Status LED is a bi-color (Green/Amber) indicator that shows the current health of the server system. The system provides two locations for this feature; one is located on the Front Control Panel, the other is located on the back edge of the server board, viewable from the back of the system. Both LEDs are tied together and will show the same state. The System Status LED states are driven by the on-board platform management subsystem.

**System Power Button with power LED** – Toggles the system power on and off. This button also functions as a sleep button if enabled by an ACPI compliant operating system. Pressing this button will send a signal to the Integrated BMC, which will either power on or power off the system. The integrated LED is a single color (Green) and is capable of supporting different indicator states as defined in the following table.

Table 98. Power/Sleep LED Functional States

| State     | Power Mode | LED                     | Description  |
|-----------|------------|-------------------------|--|
| Power-off | Non-ACPI   | Off                     | System power is off, and the BIOS has not initialized the chipset.                                     |
| Power-on  | Non-ACPI   | On                      | System power is on   |
| S5        | ACPI       | Off                     | Mechanical is off, and the operating system has not saved any context to the hard disk.                |
| S4        | ACPI       | Off                     | Mechanical is off. The operating system has saved context to the hard disk.                            |
| S3-S1     | ACPI       | Slow blink <sup>1</sup> | DC power is still on. The operating system has saved context and gone into a level of low-power state. |
| S0        | ACPI       | Steady on               | System and the operating system are up and running.  |

**HDD Activity LED** – The drive activity LED on the front panel indicates drive activity from the on-board hard disk controllers. The server board also provides a header giving access to this LED for add-in controllers.

**USB Ports** – In addition, the front panel provides two USB ports. The USB ports are cabled to the 2x5 connector on the server board.

Table 99. 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.<br>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<br>(LAN 1-2 for Intel®<br>Server Board S2600CW) | Green | On        | LAN link/no access.  |
|   | Green | Blink     | LAN access.  |
|   |       | Off       | Idle.  |
| Chassis Identification  | Blue  | On        | Front panel chassis ID button pressed.   |
|   | Blue  | Blink     | Unit selected for identification from software.  |
|   |       | Off       | No identification.   |

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**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.

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## 4.4 Common Front Panel Connector List & Pin-out

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

Table 100. Connectors for Boards

| Function                 | Qty |
|--------------------------|-----|
| RA 2x12 FP               | 1   |
| RA 1x2 Chassis Intrusion | 1   |

The following table describes the pin-out.

Table 101. Pin-out 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         |

Table 102. Chassis Intrusion Pin-out

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

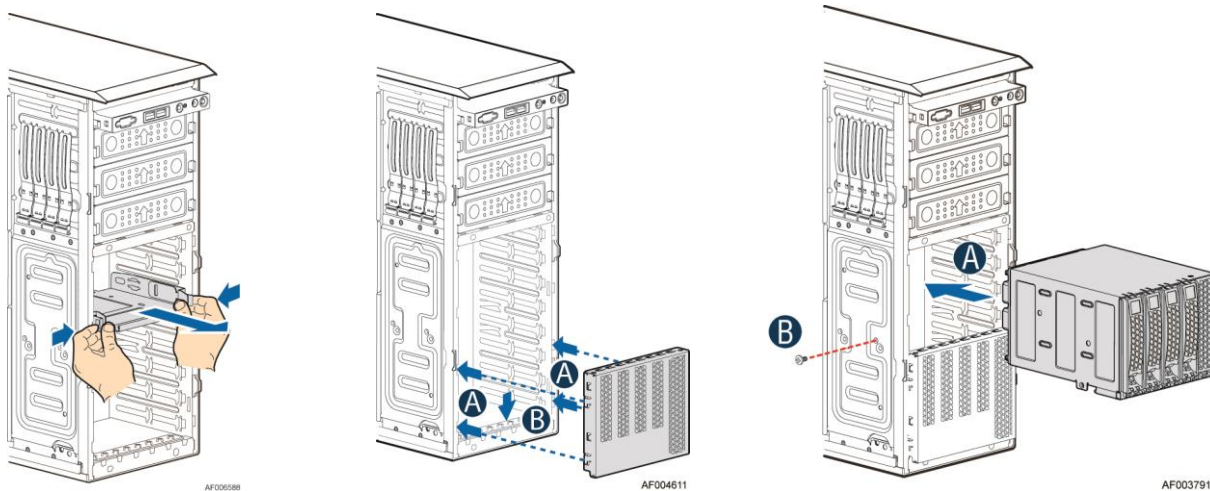
## 5. Hot-Swap Backplane (Optional)

The Intel® Server Chassis P4304XXMUXX supports hot-swap front bezel door. The fixed storage drive trays can be upgraded with hot-swap drive cages including 4x3.5" hot-swap backplane, 8x2.5" hot-swap backplane, and 8x2.5" SAS/PCIe SSD (NVMe) combo backplane.

### 5.1 4x3.5" Hot-swap Backplane

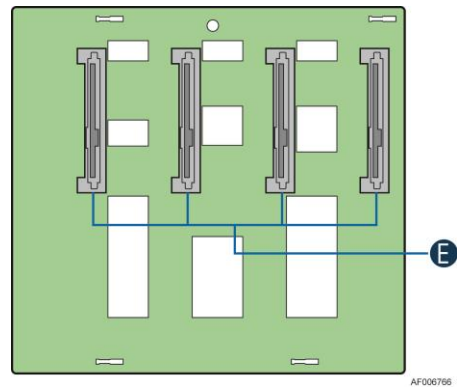
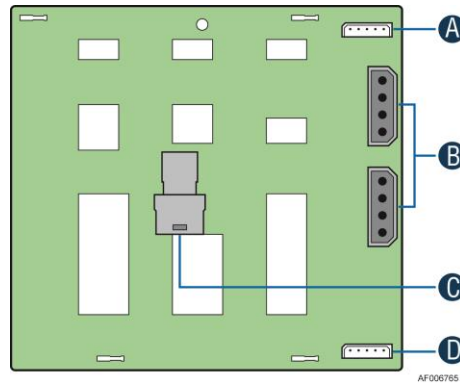
The product family supports up to two 4x3.5" backplanes capable of supporting 12 Gb/sec SAS and 6 Gb/sec SAS / SATA or slower drives. Both hard disks and Solid State Devices (SSDs) can be supported within a common backplane. Each backplane can support either SATA or SAS devices. However, mixing of SATA and SAS devices within a common hot-swap backplane is not supported. Systems with multiple hot-swap backplanes can support different drive type configurations as long as the drives attached to a common backplane are the same and the installed controller attached to the given backplane can support the drive type. Supported devices is dependent on the type of host bus controller driving the backplane, SATA only or SAS.

Follow the steps shown as below to upgrade the fixed hard drive tray with 4x3.5" hot-swap backplane. For detailed instructions, see *Intel® Server Chassis P4304XXMFEN2/P4304XXMUXX Product Family System Integration and Service Guide*.



The front side of the backplane includes x4 29-pin drive interface connectors, each capable of supporting 12Gb SAS or 6 Gb SAS/SATA or slower speeds. The connectors are numbered 0 thru 3. Signal for drive connectors 0-3 is routed to mini-SAS HD connector on the back side of the backplane.





| Label | Description                           |
|-------|---------------------------------------|
| A     | I2C_OUT                               |
| B     | Power connector r                     |
| C     | Ports 0-3 Mini-SAS HD cable connector |
| D     | I2C_IN                                |
| E     | SATA                                  |

**Connectors A and D** – I2C Cable connectors – The backplane includes two 1x5 cable connectors used as a management interface between the server board and the installed backplanes. In systems configured with multiple backplanes, a short jumper cable is attached between backplanes, with connector “A” used on the first board and connector D used on the second board, extending the SMBus to each installed backplane.

| PIN | SIGNAL        |
|-----|---------------|
| 1   | SMB_3V3SB_DAT |
| 2   | GND           |
| 3   | SMB_3V3SB_CLK |
| 4   | SMB_ADD0      |
| 5   | SMB_ADD1      |

**Connector B** – Power Harness Connector – The backplane includes two 1x4 connectors supplying power to the backplane. Power is routed to each installed backplane via a multi-connector power cable harness from the server board.

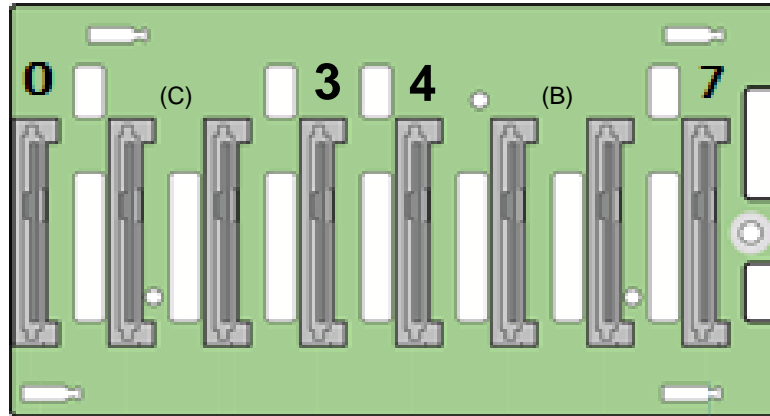
| PIN | SIGNAL | SIGNAL | PIN |
|-----|--------|--------|-----|
| 1   | GND    | P12V   | 3   |
| 2   | GND    | P12V   | 4   |

**Connectors C** – Multi-port Mini-SAS HD Cable Connector – The backplane includes one multi-port mini-SAS HD cable connector, providing SGPIO and I/O signals for four SAS/SATA hard drives on the backplane. Cables can be routed from matching connectors on the server board, installed add-in SAS/SATA RAID cards, or optionally installed SAS expander cards.

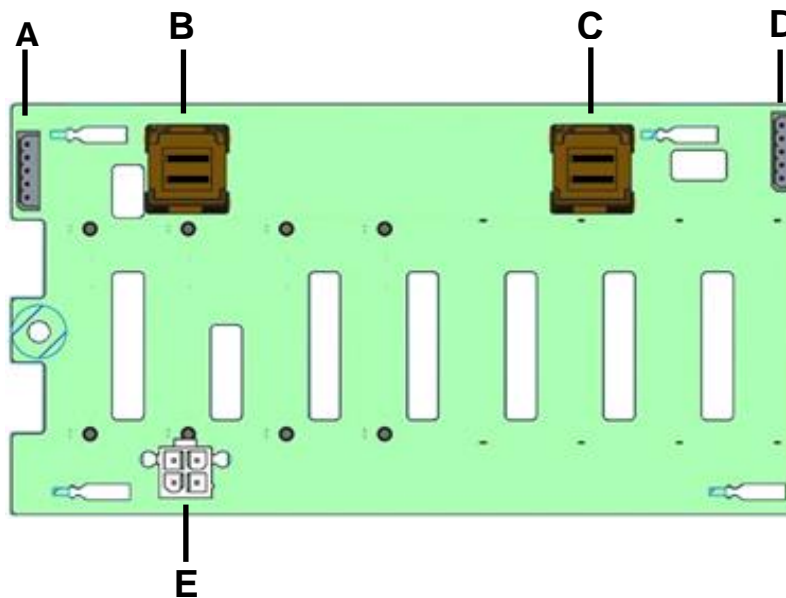
## 5.2 8x2.5" SAS Hot-swap Backplane

The product family supports up to two 8x2.5" backplanes capable of supporting 12Gb/sec SAS and 6Gb/sec SAS/SATA or slower drives. Both hard disks and Solid State Devices (SSDs) can be supported within a common backplane. Each backplane can support either SATA or SAS devices. However, mixing of SATA and SAS devices within a common hot-swap backplane is not supported. Systems with multiple hot-swap backplanes can support different drive type configurations as long as the drives attached to a common backplane are the same and the installed controller attached to the given backplane can support the drive type. Supported devices is dependent on the type of host bus controller driving the backplane, SATA only or SAS.

The front side of the backplane includes x8 29-pin drive interface connectors, each capable of supporting 12Gb SAS or 6 Gb SAS/SATA or slower speeds. The connectors are numbered 0 thru 7. Signals for each set of four drive connectors (0-3 and 4-7), are routed to separate multi-port mini-SAS HD connectors on the back side of the backplane.



**Note:** Letters in parenthesis denote references to connectors on the backside of the backplane as illustrated in the following diagram.



| Label | Description   |
|-------|---|
| A     | SMBus-Out cable connector for multi-backplane support           |
| B     | Ports 4-7 Mini-SAS HD cable connector                           |
| C     | Ports 0-3 Mini-SAS HD cable connector                           |
| D     | SMBus-In cable connector – From Server board or other backplane |
| E     | Power connector   |

**Connectors A and D** – SMBus Cable Connectors – The backplane includes two 1x5 cable connectors used as a management interface between the server board and the installed backplanes. In systems configured with multiple backplanes, a short jumper cable is attached between backplanes, with connector “A” used on the first board and connector D used on the second board, extending the SMBus to each installed backplane.

| PIN | SIGNAL        |
|-----|---------------|
| 1   | SMB_3V3SB_DAT |
| 2   | GND           |
| 3   | SMB_3V3SB_CLK |
| 4   | SMB_ADD0      |
| 5   | SMB_ADD1      |

**Connectors B and C** – Multi-port Mini-SAS HD Cable Connectors – The backplane includes two multi-port mini-SAS HD cable connectors, each providing SGPIO and I/O signals for four SAS/SATA hard drives on the backplane. Cables can be routed from matching connectors on the server board, installed add-in SAS/SATA RAID cards, or optionally installed SAS expander cards for drive configurations of greater than 8 hard drives.

**Connector E** – Power Harness Connector – The backplane includes a 2x2 connector supplying power to the backplane. Power is routed to each installed backplane via a multi-connector power cable harness from the server board.

| PIN | SIGNAL | SIGNAL | PIN |
|-----|--------|--------|-----|
| 1   | GND    | P12V   | 3   |
| 2   | GND    | P12V   | 4   |

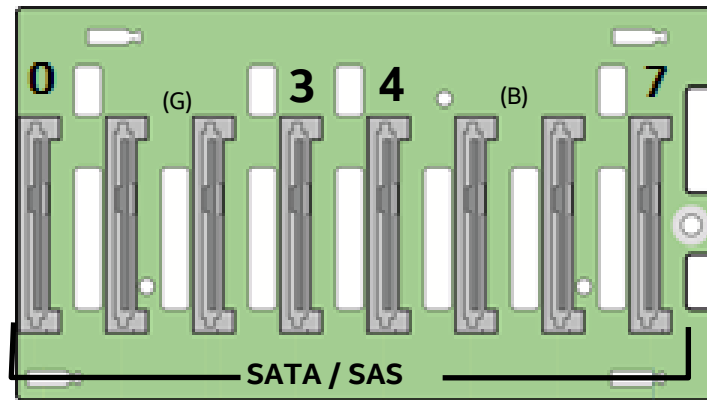
### 5.3 8x2.5" Combo SAS / PCIe SSD (NVMe) Backplane

The product family supports one 8x2.5 combo SAS/PCIe SSD backplane accessory kit which supports up to four PCIe SSDs plus four SATA/SAS drives, or eight SATA/SAS drives.

The front side of the backplane includes eight 29-pin drive interface connectors capable of supporting up to four PCIe SSD drives + four SATA/SAS drives or eight SATA/SAS drives. PCIe SSD drives can only be supported in drive interface slots 0 thru 3.

Signals for each PCIe SSD interface connector are routed to separate mini-SAS HD connectors on the backside of the backplane. PCIe SSD drives are NOT hot-swappable.

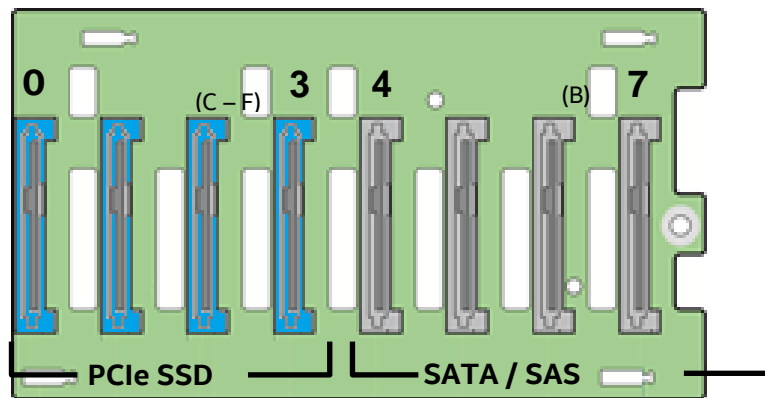
With SATA or SAS drives installed, each drive interface is capable of supporting 12Gb SAS or 6 Gb SAS/SATA or slower speeds. Depending on the chosen drive configuration, drive numbering is either 0-7 (all SATA or SAS installed), or 4-7 (w/PCIe SSDs installed). SATA/SAS signals for each set of four connectors (0-3 and/or 4-7) are routed to separate multi-port mini-SAS HD connectors on the backside of the backplane.



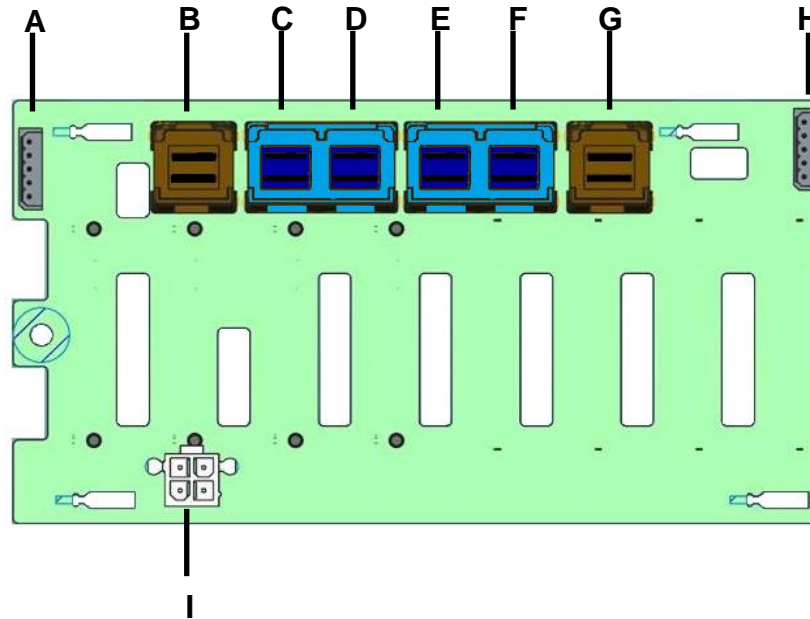
**8x SATA / SAS Only Drive Numbering**

Both hard disks and Solid State Devices (SSDs) can be supported within the backplane. The backplane can support either SATA or SAS devices. However, mixing of SATA and SAS devices within a common hot-swap backplane is not supported. Systems with multiple hot-swap backplanes can support different drive type configurations as long as the drives attached to a common backplane are the same and the installed controller attached to the given backplane can support the drive type. Supported devices is dependent on the type of host bus controller driving the backplane, SATA only or SAS.

On the backside of each backplane are several connectors. The following illustration identifies each.



**x4 PCIe SSD + x4 SATA / SAS Drive Numbering**



| Label | Description   |
|-------|---|
| A     | SMBus-Out cable connector for multi-backplane support           |
| B     | SATA/SAS Ports 4-7 Mini-SAS HD cable connector                  |
| C     | PCIe SSD Drive #3 Mini-SAS HD cable connector                   |
| D     | PCIe SSD Drive #2 Mini-SAS HD cable connector                   |
| E     | PCIe SSD Drive #1 Mini-SAS HD cable connector                   |
| F     | PCIe SSD Drive #0 Mini-SAS HD cable connector                   |
| G     | SATA/SAS Ports 0-3 Mini-SAS HD cable connector                  |
| H     | SMBus-In cable connector – From Server board or other backplane |
| I     | Power connector   |

**Connectors A and H** – SMBus Cable Connectors – The backplane includes two 1x5 cable connectors used as a management interface between the server board and the installed backplanes. In systems configured with multiple backplanes, a short jumper cable is attached between backplanes, with connector “A” used on the first board and connector “H” used on the second board, extending the SMBus to each installed backplane.

| PIN | SIGNAL        |
|-----|---------------|
| 1   | SMB_3V3SB_DAT |
| 2   | GND           |
| 3   | SMB_3V3SB_CLK |
| 4   | SMB_ADD0      |
| 5   | SMB_ADD1      |

**Connectors B and G** – Multi-port Mini-SAS HD Cable Connectors – The backplane includes two multi-port mini-SAS HD cable connectors, each providing SGPIO and I/O signals for four SAS/SATA hard drives on the backplane. Cables can be routed from matching connectors on the server board, installed add-in SAS/SATA RAID cards, or optionally installed SAS expander cards for drive configurations of greater than 8 hard drives.

**Connectors C, D, E, and F** – Each connector supports a single PCIe SSD device. Each connector is cabled directly to an add-in PCIe SSD controller card installed in one of the riser card slots on the server board.

**Connector I** – Power Harness Connector – The backplane includes a 2x2 connector supplying power to the backplane. Power is routed to each installed backplane via a multi-connector power cable harness from the server board.

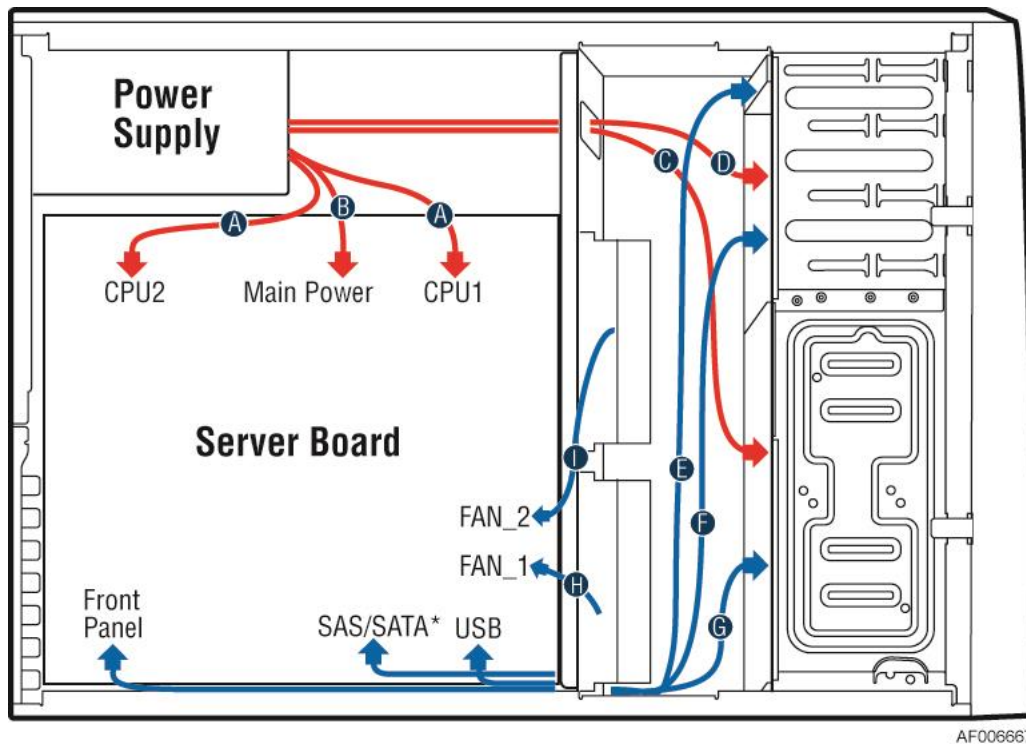
| PIN | SIGNAL | SIGNAL | PIN |
|-----|--------|--------|-----|
| 1   | GND    | P12V   | 3   |
| 2   | GND    | P12V   | 4   |

## 6. System Interconnection

### 6.1 Cable Routing Overview

All cables in the chassis that need to be routed from front to back, should be routed using the cable channels along each chassis sidewall as shown in the following illustration. When routing cables front-to-back, none should be routed through the center of the system or in the area between the system fans and the DIMM slots.

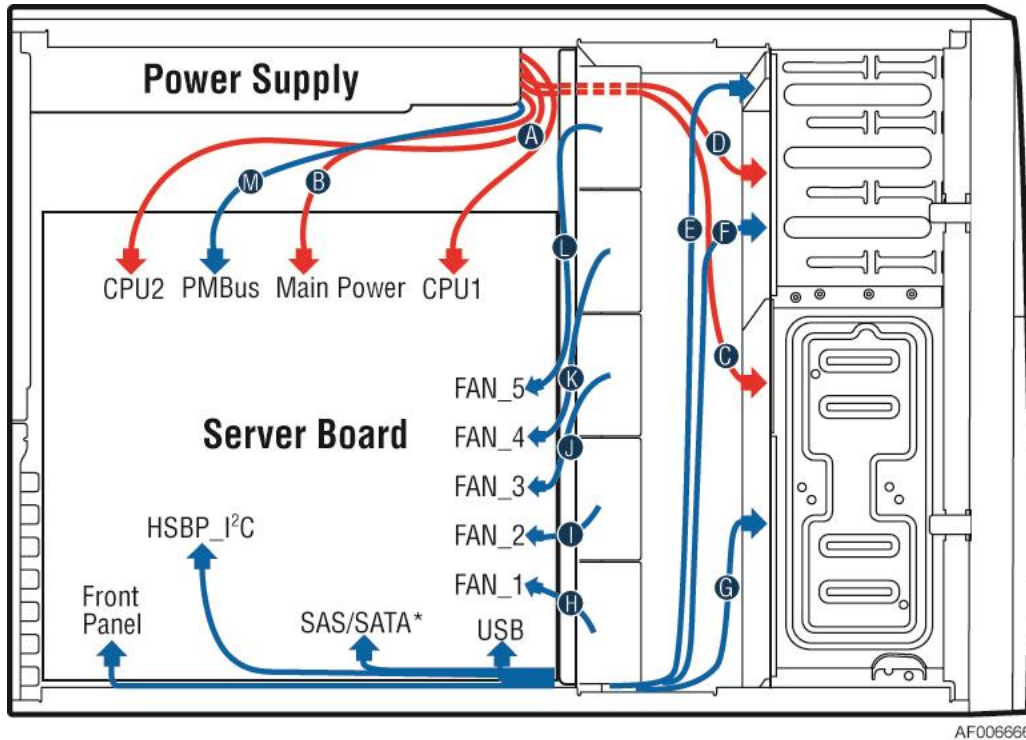
The recommended cable routing for server board S2600CW inside of server chassis P4304XXMFEN2 is shown as below.



|   |                                     |   |                           |   |  |
|---|-------------------------------------|---|---------------------------|---|--|
| A | CPU1/2 power cable                  | B | Main power cable          | C | SSD/HDD drive bay power cable (SAS/SATA) |
| D | ODD drive bay power cable           | E | Front panel and USB cable | F | ODD data cable                           |
| G | SSD/HDD drive bay data cable (SATA) | H | FAN_1 cable (PCIe fan)    | I | FAN_2 cable (CPU fan)                    |



The recommended cable routing for server board S2600CW inside of server chassis P4304XXMUXX is shown as below.



|   |                                     |               |                           |   |  |
|---|-------------------------------------|---------------|---------------------------|---|--|
| A | CPU1/2 power cable                  | B             | Main power cable          | C | SSD/HDD drive bay power cable (SAS/SATA) |
| D | ODD drive bay power cable           | E             | Front panel and USB cable | F | ODD data cable                           |
| G | SSD/HDD drive bay data cable (SATA) | H, I, J, K, L | FAN_n cables              | M | PMBus                                    |

## 6.2 Chassis Internal Cables

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

### 6.2.1 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.

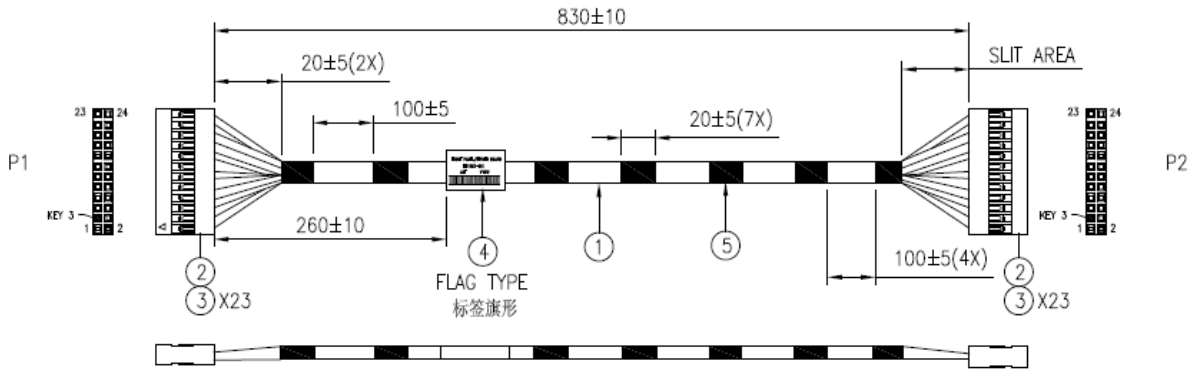


Figure 32. Chassis Front Panel Cable

### 6.2.2 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.

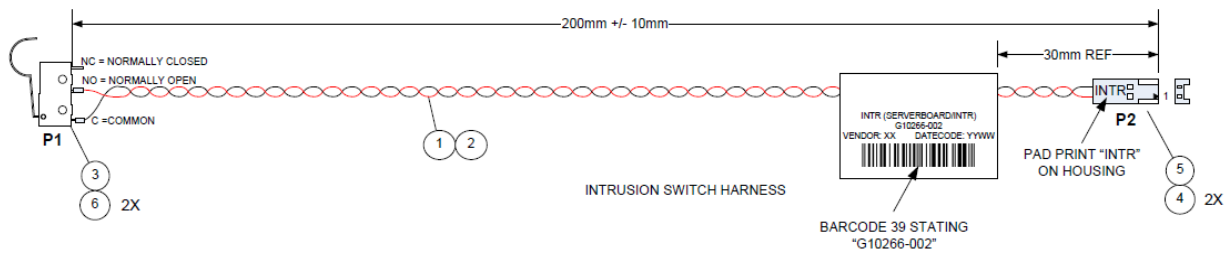


Figure 33. Intrusion Switch Cable

### 6.2.3 USB Cable

A USB cable with 2x10-pin connectors at one end and two external USB 3.0 connectors at the other end is used for connecting the front panel mounted USB connector to the server board.

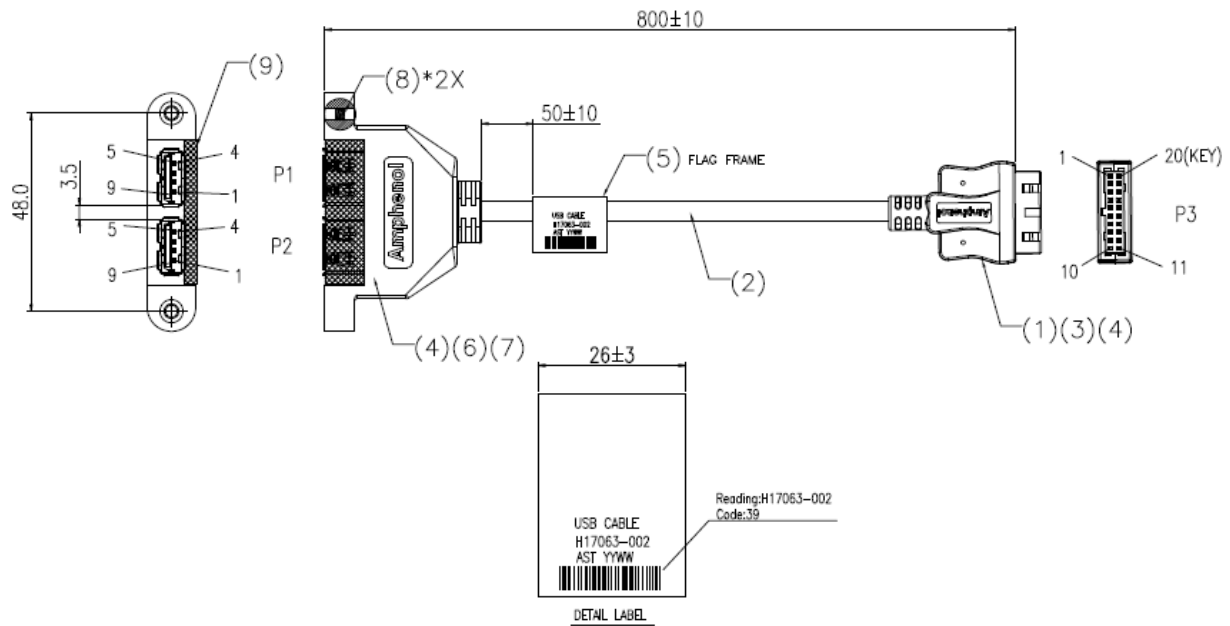


Figure 34. USB Cable Drawing

### 6.2.4 SATA Power Adapter Cable

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

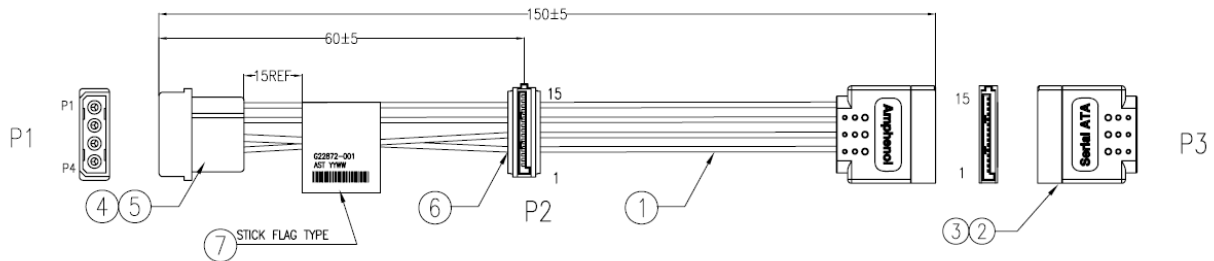


Figure 35. SATA Power Adapter Cable

### 6.2.5 Mini-SAS HD Cable Kit

The Mini SAS HD cable kit provides connection from the Mini-SAS HD connectors on the server board to the fixed storage drive tray.

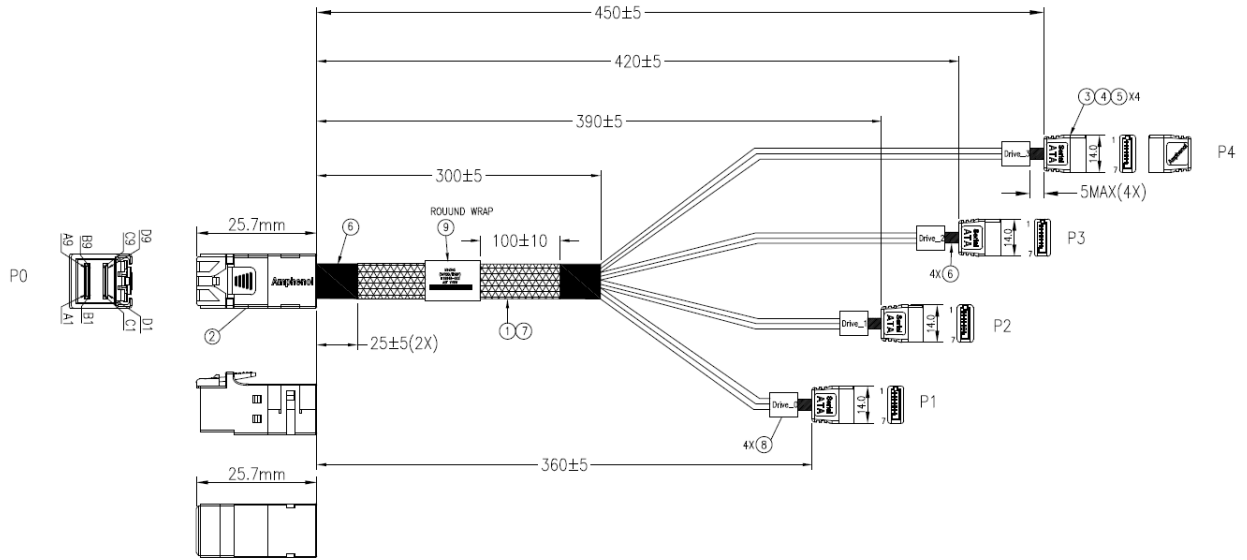


Figure 36. Mini-SAS HD Cable Kit

## 7. Reliability, Serviceability, and Availability

### 7.1 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 103. Calculated Mean Time Between Failure – P4304XXMFEN2

| Subassembly<br>(Server in 40°C ambient air) | Intel® Server Chassis P4304XXMFEN2 |                    |
|---|------------------------------------|--------------------|
|   | MTBF                               | FIT                |
|   | (Hours)                            | (Failures/109 hrs) |
| Server Board                                | 234708                             | 4261               |
| Front Panel Board                           | 5187309                            | 193                |
| Power Supply (550W) Fixed x1                | 474910                             | 2106               |
| Non-redundant Cooling Fan-CPU Zone Fan x1   | 88509                              | 11298              |
| Non-redundant Cooling Fan-PCI Zone Fan x1   | 490000                             | 2041               |
| Totals without motherboard=                 | 63949                              | 15638              |
| Totals with motherboard=                    | 50255                              | 19899              |
| System MTBF Hrs @ 40°C                      | 50255                              |                    |
| System MTBF Hrs @ 35°C                      | 64100                              |                    |
| System MTBF Hrs @ 25°C                      | 106472                             |                    |

Table 104. Calculated Mean Time Between Failure – P4308XXMUXX with 750w PSU

| Subassembly<br>(Server in 40°C ambient air) | Intel® Server Chassis P4304XXMUXX |                    |
|---|-----------------------------------|--------------------|
|   | MTBF                              | FIT                |
|   | (Hours)                           | (Failures/109 hrs) |
| Server Board                                | 234708                            | 4261               |
| Front Panel Board                           | 5187309                           | 193                |
| High current PDB                            | 1961857                           | 510                |
| 750w PSU x1                                 | 537582                            | 1860               |
| Redundant Cooling Fan x5                    | 85470                             | 11700              |
| Totals without motherboard=                 | 70111                             | 14263              |
| Totals with motherboard=                    | 53985                             | 18524              |
| System MTBF Hrs @ 40°C                      | 53985                             |                    |
| System MTBF Hrs @ 35°C                      | 68,858                            |                    |
| System MTBF Hrs @ 25°C                      | 114,375                           |                    |

Table 105. Calculated Mean Time Between Failure – P4308XXMUXX with 1600w PSU

| Subassembly<br>(Server in 40°C ambient air) | Intel® Server Chassis P4304XXMUXX |                    |
|---|-----------------------------------|--------------------|
|   | MTBF                              | FIT                |
|   | (Hours)                           | (Failures/109 hrs) |
| Server Board                                | 234708                            | 4261               |
| Front Panel Board                           | 5187309                           | 193                |
| High current PDB                            | 1961857                           | 510                |
| 1600w PSU x1                                | 506563                            | 1974               |
| Redundant Cooling Fan x5                    | 85470                             | 11700              |
| Totals without motherboard=                 | 69555                             | 14377              |
| Totals with motherboard=                    | 53655                             | 18638              |
| System MTBF Hrs @ 40°C                      | 53655                             |                    |
| System MTBF Hrs @ 35°C                      | 68,438                            |                    |
| System MTBF Hrs @ 25°C                      | 113,675                           |                    |

## 7.2 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 are 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 106. 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 replace 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   |

## 8. Environmental Limits

---

### 8.1 System Office Environment

The following table displays the System Office Environment summary.

Table 107. 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 ( $\geq 40$ 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                         |

### 8.2 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

### 8.3 Intel® Server Chassis P4304XXMFEN2 / P4304XXMUXX Acoustic Level

The following tables detail the declared acoustic data of the Intel® Server Chassis P4304XXMFEN2 / P4304XXMUXX for reference.

#### 8.3.1 Intel® Server Chassis P4304XXMFEN2 / P4304XXMUXX with Intel® Server Board S2600CW

##### 8.3.1.1 Test Conditions at Acoustic Lab

Table 108. Test Conditions at Acoustic Lab

| Function        | Conditions/Stress Software             |
|-----------------|--|
| Standby         | AC power connected                     |
| Idle Mode       | Windows-2k12R2 Idling                  |
| Stress Mode_TO1 | IO meter + PTU_1.5 (Core 50%)          |
| Stress Mode_TO2 | IO meter + PTU_1.5 (Core & Memory 50%) |

##### 8.3.1.2 Test Environment

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

##### 8.3.1.3 Declared Acoustic Data

Table 109. System Configuration with P4304XXMFEN2

| Configuration  | Config1        | Config2        | Config3        | Config4        | Config5                   |
|----------------|----------------|----------------|----------------|----------------|---------------------------|
| Server Board   | S2600CW        | S2600CW        | S2600CW        | S2600CW        | S2600CW                   |
| Storage Cage   | Two 4x3.5"     | Two 4x3.5"     | Two 4x3.5"     | Two 4x3.5"     | Two 8x2.5"                |
| Processors     | 120W           | 120W           | 135W           | 120W           | 135W                      |
| DIMM           | 16             | 16             | 16             | 16             | 16                        |
| HDD            | 4x3.5"         | 8x3.5"         | 8x3.5"         | 8x3.5"         | 4x2.5" SAS<br>+4x2.5" SSD |
| Power Supplies | 550W           | 550W           | 550W           | 550W           | 550W                      |
| PCI            | x3             | x3             | x3             | x3             | x3                        |
| Fan            | Two fixed fans | Two fixed fans | Two fixed fans | Two fixed fans | Two fixed fans            |

Table 110. Declared Acoustic Data of Intel® Server Chassis P4304XXMFEN2 Family with Intel® Server Board S2600CW

| #  | Configuration | Condition          | Declared SWL (Db) |
|----|---------------|--------------------|-------------------|
| 1  | Config 1      | Standby            | 2.7               |
| 2  |               | Idle               | 4.9               |
| 3  |               | lometer+PTU50%     | 5.2               |
| 4  |               | lometer+PTU50%+Mem | 5.2               |
| 5  | Config 2      | Standby            | 2.7               |
| 6  |               | Idle               | 5.1               |
| 7  |               | lometer+PTU50%     | 5.2               |
| 8  |               | lometer+PTU50%+Mem | 5.2               |
| 9  | Config 3      | Standby            | 2.7               |
| 10 |               | Idle               | 5.1               |
| 11 |               | lometer+PTU50%     | 5.2               |
| 12 |               | lometer+PTU50%+Mem | 5.2               |
| 13 | Config 4      | Standby            | 2.7               |
| 14 |               | Idle               | 5.3               |
| 15 |               | lometer+PTU50%     | 5.5               |
| 16 |               | lometer+PTU50%+Mem | 5.5               |
| 17 | Config 5      | Standby            | 2.7               |
| 18 |               | Idle               | 5.2               |
| 19 |               | lometer+PTU50%     | 5.4               |
| 20 |               | lometer+PTU50%+Mem | 5.4               |

Table 111. System Configuration with P4304XXMUXX

| Configuration  | Config1             | Config2             | Config3                   | Config4             |
|----------------|---------------------|---------------------|---------------------------|---------------------|
| Server Board   | S2600CW             | S2600CW             | S2600CW                   | S2600CW (10G)       |
| Storage Cage   | Two 4x3.5"          | Two 4x3.5"          | Two 8x2.5"                | Two 4x3.5"          |
| Processors     | 120W                | 135W                | 120W                      | 120W                |
| DIMM           | 16                  | 16                  | 16                        | 16                  |
| HDD            | 4*3.5"              | 4x3.5"              | 4x2.5" SAS<br>+4x2.5" SSD | 4x3.5"              |
| Power Supplies | 2x 750W             | 2x 750W             | 2x 750W                   | 2x 750W             |
| PCI            | x3                  | x3                  | x3                        | x3                  |
| Fan            | Five redundant fans | Five redundant fans | Five redundant fans       | Five redundant fans |

Table 112. Declared Acoustic Data of Intel® Server Chassis P4304XXMUXX Family with Intel® Server Board S2600CW

| #  | Configuration | Condition       | Declared SWL (Db) |
|----|---------------|-----------------|-------------------|
| 1  | Config 1      | Standby         | 2.7               |
| 2  |               | Idle            | 4.6               |
| 3  |               | Stress Mode_TO1 | 5.3               |
| 4  |               | Stress Mode_TO2 | 5.3               |
| 5  | Config 2      | Standby         | 2.7               |
| 6  |               | Idle            | 4.6               |
| 7  |               | Stress Mode_TO1 | 5.9               |
| 8  |               | Stress Mode_TO2 | 5.9               |
| 9  | Config 3      | Standby         | 2.7               |
| 10 |               | Idle            | 5.5               |
| 11 |               | Stress Mode_TO1 | 5.8               |
| 12 |               | Stress Mode_TO2 | 5.8               |
| 13 | Config 4      | Standby         | 2.7               |
| 14 |               | Idle            | 4.6               |
| 15 |               | Stress Mode_TO1 | 5.3               |
| 16 |               | Stress Mode_TO2 | 5.3               |

## 8.4 HTA Support for Intel® Server Chassis P4304XXMFEN2 / P4304XXMUXX with Intel® Server Board S2600CW

### 8.4.1 This table provides the HTA support configuration with the Intel® Server Board S2600CW installed in the Intel® Server Chassis P4304XXMFEN2.

|  |   |           |      |                          |      |                          |      |
|--|---|-----------|------|--------------------------|------|--------------------------|------|
| Config #1: P4304XXMFEN2 with fixed hard drive storage  |   | Config #1 |      | Config #2<br>See Note 7. |      | Config #3<br>See Note 7. |      |
| Config #2: P4304XXMFEN2 with upgrade option of one 4x3.5" hot-swap drive cage or one 8x2.5" hot-swap drive cage  |   |           |      |                          |      |                          |      |
| Config #3: P4304XXMFEN2 with upgrade option of two 4x3.5" hot-swap drive cages or two 8x2.5 hot-swap drive cages |   |           |      |                          |      |                          |      |
| ASHRAE<br>See Note 1.  | Classifications   | 27°C      | A2   | 27°C                     | A2   | 27°C                     | A2   |
|  | Max Ambient   | 27°C      | 35°C | 27°C                     | 35°C | 27°C                     | 35°C |
| Cooling  | Normal mode without fan failure                               | ●         | ●    | ●                        | ●    | ●                        | ●    |
| PS   | 550W AC   | ●         | ●    | ●                        | ●    | ●                        | ●    |
| EP Processors  | EP, 135w, 12C (Intel® Xeon® processor E5-2690 V3)             | ●         | ●    | ●                        | ●    | ●                        | ●    |
|  | EP, 120w, 12C (Intel® Xeon® processor E5-2680 V3, E5-2670 V3) | ●         | ●    | ●                        | ●    | ●                        | ●    |
|  | EP, 105w, 10C (Intel® Xeon® processor E5-2660 V3,             | ●         | ●    | ●                        | ●    | ●                        | ●    |

|  |   |   |   |   |   |   |   |
|--|---|---|---|---|---|---|---|
|  | E5-2650 V3)   |   |   |   |   |   |   |
|  | EP, 90w, 8C (Intel® Xeon® processor E5-2640 V3)                                       | ● | ● | ● | ● | ● | ● |
|  | EP, 85w,8C,6C (Intel® Xeon® processor E5-2630 V3, E5-2620 V3, E5-2609 V3, E5-2603 V3) | ● | ● | ● | ● | ● | ● |
|  | EP, 135w, 8C,6C,4C (Intel® Xeon® processor E5-2667 V3, E5-2643 V3, E5-2637 V3)        | ● | ● | ● | ● | ● | ● |
|  | EP, 105w, 4C (Intel® Xeon® processor E5-2623 V3)                                      | ● | ● | ● | ● | ● | ● |
|  | EP, 65w, 12C (Intel® Xeon® processor E5-2650L V3)                                     | ● | ● | ● | ● | ● | ● |
|  | EP, 55w, 8C (Intel® Xeon® processor E5-2630L V3)                                      | ● | ● | ● | ● | ● | ● |
|  | EP, 145w, 14C,18C (Intel® Xeon® processor E5-2697 V3, E5-2699 V3)                     | ● | ● | ● | ● | ● | ● |
|  | EP, 135w, 16C (Intel® Xeon® processor E5-2698 V3)                                     | ● | ● | ● | ● | ● | ● |
|  | EP, 120w, 14C (Intel® Xeon® processor E5-2695 V3, E5-2683 V3)                         | ● | ● | ● | ● | ● | ● |
| Memory Type<br>See Note 2.                         | RDIMM-2Rx8,1Rx4   | ● | ● | ● | ● | ● | ● |
|  | RDIMM-DRx4  | ● | ● | ● | ● | ● | ● |
|  | LRDIMM-QRx4 DDP   | ● | ● | ● | ● | ● | ● |
| Add-in Cards<br>See Note 3.                        | PCIe Cards  | ● | ● | ● | ● | ● | ● |
| Battery Backup<br>See Note 4.                      | BBU (rated to 45°C)   | ● | ● | ● | ● | ● | ● |
|  | Supercap (rated to 45°C)  | ● | ● | ● | ● | ● | ● |
|  | Cache Offload Module (rated to 55°C)  | ● | ● | ● | ● | ● | ● |
| 2.5" SFF NVMe<br>SSD<br>(DC P3700/P3500)           | 1600GB/2TB  | ● | ● | ● | ● | ● | ● |
|  | 800GB   | ● | ● | ● | ● | ● | ● |
|  | 500GB   | ● | ● | ● | ● | ● | ● |
|  | 400GB   | ● | ● | ● | ● | ● | ● |
|  | 200GB   | ● | ● | ● | ● | ● | ● |
| PCIe SSD AIC FF<br>(DC P3700/P3500)<br>See Note 5. | 1600GB/2TB  | ● | ● | ● | ● | ● | ● |
|  | 800GB   | ● | ● | ● | ● | ● | ● |
|  | 500GB   | ● | ● | ● | ● | ● | ● |
|  | 400GB   | ● | ● | ● | ● | ● | ● |
|  | 200GB   | ● | ● | ● | ● | ● | ● |
| M.2 (DC S3500)<br>See Note 6.                      | 340G/120G/80G   | ● | ● | ● | ● | ● | ● |

**Notes:**

1. The 27°C configuration alone is limited to elevations of 900m or less. Altitude higher than 900m needs to be de-rated same as ASHRAE Class2.
2. When identifying memory in the table, only Rank and Width are required. Capacity is not required.
3. Able to provide sufficient cooling for any PCIe card that satisfies the 55°C-200LFM boundary condition requirement.
4. Supercap use 45°C thermal spec at normal mode and 55°C at fan failure mode. Excursions over spec may result in reliability impact. BBU need to meeting 45°C thermal spec in both fan normal / fail mode.

5. Add-In-Card form factor PCIe SSD requires 300LFM for cooling. Performance mode in BIOS is required to be enabled.
6. To support full performance for Intel S3500 M.2 device, performance mode in BIOS is required to be enabled.
7. P4208/P4216 includes SAS only hot swap and Combo HDD backplane.

**8.4.2 This table provides the HTA support configuration with the Intel® Server Board S2600CW installed in the Intel® Server Chassis P4304XXMUXX at fan normal state.**

| Config #1: P4304XXMUXX with fixed hard drive storage<br>Config #2: P4304XXMUXX with upgrade option of one 4x3.5" hot-swap drive cage or one 8x2.5" hot-swap drive cage<br>Config #3: P4304XXMUXX with upgrade option of two 4x3.5" hot-swap drive cages or two 8x2.5 hot-swap drive cages |   | Config #1 |      | Config #2<br>See Note 9. |      | Config #3<br>See Note 9. |      |
|---|---|-----------|------|--------------------------|------|--------------------------|------|
| ASHRAE<br>See Note 1.   | Classifications   | 27°C      | A2   | 27°C                     | A2   | 27°C                     | A2   |
|   | Max Ambient   | 27°C      | 35°C | 27°C                     | 35°C | 27°C                     | 35°C |
| PS<br>See Note 2 and 3.   | 750W AC   | ●         | ●    | ●                        | ●    | ●                        | ●    |
|   | 1600W AC  | ●         | ●    | ●                        | ●    | ●                        | ●    |
| EP Processors   | EP, 135w, 12C (Intel® Xeon® processor E5-2690 V3)                                     | ●         | ●    | ●                        | ●    | ●                        | ●    |
|   | EP, 120w, 12C (Intel® Xeon® processor E5-2680 V3, E5-2670 V3)                         | ●         | ●    | ●                        | ●    | ●                        | ●    |
|   | EP, 105w, 10C (Intel® Xeon® processor E5-2660 V3, E5-2650 V3)                         | ●         | ●    | ●                        | ●    | ●                        | ●    |
|   | EP, 90w, 8C (Intel® Xeon® processor E5-2640 V3)                                       | ●         | ●    | ●                        | ●    | ●                        | ●    |
|   | EP, 85w,8C,6C (Intel® Xeon® processor E5-2630 V3, E5-2620 V3, E5-2609 V3, E5-2603 V3) | ●         | ●    | ●                        | ●    | ●                        | ●    |
|   | EP, 135w, 8C,6C,4C (Intel® Xeon® processor E5-2667 V3, E5-2643 V3, E5-2637 V3)        | ●         | ●    | ●                        | ●    | ●                        | ●    |
|   | EP, 105w, 4C (Intel® Xeon® processor E5-2623 V3)                                      | ●         | ●    | ●                        | ●    | ●                        | ●    |
|   | EP, 65w, 12C (Intel® Xeon® processor E5-2650L V3)                                     | ●         | ●    | ●                        | ●    | ●                        | ●    |
|   | EP, 55w, 8C (Intel® Xeon® processor E5-2630L V3)                                      | ●         | ●    | ●                        | ●    | ●                        | ●    |
|   | EP, 145w, 14C,18C (Intel® Xeon® processor E5-2697 V3, E5-2699 V3)                     | ●         | ●    | ●                        | ●    | ●                        | ●    |
|   | EP, 135w, 16C (Intel® Xeon® processor E5-2698 V3)                                     | ●         | ●    | ●                        | ●    | ●                        | ●    |
|   | EP, 120w, 14C (Intel® Xeon® processor E5-2695 V3, E5-2683 V3)                         | ●         | ●    | ●                        | ●    | ●                        | ●    |
| Memory Type<br>See Note 4.  | RDIMM-2Rx8,1Rx4   | ●         | ●    | ●                        | ●    | ●                        | ●    |
|   | RDIMM-DRx4  | ●         | ●    | ●                        | ●    | ●                        | ●    |
|   | LRDIMM-QRx4 DDP   | ●         | ●    | ●                        | ●    | ●                        | ●    |
| Add-in Cards<br>See Note 5.   | PCIe Cards  | ●         | ●    | ●                        | ●    | ●                        | ●    |

|  |                                      |   |   |   |   |   |   |
|--|--------------------------------------|---|---|---|---|---|---|
| Battery Backup<br>See Note 6.                      | BBU (rated to 45°C)                  | ● | ● | ● | ● | ● | ● |
|  | Supercap (rated to 45°C)             | ● | ● | ● | ● | ● | ● |
|  | Cache Offload Module (rated to 55°C) | ● | ● | ● | ● | ● | ● |
| 2.5" SFF NVMe SSD<br>(DC P3700/P3500)              | 1600GB/2TB                           | ● | ● | ● | ● | ● | ● |
|  | 800GB                                | ● | ● | ● | ● | ● | ● |
|  | 500GB                                | ● | ● | ● | ● | ● | ● |
|  | 400GB                                | ● | ● | ● | ● | ● | ● |
|  | 200GB                                | ● | ● | ● | ● | ● | ● |
| PCIe SSD AIC FF<br>(DC P3700/P3500)<br>See Note 7. | 1600GB/2TB                           | ● | ● | ● | ● | ● | ● |
|  | 800GB                                | ● | ● | ● | ● | ● | ● |
|  | 500GB                                | ● | ● | ● | ● | ● | ● |
|  | 400GB                                | ● | ● | ● | ● | ● | ● |
|  | 200GB                                | ● | ● | ● | ● | ● | ● |
| M.2 (DC S3500)<br>See Note 8.                      | 340G/120G/80G                        | ● | ● | ● | ● | ● | ● |
| Intel® Xeon® Phi™                                  | Active Cooling up to 300W            |   |   | ● | ● |   |   |
|  | Active Cooling up to 225W            |   |   | ● | ● |   |   |

**Notes:**

1. The 27°C configuration alone is limited to elevations of 900m or less. Altitude higher than 900m needs to be de-rated same as ASHRAE Class2.
2. In fan redundancy mode, 2 PSUs are required to keep the sufficient cooling. System fans and PSUs cannot fail at the same time.
3. System with 1600W PSU has higher acoustic at operation mode due to PSU firmware setting. It can meet Intel Blue book.
4. When identifying memory in the table, only Rank and Width are required. Capacity is not required.
5. Able to provide sufficient cooling for any PCIe card that satisfies the 55C-200LFM boundary condition requirement.
6. Supercap uses 45°C thermal spec at normal mode and 55°C at fan fail mode. Excursions over spec may result in reliability impact. BBU need to meeting 45C thermal spec in both fan normal / fail mode.
7. For Add-In-Card form factor PCIe SSD requires 300LFM for cooling, need to be placed in PCI slot3/4/5/6, at same time, performance mode in BIOS is required to be enabled.
8. To support full performance for Intel S3500 M.2 device, performance mode in BIOS is required to be enabled.
9. P4208/P4216 includes SAS only hot swap and Combo HDD backplane.

**8.4.3 This table provides the HTA support configuration with the Intel® Server Board S2600CW installed in the Intel® Server Chassis P4304XXMUXX at fan fail state.**

|   |                 |           |      |                          |      |                          |      |
|---|-----------------|-----------|------|--------------------------|------|--------------------------|------|
| Config #1: P4304XXMUXX with fixed hard drive storage<br>Config #2: P4304XXMUXX with upgrade option of one 4x3.5" hot-swap drive cage or one 8x2.5" hot-swap drive cage<br>Config #3: P4304XXMUXX with upgrade option of two 4x3.5" hot-swap drive cages or two 8x2.5 hot-swap drive cages |                 | Config #1 |      | Config #2<br>See Note 9. |      | Config #3<br>See Note 9. |      |
| ASHRAE<br>See Note 1.   | Classifications | 27°C      | A2   | 27°C                     | A2   | 27°C                     | A2   |
|   | Max Ambient     | 27°C      | 35°C | 27°C                     | 35°C | 27°C                     | 35°C |

|  |   |   |   |   |   |   |   |
|--|---|---|---|---|---|---|---|
| PS<br>See Note 2 and 3.                            | 750W AC   | ● | ● | ● | ● | ● | ● |
|  | 1600W AC  | ● | ● | ● | ● | ● | ● |
| EP Processors                                      | EP, 135w, 12C (Intel® Xeon® processor E5-2690 V3)                                     | ● | ● | ● | ● | ● | ● |
|  | EP, 120w, 12C (Intel® Xeon® processor E5-2680 V3, E5-2670 V3)                         | ● | ● | ● | ● | ● | ● |
|  | EP, 105w, 10C (Intel® Xeon® processor E5-2660 V3, E5-2650 V3)                         | ● | ● | ● | ● | ● | ● |
|  | EP, 90w, 8C (Intel® Xeon® processor E5-2640 V3)                                       | ● | ● | ● | ● | ● | ● |
|  | EP, 85w,8C,6C (Intel® Xeon® processor E5-2630 V3, E5-2620 V3, E5-2609 V3, E5-2603 V3) | ● | ● | ● | ● | ● | ● |
|  | EP, 135w, 8C,6C,4C (Intel® Xeon® processor E5-2667 V3, E5-2643 V3, E5-2637 V3)        | ● | ● | ● | ● | ● | ● |
|  | EP, 105w, 4C (Intel® Xeon® processor E5-2623 V3)                                      | ● | ● | ● | ● | ● | ● |
|  | EP, 65w, 12C (Intel® Xeon® processor E5-2650L V3)                                     | ● | ● | ● | ● | ● | ● |
|  | EP, 55w, 8C (Intel® Xeon® processor E5-2630L V3)                                      | ● | ● | ● | ● | ● | ● |
|  | EP, 145w, 14C,18C (Intel® Xeon® processor E5-2697 V3, E5-2699 V3)                     | ● | ● | ● | ● | ● | ● |
|  | EP, 135w, 16C (Intel® Xeon® processor E5-2698 V3)                                     | ● | ● | ● | ● | ● | ● |
|  | EP, 120w, 14C (Intel® Xeon® processor E5-2695 V3, E5-2683 V3)                         | ● | ● | ● | ● | ● | ● |
| Memory Type<br>See Note 4.                         | RDIMM-2Rx8,1Rx4   | ● | ● | ● | ● | ● | ● |
|  | RDIMM-DRx4  | ● | ● | ● | ● | ● | ● |
|  | LRDIMM-QRx4 DDP   | ● | ● | ● | ● | ● | ● |
| Add-in Cards<br>See Note 5.                        | PCIe Cards  | ● | ● | ● | ● | ● | ● |
| Battery Backup<br>See Note 6.                      | BBU (Rated to 45°C)   | ● | ● | ● | ● | ● | ● |
|  | Supercap (Rated to 45°C)  | ● | ● | ● | ● | ● | ● |
|  | Cache Offload Module (rated to 55°C)  | ● | ● | ● | ● | ● | ● |
| 2.5" SFF NVMe SSD<br>(DC P3700/P3500)              | 1600GB/2TB  | ● | ● | ● | ● | ● | ● |
|  | 800GB   | ● | ● | ● | ● | ● | ● |
|  | 500GB   | ● | ● | ● | ● | ● | ● |
|  | 400GB   | ● | ● | ● | ● | ● | ● |
|  | 200GB   | ● | ● | ● | ● | ● | ● |
| PCIe SSD AIC FF<br>(DC P3700/P3500)<br>See Note 7. | 1600GB/2TB  | ● | ● | ● | ● | ● | ● |
|  | 800GB   | ● | ● | ● | ● | ● | ● |
|  | 500GB   | ● | ● | ● | ● | ● | ● |
|  | 400GB   | ● | ● | ● | ● | ● | ● |
|  | 200GB   | ● | ● | ● | ● | ● | ● |
| M.2 (DC S3500)                                     | 340G/120G/80G   | ● | ● | ● | ● | ● | ● |

|                   |                           |  |  |   |   |  |  |
|-------------------|---------------------------|--|--|---|---|--|--|
| See Note 8.       |                           |  |  |   |   |  |  |
| Intel® Xeon® Phi™ | Active Cooling up to 300W |  |  | ● | ● |  |  |
|                   | Active Cooling up to 225W |  |  | ● | ● |  |  |

**Notes:**

1. The 27°C configuration alone is limited to elevations of 900m or less. Altitude higher than 900m needs to be de-rated same as ASHRAE Class2.
2. In fan redundancy mode, 2 PSUs are required to keep the sufficient cooling. System fans and PSUs cannot fail at the same time.
3. System with 1600W PSU has higher acoustic at operation mode due to PSU firmware setting. It can meet Intel Blue book.
4. When identifying memory in the table, only Rank and Width are required. Capacity is not required.
5. Able to provide sufficient cooling for any PCIe card that satisfies the 55°C-200LFM boundary condition requirement.
6. Supercap uses 45°C thermal spec at normal mode and 55°C at fan fail mode. Excursions over spec may result in reliability impact. BBU need to meeting 45C thermal spec in both fan normal / fail mode.
7. For Add-In-Card form factor PCIe SSD requires 300LFM for cooling, need to be placed in PCI slot3/4/5/6, at same time, performance mode in BIOS is required to be enabled.
8. To support full performance for Intel S3500 M.2 device, performance mode in BIOS is required to be enabled.
9. P4208/P4216 includes SAS only hot swap and Combo HDD backplane.



## 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  |

| Word/Acronym    | Definition  |
|-----------------|---|
| Noise           | The periodic or random signals over frequency band of 10 Hz to 20 MHz.  |
| 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 Modulation  |
| 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.  |