



Intel® Server System R2000BB Product Family

Technical Product Specification



Revision 1.2

January 2013

Enterprise Platforms and Services Division

Revision History

| Date | Revision Number | Modifications |
|--------------|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| April 2012 | 1.0 | 1 st Production Release |
| June 2012 | 1.1 | <ul style="list-style-type: none"> • Corrected LCP front Panel port definition • Corrected LCP product code • Added advisory note to AXXVRAIL feature list • Corrected IO Module product code definitions in Table 1 • Added note describing support requirements for AXXRMFBU2 accessory kit • Added sections for RMM4 support • Added BBU9 Installation Diagram |
| January 2013 | 1.2 | <ul style="list-style-type: none"> • Front bezel badge option diagrams added to section 2.5 • Rail Kit Caution and Advisory notes added to section 2.6 • DC Power Supply Spec content added to Chapter 3 • Added Chapter 5 – Intel Xeon® Phi™ Coprocessor and GPGPU support • Internal SSD support changes made in section 6.4 • Updated sections 7.2.2 and 7.4.4 – embedded RSTe support • Deleted sections in Chapter 9. Intel Local Control Panel. Added reference to published LCP TPS. • Corrected Appendix B - POST Code LED Decoder – (E0h – E3h) • Added Appendix D – System Configuration Table for Thermal Compatibility |

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1. Introduction

This Technical Product Specification (TPS) provides system level information for the Intel® Server System R2000BB product family. It describes the functions and features of the integrated server system which includes the chassis layout, system boards, power sub-system, cooling sub-system, storage sub-system options, and available installable options. Server board specific detail can be obtained by referencing the *Intel® Server Board S2400BB Technical Product Specification*.

In addition, design-level information related to specific server board components / subsystems can be obtained by ordering External Product Specifications (EPS) or External Design Specifications (EDS) related to this server generation. EPS and EDS documents are made available under NDA with Intel and must be ordered through your local Intel representative.

1.1 Chapter Outline

This document is divided into the following chapters:

- Chapter 1 – Introduction
- Chapter 2 – Product Family Overview
- Chapter 3 – Power Subsystem
- Chapter 4 – Thermal Management
- Chapter 5 – Intel® Xeon Phi™ Coprocessor card and GPGPU add-in card support
- Chapter 6 – System Storage and Peripherals Drive Bay Overview
- Chapter 7 – Storage Controller Options Overview
- Chapter 8 – Front Control Panel and I/O Panel Overview
- Chapter 9 – Intel® Local Control Panel
- Chapter 10 – PCI Riser Card Support
- Chapter 11 – Mezzanine Module Support
- Appendix A – Integration and Usage Tips
- Appendix B – POST Code Diagnostic LED Decoder
- Appendix C – Post Code Errors
- Appendix D – System Configuration Table for Thermal Compatibility
- Glossary
- Reference Documents

1.2 Server Board Use Disclaimer

Intel Corporation server boards support add-in peripherals and contain a number of high-density VLSI and power delivery components that need adequate airflow to cool. Intel® ensures through its own chassis development and testing that when Intel® server building blocks are used together, the fully integrated system will meet the intended thermal requirements of these components. It is the responsibility of the system integrator who chooses not to use Intel®-developed server building blocks to consult vendor datasheets and operating parameters to determine the amount of airflow required for their specific application and environmental conditions. Intel Corporation cannot be held responsible if components fail or the server board does not operate correctly when used outside any of their published operating or non-operating limits.

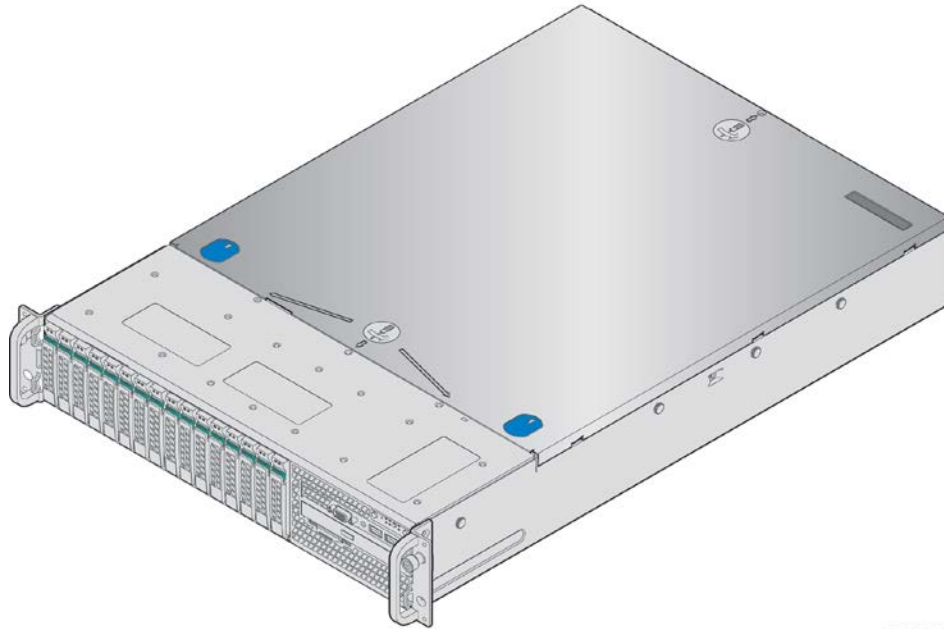
1.3 Product Errata

The products described in this document may contain design defects or errors known as errata which may cause the product to deviate from published specifications. Product Errata are documented in the *Intel® Server Board S2400BB, Intel® Server System R1000BB, Intel® Server System R2000BB Monthly Specification Update* which can be downloaded from <http://www.intel.com/support>.

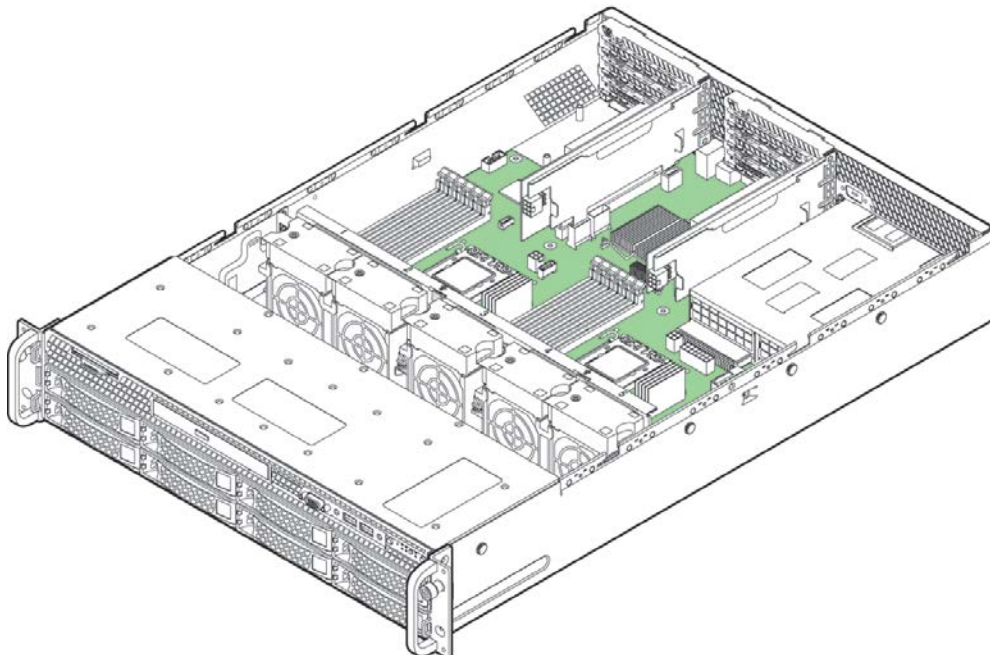
2. Product Family Overview

This generation of Intel 2U server platforms offers a variety of system options to meet the varied configuration requirements of high-density high-performance computing environments. The Intel® Server System R2000BB product family is comprised of several available 2U rack mount server systems that are all integrated with an Intel® Server Board S2400BB.

This chapter provides a high-level overview of the system features and available options as supported in different platform SKUs within this server family. Greater detail for each major system component or feature is provided in the following chapters.



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Table 1. System Feature Set

| Server System | Integrated Server Board |
|---------------------------------------------|--------------------------------|
| Intel® Server System R2000BB product family | Intel® Server Board S2400BB |

| Feature | Description |
|------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Processor Support | Support for one or two Intel® Xeon® processors E5-2400 product family <ul style="list-style-type: none"> Supported Thermal Design Power (TDP) of up to 95 Watts. |
| Memory | <ul style="list-style-type: none"> 12 DIMM slots – 2 DIMMs / Channel – 3 memory channels per processor Unbuffered DDR3 (UDIMM), registered DDR3 (RDIMM), and Load Reduced DDR3 (LRDIMM) Memory DDR3 data transfer rates of 800, 1066, 1333, and 1600 MT/s DDR3 standard I/O voltage of 1.5V and DDR3 Low Voltage of 1.35V |
| Chipset | Intel® C602 chipset with support for optional Intel® RAID C600 Upgrade keys |
| External I/O connections | <ul style="list-style-type: none"> Video - back (standard), front panel video connector available on Non-Storage SKUs RJ-45 Serial- A Port Four RJ-45 Network Interface Connectors supporting 10/100/1000Mb USB 2.0 connectors - 3 on back panel + 2 on standard (non-storage) front panel |
| Internal I/O connectors / headers | <ul style="list-style-type: none"> One Type-A USB 2.0 connector One DH-10 Serial-B port connector |
| I/O Module Accessory Options | <p>The following optional I/O modules utilize a single proprietary on-board connector. An installed I/O module can be supported in addition to standard on-board features and any add-in expansion cards.</p> <ul style="list-style-type: none"> Quad port 1 GbE based on Intel® Ethernet Controller I350 – AXX4P1GBPWLMIOM Dual RJ-45 port 10GBase-T I/O Module based on Intel® Ethernet Controller x540 – AXX10GBTWLIOM Dual SFP+ port 10GbE module based on Intel® 82599 10 GbE controller – AXX10GBNIAIOM Single Port FDR 56GT/S speed InfiniBand module with QSFP connector – AXX1FDRIBIOM Dual port FDR 56GT/S speed infiniband module with QSFP connector – AXX2FDRIBIOM |
| System Fans | <ul style="list-style-type: none"> Five managed system fans One managed power supply fan for each installed power supply module |
| Riser Cards | <p>Support for two riser cards.</p> <p>Riser Slot #1(PCIe x16) – Riser Card Options</p> <ul style="list-style-type: none"> One add-in card slot – PCIe x16 lanes, x16 slot Three add-in card slots – PCIe x8 lanes,x16 slot + two PCIe x4 lanes,x8 slot <p>Riser Slot#2 (PCIe x24)– Riser Card Options</p> <ul style="list-style-type: none"> Two add-in card slots – PCIe x16 lanes,x16 slot + PCIe x8 lanes, x8 slot Three add-in card slots – PCIe x8 lanes, x8 slot + two PCIe x8 lanes, x16 slot Three add-in card slots – PCIe x8 lanes, x8 slot + two PCIe x133Mhz |
| Video | <ul style="list-style-type: none"> Integrated 2D Video Controller 16 MB DDR3 Memory |
| On-board storage controllers and options | <ul style="list-style-type: none"> One eUSB 2x5 pin connector to support 2mm low-profile eUSB solid state devices One mSATA SSD connector One 7-pin single port AHCI SATA connector capable of supporting up to 6 Gb/sec Two SCU 4-port mini-SAS connectors capable of supporting up to 3 Gb/sec SAS/SATA Intel® RAID C600 Upgrade Key support providing optional expanded SATA / SAS RAID capabilities |
| Security | Intel® Trusted Platform Module (TPM) - AXXTPE5 – Accessory Option |
| Server Management | <ul style="list-style-type: none"> Integrated Baseboard Management Controller, IPMI 2.0 compliant Support for Intel® Server Management Software Intel® Remote Management Module 4 Lite - Accessory option Intel® Remote Management Module 4 Management NIC - Accessory option |

| | |
|---------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Power Supply Options</p> | <p>The server system can have up to two power supply modules installed, providing support for the following power configurations: 1+0, 1+1 Redundant Power, and 2+0 Combined Power.</p> <ul style="list-style-type: none"> • Three available power supply options: <ul style="list-style-type: none"> ○ AC 460W Gold ○ AC 750W Platinum ○ DC 750W |
| <p>Storage Bay Options</p> | <ul style="list-style-type: none"> • 8x – 3.5" SATA/SAS Hot Swap Hard Drive Bays + Optical Drive support • 12x – 3.5" SATA/SAS Hot Swap Hard Drive Bays • 8x – 2.5" SATA/SAS Hot Swap Hard Drive Bays + Optical Drive support • 16x – 2.5" SATA/SAS Hot Swap Hard Drive Bays + Optical Drive support • 24x – 2.5" SATA/SAS Hot Swap Hard Drive Bays • 1x – internal fixed mount SSD (standard feature on all SKUs) |
| <p>Supported Rack Mount Kit Accessory Options</p> | <ul style="list-style-type: none"> • Tool-less rack mount rail kit – Intel Product Code – AXXPRAIL • Value rack mount rail kit – Intel Product Code – AXXVRAIL • Cable Management Arm – Intel Product Code – AXX1U2UCMA (*supported with AXXPRAIL only) • 2-post fixed mount bracket kit – Intel Product Code – AXX2POSTBRCKT |

2.1 Chassis Dimensions

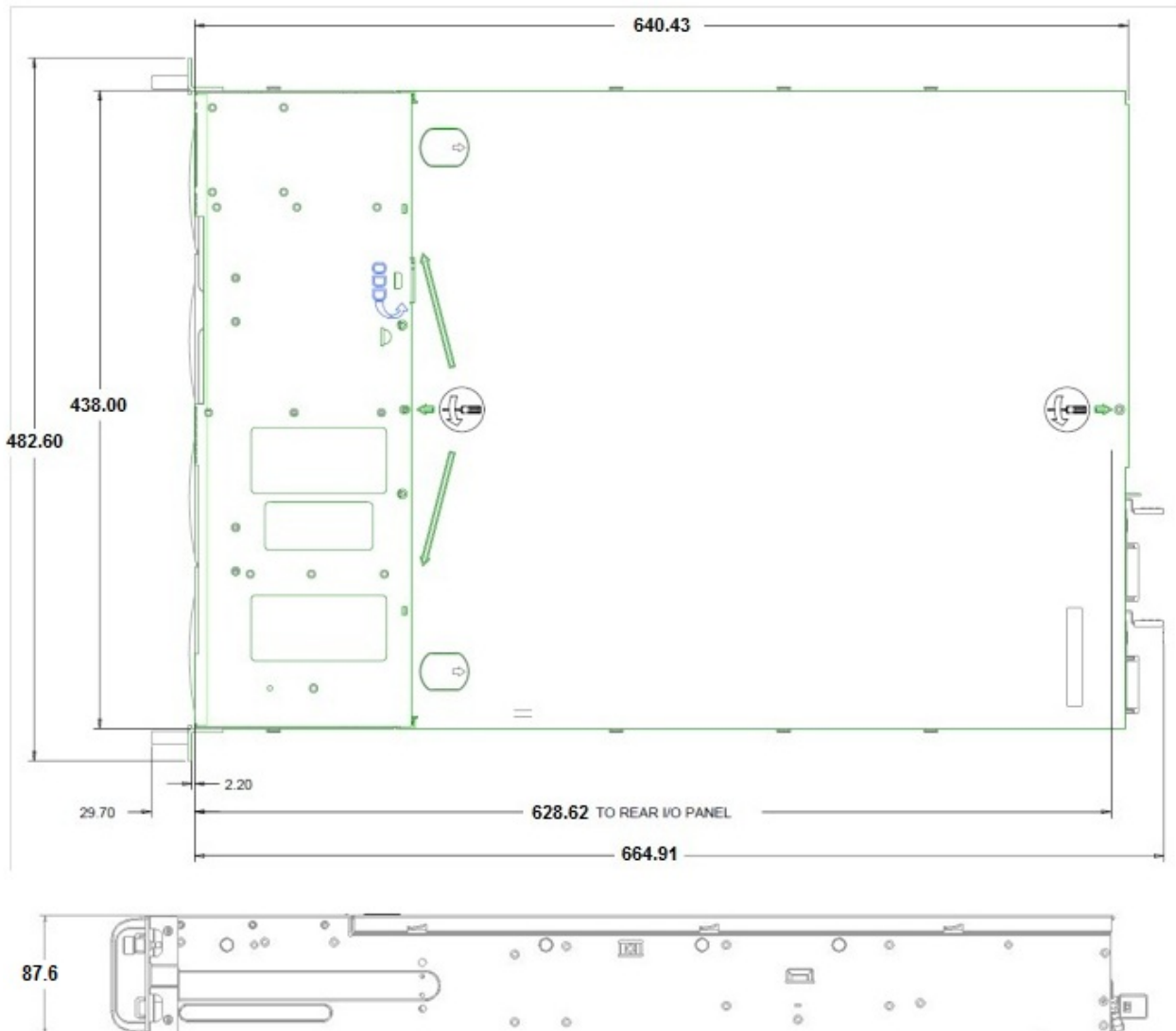


Figure 1. Chassis Dimensions

2.2 System Level Environmental Limits

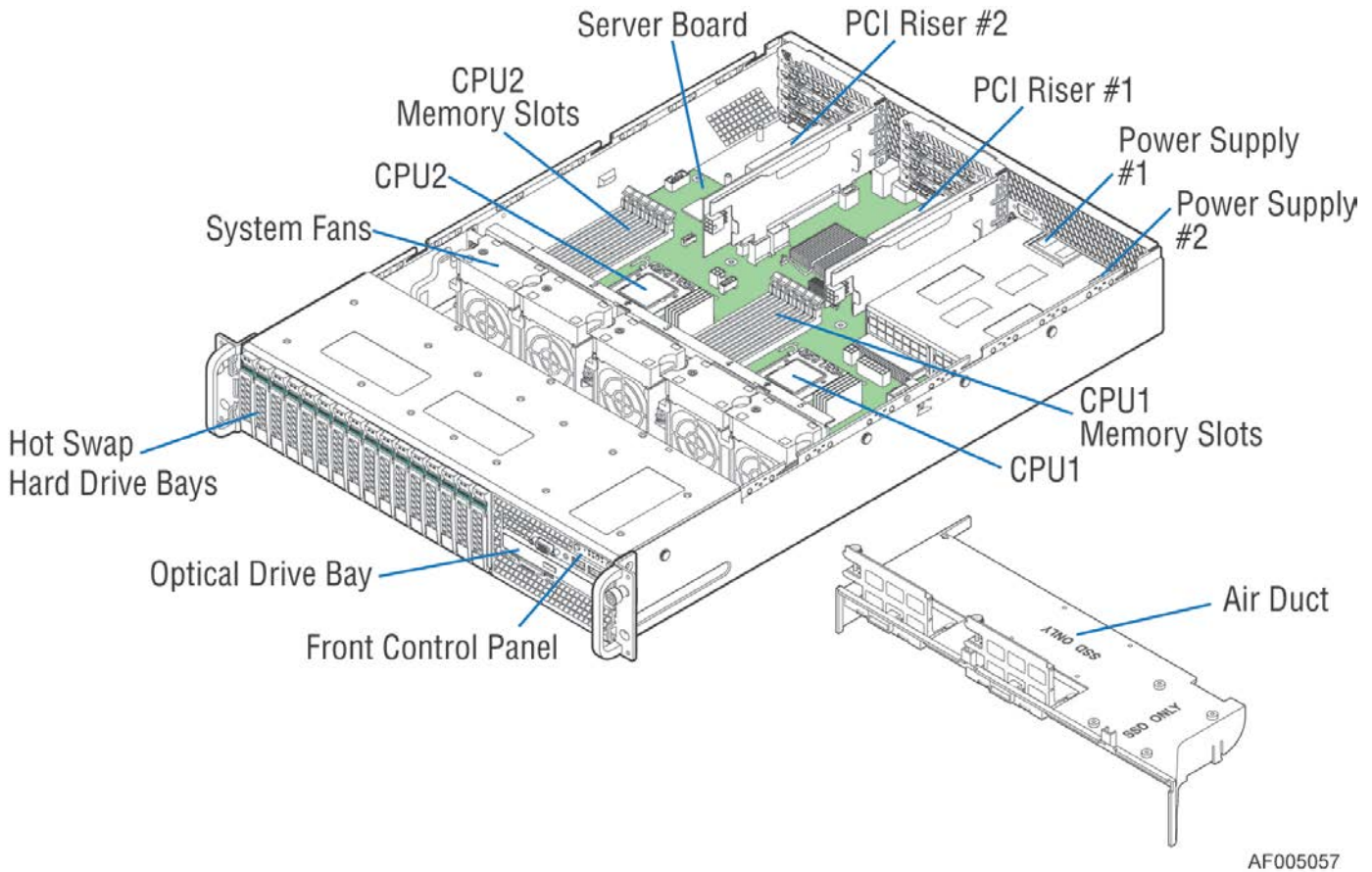
The following table defines the system level operating and non-operating environmental limits.

Table 2. System Environmental Limits Summary

| Parameter | | Limits |
|--------------------------------------|-----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| Temperature | | |
| | Operating | ASHRAE Class A2 – Continuous Operation. 10° C to 35° C (50° F to 95° F) with the maximum rate of change not to exceed 10°C per hour |
| | | ASHRAE Class A3 – Includes operation up to 40C for up to 900 hrs per year. |
| | | ASHRAE Class A4 – Includes operation up to 45C for up to 90 hrs per year. |
| | Shipping | -40° C to 70° C (-40° F to 158° F) |
| Altitude | | |
| | Operating | Support operation up to 3050m with ASHRAE class deratings. |
| Humidity | | |
| | Shipping | 50% to 90%, non-condensing with a maximum wet bulb of 28° C (at temperatures from 25° C to 35° C) |
| Shock | | |
| | Operating | Half sine, 2g, 11 mSec |
| | Unpackaged | Trapezoidal, 25 g, velocity change is based on packaged weight |
| | Packaged | Product Weight: ≥ 40 to < 80 Non-palletized Free Fall Height = 18 inches Palletized (single product) Free Fall Height = NA |
| Vibration | | |
| | Unpackaged | 5 Hz to 500 Hz 2.20 g RMS random |
| | Packaged | 5 Hz to 500 Hz 1.09 g RMS random |
| AC-DC | | |
| | Voltage | 90 Hz to 132 V and 180 V to 264 V |
| | Frequency | 47 Hz to 63 Hz |
| | Source Interrupt | No loss of data for power line drop-out of 12 mSec |
| | Surge Non-operating and operating | Unidirectional |
| | Line to earth Only | AC Leads 2.0 kV I/O Leads 1.0 kV DC Leads 0.5 kV |
| ESD | | |
| | Air Discharged | 12.0 kV |
| | Contact Discharge | 8.0 kV |
| Acoustics Sound Power Measured | | |
| | Power in Watts | <300 W ≥300 W ≥600 W ≥1000 W |
| | Servers/Rack Mount BA | 7.0 7.0 7.0 7.0 |
| | | |

See Appendix D in this document or the *Intel® S2400BB Product Family Power Budget and Thermal Configuration Tool* for system configuration requirements and limitations.

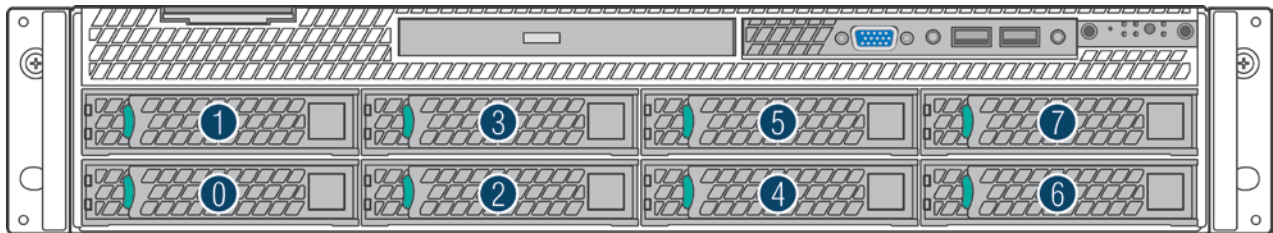
2.3 System Features and Options Overview



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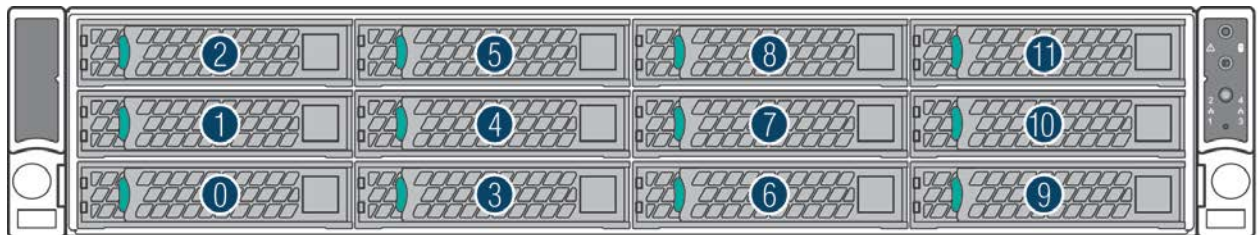
Figure 2. System Components Overview

2.3.1 Hot Swap Hard Drive Bay and Front Panel Options



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Figure 3. 3.5" Hard Drive Bay - 8 Drive Configuration



AF004103

Figure 4. 3.5" Hard Drive Bay - 12 Drive Configuration (Storage SKU)

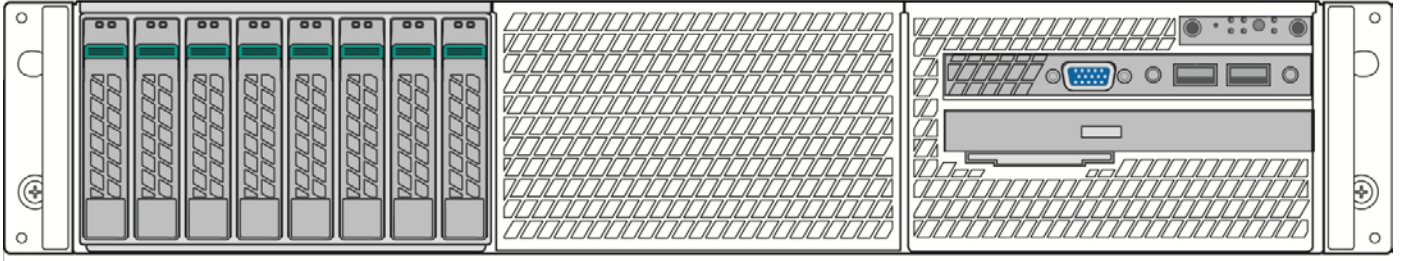


Figure 5. 2.5" Hard Drive Bay - 8 Drive Configuration

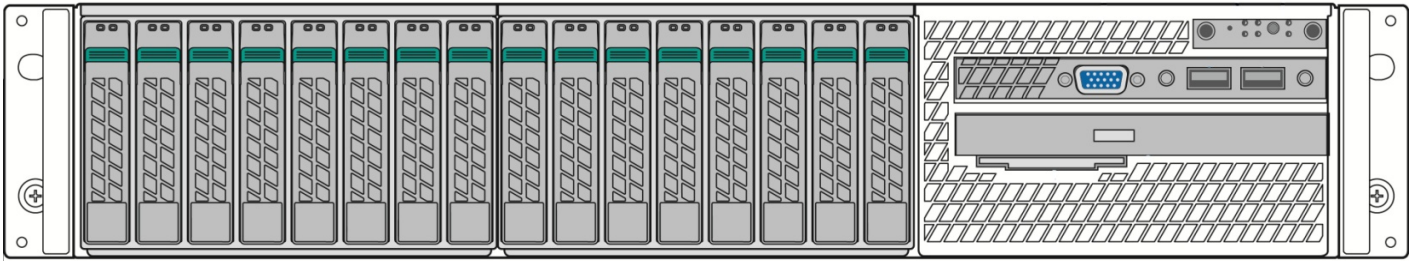
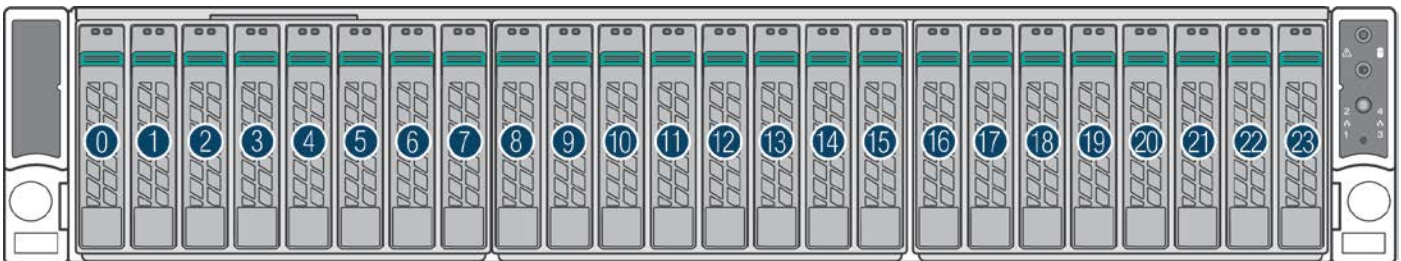


Figure 6. 2.5" Hard Drive Bay - 16 Drive Configuration



AF004064

Figure 7. 2.5" Hard Drive Bay - 24 Drive Configuration (Storage SKU)

2.3.2 Back Panel Features

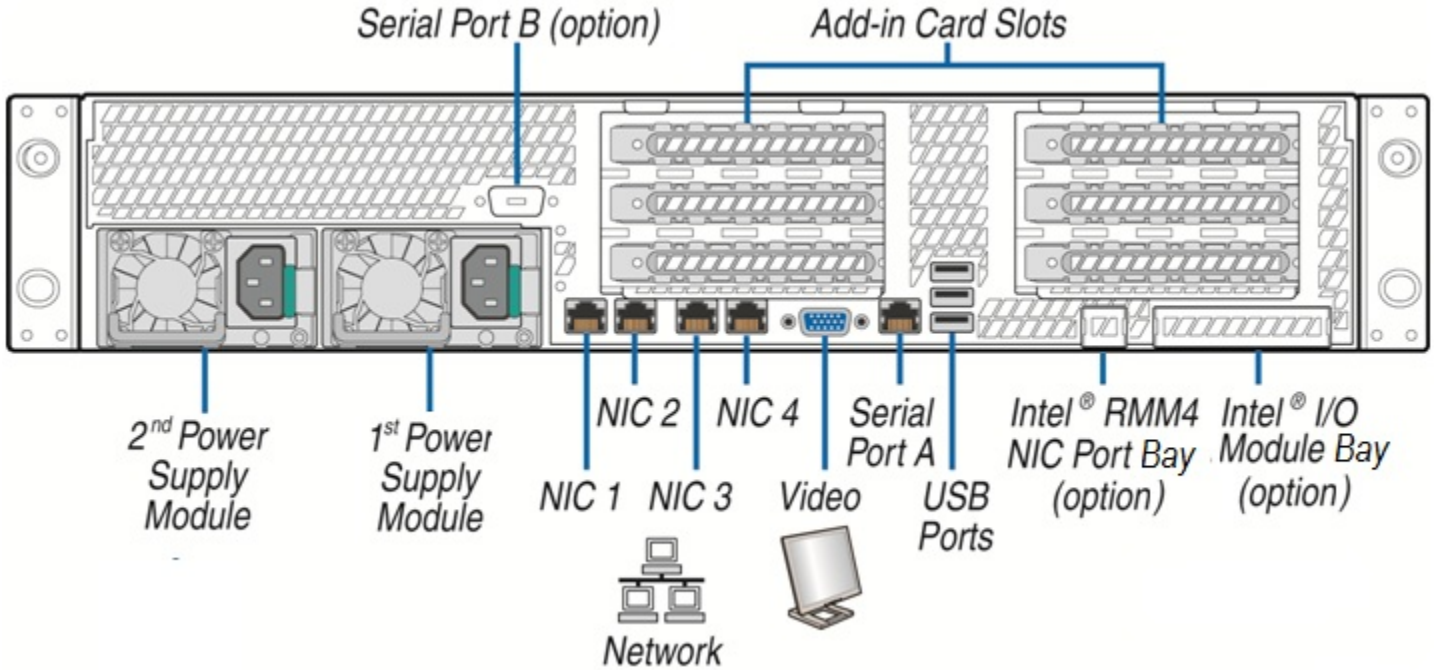
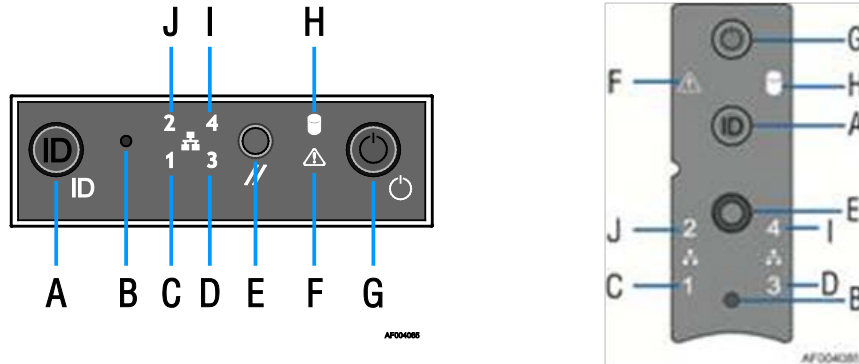


Figure 8. Back Panel Feature Identification

2.3.3 Front Control Panel Options



| Label | Description | Label | Description |
|-------|----------------------------------------------|-------|-------------------------------|
| A | System ID Button w/Integrated LED | F | System Status LED |
| B | NMI Button (recessed, tool required for use) | G | Power Button w/Integrated LED |
| C | NIC-1 Activity LED | H | Hard Drive Activity LED |
| D | NIC-3 Activity LED | I | NIC-4 Activity LED |
| E | System Cold Reset Button | J | NIC-2 Activity LED |

Figure 9. Front Control Panel Options

2.4 Server Board Features Overview

The following illustration provides a general overview of the server board, identifying key feature and component locations

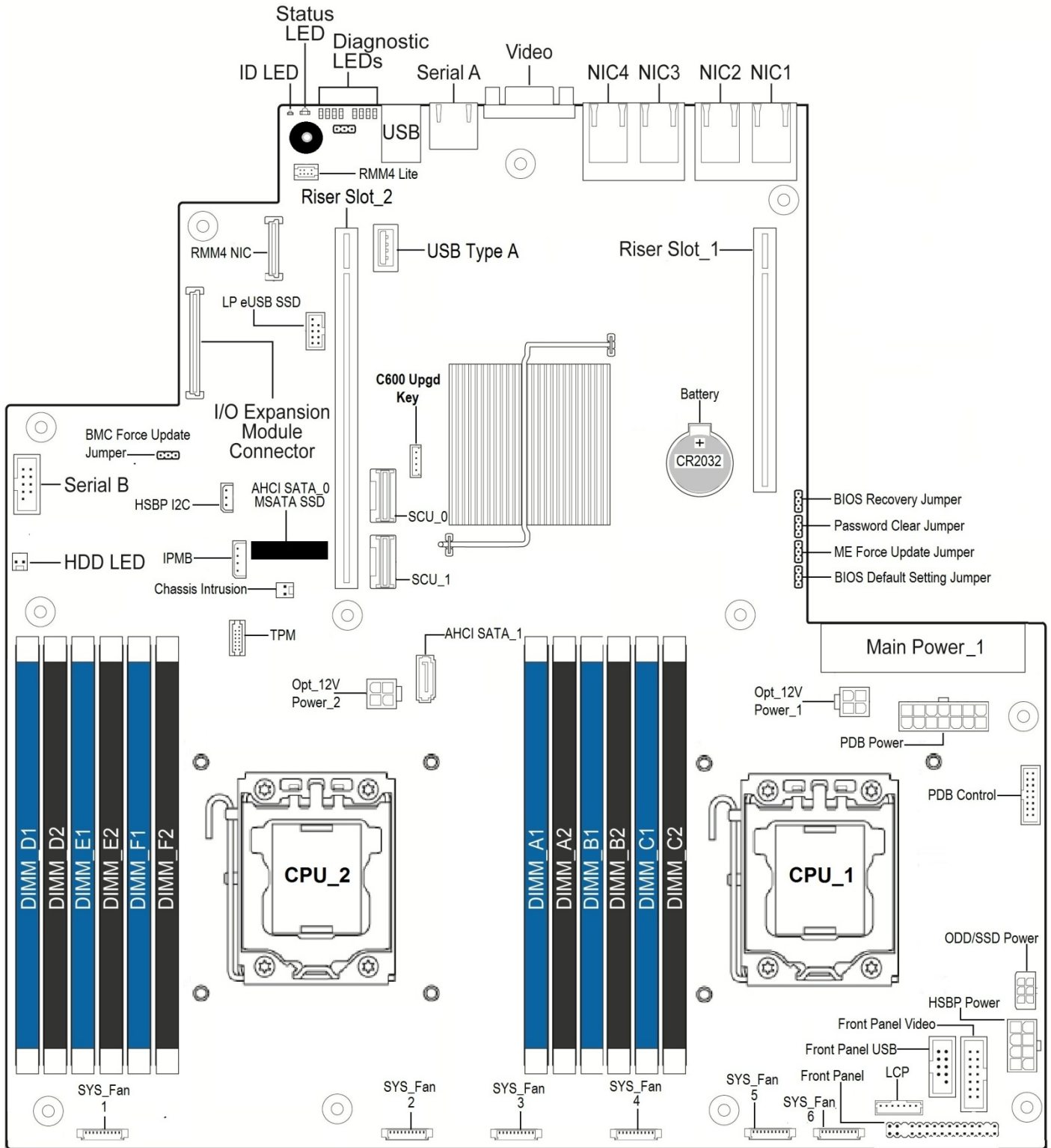


Figure 10. Intel® Server Board S2400BB

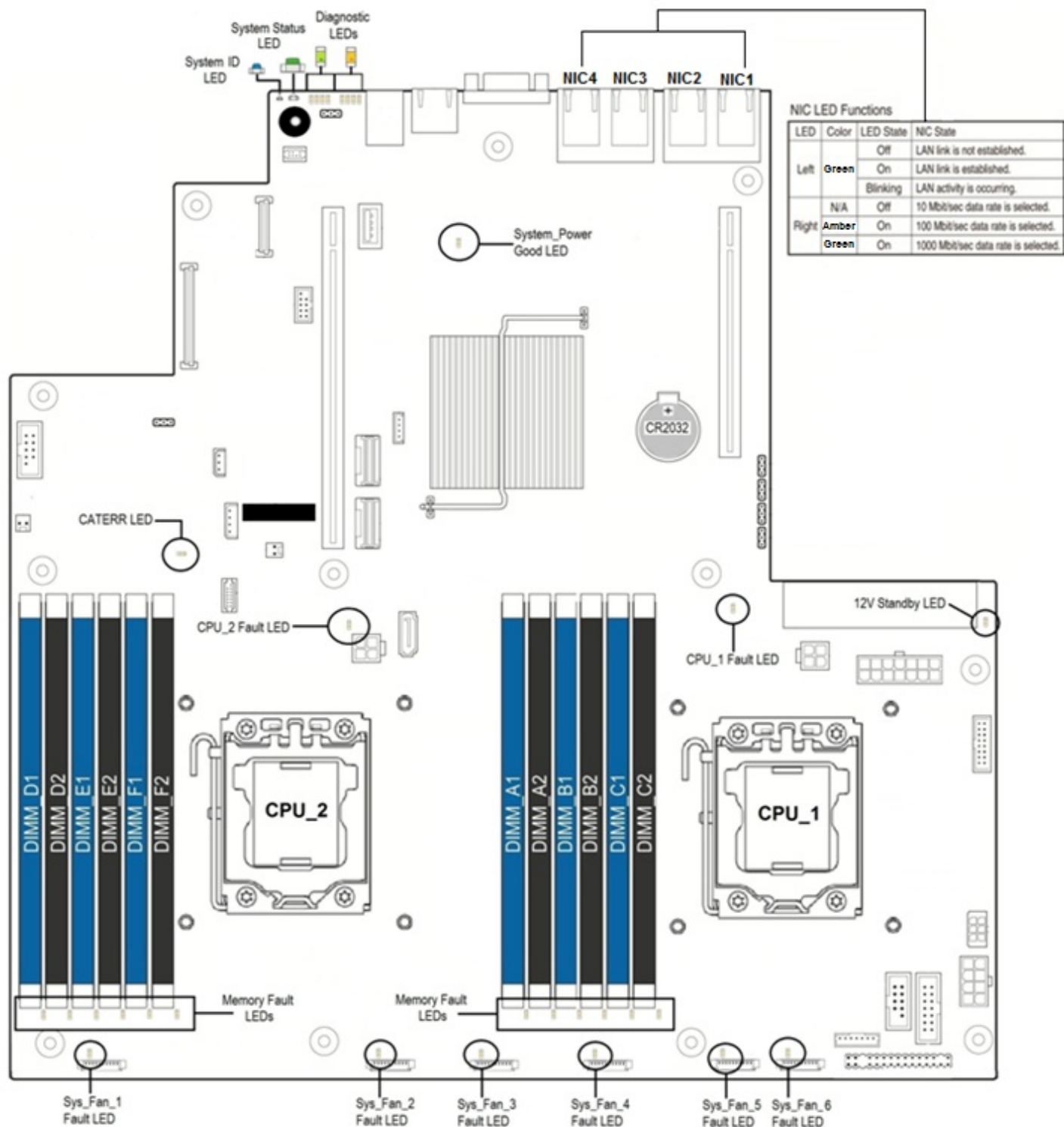
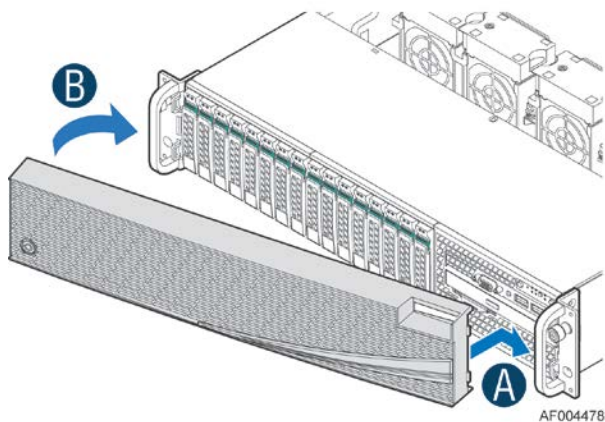


Figure 11. Intel® Light-Guided Diagnostic LEDs - Server Board

2.5 Available Front Bezel Support

The optional front bezel is made of molded plastic and uses a snap-on design. When installed, its design allows for maximum airflow to maintain system cooling requirements. The face of the bezel assembly includes snap-in identification badge options and a wave (shown) feature option to allow for customization.



(Intel Product Order Code – A2UBEZEL)

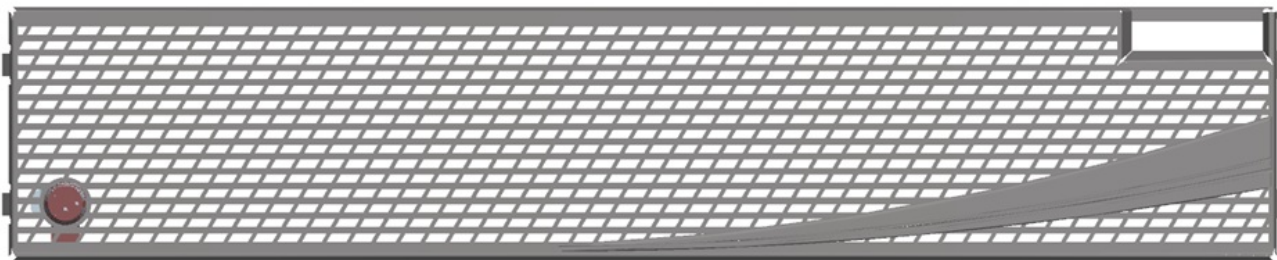


Figure 12. Front Bezel accessory with optionally installed wave feature

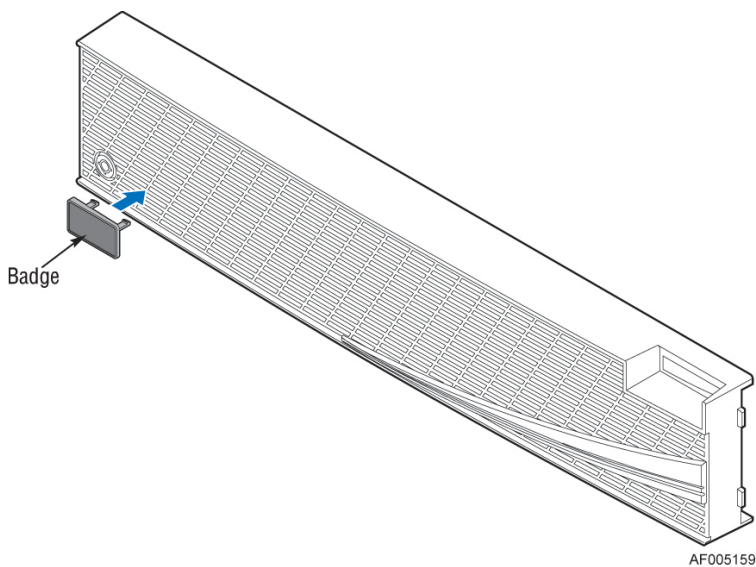


Figure 13. Front Bezel accessory with optionally installed ID Badge insert

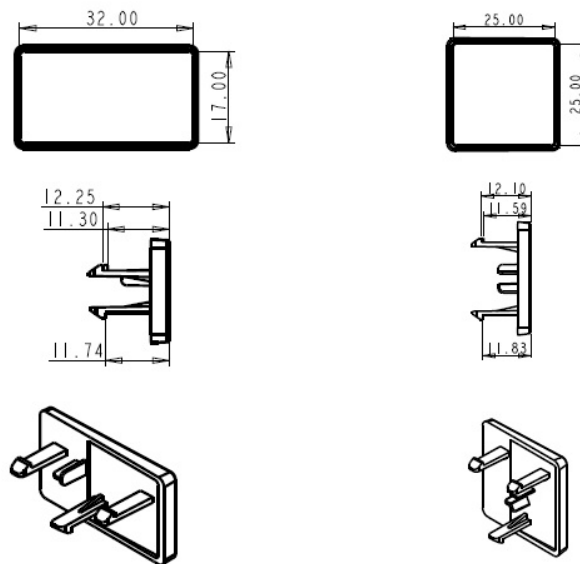


Figure 14. Front Bezel accessory ID Badge mechanical drawings

2.6 Available Rack and Cabinet Mounting Kit Options

Advisory Note – Available rack and cabinet mounting kits are not designed to support shipment of the server system while installed in a rack. If you chose to do so, Intel advises you verify your shipping configuration with appropriate shock and vibrate testing, before shipment. Intel does not perform shipping tests which cover the complex combination of unique rack offerings and custom packaging options.

Caution: Exceeding the specified maximum weight or misalignment of the server may result in failure of the rack rails, resulting in damage to the system or personal injury. The use of mechanical assists to install and align the server into the rack rails is highly recommended.

- Tool-less rack mount rail kit – Intel Product Code – **AXXPRAIL**
 - 1U and 2U compatible
 - 54 lbs (24 Kgs) max support weight
 - Tool-less installation
 - Full extension from rack
 - Drop in system install
 - Optional cable management arm support
- Value rack mount rail kit – Intel Product Code – **AXXVRAIL**
 - 1U to 4U compatible
 - 130 lbs (59 Kgs) max support weight
 - Tool-less chassis attach
 - Tools required to attach to rails to rack
 - 2/3 extension from rack
- Cable Management Arm – Intel Product Code – **AXX1U2UCMA** (*supported with AXXPRAIL only)
- 2-Post Fixed mount bracket kit – Intel Product Code - **AXX2POSTBRCKT**
 - 1U and 2U compatible
 - Tools required to attach components to rack

3. Power Subsystem

This chapter provides a high level overview of the power management features and specification data for the power supply options available for this server product. Specification variations will be identified for each supported power supply.

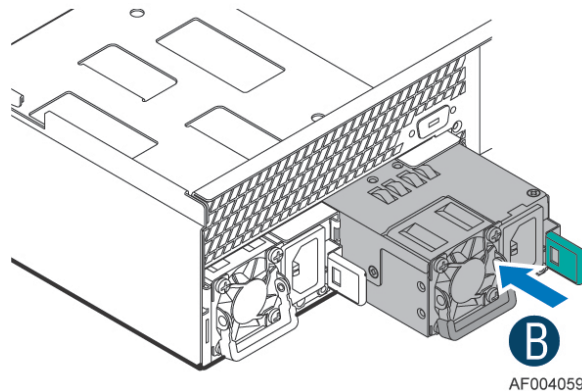
The server system can have up to two power supply modules installed, supporting the following power supply configurations: 1+0 (single power supply), 1+1 Redundant Power, and 2+0 Combined Power (non-redundant). 1+1 redundant power and 2+0 combined power configurations are automatically configured depending on the total power draw of the system. If the total system power draw exceeds the power capacity of a single power supply module, then power from the 2nd power supply module will be utilized. Should this occur, power redundancy is lost. In a 2+0 power configuration, total power available may be less than twice the rated power of the installed power supply modules due to the amount of heat produced with both supplies providing peak power. Should system thermals exceed programmed limits, platform management will attempt to keep the system operational. See *Closed Loop System Throttling (CLST)* later in this chapter, and Chapter 4 *Thermal Management*, for details.

There are three power supply options available for this server product: 460W AC, 750W AC, 750W DC.

Caution: Installing two Power Supply Units with different wattage ratings in a system is not supported. Doing so will not provide Power Supply Redundancy and will result in multiple errors being logged by the system.

The power supplies are modular, allowing for tool-less insertion and extraction from a bay in the back of the chassis. When inserted, the card edge connector of the power supply mates blindly to a matching slot connector on the server board (PS#1) or Power Distribution Board (PS#2)..

In the event of a power supply failure, redundant 1+1 power supply configurations have support for hot-swap extraction and insertion.



The AC input is auto-ranging and power factor corrected.

3.1 Mechanical Overview

The physical size of the power supply enclosure is 39/40mm x 74mm x 185mm. The power supply contains a single managed 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

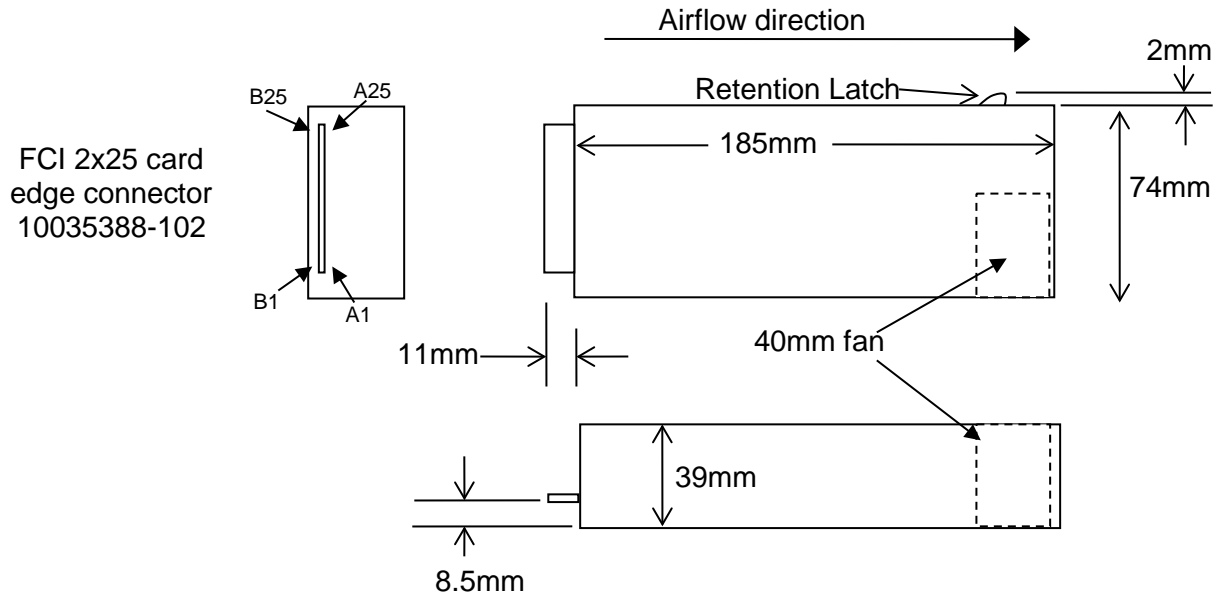


Figure 15. Power Supply Module Mechanical Drawing

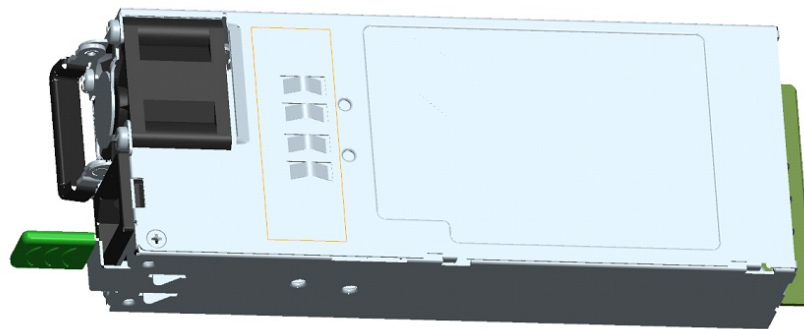


Figure 16. Power Supply Module

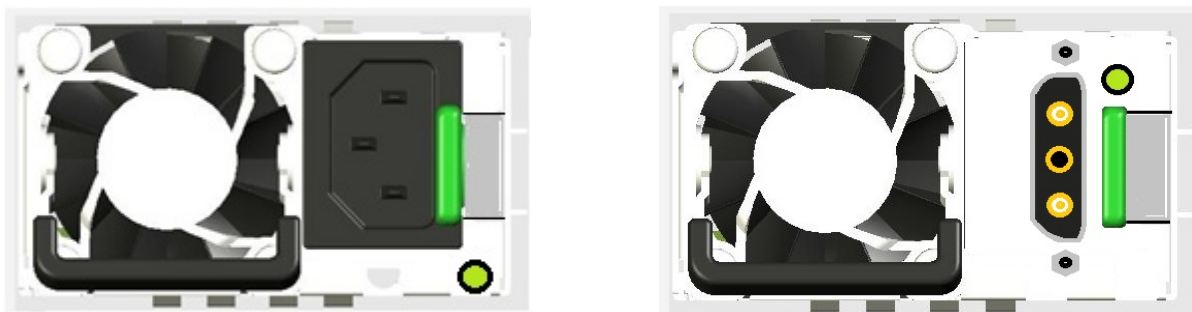


Figure 17. AC and DC Power Supplies - Connector View

3.2 Main Power Inter-Connect Layout

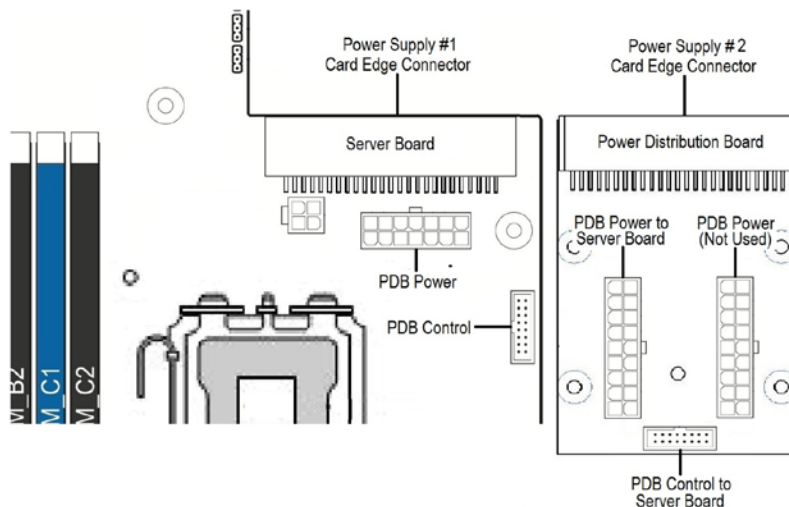


Figure 18. Main Power Connector Identification

3.3 Power Connectors

3.3.1 Power Supply Module Card Edge Connector

Each power supply module has a single 2x25 card edge output connection that plugs directly into a matching slot connector on the server board. The connector provides both power and communication signals to the server board. The following table defines the connector pin-out.

Table 3. Power Supply Module Output Power Connector Pin-out

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

The server board provides several connectors to provide power to various system options. The following sub-sections will identify the location; provide the pin-out definition; and provide a brief usage description for each.

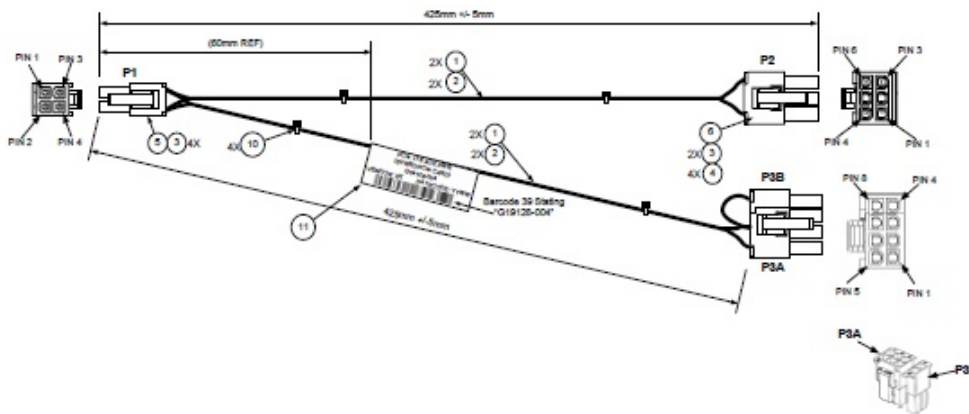
3.3.2 Riser Card Power Connectors

The server board includes two white 2x2-pin power connectors that provide supplemental power to high power PCIe x16 add-in cards that have power requirements that exceed the 75W maximum power supplied by the PCIe x16 riser slot. A cable from this connector may be routed to a power connector on the given add-in card. Maximum power draw for each connector is 225W, but is also limited by available power provided by the power supply and the total power draw of the rest of the system. A power budget for the complete system should be performed to determine how much supplemental power is available to support any high power add-in cards.

Each connector is labeled as “OPT_12V_PWR_1” and “OPT_12V_PWR_2” on the server board. The following table provides the pin-out for both connectors.

Table 4. Riser Slot Power Pin-out (“OPT_12V_PWR_#”)

| Signal Description | Pin# | Pin# | Signal Description |
|--------------------|------|------|--------------------|
| P12V | 3 | 1 | GROUND |
| P12V | 4 | 2 | GROUND |



The power cable (as shown above) for the OPT_12V_PWR_# connector is included in the following Riser Card accessory kit options: Riser Slot #1 - AXX2UPCIEX16 and Riser Slot #2 - A2UL16RISER. The cable can support both 6 and 8 pin 12V AUX power connectors located on the add-in cards.

3.3.3 Hot Swap Backplane Power Connector

The server board includes one white 2x4-pin power connector designated as the power source for any installed hot swap backplanes. On the server board, this connector is labeled as “HSBP PWR”. The following table provides the pin-out for this connector.

Table 5. Hot Swap Backplane Power Connector Pin-out (“HSBP PWR”)

| Signal Description | Pin# | Pin# | Signal Description |
|--------------------|------|------|--------------------|
| P12V_240VA | 5 | 1 | GROUND |
| P12V_240VA | 6 | 2 | GROUND |
| P12V_240VA | 7 | 3 | GROUND |
| P12V_240VA | 8 | 4 | GROUND |

3.3.4 Optical Drive and SSD Power Connector

The server board includes one brown 2x3-pin power connector intended to provide power to an optionally installed optical drive and up to two Solid State Devices (SSDs). On the server board this connector is labeled as “ODD/SSD PWR”. The following table provides the pin-out for this connector.

Table 6. Peripheral Drive Power Connector Pin-out (“ODD/SSD PWR”)

| Signal Description | Pin# | Pin# | Signal Description |
|--------------------|------|------|--------------------|
| P12V | 4 | 1 | P5V |
| P3V3 | 5 | 2 | P5V |
| GROUND | 6 | 3 | GROUND |

3.4 Power Supply Module Efficiency

The following tables provide the required minimum efficiency level at various loading conditions. These are provided at three different load levels: 100%, 50% and 20%. Efficiency is tested over an AC input voltage range of 115 VAC to 220 VAC.

Table 7. 460 Watt Power Supply Efficiency (Gold)

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

Table 8. 750 Watt Power Supply Efficiency (Platinum)

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

Table 9. 750 Watt DC Power Supply Efficiency (Gold)

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

3.5 Power Cord Specification Requirements

Power cords used must meet the specification requirements listed in the following table.

Table 10. AC Power Cord Specifications

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

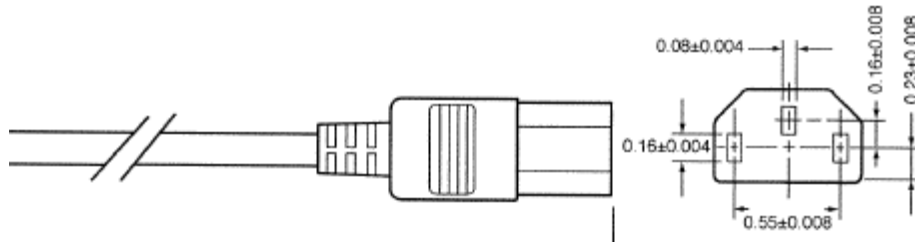


Figure 19. AC Power Cord

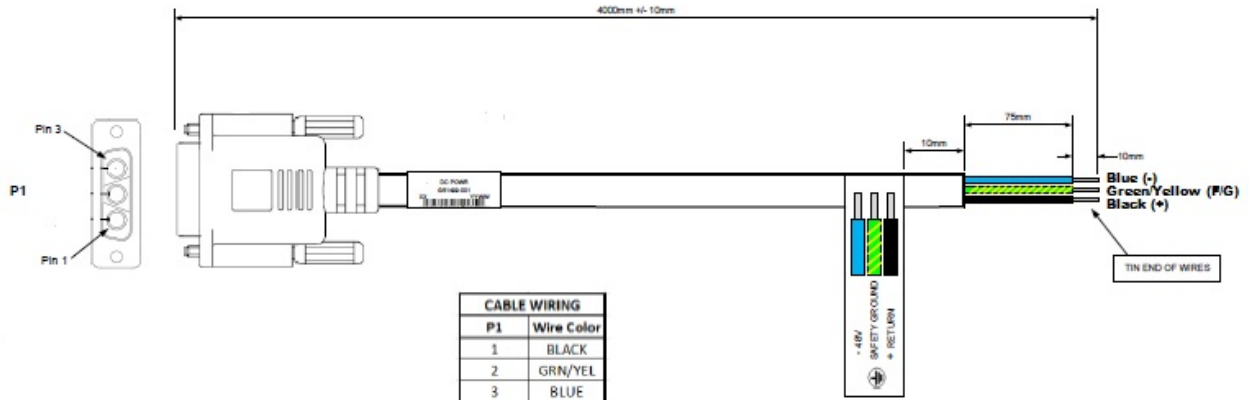


Figure 20. DC Power Cord

Table 11. DC Power Cable Connector Pin-out

| Pin | Definition |
|-----|---------------|
| 1 | + Return |
| 2 | Safety Ground |
| 3 | - 48V |

3.6 Optional Chassis Grounding Support

The system provides 10-32 threaded grounding studs on the back panel of the chassis, allowing for optional system grounding via a grounding strap.

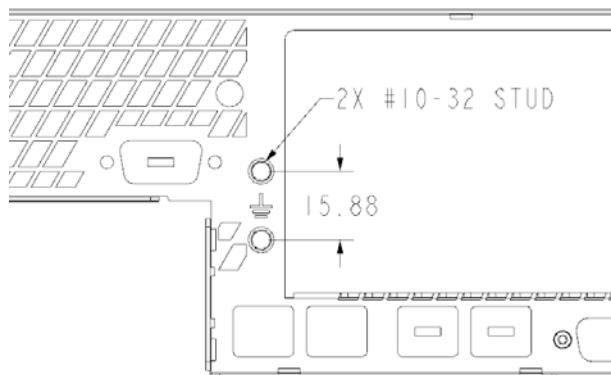


Figure 21. Chassis Grounding Studs

3.7 AC Input Requirement

3.7.1 Power Factor

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

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

Tested at 230Vac, 50Hz and 60Hz and 115VAC, 60Hz

3.7.2 AC Input Voltage Specification

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

Table 12. AC Input Voltage Range

| PARAMETER | MIN | RATED | VMAX | Start up VAC | Power Off VAC |
|---------------|----------|--------------|----------|----------------|----------------|
| Voltage (110) | 90 Vrms | 100-127 Vrms | 140 Vrms | 85VAC +/- 4VAC | 70VAC +/- 5VAC |
| Voltage (220) | 180 Vrms | 200-240 Vrms | 264 Vrms | | |
| Frequency | 47 Hz | 50/60 | 63 Hz | | |

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.

3.7.3 AC Line Isolation Requirements

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.

3.7.4 AC Line Dropout / Holdup

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

| Loading | Holdup time |
|---------|-------------|
| 70% | 12msec |

3.7.4.1 AC Line 12VSB Holdup

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

3.7.5 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.

3.7.6 AC Inrush

AC line inrush current shall not exceed **55A 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}).

3.7.7 AC Line Transient Specification

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

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

Table 13. AC Line Sag Transient Performance

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

Table 14. AC Line Surge Transient Performance

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

3.7.8 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 Intel standards please request a copy of the Intel Environmental Standards Handbook

Table 15. 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. |

3.7.9 Electrostatic Discharge Susceptibility

The power supply shall comply with the limits defined in EN 55024: 1998/A1: 2001/A2: 2003 using the IEC 61000-4-2: Edition 1.2: 2001-04 test standard and performance criteria B defined in Annex B of CISPR 24.

3.7.10 Fast Transient/Burst

The power supply shall comply with the limits defined in EN55024: 1998/A1: 2001/A2: 2003 using the IEC 61000-4-4: Second edition: 2004-07 test standard and performance criteria B defined in Annex B of CISPR 24.

3.7.11 Radiated Immunity

The power supply shall comply with the limits defined in EN55024: 1998/A1: 2001/A2: 2003 using the IEC 61000-4-3: Edition 2.1: 2002-09 test standard and performance criteria A defined in Annex B of CISPR 24.

3.7.12 Surge Immunity

The power supply shall be tested with the system for immunity to AC Unidirectional wave; 2kV line to ground and 1kV line to line, per EN 55024: 1998/A1: 2001/A2: 2003, EN 61000-4-5: Edition 1.1:2001-04 .

The pass criteria include: 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 EN55024: 1998/A1: 2001/A2: 2003 using the IEC 61000-4-5: Edition 1.1:2001-04 test standard and performance criteria B defined in Annex B of CISPR 24.

3.7.13 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.

3.7.14 Voltage Interruptions

The power supply shall comply with the limits defined in EN55024: 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.

3.7.15 Protection Circuits

Protection circuits inside the power supply 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 15 seconds and a PSON[#] cycle HIGH for one second reset the power supply.

3.7.16 Over-current Protection (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 16. 460 Watt Power Supply Over Current Protection

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

Table 17. 750 Watt Power Supply 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 |

3.7.17 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 18. Over Voltage Protection (OVP) Limits

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

3.7.18 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 shutdown. 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.

3.8 DC Power Supply Input Specifications

The following sections provide the DC Input Specifications for systems configured with DC power supply modules.

3.8.1 DC Input Voltage

The power supply must operate within all specified limits over the following input voltage range.

Table 19. DC Input Rating

| PARAMETER | MIN | RATED | MAX |
|---------------|-----------|---------------|--------|
| DC Voltage | -40.5 VDC | -48VDC/-60VDC | -75VDC |
| Input Current | 24A | | 12.5A |

3.8.2 DC Input Fuse

The power supply shall have the –48VDC input fused. The fusing shall be acceptable for all safety agency requirements. DC inrush current shall not cause the fuse to blow under any conditions. No protection circuits in the power supply shall cause the DC fuse to blow unless a component in the power supply has failed. This includes DC output load short conditions.

3.8.3 DC Inrush Current

Maximum inrush current from power-on shall be limited to a level below the surge rating of the input line cable; input diodes, fuse, and EMI filter components. To allow multiple power cycling events and DC line transient conditions max I²t value shall not exceed 20% of the fuse max rating. Repetitive ON/OFF cycling of the DC input line voltage should not damage the power supply or cause the input fuse to blow.

3.8.4 DC Input Under Voltage

The power supply shall contain protection circuitry (under-voltage lock-out) such that the application of an input voltage below the specified minimum specified, shall not cause damage (overstress) to the power supply unit (due to over-heating or otherwise).

3.8.5 DC Holdup Time and Dropout

| Loading | Holdup time |
|-------------|-------------|
| 750W (100%) | 0.2msec |

During a DC dropout of **0.2ms** or less the power supply must meet dynamic voltage regulation requirements for every rated load condition. A DC line dropout of 0.2ms or less shall not cause tripping of control signals or protection circuits. Repeated every **10 seconds** starting at the min input voltage DC line dropout shall not damage the power supply under any specified load conditions. The PWOK signal shall not go to a low state under these conditions. DC dropout transients in excess of 0.2 **milliseconds** may cause shutdown of the PS or out of regulation conditions, but shall not damage the power supply. The power supply should recover and meet all turn on requirements for DC dropouts that last longer than **0.2ms**. The power supply must meet the DC dropout requirement over rated DC voltages and output loading conditions.

3.8.6 DC Line Surge Voltages (Line Transients)

The Power Supply should demonstrate tolerance for transients in the input DC power line caused by switching or lightning. The power supply shall be primarily tested and must be compliant with the requirements of EN61000-4-5: "Electrical Fast transients / Burst Requirements and Surge Immunity Requirements" for surge withstand capability. The test voltage surge levels are to be: **500Vpk for each Line to Primary Earth Ground test (none required between the L1 and L2)**. The exact description can be found in Intel Environmental Standards Handbook 2001.

Table 20. Line Voltage Transient Limits

| Duration | Slope/Rate | Output | Performance criteria |
|-----------|--------------------------|-------------------|------------------------------------|
| 200µs max | -48V → -30V w/ +2V/µs | Rated DC Voltages | No loss of function or performance |
| | -30V → -48V w/ -2V/µs | Rated DC Voltages | No loss of function or performance |

3.8.7 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 Intel standards please request a copy of the Intel Environmental Standards Handbook.

| 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. |

3.8.7.1 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. Limits shall comply with those specified in the Intel Environmental Standards Handbook.

3.8.7.2 Fast Transient/Burst

The power supply shall comply with the limits defined in EN55024: 1998 using the IEC 61000-4-4:1995 test standard and performance criteria B defined in Annex B of CISPR 24. . Limits shall comply with those specified in the Intel Environmental Standards Handbook.

3.8.7.3 Radiated Immunity

The power supply shall comply with the limits defined in EN55024: 1998 using the IEC 61000-4-3:1995 test standard and performance criteria A defined in Annex B of CISPR 24. . Limits shall comply with those specified in the Intel Environmental Standards Handbook. Additionally, must also comply with field strength requirements specified in GR 1089 (10V/meter).

3.8.7.4 Surge Immunity

The power supply shall be tested with the system for immunity, per EN 55024:1998, EN 61000-4-5:1995 and ANSI C62.45: 1992.

The pass criteria include: 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 EN55024: 1998 using the IEC 61000-4-5:1995 test standard and performance criteria B defined in Annex B of CISPR 24. Limits shall comply with those specified in the Intel Environmental Standards Handbook.

3.8.8 Protection Circuits

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

3.8.8.1 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 DC 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 21. Over Current Protection

| Output VOLTAGE | Input voltage range | OVER CURRENT LIMITS |
|----------------|---------------------|---------------------|
| +12V | | 72A min; 78A max |
| 12VSB | | 2.5A min; 3.5A max |

3.8.8.2 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 DC 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 22. Over Voltage Protection Limits

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

3.8.8.3 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 shutdown. 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 of ambient temperature margin. □C

3.9 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 via 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.

3.9.1 Powering on Cold Standby supplies to maintain best efficiency

Power supplies in Cold Standby state shall monitor the shared voltage level of the load share signal to sense when it needs to power on. Depending upon which position (1, 2, or 3) the system defines that power supply to be in the cold standby configuration; will slightly change the load share threshold that the power supply shall power on at.

Table 23. Example Load Share Threshold for Activating Supplies

| | Enable Threshold for V _{CR_ON_EN} | Disable Threshold for V _{CR_ON_DIS} | CR_BUS De-asserted / Asserted States |
|-----------------------|-------------------------------------------------------------|----------------------------------------------|--------------------------------------|
| Standard Redundancy | NA; Ignore dc/dc_ active# signal; power supply is always ON | | OK = High Fault = Low |
| Cold Redundant Active | NA; Ignore dc/dc_ active# signal; power supply is always ON | | OK = High Fault = Low |
| Cold Standby 1 (02h) | 3.2V (40% of max) | $3.2V \times 0.5 \times 0.9 = 1.44V$ | OK = Open Fault = Low |
| Cold Standby 2 (03h) | 5.0V (62% of max) | $5.0V \times 0.67 \times 0.9 = 3.01V$ | OK = Open Fault = Low |
| Cold Standby 3 (04h) | 6.7V (84% of max) | $6.7V \times 0.75 \times 0.9 = 4.52V$ | OK = Open Fault = Low |

Notes:

Maximum load share voltage = 8.0V at 100% of rated output power

These are example load share bus thresholds; for a given power supply, these shall be customized to maintain the best efficiency curve for that specific model.

3.9.2 Powering on Cold Standby supplies during a fault or over current condition

When an active power supply asserts its CR_BUS signal (pulling it low), all parallel power supplies in cold standby mode shall power on within 100µsec

3.9.3 BMC Requirements

The BMC uses the Cold_Redundancy_Config command to define/configure the power supply's roll in cold redundancy and to turn on/off cold redundancy.

The BMC shall schedule a rolling change for which PSU is the Active, Cold Stby1, Cold Stby 2, and Cold Stby 3 power supply. This allows for equal loading across power supply over their life.

Events that trigger a re-configuration of the power supplies using the Cold_Redundancy_Config command.

- AC power ON
- PSON power ON
- Power Supply Failure
- Power supply inserted into system

3.9.4 Power Supply Turn On Function

Powering on and off of the cold standby power supplies is only controlled by each PSU sensing the Vshare bus. Once a power supply turns on after crossing the enable threshold; it lowers its threshold to the disable threshold. The system defines the 'position' of each power supply in the Cold Redundant operation. It will do this each time the system is powered on, a power supply fails, or a power supply is added to the system.

The system is relied upon to tell each power supply where it resides in the Cold Redundancy scheme.

3.10 Closed Loop System Throttling (CLST)

The server system has support for Closed Loop System Throttling (CLST). This feature prevents the system from crashing if a power supply module is overloaded. Should system power reach a pre-programmed power limit, CLST will throttle system memory and/or processors to reduce power. System performance will be impacted should this occur. For more in depth information about CLST implementation, please refer to the *SmaRT & CLST Architecture on "Romley" Systems and Power Supplies Specification* (IBL Reference # 461024).

3.11 Smart Ride Through Throttling (SmaRT)

The server system has support for Smart Ride Through Throttling (SmaRT). This feature increases the reliability for a system operating in a heavy power load condition, to remain operational during an AC line dropout event. See section 3.5.4 *AC Line Dropout / Holdup* for power supply hold up time requirements for AC Line dropout events.

When AC voltage is too low, a fast AC loss detection circuit inside each installed power supply asserts an SMBALERT# signal to initiate a throttle condition in the system. System throttling reduces the bandwidth to both system memory and CPUs, which in turn reduces the power load during the AC line drop out event.

3.12 Power Supply Status LED

There is a single bi-color LED to indicate power supply status. The LED operation is defined in the following table.

Table 24. LED Indicators

| 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 |

4. Thermal Management

The fully integrated system is designed to operate at external ambient temperatures of between 10°C- 35°C with limited excursion based operation up to 45°C, as specified in *Table 2. System Environmental Limits Summary*. Working with integrated platform management, several features within the system are designed to move air in a front to back direction, through the system and over critical components to prevent them from overheating and allow the system to operate with best performance.

The Intel® Server System R2000BB product family supports short-term, excursion-based, operation up to 45°C (ASHRAE A4) with limited performance impact. The configuration requirements and limitations are described in the configuration matrix found in Appendix D of this document and in the *Intel® S2400B Product Family Power Budget and Thermal Configuration Tool*, available as a download online at <http://www.intel.com/support>.

The installation and functionality of several system components are used to maintain system thermals. They include five managed 60mm system fans, one integrated 40mm fan for each installed power supply module, an air duct, populated hard drive carriers, and installed CPU heats sinks. Hard drive carriers can be populated with a hard drive or supplied drive blank. In addition, it may be necessary to have specific DIMM slots populated with DIMMs or factory installed DIMM blanks.

4.1 Thermal Operation and Configuration Requirements

To keep the system operating within supported maximum thermal limits, the system must meet the following operating and configuration guidelines:

- The system operating ambient is designed for sustained operation up to 35°C (ASHRAE Class A2) with short term excursion based operation up to 45°C (ASHRAE Class A4).
 - The system can operate up to 40°C (ASHRAE Class A3) for up to 900 hours per year
 - The system can operate up to 45°C (ASHRAE Class A4) for up to 90 hours per year
 - System performance may be impacted when operating within the extended operating temperature range
 - There is no long term system reliability impact when operating at the extended temperature range within the approved limits.
- Specific configuration requirements and limitations are documented in Appendix D of this document and in the configuration matrix found in the *Intel® S2400BB Product Family Power Budget and Thermal Configuration Tool*, available as a download online at <http://www.intel.com/support>.
- The CPU-1 processor + CPU heat sink must be installed first. The CPU-2 heat sink must be installed at all times, with or without a processor installed.
- **Memory Slot population requirements –**

NOTE: Some system configurations may come with factory installed DIMM blanks. DIMM blanks should only be removed when installing a DIMM in the same DIMM slot. Memory population rules apply when installing DIMMs.

 - **DIMM Population Rules on CPU-1** – Install DIMMs in order; Channels A, B, and C. Start with 1st DIMM (Blue Slot) on each channel, then slot 2. Only remove factory installed DIMM blanks when populating the slot with memory.
 - **DIMM Population Rules on CPU-2** – Install DIMMs in order; Channels D, E, and F. Start with 1st DIMM (Blue Slot) on each channel, then slot 2. Only remove factory installed DIMM blanks when populating the slot with memory.
- All hard drive bays must be populated. Hard drive carriers can be populated with a hard drive or supplied drive blank.
- With the system operating, the air duct must be installed at all times
- In single power supply configurations, the 2nd power supply bay must have the supplied filler blank installed at all times.
- Two power supplies must be installed for the system to support fan redundancy.
- Thermally, the system can support the following PCI add-in cards.
 - Add-in cards with a minimum 100 LFM (0.5 m/s) air flow requirement can be installed in any available add-in card slot in both Riser Card #1 and Riser Card #2

- Add-in cards with a minimum 200 LFM (1 m/s) air flow requirement can be installed in any available add-in card slot on Riser Card #1 and the bottom add-in card slot on Riser Card #2. Middle and Top add-in card slots on Riser Card #2 cannot support PCI add-in cards with air flow requirements greater than 100 LFM.
- Add-in cards with a >200 LFM air flow requirement cannot be supported.
- **Note:** Most PCI add-in cards have minimum air flow requirements of 100 LFM (0.5m/s). Some high power add-in cards have minimum air flow requirements of 200 LFM (1 m/s). System integrators should verify PCI add-in card air flow requirements from vendor specifications when integrating add-in cards into the system.
- The system top-cover must be installed at all times when the system is in operation. The only exception to this requirement is to hot replace a failed system fan, in which case the top cover can be removed for no more than 3 minutes at a time.

4.2 Thermal Management Overview

In order to maintain the necessary airflow within the system, all of the previously listed components and top cover need to be properly installed. For best system performance, the external ambient temperature should remain below 35°C and all system fans should be operational. The system is designed for fan redundancy when the system is configured with two power supplies. Should a single system fan fail (System fan or Power Supply Fan), integrated platform management will: change the state of the System Status LED to flashing Green, report an error to the system event log, and automatically adjust fan speeds as needed to maintain system temperatures below maximum thermal limits.

Note: All system fans are controlled independent of each other. The fan control system may adjust fan speeds for different fans based on increasing/decreasing temperatures in different thermal zones within the chassis.

In the event that system temperatures should continue to increase with the system fans operating at their maximum speed, platform management may begin to throttle bandwidth of either the memory subsystem or the processors or both, in order to keep components from overheating and keep the system operational. Throttling of these sub-systems will continue until system temperatures are reduced below preprogrammed limits.

Should system temperatures increase to a point beyond the maximum thermal limits, the system will shut down, the System Status LED will change to a solid Amber state, and the event will be logged to the system event log.

Note: Sensor data records (SDRs) for any given system configuration must be loaded by the system integrator for proper thermal management of the system. SDRs are loaded using the FRUSDR utility.

An intelligent Fan Speed Control (FSC) and thermal management technology (mechanism) is used to maintain comprehensive thermal protection, deliver the best system acoustics, and fan power efficiency. Options in <F2> BIOS Setup (**BIOS>Advanced>System Acoustic and Performance Configuration**) allow for parameter adjustments based on the actual system configuration and usage. Refer to the following sections for a description of each setting.

4.2.1 Set Throttling Mode

This option is used to select the desired memory thermal throttling mechanism. Available settings include: **[Auto]**, **[DCLTT]**, **[SCLTT]** and **[SOLTT]**.

[Auto] – Factory Default Setting - BIOS automatically detects and identifies the appropriate thermal throttling mechanism based on DIMM type, airflow input, and DIMM sensor availability.

[DCLTT] – Dynamic Closed Loop Thermal Throttling: for the SOD DIMM with system airflow input

[SCLTT] – Static Close Loop Thermal Throttling: for the SOD DIMM without system airflow input

[SOLTT] – Static Open Loop Thermal Throttling: for the DIMMs without sensor on dimm (SOD)

4.2.2 Altitude

This option sets the proper altitude that the system will be used. Available settings include: [300m or less], [301m-900m], [901m-1500m], [Above 1500m].

Selecting an altitude range that is lower than the actual altitude the system will be operating at, can cause the fan control system to operate less efficiently, leading to higher system thermals and lower system performance. If the altitude range selected is higher than the actual altitude the system will be operating at, the fan control system may provide better cooling but with higher acoustics and higher fan power consumption. If the altitude is not known, selecting a higher altitude is recommended in order to provide sufficient cooling.

4.2.3 Set Fan Profile

This option sets the desired Fan Profile. Available settings include: [Performance] and [Acoustic].

The Acoustic mode offers the best acoustic experience and appropriate cooling capability supporting the majority of the add-in cards used. Performance mode is designed to provide sufficient cooling capability covering all kinds of add-in cards on the market.

4.2.4 Fan PWM Offset

This option is reserved for manual adjustment to the minimum fan speed curves. The valid range is from [0 to 100] which stands for 0% to 100% PWM adding to the minimum fan speed. This feature is valid when Quiet Fan Idle Mode is at Enabled state. The default setting is [0]

4.2.5 Quiet Fan Idle Mode

This feature can be [Enabled] or [Disabled]. If enabled, the fans will either shift to a lower speed or stop when the aggregate sensor temperatures are satisfied, indicating the system is at ideal thermal/light loading conditions. When the aggregate sensor temperatures are not satisfied, the fans will shift back to normal control curves. If disabled, the fans will never shift into lower fan speeds or stop, regardless of whether the aggregate sensor temperatures are satisfied or not. The default setting is [Disabled]

Note: The above feature may or may not be in effect and depends on the actual thermal characteristics of the specified system.

4.2.6 Thermal Sensor Input for Fan Speed Control

The BMC uses various IPMI sensors as inputs to fan speed control. Some of the sensors are actual physical sensors and some are “virtual” sensors derived from calculations.

The following IPMI thermal sensors are used as input to fan speed control:

- Front Panel Temperature Sensor¹
- CPU Margin Sensors^{2,4,5}
- DIMM Thermal Margin Sensors^{2,4}
- Exit Air Temperature Sensor^{1,7,9}
- PCH Temperature Sensor^{3,5}
- On-board Ethernet Controller Temperature Sensors^{3,5}
- Add-In Intel SAS/IO Module Temperature Sensors^{3,5}
- PSU Thermal Sensor^{3,8}
- CPU VR Temperature Sensors^{3,6}
- DIMM VR Temperature Sensors^{3,6}
- BMC Temperature Sensor^{3,6}
- Global Aggregate Thermal Margin Sensors⁷
- Hot Swap Backplane Temperature Sensors
- I/O module Temperature Sensor (With option installed)
- Intel® ROC Module (With option installed)

Notes:

1. For fan speed control in Intel chassis
2. Temperature margin from throttling threshold
3. Absolute temperature
4. PECL value or margin value
5. On-die sensor
6. On-board sensor
7. Virtual sensor
8. Available only when PSU has PMBus
9. Calculated estimate

The following diagram illustrates the fan speed control structure.

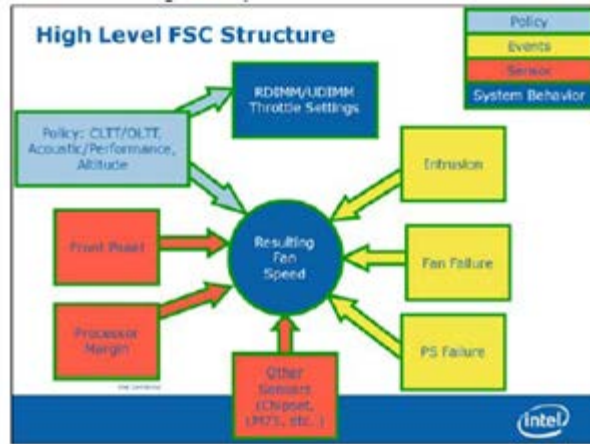


Figure 22. Fan Control Model

4.3 System Fans

Five 60x38-mm fans and an embedded fan for each installed power supply, provide the primary airflow for the system. The system is designed for fan redundancy when configured with two power supply modules. Should a single fan fail (system fan or power supply fan), platform management will adjust air flow of the remaining fans and manage other platform features to maintain system thermals. Fan redundancy is lost if more than one fan is in a failed state.

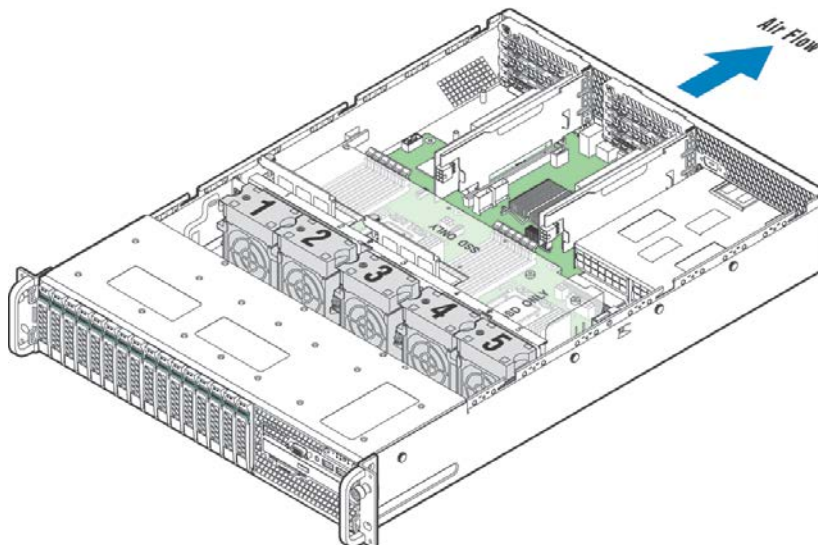


Figure 23. System Fan identification

AF005077



Figure 24. System Fan Assembly

The system fan assembly is designed for ease of use and supports several features.

- Each fan is hot-swappable.
- Each fan is designed for tool-less insertion and extraction from the fan assembly. For instructions on installing or removing a fan module, see the *Intel® Server System R2000BB Service Guide*.
- Fan speed for each fan is controlled by integrated platform management as controlled by the integrated BMC on the server board. As system thermals fluctuate high and low, the integrated BMC firmware will increase and decrease the speeds to specific fans within the fan assembly to regulate system thermals.
- Each fan has a tachometer signal that allows the integrated BMC to monitor their status.
- On top of each fan is an integrated fault LED. Platform management illuminates the fault LED for the failed fan.
- Each fan has a 10-pin wire harness that connects to a matching connector on the server board.

Note: Due to cable length limitations, the system fan connector labeled “SYS_FAN_5” on the server board is NOT used in this system. System Fan 5 will plug into the fan connector labeled “SYS_FAN_6”.

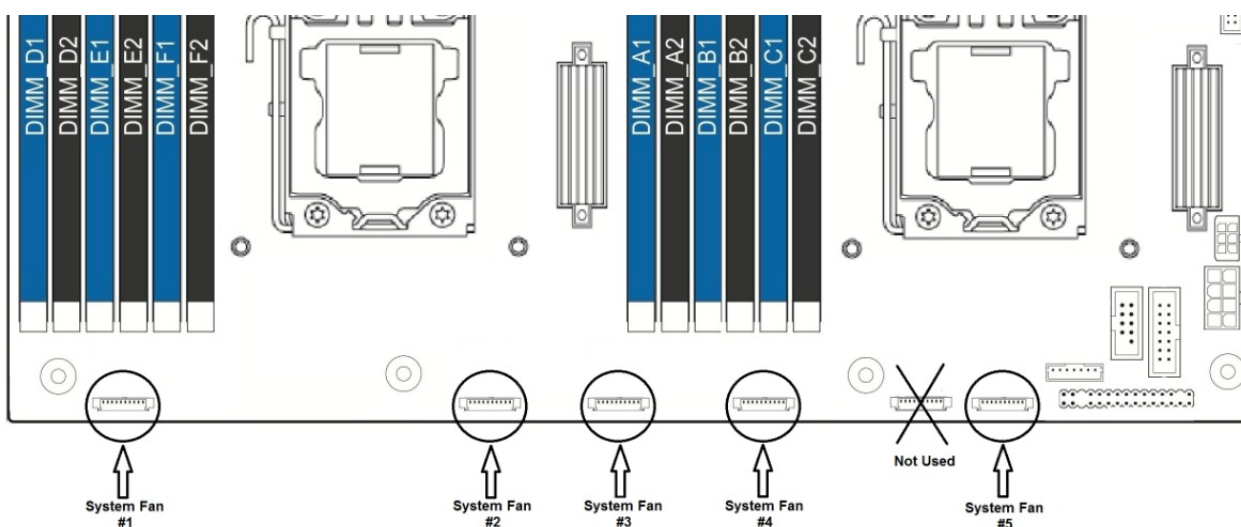


Figure 25. Server Board System Fan Connector Locations

Table 25. System Fan Connector Pin-out

| SYS_FAN 1 | | SYS_FAN 2 | | SYS_FAN 3 | |
|---------------------|------|----------------------|------|---------------------|------|
| Signal Description | Pin# | Signal Description | Pin# | Signal Description | Pin# |
| FAN_TACH1_IN | 1 | FAN_TACH3_IN | 1 | FAN_TACH5_IN | 1 |
| FAN_IBMC_PWM0_R_BUF | 2 | FAN_IBMC_PWM1_R_BUF | 2 | FAN_IBMC_PWM2_R_BUF | 2 |
| P12V_FAN | 3 | P12V_FAN | 3 | P12V_FAN | 3 |
| P12V_FAN | 4 | P12V_FAN | 4 | P12V_FAN | 4 |
| FAN_TACH0_IN | 5 | FAN_TACH2_IN | 5 | FAN_TACH4_IN | 5 |
| GROUND | 6 | GROUND | 6 | GROUND | 6 |
| GROUND | 7 | GROUND | 7 | GROUND | 7 |
| FAN_SYS0_PRSENT_N | 8 | FAN_SYS1_PRSENT_N | 8 | FAN_SYS2_PRSENT_N | 8 |
| LED_FAN_FAULT0_R | 9 | LED_FAN_FAULT1_R | 9 | LED_FAN_FAULT2_R | 9 |
| LED_FAN0 | 10 | LED_FAN1 | 10 | LED_FAN2 | 10 |
| SYS_FAN 4 | | SYS_FAN 5 (Not used) | | SYS_Fan 6 | |
| Signal Description | Pin# | Signal Description | Pin# | Signal Description | Pin# |
| FAN_TACH7_IN | 1 | FAN_TACH9_IN | 1 | FAN_TACH11_IN | 1 |
| FAN_IBMC_PWM3_R_BUF | 2 | FAN_IBMC_PWM4_R_BUF | 2 | FAN_IBMC_PWM5_R_BUF | 2 |
| P12V_FAN | 3 | P12V_FAN | 3 | P12V_FAN | 3 |
| P12V_FAN | 4 | P12V_FAN | 4 | P12V_FAN | 4 |
| FAN_TACH6_IN | 5 | FAN_TACH8_IN | 5 | FAN_TACH10_IN | 5 |
| GROUND | 6 | GROUND | 6 | GROUND | 6 |
| GROUND | 7 | GROUND | 7 | GROUND | 7 |
| FAN_SYS3_PRSENT_N | 8 | FAN_SYS4_PRSENT_N | 8 | FAN_SYS5_PRSENT_N | 8 |
| LED_FAN_FAULT3_R | 9 | LED_FAN_FAULT4_R | 9 | LED_FAN_FAULT5_R | 9 |
| LED_FAN3 | 10 | LED_FAN4 | 10 | LED_FAN5 | 10 |

4.4 Power Supply Module Fan

Each installed power supply module includes one embedded (non-removable) 40-mm fan. It is responsible for airflow through the power supply module. This fan is managed by the fan control system. Should this fan fail, the power supply will continue to operate until its internal temperature reaches an upper critical limit. The power supply will be protected against over temperature conditions caused by loss of fan cooling or excessive ambient temperature. In an over-temperature protection condition, the power supply module will shut down.

4.5 FRUSDR Utility

The purpose of the embedded platform management and fan control systems is to monitor and control various system features, and to maintain an efficient operating environment. Platform management is also used to communicate system health to supported platform management software and support mechanisms. The FRUSDR utility is used to program the server board with platform specific environmental limits, configuration data, and the appropriate sensor data records (SDRs), for use by these management features.

The FRUSDR utility must be run as part of the initial platform integration process before it is deployed into a live operating environment. It must be run with the system fully configured and each time the system configuration changes.

The FRUSDR utility for the given server platform can be run as part of the *Intel® Server Deployment Toolkit and Management* DVD that ships with each Intel server, or can be downloaded from <http://downloadcenter.intel.com>.

Note: The embedded platform management system may not operate as expected if the platform is not updated with accurate system configuration data. The FRUSDR utility must be run with the system fully configured and each time the system configuration changes for accurate system monitoring and event reporting.

5. Intel® Xeon Phi™ Coprocessor and GPGPU Add-in Card Support

Some (not all) system configurations of the Intel® Server System R2000BB product family have thermal and mechanical support for Intel® Xeon Phi™ Coprocessor cards and Non-Intel GPGPU add-in cards. Which card and system configurations can be supported is dependent on power and thermal limits of the system, and power and thermal requirements of the add-in card. This chapter will provide an overview of the system configuration criteria needed to support these high power cards.

Advisory Note: Shipping a fully configured system that includes the Intel® Xeon Phi™ card or other high end PCI graphics card is NOT supported using the original Intel packaging that the system came in. If the original Intel packaging is re-used, Intel recommends installing the Intel® Xeon Phi™ card or other high end PCI graphics card into the system after it reaches its final destination. Shipping a fully integrated system that includes the Intel® Xeon Phi™ card or other high end PCI graphics card using Intel's original system packaging may result in system or component damage.

5.1 High Power Add-in Card Support Criteria

- Due to thermal limits, Intel® Xeon Phi™ coprocessor cards and non-Intel GPGPU cards will only be supported in the following base system SKUs: R2308BB#####, R2208BB#####, and R2216BB#####. See Appendix D at the end of this document for additional configuration information.
- Only Intel® Xeon Phi™ coprocessor cards and non-Intel GPGPU cards configured with active heat sinks (heat sink + fan) will be supported.

NOTE: Due to thermal and air flow limits, high power add-in cards (> 75W) with passive heat sinks and/or a minimum air flow requirement of >200 LFM, cannot be supported.

- Intel® Xeon Phi™ coprocessor cards and non-Intel GPGPU cards with active heat sinks will only be supported when installed in either of the two following riser card options:
 - Riser #1 – Riser card with one PCIe add-in card slot (Intel product code **AXX2UPCIEX16**)
 - Riser #2 – Riser card with two PCIe add-in card slots (Intel product code **A2UL16RISER**).
 With these riser cards installed, the fan control system will operate system fans at a higher speed. No other riser cards can be supported due to air flow and thermal limits.
- A maximum of 75W of power can be supported directly from the riser card. Power requirements above 75W will require the additional power to be drawn from either of the two 2x2 pin “OPT_12V_PWR” connectors on the server board. Power cables for these connectors are included in the A2UL16RISER and AXX2UPCIEX16 riser card accessory kits and can support both 6 and 8 pin GPU card power connectors.
- **Configuration Note:** In order to support a non-Intel GPGPU card in Riser Slot #2, the Auxiliary 12V power connector of the add-in card MUST be located on the back edge of the card. Aux 12V power connectors located on the top edge of the add-in card will interfere with the chassis side wall.
- A total system power budget should be calculated to determine if the power draw of the desired system configuration meets the power limits of the power supplies. A power budget tool for the specified system can be downloaded from <http://www.intel.com/support>.
- High power add-in cards with active cooling solutions that require up to 300W, can be supported. A total system power budget should be calculated to determine if the power draw of the desired system configuration meets the power limits of the installed power supplies. A power budget tool for the specified system can be downloaded from <http://www.intel.com/support>.

- Riser cards can support a maximum combined (all PCIe slots) power draw of up to 75W. Add-in cards with power requirements above 75W will require the additional power to be drawn from either of two 2x2 pin “OPT_12V_PWR” connectors on the server board. Power cables for these connectors are included in the A2UL16RISER accessory kit and can support both 6 and 8 pin 12V AUX power connectors located on the add-in cards. See section 3.3.2 *Riser Card Power Connectors*, for the Optional12V power connector usage and power cable specification.
- **NOTE:** The latest posted system software updates must be installed on the system to ensure proper fan speed control is enabled. The latest system update package can be downloaded from the following Intel web site: <http://downloadcenter.intel.com>

5.2 Intel® Xeon Phi™ Coprocessor Card – System Configuration Requirements

Intel highly recommends that the latest available system software be installed. The latest system update package can be downloaded from the following Intel web site: <http://downloadcenter.intel.com>

- The following <F2> BIOS Setup Utility Options must be set as follows:
 - MMIO over 4GB = Enabled
 - MMIO Size = 256GB

6. System Storage and Peripheral Drive Bays Overview

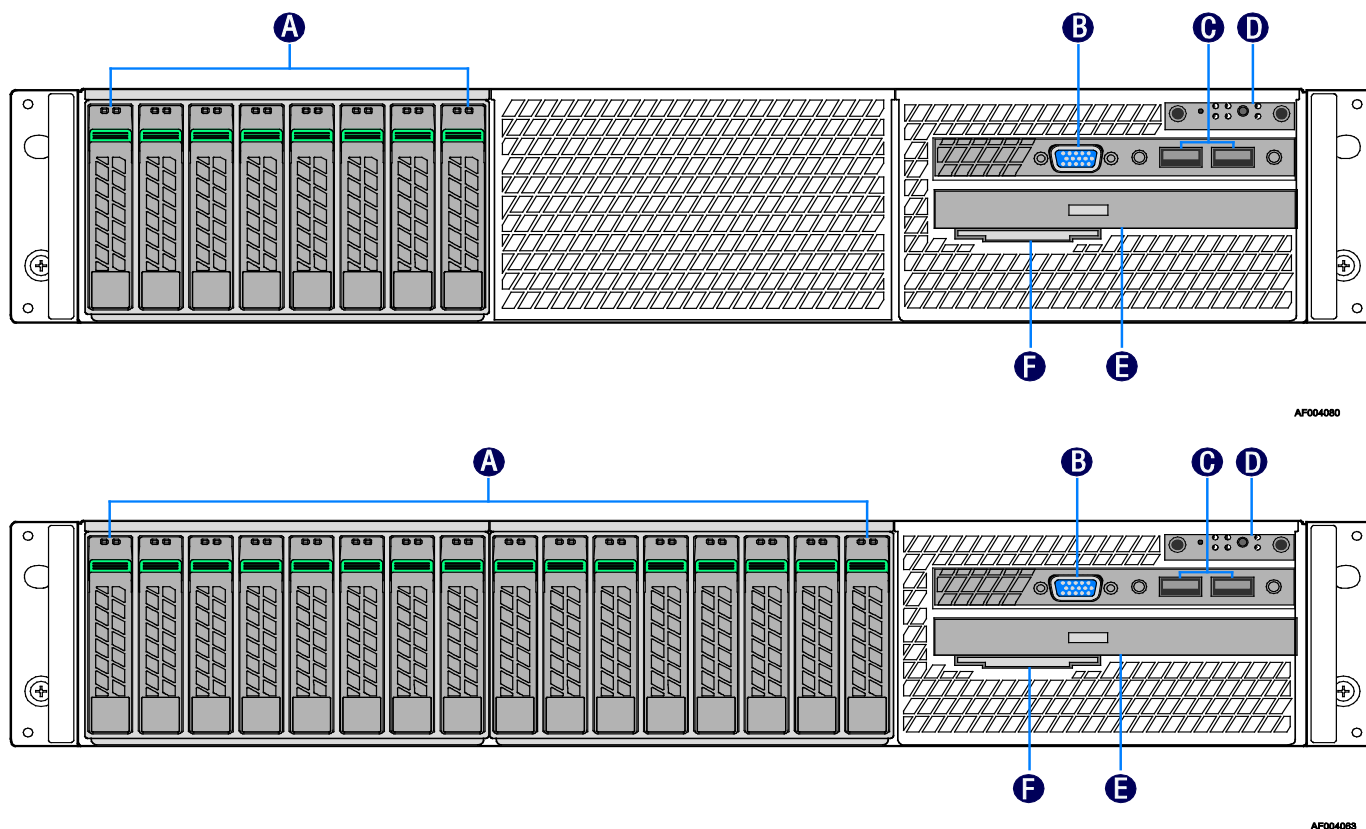
The Intel® Server System R2000BB product family has support for many storage device options, including:

- Hot Swap 2.5” Hard Disk Drives
- Hot Swap 3.5” Hard Disk Drives
- SATA Optical Drive
- SATA Solid State Devices (SSDs)
- Low Profile (2mm) eUSB Solid State Device (eUSB SSD)
- mSATA Solid State Device
- SATA DOM

Support for different storage and peripheral device options will vary depending on the system SKU.

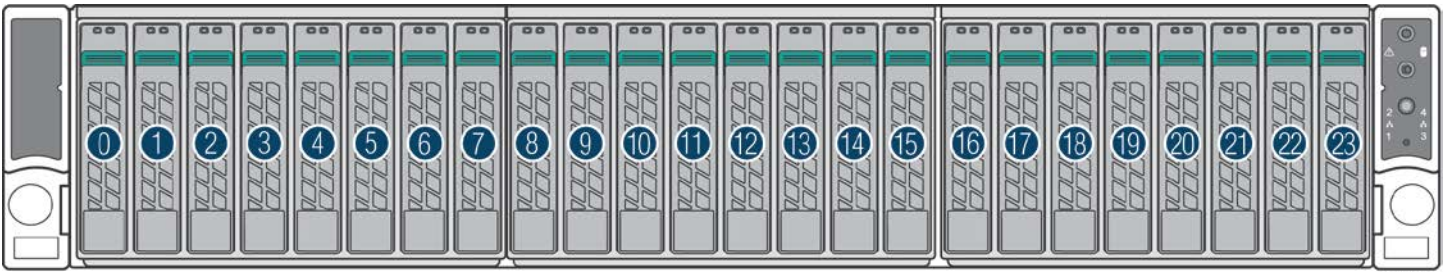
6.1 2.5” Hard Disk Drive Support

The server is available in 2.5” hard disk configurations of 8, 16, and 24 drives as illustrated below.



| Label | Description |
|-------|-----------------------|
| A | 2.5” Hard Drive Bays |
| B | Video Connector |
| C | USB Ports |
| D | Front Control Panel |
| E | SATA Optical Drive |
| F | System Label Pull-out |

Figure 26. 2.5” Hard Drive Bay - 8 & 16 Drive Configuration

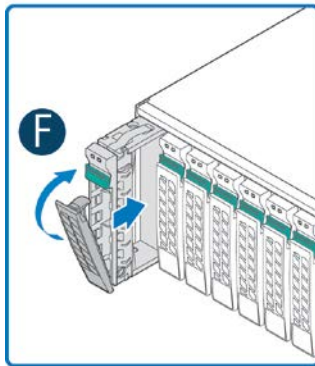


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Figure 27. 2.5" Hard Drive Bay - 24 Drive Configuration

The drive bay can support either SATA or SAS hard disk drives. Mixing of drive types 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. Hard disk drive type is dependent on the type of host bus controller used, SATA only or SAS.

Each 2.5" hard disk drive is mounted to a drive tray, allowing for hot swap extraction and insertion. Drive trays have a latching mechanism that is used to extract and insert drives from the chassis, and lock the tray in place.



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Light pipes integrated into the drive tray assembly direct light emitted from Amber drive status and Green activity LEDs located next to each drive connector on the backplane, to the drive tray faceplate, making them visible from the front of the system.

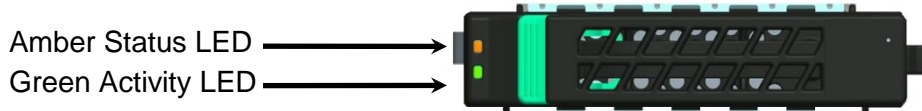


Table 26. Drive Status LED States

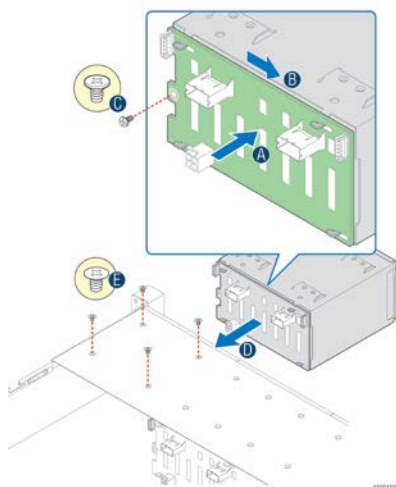
| | | |
|--------------|----------|--------------------------------------------------|
| Amber | Off | No access and no fault |
| | Solid On | Hard Drive Fault has occurred |
| | Blink | RAID rebuild in progress (1 Hz), Identify (2 Hz) |

Table 27. Drive Activity LED States

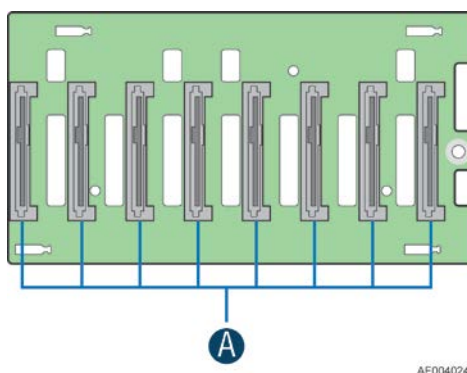
| | Condition | Drive Type | Behavior |
|--------------|---------------------------------|------------|------------------------------------------|
| Green | Power on with no drive activity | SAS | LED stays on |
| | | SATA | LED stays off |
| | Power on with drive activity | SAS | LED blinks off when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

6.1.1 2.5” Drive Hot-Swap Backplane Overview

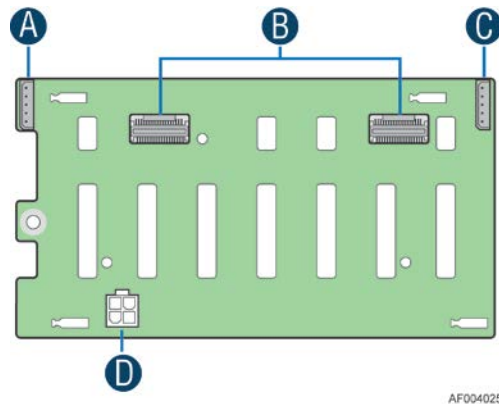
Depending on the number of hard disk drives supported by a given system SKU, a system can be configured with 1, 2, or 3 eight drive backplanes. Each backplane is attached to the back of the drive bay assembly.



On the front side of each backplane are mounted eight hard disk drive interface connectors (A), each providing both power and I/O signals to attached hard disk drives.



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



| Label | Description |
|-------|-----------------------------------------------------------------|
| A | SMBus-Out cable connector for multi-backplane support |
| B | 4-port Mini-SAS cable connectors |
| C | SMBus-In cable connector – From Server board or other backplane |
| D | Power connector |

A and C – 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 B used on the first board and connector D used on the second board, extending the SMBus to each installed backplane.

B – Multi-port Mini-SAS Cable Connectors – The backplane includes two multi-port mini-SAS 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.

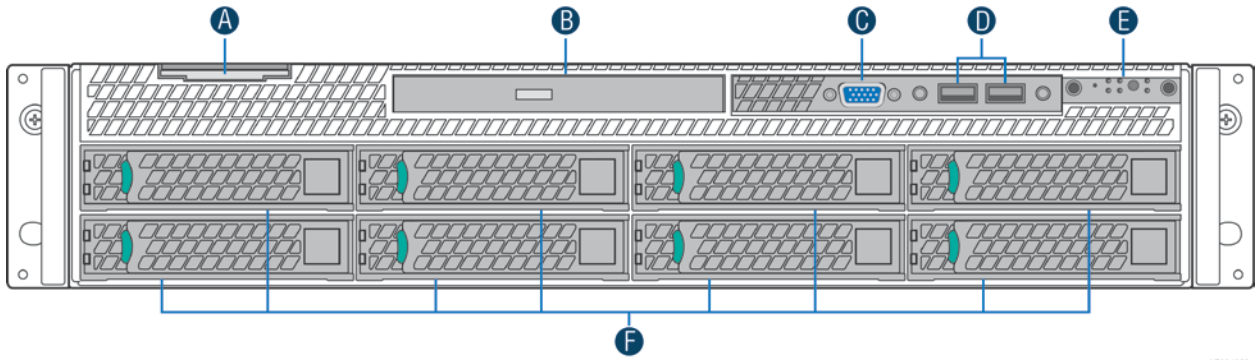
D – Power Harness Connector – The backplane includes a 2x2 connector supplying power to the backplane. Power is routed to each installed backplane via a multi-connector power cable harness from the server board.

6.1.2 Cypress* CY8C22545 Enclosure Management Controller

The backplanes support enclosure management using a Cypress* CY8C22545 Programmable System-on-Chip (PSoC*) device. The CY8C22545 drives the hard drive activity/fault LED, hard drive present signal, and controls hard drive power-up during system power-on.

6.2 3.5” Hard Disk Drive Support

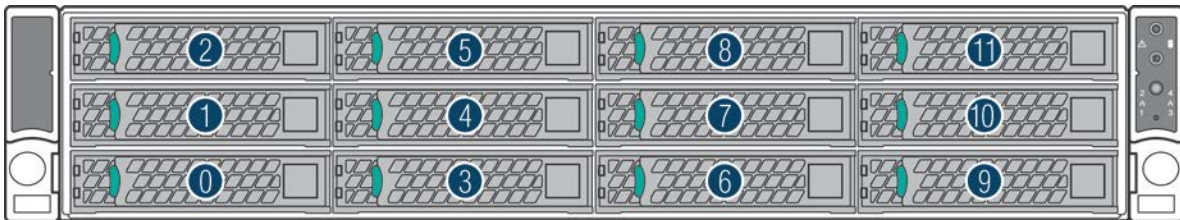
The server is available in 3.5” hard disk configurations of 8 and 12 drives as illustrated below.



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| Label | Description |
|-------|---------------------------|
| A | System Label Pull-out Tab |
| B | SATA Optical Drive |
| C | Video Connector |
| D | USB Ports |
| E | Front Control Panel |
| F | 3.5” Hard Drive Bays |

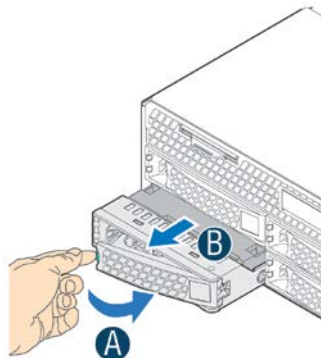
Figure 28. 3.5” Hard Drive Bay - 8 Drive Configuration



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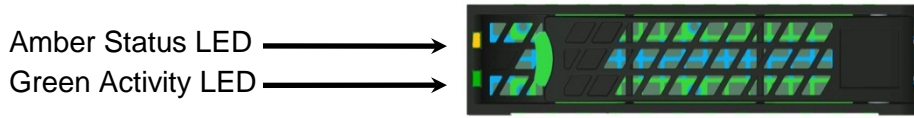
Figure 29. 3.5” Hard Drive Bay - 12 Drive Configuration

The drive bay can support either SATA or SAS hard disk drives. Mixing of drive types within the hard drive bay is not supported. Hard disk drive type is dependent on the type of host bus controller used, SATA only or SAS. Each 3.5” hard disk drive is mounted to a drive tray, allowing for hot swap extraction and insertion. Drive trays have a latching mechanism that is used to extract and insert drives from the chassis, and lock the tray in place.



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Light pipes integrated into the drive tray assembly direct light emitted from Amber drive status and Green activity LEDs located next to each drive connector on the backplane, to the drive tray faceplate, making them visible from the front of the system.



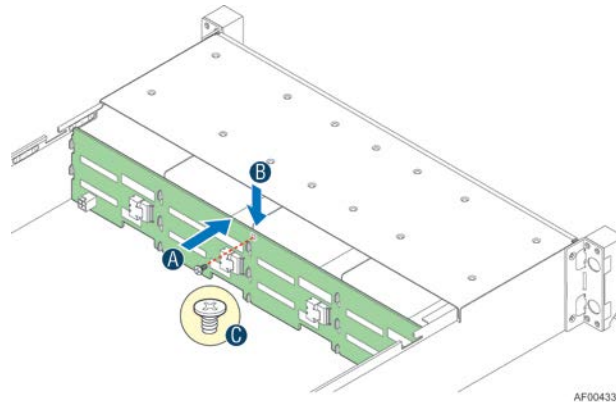
| | | |
|--------------|----------|--------------------------------------------------|
| Amber | Off | No access and no fault |
| | Solid On | Hard Drive Fault has occurred |
| | Blink | RAID rebuild in progress (1 Hz), Identify (2 Hz) |

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

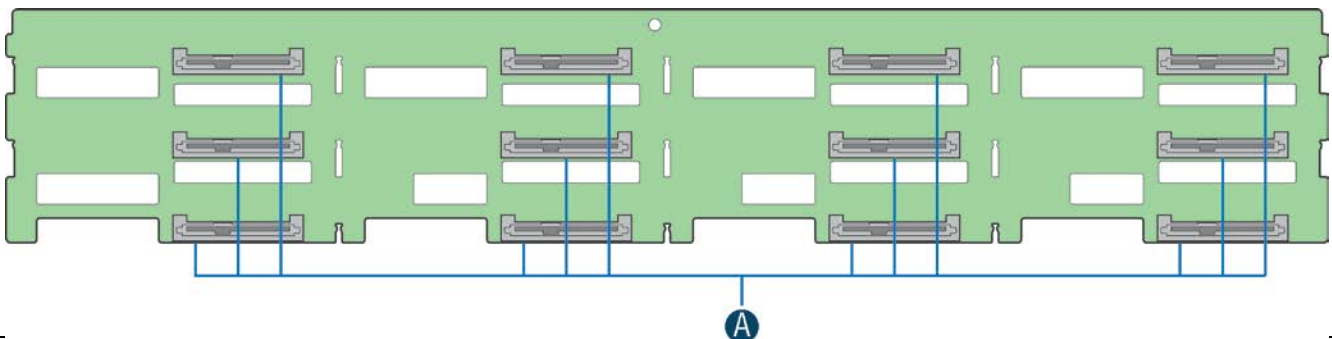
6.2.1 3.5” Drive Hot-Swap Backplane Overview

Systems with 8 or 12 drive configurations have their own unique backplane. Both 8 and 12 drive backplanes share identical features. The following will be used to describe the features of both backplanes. Differences between the two will be noted.

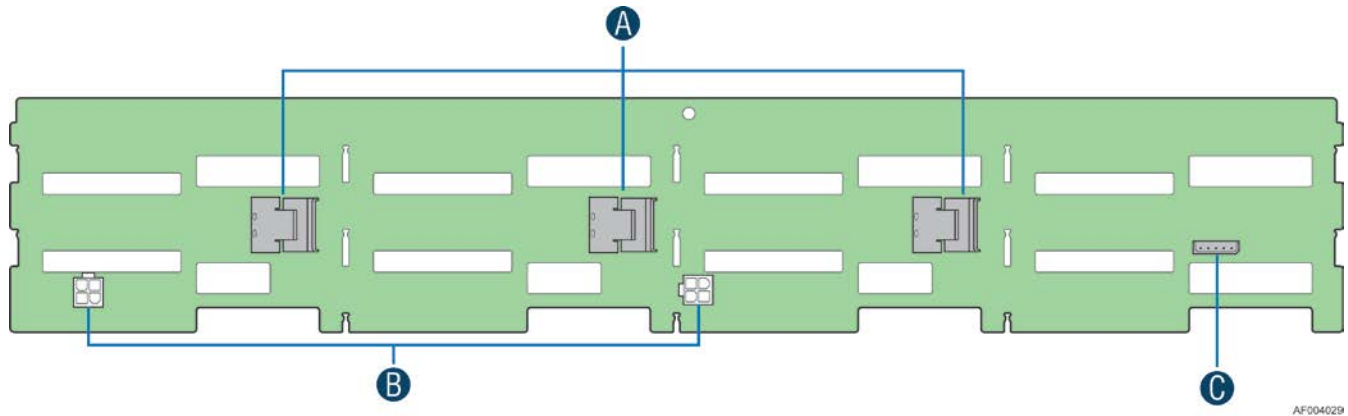
The backplanes mount to the back of the drive bay assembly.



On the front side of each back plane are mounted eight or twelve hard disk drive interface connectors, each providing both power and I/O signals to attached hard disk drives.



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



AF004029

| Label | Description |
|-------|----------------------------|
| A | 4-port mini-SAS connectors |
| B | Power connectors |
| C | SMBus connector |

A – 4-port Mini-SAS Connectors – The backplane includes two or three multi-port mini-SAS 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, add-in SAS/SATA RAID cards, or an optionally installed SAS expander card. Each mini-SAS connector will include a silk-screen identifying which drives the connector supports; Drives 0-3, Drives 4-7, and Drives 8-11.

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

C- SMBus Cable Connectors – The backplane includes a 1x5 cable connector used as a management interface to the server board.

6.2.2 Cypress* CY8C22545 Enclosure Management Controller

The backplanes support enclosure management using a Cypress* CY8C22545 Programmable System-on-Chip (PSoC*) device. The CY8C22545 drives the hard drive activity/fault LED, hard drive present signal, and controls hard drive power-up during system power-on.

6.3 Optical Drive Support

Systems configured with eight 3.5" hard drive bays or up to sixteen 2.5" hard drive bays also include support for an optical drive bay 'A' as illustrated below.

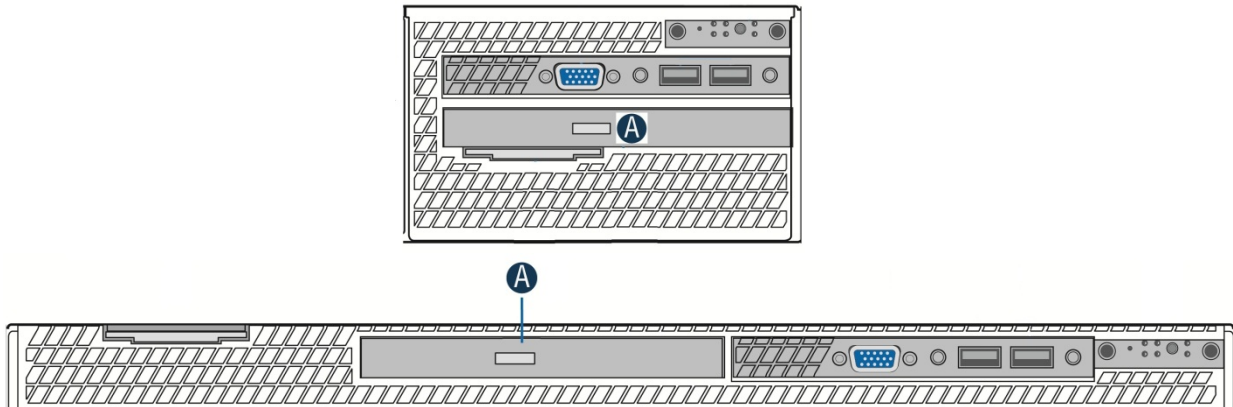
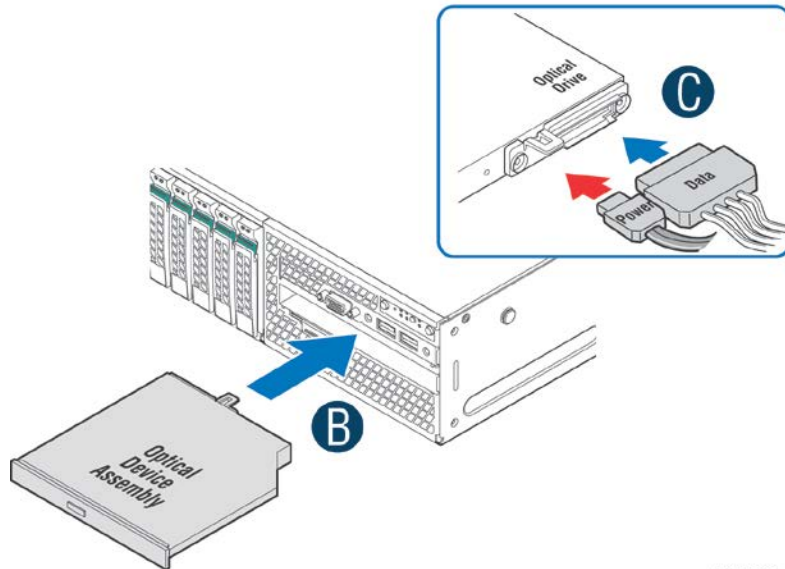


Figure 30. Optical Drive Support

A 2x3 pin power connector on the server board labeled “ODD/SSD PWR” is designed to provide power to a SATA SSD or SATA optical drive using the supplied power cable. SATA signals for one SATA device is cabled from the white 7-pin single port AHCI SATA connector labeled “AHCI_SATA_1” on the server board.



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6.4 Internal – Fixed Mount Solid State Drive (SSD) Support

The system can support one internal fixed mount 2.5" Solid State Drive (SSD). The drive is attached via 4-attachment screws to the top side of the air duct.

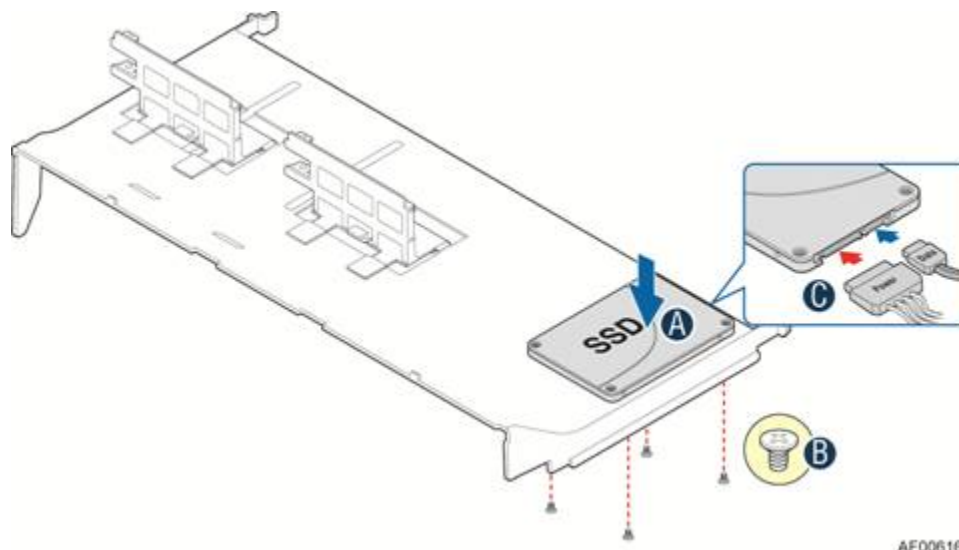


Figure 31. 2.5" Internal Fixed Mount Solid State Drive (SSD) Mounting Option

A 2x3 pin power connector on the server board labeled “ODD/SSD PWR” is designed to provide power to the SSD. SATA signals for a single SATA device can be cabled from the white 7-pin AHCI SATA connector on the server board.

NOTES: Mounting standard mechanical hard disk drives to the air duct is NOT a supported configuration. Mounting hard disk drives to the air duct may cause data loss, performance degradation, and premature drive failures.

6.5 Low Profile eUSB SSD Support

The system provides support for a low profile eUSB SSD storage device. A 2mm 2x5-pin connector labeled “eUSB SSD” near the rear I/O section of the server board is used to plug this small flash storage device into.

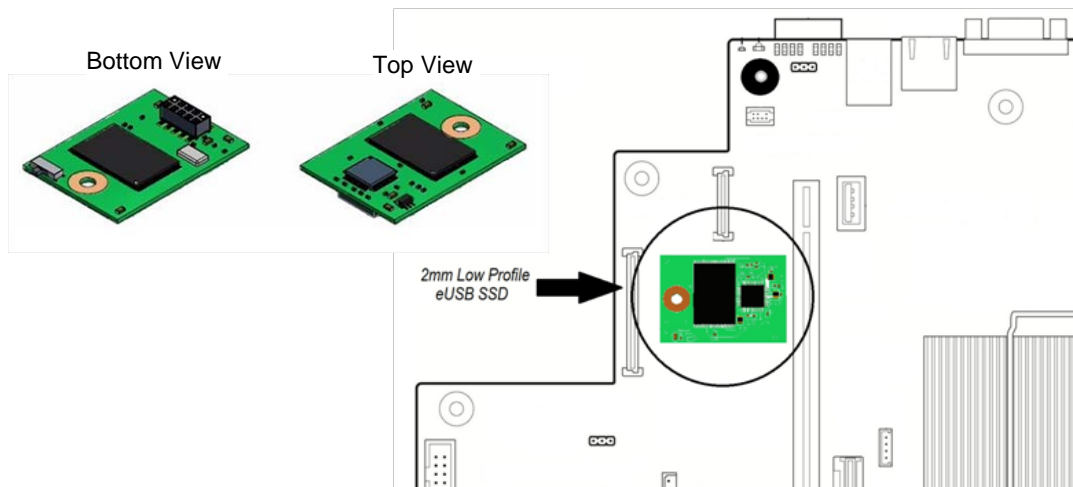


Figure 32. Low Profile eUSB Placement

eUSB features include:

- 2 wire small form factor Universal Serial Bus 2.0 (Hi-Speed USB) interface to host
- Read Speed up to 35 MB/s and write Speed up to 24 MB/s
- Capacity range from 256 MB to 32 GB
- Support USB Mass Storage Class requirements for Boot capability

6.6 SATA DOM Support

The system has support for a vertical low profile Innodisk* SATA Disk-on-Module (DOM) device.

The SATA DOM plugs directly into the 7-pin AHCI SATA port on the server board, which provides both power and I/O signals.



Figure 33. Innodisk* Low Profile SATA DOM

SATA DOM features include:

- Ultra low Profile
- High Speed and Capacity
- Built-in VCC at pin 7

Note: Visit <http://www.intel.com/support>. for a list of supported Innodisk SATA DOM parts

6.7 mSATA SSD Support

The system provides support for a mSATA SSD storage device.

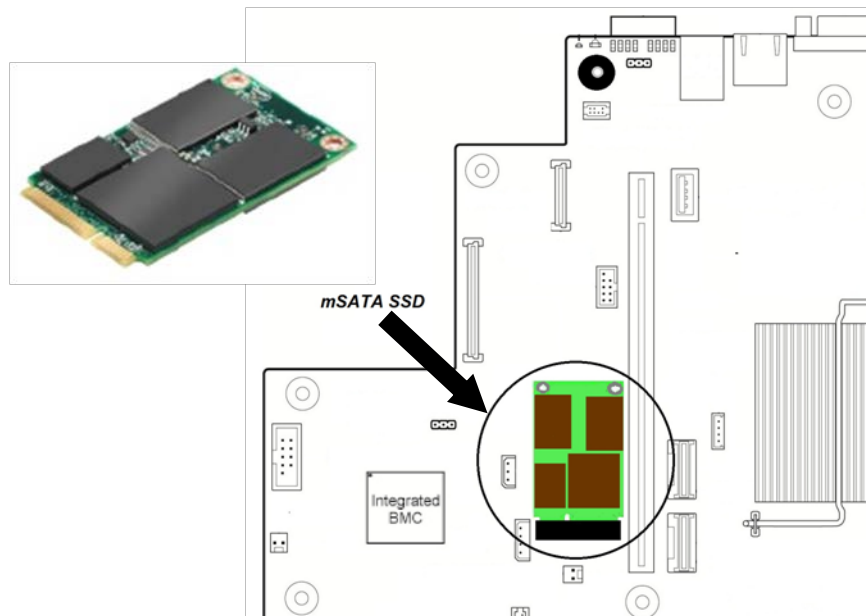


Figure 34. mSATA Placement

The mSATA storage device plugs in to a 52-pin PCIe mini-connector on the server labeled “mSATA SSD”. mSATA SSD features include:

- Capacities ranging from 40GB to 128GB
- Small foot print
- Low power

7. Storage Controller Options Overview

The server platform supports many different embedded and add-in SATA/SAS controller and SAS Expander options to provide a large number of possible storage configurations. This section will provide an overview of the different options available.

7.1 Embedded SATA / SAS Controller support

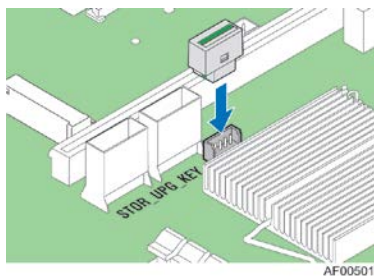
Integrated on the server board is an Intel® C602 chipset that provides embedded storage support via two integrated controllers: AHCI and SCU.

The standard server board (with no additional storage options installed) will support up to six SATA ports:

- One single 6 Gb/sec SATA port routed from the AHCI controller to a white 7-pin SATA ports labeled “SATA_1” on the server board. This port can be used to support either a SATA optical drive or SATA SSD.
- One single 6 Gb/sec SATA port routed from the AHCI controller to the mSATA connector.
- Four 3 Gb/sec SATA ports routed from the SCU controller to the multi-port mini-SAS connector labeled “SCU_0 (0-3)”.

Note: The mini-SAS connector labeled “SCU_1” is NOT functional by default and is only enabled with the addition of an Intel® RAID C600 Upgrade Key option supporting 8 SAS/SATA ports.

With the addition of one of several available Intel® RAID C600 Upgrade Keys, the system is capable of supporting additional embedded SATA, SAS, and software RAID options. Upgrade keys install onto a 4-pin connector on the server board labeled “STOR_UPG_KEY”.



The following table identifies available upgrade key options and their supported features.

Table 28. Intel® RAID C600 Upgrade Key Options

| Intel® RAID C600 Upgrade Key (Intel Product Codes) | Key Color | Description |
|----------------------------------------------------|-----------|-----------------------------------------------------------------------------|
| Default – No option key installed | N/A | 4 Port SATA with Intel® ESRT RAID 0,1,10 and Intel® RSTe RAID 0,1,5,10 |
| RKSATA4R5 | Black | 4 Port SATA with Intel® ESRT2 RAID 0,1, 5, 10 and Intel® RSTe RAID 0,1,5,10 |
| RKSATA8 | Blue | 8 Port SATA with Intel® ESRT2 RAID 0,1, 10 and Intel® RSTe RAID 0,1,5,10 |
| RKSATA8R5 | White | 8 Port SATA with Intel® ESRT2 RAID 0,1, 5, 10 and Intel® RSTe RAID 0,1,5,10 |
| RKSAS4 | Green | 4 Port SAS with Intel® ESRT2 RAID 0,1, 10 and Intel® RSTe RAID 0,1,10 |
| RKSAS4R5 | Yellow | 4 Port SAS with Intel® ESRT2 RAID 0,1, 5, 10 and Intel® RSTe RAID 0,1,10 |
| RKSAS8 | Orange | 8 Port SAS with Intel® ESRT2 RAID 0,1, 10 and Intel® RSTe RAID 0,1,10 |
| RKSAS8R5 | Purple | 8 Port SAS with Intel® ESRT2 RAID 0,1, 5, 10 and Intel® RSTe RAID 0,1,10 |

Additional information for the on-board RAID features and functionality can be found in the *Intel® RAID Software Users Guide* (Intel Document Number D29305-015).

7.2 Embedded Software RAID Support

The system includes support for two embedded software RAID options:

- Intel® Embedded Server RAID Technology 2 (ESRT2) based on LSI* MegaRAID SW RAID technology
- Intel® Rapid Storage Technology (RSTe)

Using the <F2> BIOS Setup Utility, accessed during system POST, options are available to enable/disable SW RAID, and select which embedded software RAID option to use.

7.2.1 Intel® Embedded Server RAID Technology 2 (ESRT2)

Features of the embedded software RAID option Intel® Embedded Server RAID Technology 2 (ESRT2) include the following:

- Based on LSI* MegaRAID Software Stack
- Software RAID with system providing memory and CPU utilization
- Supported RAID Levels – 0,1,5,10
 - 4 & 8 Port SATA RAID 5 support provided with appropriate Intel® RAID C600 Upgrade Key
 - 4 & 8 Port SAS RAID 5 support provided with appropriate Intel® RAID C600 Upgrade Key
- Maximum drive support = 8
 - NOTE: ESRT2 has no SAS Expander Support
- Open Source Compliance = Binary Driver (includes Partial Source files)
 - Meta data is also recognized by MDRAID layer in Linux (No direct Intel support, not validated by Intel)
- OS Support = Windows 7*, Windows 2008*, Windows 2003*, RHEL*, SLES*, other Linux variants using partial source builds.
- Utilities = Windows* GUI and CLI, Linux GUI and CLI, DOS CLI, and EFI CLI

7.2.2 Intel® Rapid Storage Technology (RSTe)

Features of the embedded software RAID option Intel® Rapid Storage Technology (RSTe) include the following:

- Software RAID with system providing memory and CPU utilization
- Supported RAID Levels – 0,1,5,10
 - 4 Port SATA RAID 5 available standard (no option key required)
 - 8 Port SATA RAID 5 support provided with appropriate Intel® RAID C600 Upgrade Key
 - No SAS RAID 5 support
- Maximum drive support = 32 (in arrays with 8 port SAS), 16 (in arrays with 4 port SAS), 128 (JBOD)
- Open Source Compliance = Yes (uses MDRAID)
- MDRAID supported in Linux (Does not require a driver)
- OS Support = Windows 7*, Windows 2008*, Windows 2003*, RHEL*¹, SLES*¹, VMWare 5.x.
- Utilities = Windows* GUI and CLI, Linux CLI, DOS CLI, and EFI CLI
- **NOTE:** Boot drive support to targets attached through SAS expander card requires BIOS update. Must connect expander to SCU_0 and drives to ports 0&1 on RES2SV240 expander or A&B on RES2CV**0 for boot support.

Note 1) See latest product errata list for Linux support status. Product Errata are documented in the *Intel® Server Board S2400BB, Intel® Server System R1000BB, Intel® Server System R2000BB Monthly Specification Update* which can be downloaded from <http://www.intel.com/support>.

Visit <http://www.intel.com/support> for a list of supported operating systems.

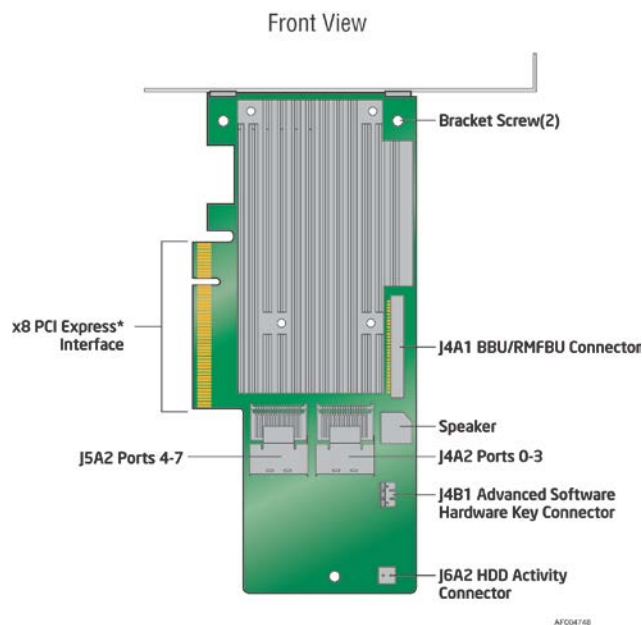
7.3 Intel® Integrated RAID Module Support (Available Option)

The system has support for several Intel® Integrated RAID adapters. The RAID adapter can be installed in to any available PCIe slot on either Riser Card #1 or Riser Card #2.

Table 29. Supported Intel® Integrated RAID Modules

| External Name | Description | Product Code |
|------------------------------------------|---------------------------------------|--------------|
| Intel® Integrated RAID Module RMS25PB080 | 8P SAS-2.1, Full HW RAID, 1GB, PCIe | RMS25PB080 |
| Intel® Integrated RAID Module RMS25PB040 | 4P SAS-2.1, Full HW RAID, 1GB, PCIe | RMS25PB040 |
| Intel® Integrated RAID Module RMT3PB080 | 8P SATA-3, Full HW RAID, 512MB, PCIe | RMT3PB080 |
| Intel® Integrated RAID Module RMS25KB080 | 8P SAS-2.1, Entry-level HW RAID, PCIe | RMS25KB080 |
| Intel® Integrated RAID Module RMS25KB040 | 4P SAS-2.1, Entry-level HW RAID, PCIe | RMS25KB040 |

Note: With only one processor installed, there are only 4 or 8 PCIe bus lanes routed to Riser Card #2. See Chapter #9 for full architectural details. Therefore, with only one processor installed, when installing an add-in card onto Riser Card #2, the card must be installed into PCIe slot #3 (Bottom x8 Slot) for the card to be functional.



Features of this option include:

- SKU options to support full or entry level hardware RAID
- 4 or 8 port and SAS/SATA or SATA –only ROC options
- SKU options to support 512MB or 1GB embedded memory
- Support for RAID Battery Backup Unit (**AXXRBBU9**)
- ROC support for the Intel® Raid Maintenance Free Backup Unit (**AXXRMFBU2**)
 - **Accessory Support Note:** Due to space limitations, the AXXRMFBU2 accessory cannot be mounted on the side wall attach feature used for the AXXRBBU9. To support the AXXRMFBU2 in the 2U chassis, an optional mounting bracket must be installed over the power supply bay. The Intel part number for the 2U system AXXRMFBU2 mounting bracket is **A2UBKTMFBUSSD**.

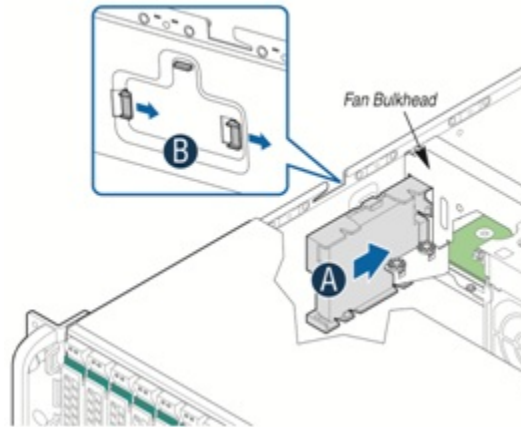


Figure 35. Mounting feature for accessory kit AXRBBU9

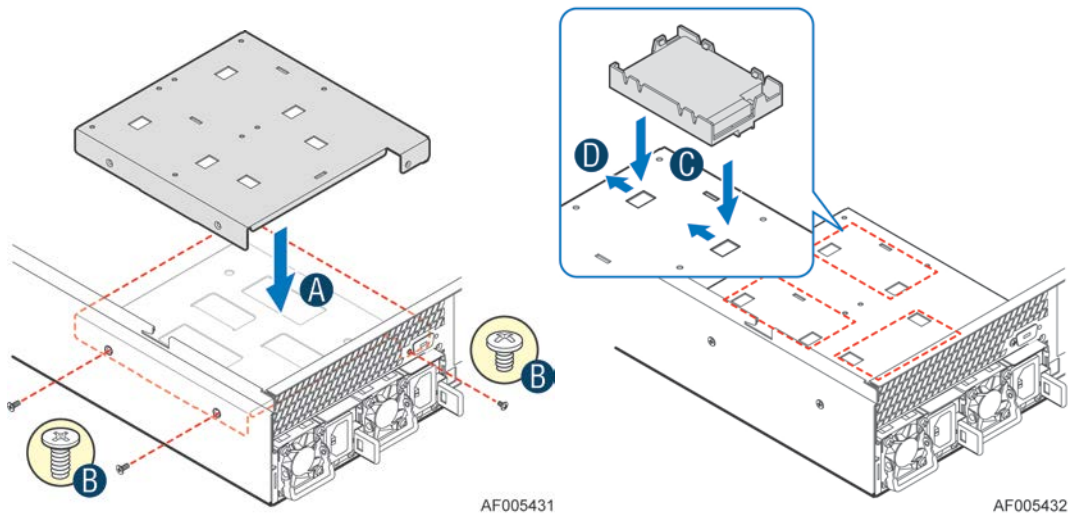


Figure 36. A2UBKTRMFBUSSD Bracket + AXRMFBU2 Installation

For additional product information, please reference the following Intel document:

- *Intel Integrated RAID Module RMS25PB040, RMS25PB080, RMS25CB040, and RMS25CB080 Hardware / Installation Users Guide*
- *Intel Integrated RAID Module RMT3PB080 and RMT3CB080 Hardware / Installation Users Guide*
- *Intel Integrated RAID Module RMS25KB040, RMS25KB080, RMS25JB040, and RMS25JB080 Hardware / Installation Users Guide*
- *Intel® Raid Maintenance Free Backup Unit AXRMFBU2 User's Guide*

7.4 Intel® SAS Expander Support Options

The system is designed to support SAS Expander cards for storage configurations that require more than eight hard disk drives.

| Intel® SAS Expander | Installation type | Hard Drive Configuration |
|------------------------------------------------------|-------------------|-----------------------------------------|
| 24 Port PCIe Intel® RAID Expander Card RES2SV240 | PCIe add-in card | 3.5" Hard Disk drive bay configurations |
| 24 Port Internal Intel® RAID Expander Card RES2CV240 | Internal mount | 2.5" Hard Disk drive bay configurations |
| 36 Port Internal Intel® SAS Expander Card RES2CV360 | Internal mount | 2.5" Hard Disk drive bay configurations |

Intel® RAID Expander Features:

- SAS protocol, described in the Serial Attached SCSI (SAS) Standard, version 2.0
- Serial SCSI Protocol (SSP) to enable communication with other SAS devices
- Serial Tunneling Protocol (STP) support for SATA II through expander interfaces
- Serial Management Protocol (SMP) to share topology management information with expanders
- Supports SES for enclosure management
- Output mini-SAS connectors support sideband SGPIO as per SFF-8485 specification
- Supports both Serial Attached SCSI and Serial ATA device targets
- 6.0 Gbit/s, 3.0 Gbit/s, and 1.5 Gbit/s data transfer rate
- SFF-8087 mini-SAS connectors
- Provides a low-latency connection to create and maintain transparent access to each connected SAS/SATA physical drive
- Staggered spin-up
- Hot Plug
- Native Command Queuing
- Allows multiple initiators to address a single target (in a fail-over configuration)

7.4.1 24-Port PCIe Intel® RAID Expander Card RES2SV240

For large storage configurations that include a drive bay supporting twelve 3.5" hard disk drives, a 24-Port PCIe Intel® RAID Expander Card RES2SV240 may be installed into any available PCIe add-in slot.

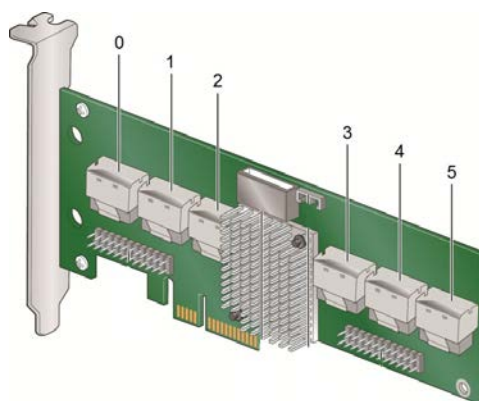


Figure 37. 24 Port PCIe Intel® RAID Expander Card RES2SV240

For additional information on the Intel® RAID Expander Card RES2SV240, please reference the *Intel® RAID Expander Card RES2SV240 Hardware Users Guide*, Intel Document Order # E93121-003.

7.4.2 24-Port and 36-Port Internal Intel RAID Expander Cards

For large storage configurations that include a drive bay supporting more than eight 2.5" hard disk drives, the system may be configured with an internally mounted 24-port or 36-port SAS expander card mounted directly behind the drive bay assembly as shown in the following illustration. SAS expander selection is dependent on the desired SAS controller configuration.

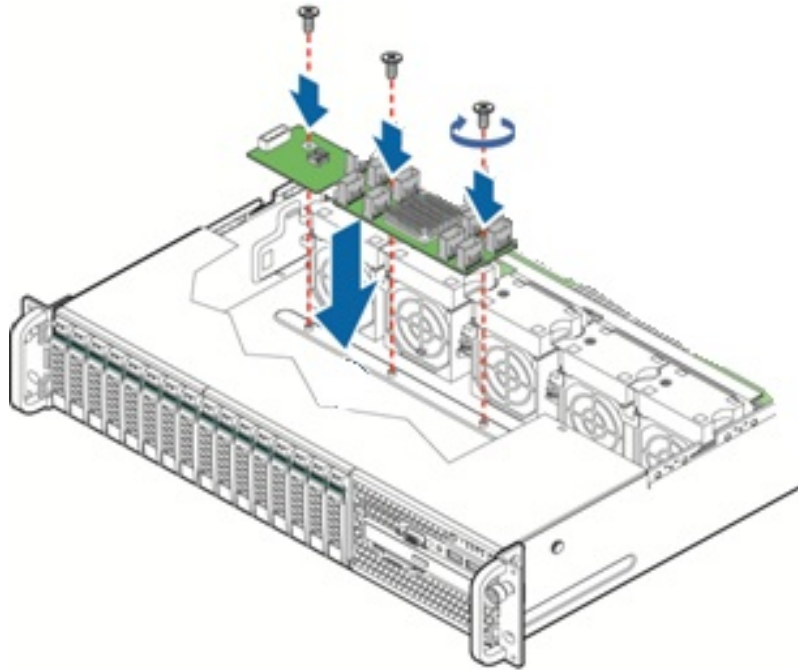


Figure 38. Internal SAS Expander Installation

The following diagrams are used to help identify the mini-SAS connectors found on the SAS expander cards. Care should be taken when connecting connectors from the SAS expander to the connectors on the backplane because each connector is pre-programmed at the factory to provide specific drive identification mapping. Improper connections may provide undesirable drive mappings.

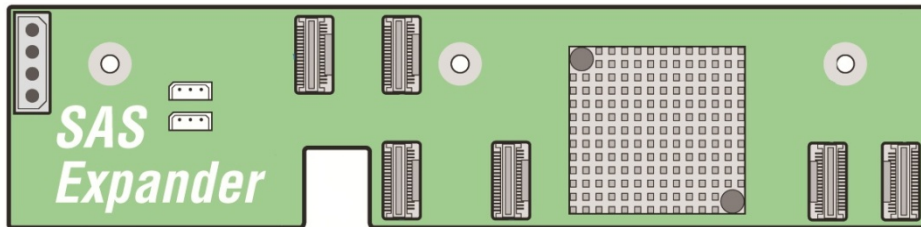


Figure 39. Internal 24-Port SAS Expander Card (RES2CV240)

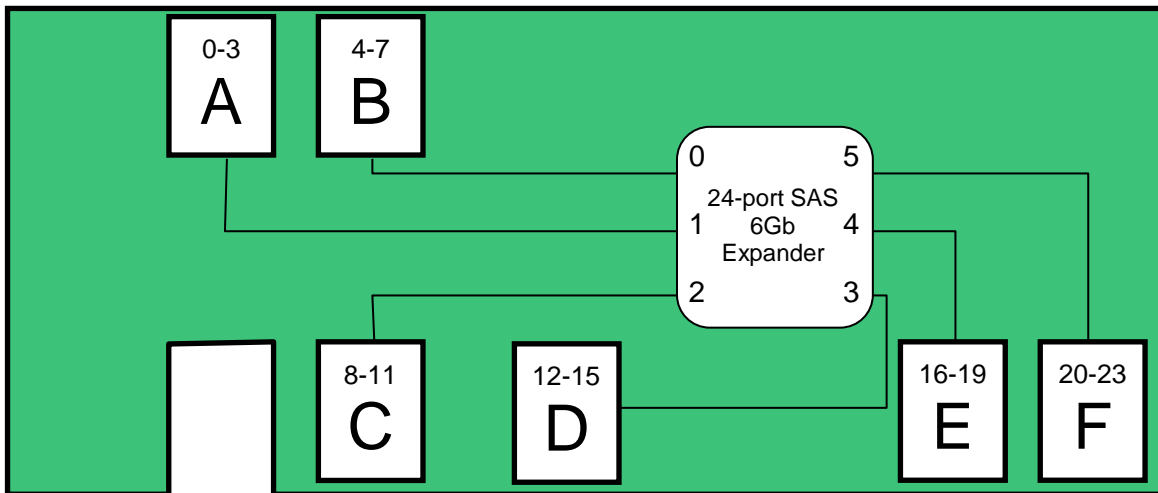


Figure 40. 24-Port Expander SAS Connector/Drive Identification Block Diagram

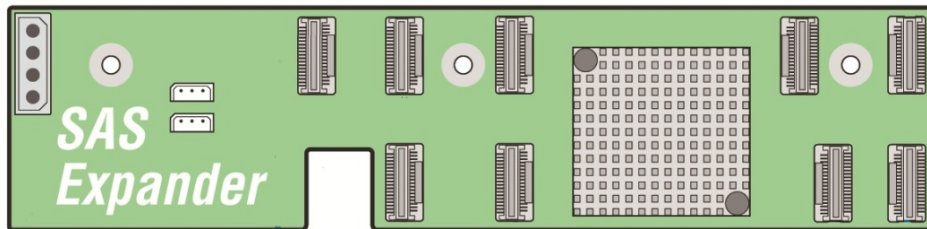


Figure 41. Internal 36-Port SAS Expander Card (RES2CV360)

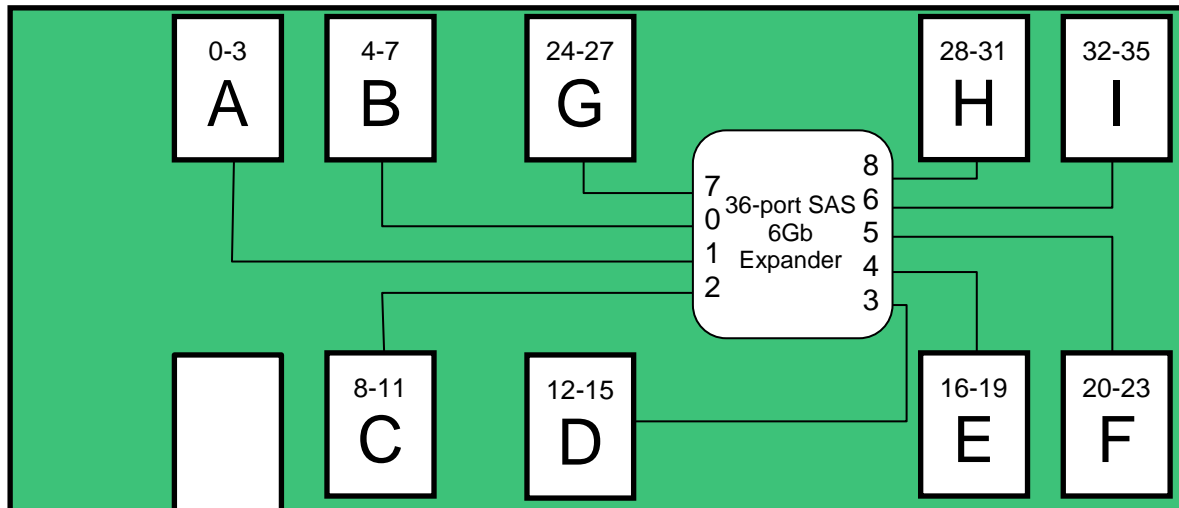


Figure 42. 36-Port Expander SAS Connector/Drive Identification Block Diagram

Each connector on the SAS expander card can be used as a “cable in” (SAS Controller to SAS Expander) or “cable out” (SAS Expander to Hot Swap Backplane) type connector. However, for contiguous drive mapping (0 – 16 or 0 – 24), cable routing differs when using a x8 wide-port capable 6 Gb SAS / SAS RAID Controller vs. using the embedded SCU ports.

7.4.3 SAS Expander Usage Guidelines

- SCU controller limitations prevent both SCU mini-SAS connectors on the server board from being attached to the same expander card.
- When attaching a SAS expander to one of the SCU mini-SAS connectors on the server board, the embedded RAID option must be configured as RSTe. The ESRT2 stack does not have SAS expander support.
- The RSTe stack supports booting from drives connected to an expander when the EFI Optimized Boot option is enabled in <F2> BIOS Setup (often referred to as UEFI boot). There are no restrictions on this configuration.
- Using Legacy mode BIOS for booting to targets attached through SAS expander card requires a BIOS update. Must connect the expander to SCU_0. Drives must be connected to ports 0&1 on RES2SV240 expander or A&B on RES2CV**0 for legacy mode boot support
- All Intel supported 6Gb SAS/RAID adapters can connect both quad-port connectors (x8 wide port) to the expander card.
- All Intel supported 3Gb SAS/RAID adapters may only connect a single quad-port connector (x4 wide port) to the expander card

7.4.4 Sample SAS Expander Configurations

Please reference the *Intel® Server System R2000BB Product Family Service Guide* for cable routing diagrams illustrating a variety of different storage configurations.

7.4.4.1 Cable Routing using the both embedded SCU ports and a SAS Expander Card (RSTe only)

SCU controller limitations prevent both SCU mini-SAS connectors on the server board from being attached to the same expander card. Therefore, in order to use both embedded SCU ports with a SAS expander card, one SCU port is connected directly to backplane and one SCU port is connected to the expander card.

To ensure contiguous drive mapping, cables should be routed as follows:

Config Option #1:

- The **SCU_0 (0-3)** connector is cabled to first connector on the hot swap backplane
- The **SCU_1 (4-7)** connector is cabled to **Connector A (RES2CV240 or RES2CV360) or Connector 0 (RES2SV240)** on the SAS expander card
- Cables from the SAS Expander to the hot swap backplane are connected in order starting with **Connector B (RES2CV240 or RES2CV360) or Connector 1 (RES2SV240)**

Config Option #2:

- The **SCU_0 (0-3)** connector is cabled the expander. Do not use connectors A&B (RES2CV240 or RES2CV360) or connectors 0&1 (RES2SV240) for the SCU.
- The **SCU_1 (4-7)** connector is not used, or can be connected directly to the backplane.
- Cables from the SAS Expander to the hot swap backplane are connected in order starting with **Connector A (RES2CV240 or RES2CV360) or Connector 0 (RES2SV240)**

7.4.4.2 Cable Routing using a x8 wide-port capable 6 Gb SAS / SAS RAID Controller and an expander card

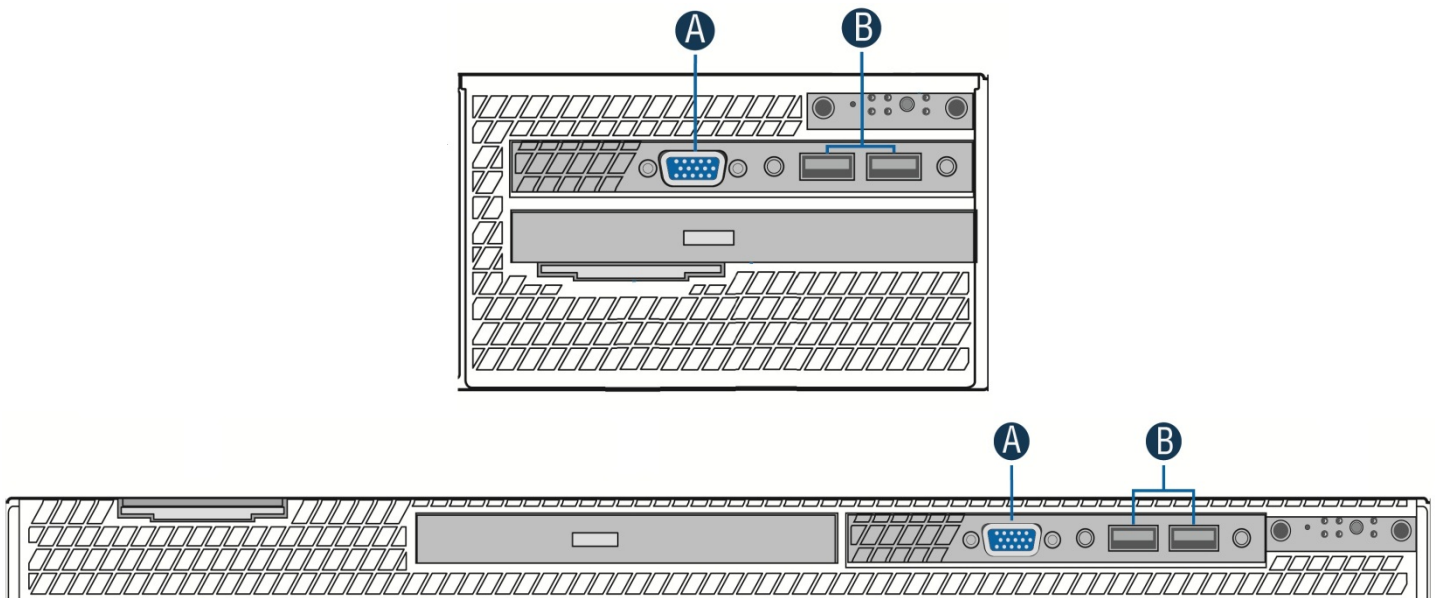
To ensure contiguous drive mapping when using a x8 wide-port capable 6 Gb SAS / SAS RAID Controller with the a SAS expander card, the system should may be cabled as follows:

- Cables from the SAS Expander to the hot swap backplane should be connected in order starting with **Connector A (RES2CV240 or RES2CV360) or Connector 0 (RES2SV240)**
- Once all connections from the SAS expander card to the backplane are made, the cables from the SAS controller can be attached to any of the remaining connectors on the SAS expander card

8. Front Control Panel and I/O Panel Overview

All system configurations will include a Control Panel on the front of the system providing push button system controls and LED indicators for several system features. Systems configured with eight 3.5" hard drive bays or up to sixteen 2.5" hard drive bays will also include an I/O Panel providing additional system I/O features. This section describes the features and functions of both front panel options.

8.1 I/O Panel Features



| Label | Description |
|-------|-----------------|
| A | Video connector |
| B | USB ports |

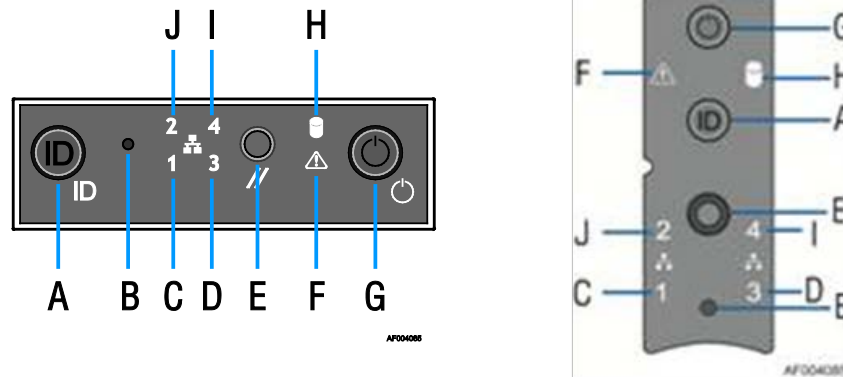
Figure 43. Front I/O Panel Features

A – Video connector – The front I/O Panel video connector gives the option of attaching a monitor to the front of the system. When BIOS detects that a monitor is attached to the front video connector, it disables the video signals routed to the on-board video connector on the back of the system. Video resolutions from the front video connector may be lower than that of the rear on-board video connector. A short video cable should be used for best resolution. The front video connector is cabled to a 2x7 header on the server board labeled “FP Video”.

B – USB Ports – The front I/O panel includes two USB ports. The USB ports are cabled to a 2x5 connector on the server board labeled “FP USB”.

8.2 Control Panel Features

The system includes a control panel that provides push button system controls and LED indicators for several system features. Depending on the hard drive configuration, the front control panel may come in either of two formats; however, both provide the same functionality. This section will provide a description for each front control panel feature.



| Label | Description | Label | Description |
|-------|----------------------------------------------|-------|---------------------------------------|
| A | System ID Button w/Integrated LED | F | System Status LED |
| B | NMI Button (recessed, tool required for use) | G | Power / Sleep Button w/Integrated LED |
| C | NIC-1 Activity LED | H | Hard Drive Activity LED |
| D | NIC-3 Activity LED | I | NIC-4 Activity LED |
| E | System Cold Reset Button | J | NIC-2 Activity LED |

Figure 44. Front Control Panel Features

A – System ID Button w/Integrated LED – Toggles the integrated ID LED and the Blue server board ID LED on and off. The System ID LED is used to identify the system for maintenance when installed in a rack of similar server systems. The System 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.

B – 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.

C, D, I and J – Network Activity LEDs – 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.

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

F – 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 sub-system. The following table provides a description of each supported LED state.

Table 30. System Status LED State Definitions

| Color | State | Criticality | Description |
|-------|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Off | System is not operating | Not ready | System is powered off (AC and/or DC). System is in EuP Lot6 Off Mode. System is in S5 Soft-Off State. System is in S4 Hibernate Sleep State. |
| Green | Solid on | Ok | Indicates that the System is running (in S0 State) and its status is 'Healthy'. The system is not exhibiting any errors. AC power is present and BMC has booted and manageability functionality is up and running. |
| Green | ~1 Hz blink | Degraded - system is operating in a degraded state although still functional, or system is operating in a redundant state but with an impending failure warning | System degraded: Redundancy loss, such as power-supply or fan. Applies only if the associated platform sub-system has redundancy capabilities. Fan warning or failure when the number of fully operational fans is more than minimum number needed to cool the system. Non-critical threshold crossed – Temperature (including HSBP temp), voltage, input power to power supply, output current for main power rail from power supply and Processor Thermal Control (Therm Ctrl) sensors. Power supply predictive failure occurred while redundant power supply configuration was present. Unable to use all of the installed memory (one or more DIMMs failed/disabled but functional memory remains available) Correctable Errors over a threshold and migrating to a spare DIMM (memory sparing). This indicates that the user no longer has spared DIMMs indicating a redundancy lost condition. Corresponding DIMM LED lit. Uncorrectable memory error has occurred in memory Mirroring Mode, causing Loss of Redundancy. Correctable memory error threshold has been reached for a failing DDR3 DIMM when the system is operating in fully redundant RAS Mirroring Mode. Battery failure. BMC executing in uBoot. (Indicated by Chassis ID blinking at Blinking at 3Hz). System in degraded state (no manageability). BMC uBoot is running but has not transferred control to BMC Linux. Server will be in this state 6-8 seconds after BMC reset while it pulls the Linux image into flash BMC booting Linux. (Indicated by Chassis ID solid ON). System in degraded state (no manageability). Control has been passed from BMC uBoot to BMC Linux itself. It will be in this state for ~10~20 seconds. BMC Watchdog has reset the BMC. Power Unit sensor offset for configuration error is asserted. HDD HSC is off-line or degraded. |
| Amber | ~1 Hz blink | Non-critical - System is operating in a degraded state with an impending failure warning, although still functioning | Non-fatal alarm – system is likely to fail: Critical threshold crossed – Voltage, temperature (including HSBP temp), input power to power supply, output current for main power rail from power supply and PROCHOT (Therm Ctrl) sensors. VRD Hot asserted. Minimum number of fans to cool the system not present or failed Hard drive fault Power Unit Redundancy sensor – Insufficient resources offset (indicates not enough power supplies present) In non-sparing and non-mirroring mode if the threshold of correctable errors is crossed within the window Correctable memory error threshold has been reached for a failing DDR3 DIMM when the system is operating in a non-redundant mode |

| Color | State | Criticality | Description |
|-------|----------|----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Amber | Solid on | Critical, non-recoverable – System is halted | Fatal alarm – system has failed or shutdown: CPU CATERR signal asserted MSID mismatch detected (CATERR also asserts for this case). CPU 1 is missing CPU Thermal Trip No power good – power fault DIMM failure when there is only 1 DIMM present and hence no good memory present ¹ . Runtime memory uncorrectable error in non redundant mode. DIMM Thermal Trip or equivalent SSB Thermal Trip or equivalent CPU ERR2 signal asserted BMC\Video memory test failed. (Chassis ID shows blue/solid-on for this condition) Both uBoot BMC FW images are bad. (Chassis ID shows blue/solid-on for this condition) 240VA fault Fatal Error in processor initialization: Processor family not identical Processor model not identical Processor core/thread counts not identical Processor cache size not identical Unable to synchronize processor frequency Unable to synchronize QPI link frequency |

G – Power/Sleep Button – 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 iBMC, 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.

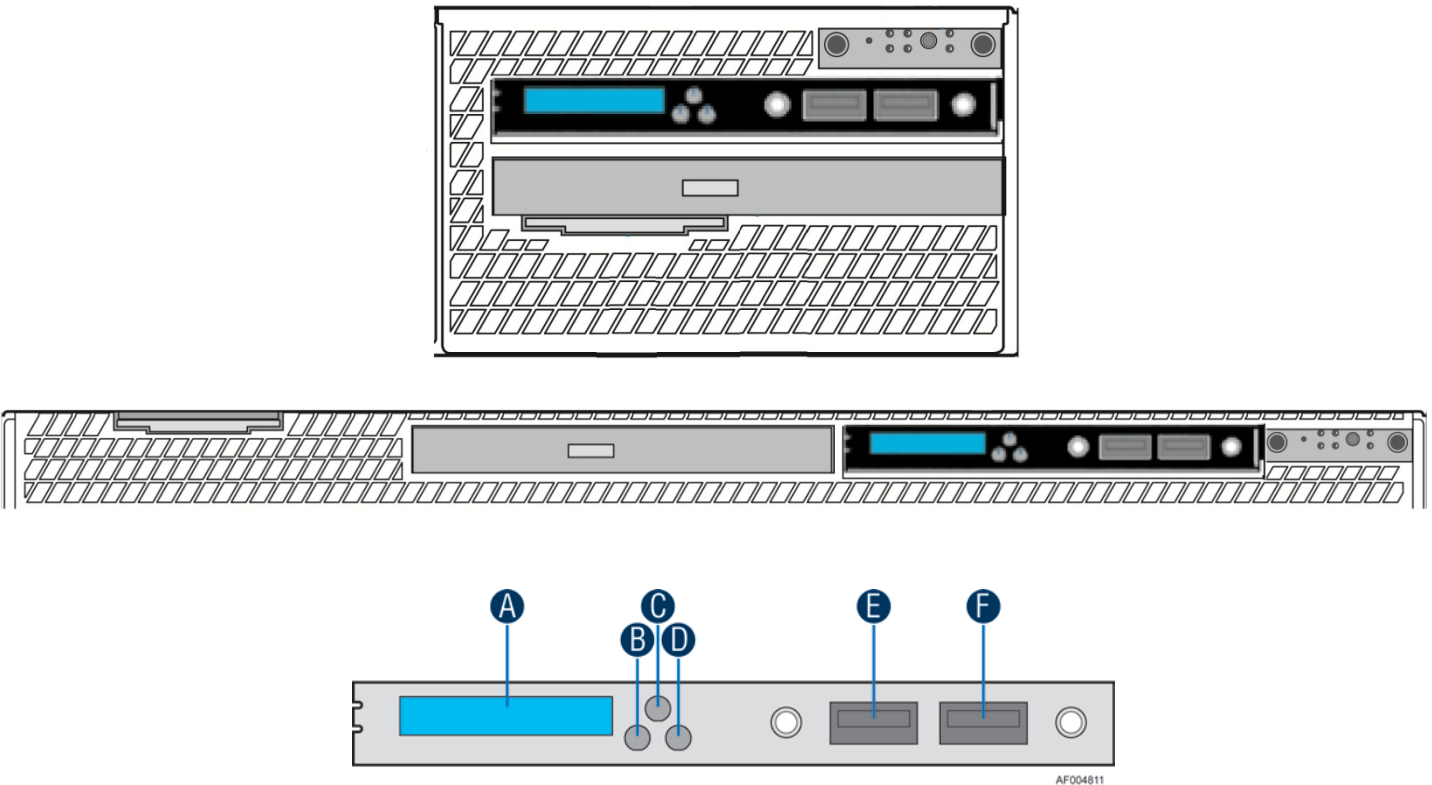
Table 31. Power/Sleep LED Functional States

| 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 ¹ | 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. |

H- Drive 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.

9. Intel® Local Control Panel

The Intel® Local Control Panel option (Intel Product Order Code – **A1U2ULCP**) utilizes a combination of control buttons and LCD display to provide system accessibility and monitoring.



| Label | Description | Functionality |
|-------|----------------------|-----------------------------------------------------|
| A | LCD Display | one line 18 character display |
| B | Left Control Button | moves the cursor backward one step or one character |
| C | “Enter” Button | selects the menu item highlighted by the cursor |
| D | Right Control Button | moves the cursor forward one step or one character |
| E | USB 2.0 Port | |
| F | USB 2.0 Port | |

Figure 45. Intel® Local Control Panel Option

The LCD (Local Control Display) is a one line character display that resides on the front panel of the chassis. It can display a maximum of 16 characters at a time. This device also contains 3 buttons (Left, Right and Enter). The user can select the content that needs to be displayed on the LCD screen by operating these buttons.

For a complete description of the LCP accessory, please reference the *Intel® Local Control Panel for EPSSD Platforms Based on Intel® Xeon® Processor E5 4600/2600/2400/1600/1400 Product Families Technical Product Specification*. (Intel document order number G83726-001)

10. PCI Riser Card Support

The system includes two riser card slots on the server board. Riser cards for this server are NOT interchangeable between riser slots. This section will provide an overview of each available riser card and describe the server board features and architecture supporting them.

10.1 Architectural Overview of the Server Board Riser Slots

The server board includes two riser card slots labeled “RISER_Slot_1” and “RISER_Slot_2”. The following diagrams illustrate the general server board architecture supporting these two slots.

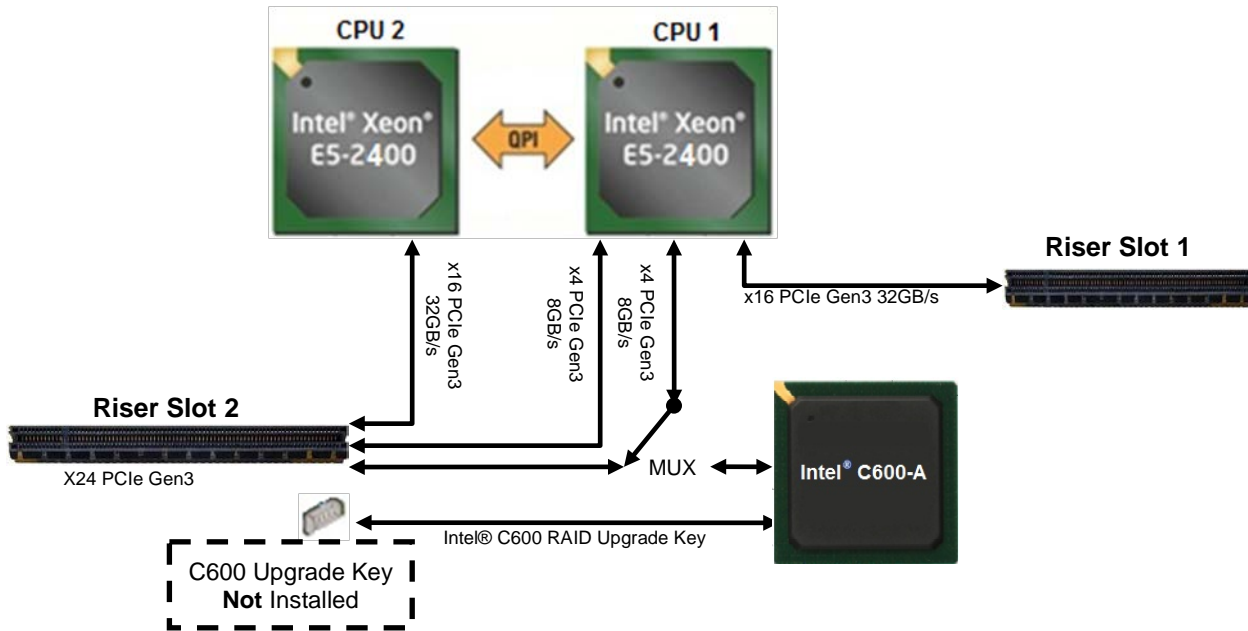


Figure 46. Riser Slot Architecture – Intel® C600 Upgrade Key NOT Installed

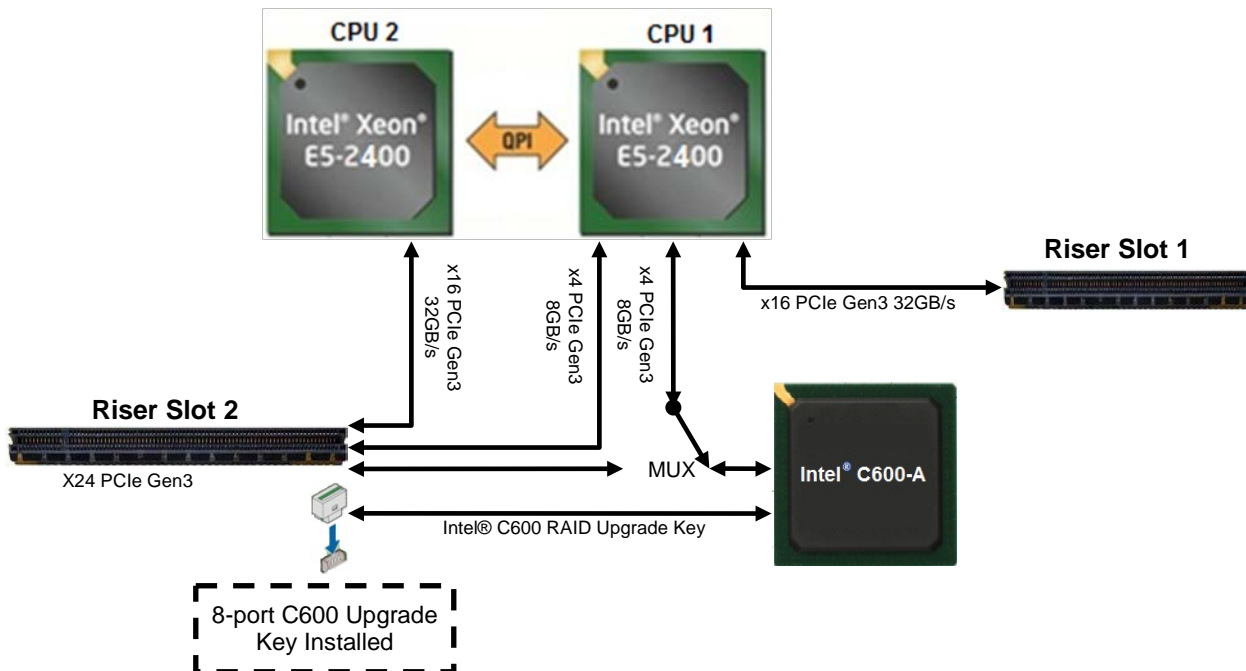


Figure 47. Riser Slot Architecture - Intel® C600 Upgrade Key Installed

CPU #1 provides Riser Slot #1 with x16 PCIe bus lanes which can be bifurcated to support multi-slot riser cards.

The number of PCIe lanes routed to Riser Slot #2 is dependent on the system configuration. In a single processor configuration, CPU #1 will route x8 (default) bus lanes to Riser Slot #2. However, should the system be configured with an optionally installed 8-port Intel® C600 Upgrade Key, four of eight PCIe bus lanes from CPU #1 will be routed via a multiplexor to the Intel® C602 chipset to support the embedded 8-port SCU SATA/SAS controller. With CPU #2 installed, an additional x16 PCIe bus lanes are routed to Riser Slot #2. All available PCIe lanes routed to Riser Slot #2 can be bifurcated to support multi-slot riser cards. See the following diagram to determine PCI bus lane routing for each riser card.

NOTE: The riser card slots on the server board are designed to support riser cards only. Inserting a PCIe add-in card directly into the riser card slot on the server board will result in damage to the server board, the add-in card, or both. PCIe add-in cards should only be installed into a supported riser card assembly.

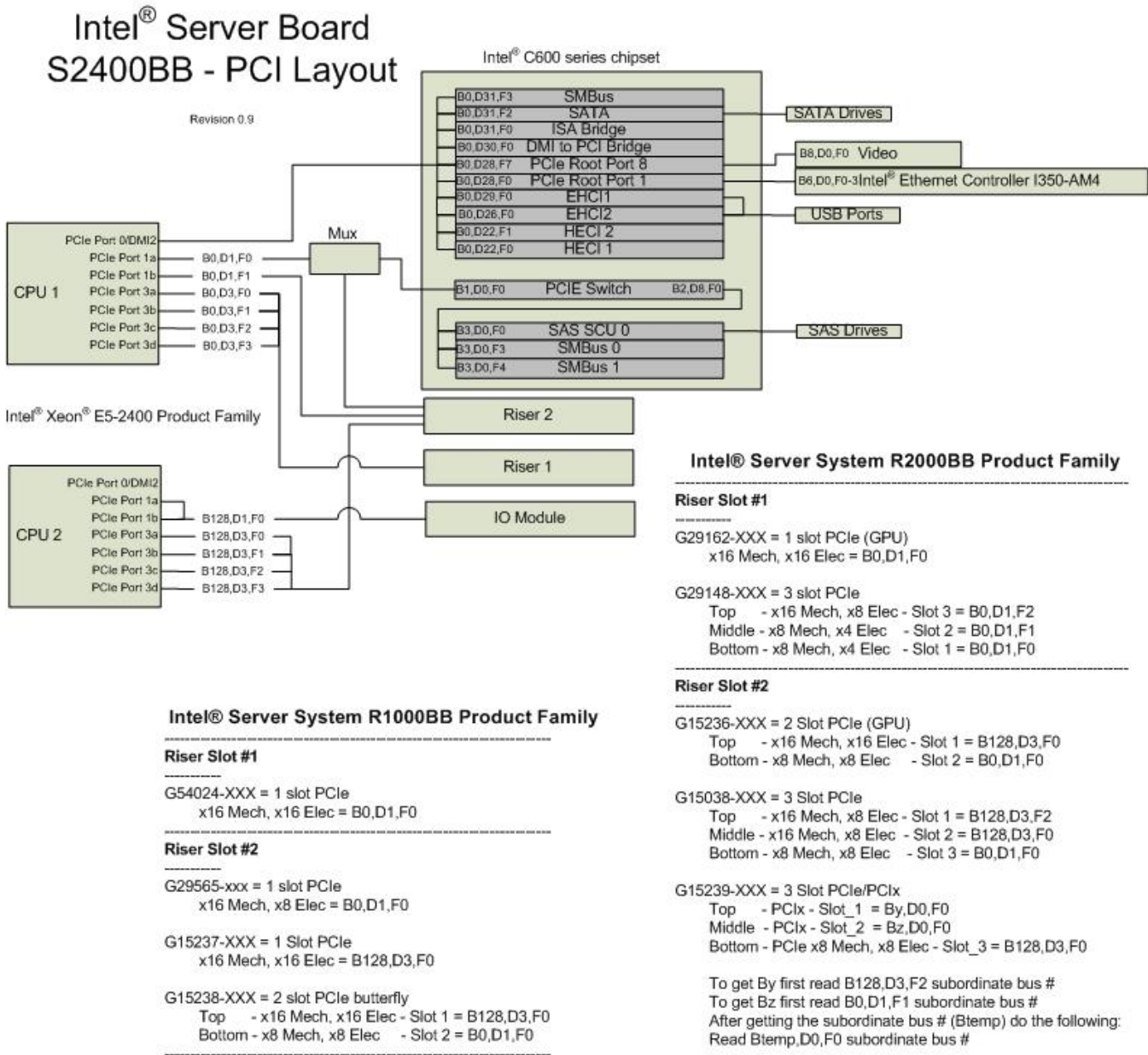


Figure 48. Intel® Server Board S2400BB PCI Bus Layout Diagram

10.2 Riser Card Support

The system has concurrent support for two riser cards. Each riser card is mounted to a bracket assembly and is installed into the system by aligning the edge connector of the riser card with the matching slot connector on the server board, and with hooks on the bracket assembly to slots on the back edge of the chassis.

Two card guide brackets on the air duct provide support for Full Height / Full Length PCIe add-in cards installed in the top and middle slots of each installed riser card assembly.

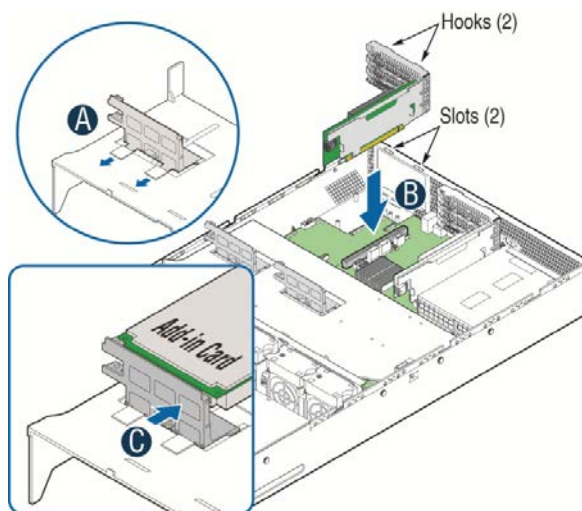


Figure 49. Full Height / Full Length Add-in Card Support

Caution: Riser cards are NOT interchangeable between Riser Slot #1 and Riser Slot #2. The riser card assembly for Riser #1 will include a mechanical block to prevent accidental insertion into Riser Slot #2.

Do not install a riser card designed for Riser Slot #1 into Riser Slot #2. Doing so will electrically damage the riser card, riser slot, or both.

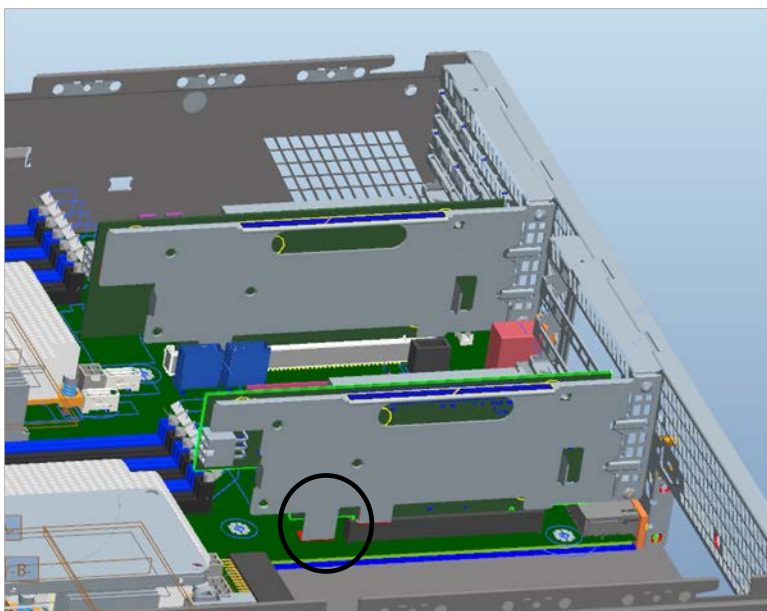
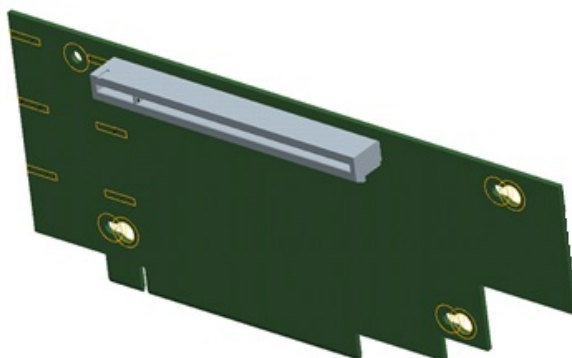


Figure 50. Riser Card #1 Assembly Showing Mechanical Block

10.3 Riser Card Options – Riser Slot #1

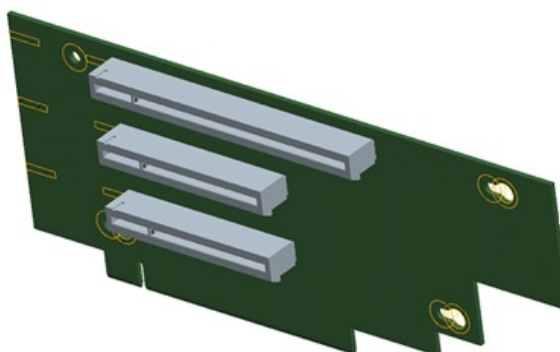
All x16 PCIe bus lanes for Riser Slot #1 on the server board are routed from CPU #1. Riser cards designed for Riser Slot #1 include the following.

10.3.1 1-Slot PCIe Riser Card (Required for Intel® Xeon Phi™ and GPGPU Support)



| Slot # | Description | PCI Lane Routing Riser Slot #1 |
|--------------|--------------------------|-----------------------------------|
| Slot-1 (Top) | PCIe x16 lanes, x16 slot | CPU 1 |
| | | |
| | | |

10.3.2 3-Slot PCIe Riser Card

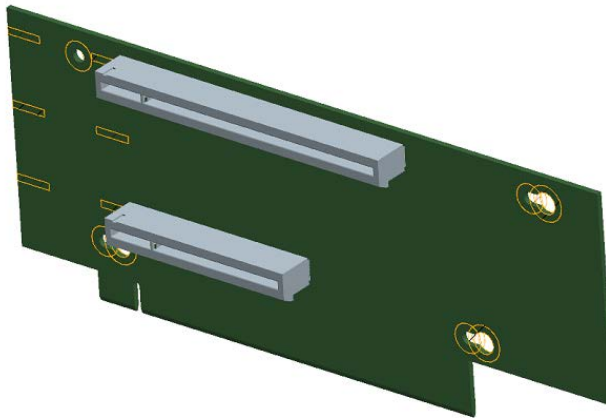


| Slot # | Description | PCI Lane Routing Riser Slot #1 |
|-----------------|-------------------------|-----------------------------------|
| Slot-1 (Top) | PCIe x8 lanes, x16 slot | CPU 1 |
| Slot-2 (Middle) | PCIe x4 lanes, x8 slot | CPU 1 |
| Slot-3 (Bottom) | PCIe x4 lanes, x8 slot | CPU 1 |

10.4 Riser Card Options – Riser Slot #2

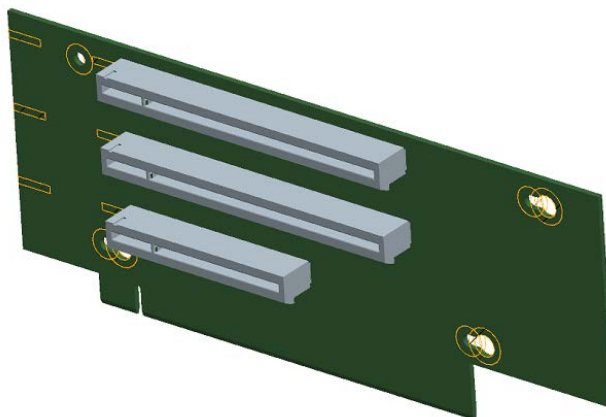
The number of PCIe bus lanes routed to Riser Slot #2 is dependent on the system configuration. In a single processor configuration, CPU #1 will route x8 PCIe (default) bus lanes to the bottom x8 PCIe add-in slot. However, should the system be configured with an 8-port Intel® C600 Upgrade Key, four of eight PCIe bus lanes from CPU #1 will be routed via a multiplexor to the Intel® C602 chipset to support the embedded 8-port SCU SATA/SAS controller. With CPU #2 installed, an additional x16 PCIe bus lanes are routed to support the other PCIe add-in card slots on the riser. Riser cards designed for Riser Slot #2 include the following.

10.4.1 2-Slot PCIe Riser Card (Required for Intel® Xeon Phi™ and GPGPU Support)



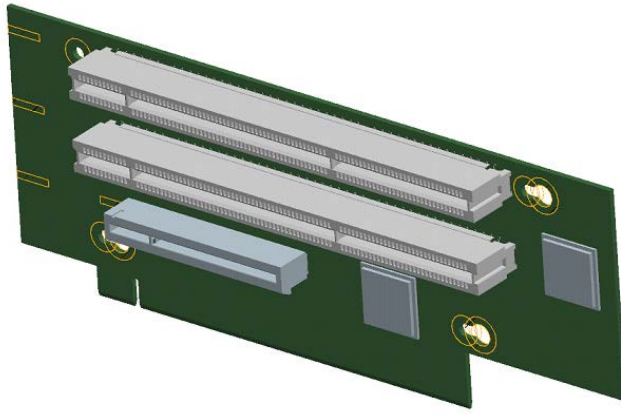
| Slot # | Description | PCI Lane Routing Riser Slot #2 |
|-----------------|--------------------------|--------------------------------|
| Slot-1 (Top) | PCIe x16 lanes, x16 slot | CPU 2 |
| Slot-2 (Bottom) | PCIe x8 lanes, x8 slot | CPU 1 with no RAID key |
| Slot-2 (Bottom) | PCIe x4 lanes, x8 slot | CPU 1 with 8-port RAID key |

10.4.2 3-Slot PCIe Riser Card



| Slot # | Description | PCI Lane Routing Riser Slot #2 |
|-----------------|-------------------------|--------------------------------------|
| Slot-1 (Top) | PCIe x8 lanes, x16 slot | CPU 2 |
| Slot-2 (Middle) | PCIe x8 lanes, x16 slot | CPU 2 |
| Slot-3 (Bottom) | PCIe x8 lanes, x8 slot | CPU 1 with no RAID Key installed |
| Slot-3 (Bottom) | PCIe x4 lanes, x8 slot | CPU 1 with 8-port RAID Key installed |

10.4.3 3-Slot PCIx / PCIe Riser Card



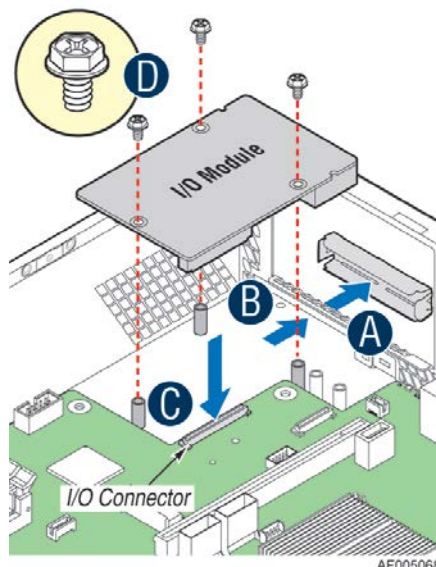
| Slot # | Description | PCI Lane Routing Riser Slot #2 |
|-----------------|------------------------|-----------------------------------|
| Slot-1 (Top) | PCIx 133MHz | CPU 2 |
| Slot-2 (Middle) | PCIx133 MHz | CPU 1 |
| Slot-3 (Bottom) | PCIe x8 lanes, x8 slot | CPU 2 |

11. Mezzanine Module Support

11.1 IO Module Support

In addition to the embedded I/O features of the server board, and those available with the addition of a PCIe add-in card, the server also provides concurrent support of an optionally installed mezzanine I/O module.

Note: I/O modules can only be supported in dual processor configurations.



The following table lists the Intel® I/O modules available for this server.

| Product Code | Description |
|-----------------|--------------------------------------------------------------------------------|
| AXX10GBNIAIOM | Dual SFP+ port 10GbE IO Module based on Intel® 82599 10GbE Ethernet Controller |
| AXX10GBTWLIOM | Dual RJ-45 port 10GBase-T I/O Module based on Intel® Ethernet Controller x540 |
| AXX1FDRIBIOM | Single Port FDR 56GT/S speed InfiniBand module with QSFP connector |
| AXX2FDRIBIOM | Dual port FDR 56GT/S speed infiniband module with QSFP connector |
| AXX4P1GBPWL IOM | Quad Port 1GbE I/O Module based on Intel® Ethernet Controller I350 |

11.2 Intel® Remote Management Module 4 (RMM4) Lite and Management NIC Support

The integrated baseboard management controller has support for advanced management features which are enabled when an optional Intel® Remote Management Module 4 (RMM4) is installed.

RMM4 is comprised of two boards – RMM4 lite and the optional Dedicated Server Management NIC (DMN).

| Intel Product Code | Description | Kit Contents | Benefits |
|--------------------|----------------------------------------|-------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|
| AXXRMM4LITE | Intel® Remote Management Module 4 Lite | RMM4 Lite Activation Key | Enables KVM & media redirection via onboard NIC |
| AXXRMM4R | Intel® Remote Management Module 4 | RMM4 Lite Activation Key Dedicated NIC Port Module | Dedicated NIC for management traffic. Higher bandwidth connectivity for KVM & media Redirection with 1Gbe NIC. |

On the server board each Intel® RMM4 component is installed at the following locations.

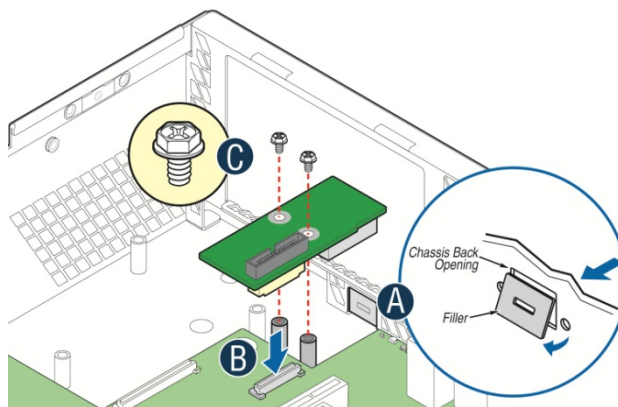


Figure 51. Intel® RMM4 Dedicated Management NIC Installation

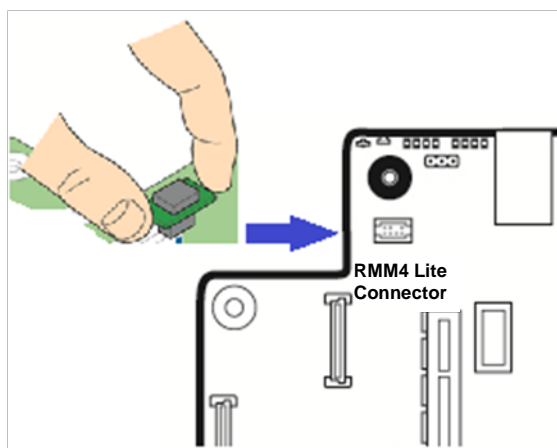


Figure 52. Intel® RMM4 Lite Activation Key Installation

Table 32. Enabling Advanced Management Features

| Manageability Hardware | Benefits |
|-------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|
| Intel® Integrated BMC | Comprehensive IPMI based base manageability features |
| Intel® Remote Management Module 4 – Lite Package contains one module – 1- Key for advance Manageability features. | No dedicated NIC for management Enables KVM & media redirection via onboard NIC |
| Intel® Remote Management Module 4 Package includes 2 modules – 1 - key for advance features 2 - Dedicated NIC (1Gbe) for management | Dedicated NIC for management traffic. Higher bandwidth connectivity for KVM & media Redirection with 1Gbe NIC. |

For further RMM4 information, please refer to the following documents:

- *Intel® Server Board S2400BB Technical Product Specification*
- *Intel® Remote Management Module 4 Technical Product Specification*
- *Intel® Remote Management Module 4 and Integrated BMC Web Console Users Guide*

Appendix A: Integration and Usage Tips

This section provides a list of useful information that is unique to the Intel® Server System R2000BB Product Family and should be kept in mind while configuring your server system.

- Only the Intel® Xeon® processor E5-2400 product family is supported in this Intel server system. Previous generation Intel® Xeon® processors are not supported.
- For best system performance, follow memory population guidelines as specified in the *Intel® Server Board S2400BB Technical Product Specification*.
- For best system performance, follow all thermal configuration guidelines as specified in this document.
- The Mini-SAS connector labeled “SCU_1” on the server board is only functional when an appropriate Intel® RAID C600 Upgrade Key is installed.
- Many integrated on-board SAS and RAID options are available by installing any of several available Intel® RAID C600 Upgrade Keys.
- The riser cards for Riser Slot #1 and Riser Slot #2 are **NOT** interchangeable.
- The embedded platform management system may not operate as expected if the platform is not updated with accurate system configuration data. The FRUSDR utility must be run with the system fully configured and each time the system configuration changes for accurate system monitoring and event reporting.
- Make sure the latest system software is loaded on the server. This includes System BIOS, BMC Firmware, ME Firmware and FRUSDR. The latest system software can be downloaded from the [Http://www.intel.com/support](http://www.intel.com/support) web site.

Appendix B: POST Code Diagnostic LED Decoder

As an aid to assist in trouble shooting a system hang that occurs during a system's Power-On Self Test (POST) process, the server board includes a bank of eight POST Code Diagnostic LEDs on the back edge of the server board.

During the system boot process, Memory Reference Code (MRC) and System BIOS execute a number of memory initialization and platform configuration processes, each of which is assigned a specific hex POST code number. As each routine is started, the given POST code number is displayed to the POST Code Diagnostic LEDs on the back edge of the server board.

During a POST system hang, the displayed post code can be used to identify the last POST routine that was run prior to the error occurring, helping to isolate the possible cause of the hang condition.

Each POST code is represented by eight LEDs; four Green and four Amber. The POST codes are divided into two nibbles, an upper nibble and a lower nibble. The upper nibble bits are represented by Amber Diagnostic LEDs #4, #5, #6, #7. The lower nibble bits are represented by Green Diagnostics LEDs #0, #1, #2 and #3. If the bit is set in the upper and lower nibbles, the corresponding LED is lit. If the bit is clear, the corresponding LED is off.

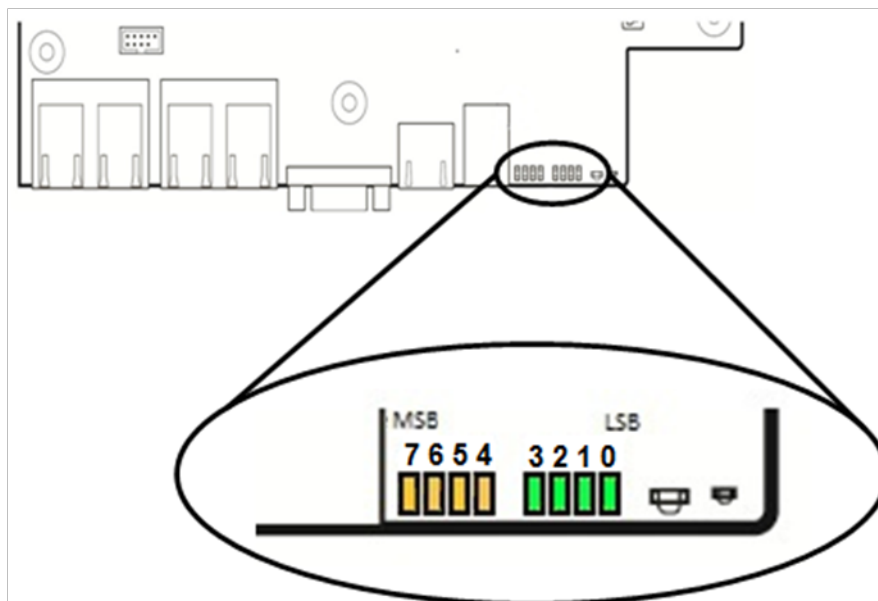


Figure 53. POST Diagnostic LED Location

In the following example, the BIOS sends a value of ACh to the diagnostic LED decoder. The LEDs are decoded as follows:

Table 33. POST Progress Code LED Example

| LEDs | Upper Nibble AMBER LEDs | | | | Lower Nibble GREEN LEDs | | | |
|---------|-------------------------|--------|--------|--------|-------------------------|--------|--------|---------------|
| | MSB LED #7 | LED #6 | LED #5 | LED #4 | LED #3 | LED #2 | LED #1 | LSB LED #0 |
| | 8h | 4h | 2h | 1h | 8h | 4h | 2h | 1h |
| Status | ON | OFF | ON | OFF | ON | ON | OFF | OFF |
| Results | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 |
| | Ah | | | | Ch | | | |

- Upper nibble bits = 1010b = Ah; Lower nibble bits = 1100b = Ch; the two are concatenated as ACh.

Table 34. Diagnostic LED POST Code Decoder

| Checkpoint | Diagnostic LED Decoder | | | | | | | | Description |
|----------------------------------------------------------------------------------|-------------------------|----|----|-----|--------------|----|----|----|--------------------------------------------|
| | 1 = LED On, 0 = LED Off | | | | | | | | |
| | Upper Nibble | | | | Lower Nibble | | | | |
| LED # | MSB | | | LSB | | | | | |
| | 8h | 4h | 2h | 1h | 8h | 4h | 2h | 1h | |
| LED # | #7 | #6 | #5 | #4 | #3 | #2 | #1 | #0 | |
| SEC Phase | | | | | | | | | |
| 01h | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | First POST code after CPU reset |
| 02h | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | Microcode load begin |
| 03h | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | CRAM initialization begin |
| 04h | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | Pei Cache When Disabled |
| 05h | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | SEC Core At Power On Begin. |
| 06h | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | Early CPU initialization during Sec Phase. |
| 07h | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | Early SB initialization during Sec Phase. |
| 08h | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | Early NB initialization during Sec Phase. |
| 09h | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | End Of Sec Phase. |
| 0Eh | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | Microcode Not Found. |
| 0Fh | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | Microcode Not Loaded. |
| PEI Phase | | | | | | | | | |
| 10h | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | PEI Core |
| 11h | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | CPU PEIM |
| 15h | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | NB PEIM |
| 19h | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | SB PEIM |
| MRC Process Codes – MRC Progress Code Sequence is executed - See Table 28 | | | | | | | | | |
| PEI Phase continued... | | | | | | | | | |
| 31h | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | Memory Installed |
| 32h | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | CPU PEIM (Cpu Init) |
| 33h | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | CPU PEIM (Cache Init) |
| 34h | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | CPU PEIM (BSP Select) |
| 35h | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | CPU PEIM (AP Init) |
| 36h | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | CPU PEIM (CPU SMM Init) |
| 4Fh | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | Dxe IPL started |
| DXE Phase | | | | | | | | | |
| 60h | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | DXE Core started |
| 61h | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | DXE NVRAM Init |
| 62h | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | SB RUN Init |
| 63h | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | Dxe CPU Init |
| 68h | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | DXE PCI Host Bridge Init |
| 69h | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | DXE NB Init |
| 6Ah | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | DXE NB SMM Init |
| 70h | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | DXE SB Init |
| 71h | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | DXE SB SMM Init |
| 72h | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | DXE SB devices Init |
| 78h | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | DXE ACPI Init |
| 79h | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | DXE CSM Init |
| 90h | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | DXE BDS Started |
| 91h | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | DXE BDS connect drivers |
| 92h | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | DXE PCI Bus begin |
| 93h | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | DXE PCI Bus HPC Init |
| 94h | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | DXE PCI Bus enumeration |
| 95h | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | DXE PCI Bus resource requested |
| 96h | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | DXE PCI Bus assign resource |
| 97h | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | DXE CON_OUT connect |
| 98h | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | DXE CON_IN connect |
| 99h | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | DXE SIO Init |
| 9Ah | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | DXE USB start |
| 9Bh | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | DXE USB reset |
| 9Ch | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | DXE USB detect |
| 9Dh | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | DXE USB enable |
| A1h | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | DXE IDE begin |
| A2h | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | DXE IDE reset |

| Checkpoint | Diagnostic LED Decoder | | | | | | | | Description |
|----------------------|-------------------------|----|----|----|--------------|----|-----|----|-----------------------------------------------|
| | 1 = LED On, 0 = LED Off | | | | | | | | |
| | Upper Nibble | | | | Lower Nibble | | | | |
| | MSB | | | | | | LSB | | |
| LED # | 8h | 4h | 2h | 1h | 8h | 4h | 2h | 1h | |
| A3h | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | DXE IDE detect |
| A4h | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | DXE IDE enable |
| A5h | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | DXE SCSI begin |
| A6h | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | DXE SCSI reset |
| A7h | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | DXE SCSI detect |
| A8h | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | DXE SCSI enable |
| A9h | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | DXE verifying SETUP password |
| ABh | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | DXE SETUP start |
| ACh | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | DXE SETUP input wait |
| ADh | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | DXE Ready to Boot |
| A Eh | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | DXE Legacy Boot |
| AFh | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | DXE Exit Boot Services |
| B0h | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | RT Set Virtual Address Map Begin |
| B1h | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | RT Set Virtual Address Map End |
| B2h | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | DXE Legacy Option ROM init |
| B3h | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | DXE Reset system |
| B4h | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | DXE USB Hot plug |
| B5h | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | DXE PCI BUS Hot plug |
| B6h | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | DXE NVRAM cleanup |
| B7h | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | DXE Configuration Reset |
| 00h | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | INT19 |
| S3 Resume | | | | | | | | | |
| E0h | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | S3 Resume PEIM (S3 started) |
| E1h | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | S3 Resume PEIM (S3 boot script) |
| E2h | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | S3 Resume PEIM (S3 Video Repost) |
| E3h | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | S3 Resume PEIM (S3 OS wake) |
| BIOS Recovery | | | | | | | | | |
| F0h | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | PEIM which detected forced Recovery condition |
| F1h | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | PEIM which detected User Recovery condition |
| F2h | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | Recovery PEIM (Recovery started) |
| F3h | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | Recovery PEIM (Capsule found) |
| F4h | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | Recovery PEIM (Capsule loaded) |

POST Memory Initialization MRC Diagnostic Codes

There are two types of POST Diagnostic Codes displayed by the MRC during memory initialization; Progress Codes and Fatal Error Codes.

The MRC Progress Codes are displays to the Diagnostic LEDs that show the execution point in the MRC operational path at each step.

Table 35. MRC Progress Codes

| Checkpoint | Diagnostic LED Decoder | | | | | | | | Description |
|---------------------------|-------------------------|----|----|----|--------------|----|----|-----|---------------------------------------------------|
| | 1 = LED On, 0 = LED Off | | | | | | | | |
| | Upper Nibble | | | | Lower Nibble | | | | |
| | MSB | | | | | | | LSB | |
| | 8h | 4h | 2h | 1h | 8h | 4h | 2h | 1h | |
| LED | #7 | #6 | #5 | #4 | #3 | #2 | #1 | #0 | |
| MRC Progress Codes | | | | | | | | | |
| B0h | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | Detect DIMM population |
| B1h | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | Set DDR3 frequency |
| B2h | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | Gather remaining SPD data |
| B3h | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | Program registers on the memory controller level |
| B4h | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | Evaluate RAS modes and save rank information |
| B5h | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | Program registers on the channel level |
| B6h | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | Perform the JEDEC defined initialization sequence |
| B7h | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | Train DDR3 ranks |
| B8h | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | Initialize CLTT/OLTT |
| B9h | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | Hardware memory test and init |
| BAh | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | Execute software memory init |
| BBh | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | Program memory map and interleaving |
| BCh | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | Program RAS configuration |
| BFh | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | MRC is done |

Memory Initialization at the beginning of POST includes multiple functions, including: discovery, channel training, validation that the DIMM population is acceptable and functional, initialization of the IMC and other hardware settings, and initialization of applicable RAS configurations.

When a major memory initialization error occurs and prevents the system from booting with data integrity, a beep code is generated, the MRC will display a fatal error code on the diagnostic LEDs, and a system halt command is executed. Fatal MRC error halts do NOT change the state of the System Status LED, and they do NOT get logged as SEL events. The following table lists all MRC fatal errors that are displayed to the Diagnostic LEDs.

Table 36. MRC Fatal Error Codes

| Checkpoint | Diagnostic LED Decoder | | | | | | | | Description |
|------------------------------|-------------------------|----|----|----|--------------|----|----|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | 1 = LED On, 0 = LED Off | | | | | | | | |
| | Upper Nibble | | | | Lower Nibble | | | | |
| | MSB | | | | | | | LSB | |
| | 8h | 4h | 2h | 1h | 8h | 4h | 2h | 1h | |
| LED | #7 | #6 | #5 | #4 | #3 | #2 | #1 | #0 | |
| MRC Fatal Error Codes | | | | | | | | | |
| E8h | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | No usable memory error 01h = No memory was detected via SPD read, or invalid config that causes no operable memory. 02h = Memory DIMMs on all channels of all sockets are disabled due to hardware memtest error. 3h = No memory installed. All channels are disabled. |
| E9h | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | Memory is locked by Intel Trusted Execution Technology and is inaccessible |
| EAh | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | DDR3 channel training error 01h = Error on read DQ/DQS (Data/Data Strobe) init 02h = Error on Receive Enable 3h = Error on Write Leveling 04h = Error on write DQ/DQS (Data/Data Strobe) |
| EBh | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | Memory test failure 01h = Software memtest failure. 02h = Hardware memtest failed. 03h = Hardware Memtest failure in Lockstep Channel mode requiring a channel to be disabled. <i>This is a fatal error which requires a reset and calling MRC with a different RAS mode to retry.</i> |
| EDh | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | DIMM configuration population error 01h = Different DIMM types (UDIMM, RDIMM, LRDIMM) are detected installed in the system. 02h = Violation of DIMM population rules. 03h = The 3rd DIMM slot can not be populated when QR DIMMs are installed. 04h = UDIMMs are not supported in the 3rd DIMM slot. 05h = Unsupported DIMM Voltage. |
| EFh | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | Indicates a CLTT table structure error |

Appendix C: POST Code Errors

Most error conditions encountered during POST are reported using **POST Error Codes**. These codes represent specific failures, warnings, or are informational. POST Error Codes may be displayed in the Error Manager display screen, and are always logged to the System Event Log (SEL). Logged events are available to System Management applications, including Remote and Out of Band (OOB) management.

There are exception cases in early initialization where system resources are not adequately initialized for handling POST Error Code reporting. These cases are primarily Fatal Error conditions resulting from initialization of processors and memory, and they are handed by a Diagnostic LED display with a system halt.

The following table lists the supported POST Error Codes. Each error code is assigned an error type which determines the action the BIOS will take when the error is encountered. Error types include Minor, Major, and Fatal. The BIOS action for each is defined as follows:

- **Minor:** The error message is displayed on the screen or on the Error Manager screen, and an error is logged to the SEL. The system continues booting in a degraded state. The user may want to replace the erroneous unit. The POST Error Pause option setting in the BIOS setup does not have any effect on this error.
- **Major:** The error message is displayed on the Error Manager screen, and an error is logged to the SEL. The POST Error **P**ause option setting in the BIOS setup determines whether the system pauses to the Error Manager for this type of error so the user can take immediate corrective action or the system continues booting.

Note that for 0048 “Password check failed”, the system halts, and then after the next reset/reboot will displays the error code on the Error Manager screen.

- **Fatal:** The system halts during post at a blank screen with the text “**Unrecoverable fatal error found. System will not boot until the error is resolved**” and “**Press <F2> to enter setup**” The POST Error Pause option setting in the BIOS setup does not have any effect with this class of error.

When the operator presses the **F2** key on the keyboard, the error message is displayed on the Error Manager screen, and an error is logged to the SEL with the error code. The system cannot boot unless the error is resolved. The user needs to replace the faulty part and restart the system.

NOTE: The POST error codes in the following table are common to all current generation Intel server platforms. Features present on a given server board/system will determine which of the listed error codes are supported.

Table 37. POST Error Messages and Handling

| Error Code | Error Message | Response |
|------------|---------------------------------------------------------------|----------|
| 0012 | System RTC date/time not set | Major |
| 0048 | Password check failed | Major |
| 0140 | PCI component encountered a PERR error | Major |
| 0141 | PCI resource conflict | Major |
| 0146 | PCI out of resources error | Major |
| 0191 | Processor core/thread count mismatch detected | Fatal |
| 0192 | Processor cache size mismatch detected | Fatal |
| 0194 | Processor family mismatch detected | Fatal |
| 0195 | Processor Intel(R) QPI link frequencies unable to synchronize | Fatal |
| 0196 | Processor model mismatch detected | Fatal |
| 0197 | Processor frequencies unable to synchronize | Fatal |
| 5220 | BIOS Settings reset to default settings | Major |
| 5221 | Passwords cleared by jumper | Major |

| Error Code | Error Message | Response |
|------------|-------------------------------------------------------------------|----------|
| 5224 | Password clear jumper is Set | Major |
| 8130 | Processor 01 disabled | Major |
| 8131 | Processor 02 disabled | Major |
| 8132 | Processor 03 disabled | Major |
| 8133 | Processor 04 disabled | Major |
| 8160 | Processor 01 unable to apply microcode update | Major |
| 8161 | Processor 02 unable to apply microcode update | Major |
| 8162 | Processor 03 unable to apply microcode update | Major |
| 8163 | Processor 04 unable to apply microcode update | Major |
| 8170 | Processor 01 failed Self Test (BIST) | Major |
| 8171 | Processor 02 failed Self Test (BIST) | Major |
| 8172 | Processor 03 failed Self Test (BIST) | Major |
| 8173 | Processor 04 failed Self Test (BIST) | Major |
| 8180 | Processor 01 microcode update not found | Minor |
| 8181 | Processor 02 microcode update not found | Minor |
| 8182 | Processor 03 microcode update not found | Minor |
| 8183 | Processor 04 microcode update not found | Minor |
| 8190 | Watchdog timer failed on last boot | Major |
| 8198 | OS boot watchdog timer failure | Major |
| 8300 | Baseboard management controller failed self-test | Major |
| 8305 | Hot Swap Controller failure | Major |
| 83A0 | Management Engine (ME) failed Selftest | Major |
| 83A1 | Management Engine (ME) Failed to respond. | Major |
| 84F2 | Baseboard management controller failed to respond | Major |
| 84F3 | Baseboard management controller in update mode | Major |
| 84F4 | Sensor data record empty | Major |
| 84FF | System event log full | Minor |
| 8500 | Memory component could not be configured in the selected RAS mode | Major |
| 8501 | DIMM Population Error | Major |
| 8520 | DIMM_A1 failed test/initialization | Major |
| 8521 | DIMM_A2 failed test/initialization | Major |
| 8522 | DIMM_A3 failed test/initialization | Major |
| 8523 | DIMM_B1 failed test/initialization | Major |
| 8524 | DIMM_B2 failed test/initialization | Major |
| 8525 | DIMM_B3 failed test/initialization | Major |
| 8526 | DIMM_C1 failed test/initialization | Major |
| 8527 | DIMM_C2 failed test/initialization | Major |
| 8528 | DIMM_C3 failed test/initialization | Major |
| 8529 | DIMM_D1 failed test/initialization | Major |
| 852A | DIMM_D2 failed test/initialization | Major |
| 852B | DIMM_D3 failed test/initialization | Major |
| 852C | DIMM_E1 failed test/initialization | Major |
| 852D | DIMM_E2 failed test/initialization | Major |
| 852E | DIMM_E3 failed test/initialization | Major |
| 852F | DIMM_F1 failed test/initialization | Major |
| 8530 | DIMM_F2 failed test/initialization | Major |
| 8531 | DIMM_F3 failed test/initialization | Major |
| 8532 | DIMM_G1 failed test/initialization | Major |
| 8533 | DIMM_G2 failed test/initialization | Major |
| 8534 | DIMM_G3 failed test/initialization | Major |
| 8535 | DIMM_H1 failed test/initialization | Major |
| 8536 | DIMM_H2 failed test/initialization | Major |
| 8537 | DIMM_H3 failed test/initialization | Major |
| 8538 | DIMM_I1 failed test/initialization | Major |
| 8539 | DIMM_I2 failed test/initialization | Major |
| 853A | DIMM_I3 failed test/initialization | Major |
| 853B | DIMM_J1 failed test/initialization | Major |
| 853C | DIMM_J2 failed test/initialization | Major |
| 853D | DIMM_J3 failed test/initialization | Major |
| 853E | DIMM_K1 failed test/initialization | Major |

| Error Code | Error Message | Response |
|----------------------|---------------------------------------------------------------|----------|
| 853F (Go to 85C0) | DIMM_K2 failed test/initialization | Major |
| 8540 | DIMM_A1 disabled | Major |
| 8541 | DIMM_A2 disabled | Major |
| 8542 | DIMM_A3 disabled | Major |
| 8543 | DIMM_B1 disabled | Major |
| 8544 | DIMM_B2 disabled | Major |
| 8545 | DIMM_B3 disabled | Major |
| 8546 | DIMM_C1 disabled | Major |
| 8547 | DIMM_C2 disabled | Major |
| 8548 | DIMM_C3 disabled | Major |
| 8549 | DIMM_D1 disabled | Major |
| 854A | DIMM_D2 disabled | Major |
| 854B | DIMM_D3 disabled | Major |
| 854C | DIMM_E1 disabled | Major |
| 854D | DIMM_E2 disabled | Major |
| 854E | DIMM_E3 disabled | Major |
| 854F | DIMM_F1 disabled | Major |
| 8550 | DIMM_F2 disabled | Major |
| 8551 | DIMM_F3 disabled | Major |
| 8552 | DIMM_G1 disabled | Major |
| 8553 | DIMM_G2 disabled | Major |
| 8554 | DIMM_G3 disabled | Major |
| 8555 | DIMM_H1 disabled | Major |
| 8556 | DIMM_H2 disabled | Major |
| 8557 | DIMM_H3 disabled | Major |
| 8558 | DIMM_I1 disabled | Major |
| 8559 | DIMM_I2 disabled | Major |
| 855A | DIMM_I3 disabled | Major |
| 855B | DIMM_J1 disabled | Major |
| 855C | DIMM_J2 disabled | Major |
| 855D | DIMM_J3 disabled | Major |
| 855E | DIMM_K1 disabled | Major |
| 855F (Go to 85D0) | DIMM_K2 disabled | Major |
| 8560 | DIMM_A1 encountered a Serial Presence Detection (SPD) failure | Major |
| 8561 | DIMM_A2 encountered a Serial Presence Detection (SPD) failure | Major |
| 8562 | DIMM_A3 encountered a Serial Presence Detection (SPD) failure | Major |
| 8563 | DIMM_B1 encountered a Serial Presence Detection (SPD) failure | Major |
| 8564 | DIMM_B2 encountered a Serial Presence Detection (SPD) failure | Major |
| 8565 | DIMM_B3 encountered a Serial Presence Detection (SPD) failure | Major |
| 8566 | DIMM_C1 encountered a Serial Presence Detection (SPD) failure | Major |
| 8567 | DIMM_C2 encountered a Serial Presence Detection (SPD) failure | Major |
| 8568 | DIMM_C3 encountered a Serial Presence Detection (SPD) failure | Major |
| 8569 | DIMM_D1 encountered a Serial Presence Detection (SPD) failure | Major |
| 856A | DIMM_D2 encountered a Serial Presence Detection (SPD) failure | Major |
| 856B | DIMM_D3 encountered a Serial Presence Detection (SPD) failure | Major |
| 856C | DIMM_E1 encountered a Serial Presence Detection (SPD) failure | Major |
| 856D | DIMM_E2 encountered a Serial Presence Detection (SPD) failure | Major |
| 856E | DIMM_E3 encountered a Serial Presence Detection (SPD) failure | Major |
| 856F | DIMM_F1 encountered a Serial Presence Detection (SPD) failure | Major |
| 8570 | DIMM_F2 encountered a Serial Presence Detection (SPD) failure | Major |
| 8571 | DIMM_F3 encountered a Serial Presence Detection (SPD) failure | Major |
| 8572 | DIMM_G1 encountered a Serial Presence Detection (SPD) failure | Major |
| 8573 | DIMM_G2 encountered a Serial Presence Detection (SPD) failure | Major |
| 8574 | DIMM_G3 encountered a Serial Presence Detection (SPD) failure | Major |
| 8575 | DIMM_H1 encountered a Serial Presence Detection (SPD) failure | Major |
| 8576 | DIMM_H2 encountered a Serial Presence Detection (SPD) failure | Major |
| 8577 | DIMM_H3 encountered a Serial Presence Detection (SPD) failure | Major |
| 8578 | DIMM_I1 encountered a Serial Presence Detection (SPD) failure | Major |

| Error Code | Error Message | Response |
|-------------------------|---------------------------------------------------------------|----------|
| 8579 | DIMM_I2 encountered a Serial Presence Detection (SPD) failure | Major |
| 857A | DIMM_I3 encountered a Serial Presence Detection (SPD) failure | Major |
| 857B | DIMM_J1 encountered a Serial Presence Detection (SPD) failure | Major |
| 857C | DIMM_J2 encountered a Serial Presence Detection (SPD) failure | Major |
| 857D | DIMM_J3 encountered a Serial Presence Detection (SPD) failure | Major |
| 857E | DIMM_K1 encountered a Serial Presence Detection (SPD) failure | Major |
| 857F (Go to 85E0) | DIMM_K2 encountered a Serial Presence Detection (SPD) failure | Major |
| 85C0 | DIMM_K3 failed test/initialization | Major |
| 85C1 | DIMM_L1 failed test/initialization | Major |
| 85C2 | DIMM_L2 failed test/initialization | Major |
| 85C3 | DIMM_L3 failed test/initialization | Major |
| 85C4 | DIMM_M1 failed test/initialization | Major |
| 85C5 | DIMM_M2 failed test/initialization | Major |
| 85C6 | DIMM_M3 failed test/initialization | Major |
| 85C7 | DIMM_N1 failed test/initialization | Major |
| 85C8 | DIMM_N2 failed test/initialization | Major |
| 85C9 | DIMM_N3 failed test/initialization | Major |
| 85CA | DIMM_O1 failed test/initialization | Major |
| 85CB | DIMM_O2 failed test/initialization | Major |
| 85CC | DIMM_O3 failed test/initialization | Major |
| 85CD | DIMM_P1 failed test/initialization | Major |
| 85CE | DIMM_P2 failed test/initialization | Major |
| 85CF | DIMM_P3 failed test/initialization | Major |
| 85D0 | DIMM_K3 disabled | Major |
| 85D1 | DIMM_L1 disabled | Major |
| 85D2 | DIMM_L2 disabled | Major |
| 85D3 | DIMM_L3 disabled | Major |
| 85D4 | DIMM_M1 disabled | Major |
| 85D5 | DIMM_M2 disabled | Major |
| 85D6 | DIMM_M3 disabled | Major |
| 85D7 | DIMM_N1 disabled | Major |
| 85D8 | DIMM_N2 disabled | Major |
| 85D9 | DIMM_N3 disabled | Major |
| 85DA | DIMM_O1 disabled | Major |
| 85DB | DIMM_O2 disabled | Major |
| 85DC | DIMM_O3 disabled | Major |
| 85DD | DIMM_P1 disabled | Major |
| 85DE | DIMM_P2 disabled | Major |
| 85DF | DIMM_P3 disabled | Major |
| 85E0 | DIMM_K3 encountered a Serial Presence Detection (SPD) failure | Major |
| 85E1 | DIMM_L1 encountered a Serial Presence Detection (SPD) failure | Major |
| 85E2 | DIMM_L2 encountered a Serial Presence Detection (SPD) failure | Major |
| 85E3 | DIMM_L3 encountered a Serial Presence Detection (SPD) failure | Major |
| 85E4 | DIMM_M1 encountered a Serial Presence Detection (SPD) failure | Major |
| 85E5 | DIMM_M2 encountered a Serial Presence Detection (SPD) failure | Major |
| 85E6 | DIMM_M3 encountered a Serial Presence Detection (SPD) failure | Major |
| 85E7 | DIMM_N1 encountered a Serial Presence Detection (SPD) failure | Major |
| 85E8 | DIMM_N2 encountered a Serial Presence Detection (SPD) failure | Major |
| 85E9 | DIMM_N3 encountered a Serial Presence Detection (SPD) failure | Major |
| 85EA | DIMM_O1 encountered a Serial Presence Detection (SPD) failure | Major |
| 85EB | DIMM_O2 encountered a Serial Presence Detection (SPD) failure | Major |
| 85EC | DIMM_O3 encountered a Serial Presence Detection (SPD) failure | Major |
| 85ED | DIMM_P1 encountered a Serial Presence Detection (SPD) failure | Major |
| 85EE | DIMM_P2 encountered a Serial Presence Detection (SPD) failure | Major |
| 85EF | DIMM_P3 encountered a Serial Presence Detection (SPD) failure | Major |
| 8604 | POST Reclaim of non-critical NVRAM variables | Minor |
| 8605 | BIOS Settings are corrupted | Major |
| 8606 | NVRAM variable space was corrupted and has been reinitialized | Major |
| 92A3 | Serial port component was not detected | Major |
| 92A9 | Serial port component encountered a resource conflict error | Major |

| Error Code | Error Message | Response |
|------------|------------------------------------------------------------------------------------|----------|
| A000 | TPM device not detected. | Minor |
| A001 | TPM device missing or not responding. | Minor |
| A002 | TPM device failure. | Minor |
| A003 | TPM device failed self test. | Minor |
| A100 | BIOS ACM Error | Major |
| A421 | PCI component encountered a SERR error | Fatal |
| A5A0 | PCI Express component encountered a PERR error | Minor |
| A5A1 | PCI Express component encountered an SERR error | Fatal |
| A6A0 | DXE Boot Service driver: Not enough memory available to shadow a Legacy Option ROM | Minor |

POST Error Beep Codes

The following table lists the POST error beep codes. Prior to system video initialization, the BIOS uses these beep codes to inform users on error conditions. The beep code is followed by a user-visible code on the POST Progress LEDs

Table 38. POST Error Beep Codes

| Beeps | Error Message | POST Progress Code | Description |
|--------|-------------------------------|----------------------|------------------------------------------------------------------------------------------------------------------------------|
| 1 | USB device action | NA | Short beep sounded whenever a USB device is discovered in POST, or inserted or removed during runtime |
| 1 long | Intel® TXT security violation | 0xAE, 0xAF | System halted because Intel® Trusted Execution Technology detected a potential violation of system security. |
| 3 | Memory error | See Tables 28 and 29 | System halted because a fatal error related to the memory was detected. |
| 2 | BIOS Recovery started | NA | Recovery boot has been initiated |
| 4 | BIOS Recovery failure | NA | BIOS recovery has failed. This typically happens so quickly after recovery us initiated that it sounds like a 2-4 beep code. |

The Integrated BMC may generate beep codes upon detection of failure conditions. Beep codes are sounded each time the problem is discovered, such as on each power-up attempt, but are not sounded continuously. Codes that are common across all Intel server boards and systems that use same generation chipset are listed in the following table. Each digit in the code is represented by a sequence of beeps whose count is equal to the digit.

Table 39. Integrated BMC Beep Codes

| Code | Reason for Beep | Associated Sensors |
|---------|-----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1-5-2-1 | No CPUs installed or first CPU socket is empty. | CPU1 socket is empty, or sockets are populated incorrectly CPU1 must be populated before CPU2. |
| 1-5-2-4 | MSID Mismatch | MSID mismatch occurs if a processor is installed into a system board that has incompatible power capabilities. |
| 1-5-4-2 | Power fault | DC power unexpectedly lost (power good dropout) – Power unit sensors report power unit failure offset |
| 1-5-4-4 | Power control fault (power good assertion timeout). | Power good assertion timeout – Power unit sensors report soft power control failure offset |
| 1-5-1-2 | VR Watchdog Timer sensor assertion | VR controller DC power on sequence was not completed in time. |
| 1-5-1-4 | Power Supply Status | The system does not power on or unexpectedly powers off and a Power Supply Unit (PSU) is present that is an incompatible model with one or more other PSUs in the system. |

Appendix D: System Configuration Table for Thermal Compatibility

The following list reflects specified notes identified in the “**Support Notes**” column in the table. Each note reflects support criteria associated with a specific system configuration. Notes that may not be specified in the table may reflect support criteria for a R1000BB Base System SKU described in the appropriate 1U Technical Product Specification.

Table Notes:

1. The 25°C configuration alone is limited to elevations of 900m or less
2. Use of the designated PCI slot is limited to add-in cards that have air flow requirements of 100 LFM or less. See add-in card specs for air flow requirements.
3. Fan redundancy is not supported in base system SKUs R2312BBxxxx and R2224BBxxxx, when any of the following IO modules are installed: AXX10GBTWLIOM , AXX2FDRIBIOM, AXX1FDRIBIOM
4. Processor and Memory throttling may occur with a system fan failure, impacting system performance.
 - For base system SKUs R2312BBxxxx and R2224BBxxxx, installing the following processors may have some performance impact under A4: EN 95W-6C/8C, EN 80W-4C, EN 70W-8C
5. Specifically for A3/A4 individual Power Supply selection power margin is required to meet thermal specifications:
 - a) For dual power supply configuration, the power budget must fit within a single power supply rated load
 - b) For single power supply configuration, the power budget must be sized with 30% margin to single power supply rated load.
6. Intel® Xeon Phi™ or Non-Intel GPGPU cards may have performance impact during ambient excursions
7. When identifying memory in the table, only Rank and Width are required. Capacity is not required.
8. LV refers to low voltage DIMMs (1.35V)
9. Installation of the AXCRMFBU2 in a 2U system will also require the installation of Intel mounting bracket A2UBKTMFBUSSD. The Cache offload Module can only be installed with 95W processors and DRx8 or equivalent memory.
10. Confirm the case temperature specification for the SSD to make appropriate selection
11. Fan fail of dual-rotor fans refers to one rotor fail. “Fan Fail Support” indicates if fan fail can be supported with specified configuration in each column.

Intel® Server System R2000BB Product Family TPS

| | | Base System SKUs: R2312BBxxxx R2224BBxxxx | | | | | Base System SKUs: R2216BBxxxx | | | | | Base System SKUs: R2308BBxxxx | | | | | Base System SKUs: R2208BBxxxx | | | | | Notes |
|-----------------------------------------------|-----------------------------------------------------|-------------------------------------------------|----------|----------|----------|----------|----------------------------------|----------|----------|----------|----------|----------------------------------|----------|----------|----------|----------|----------------------------------|----------|----------|----------|----------|-------------|
| ASHRAE | Classifications | 25° C | A2 | A2 | A3 | A4 | 25° C | A2 | A2 | A3 | A4 | 25° C | A2 | A2 | A3 | A4 | 25° C | A2 | A2 | A3 | A4 | |
| | Max Ambient | 25° C | 35° C | 35° C | 40° C | 45° C | 25° C | 35° C | 35° C | 40° C | 45° C | 25° C | 35° C | 35° C | 40° C | 45° C | 25° C | 35° C | 35° C | 40° C | 45° C | Note 1 |
| Cooling | Redundant Fan Configuration | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | Note 11 |
| | Fan Redundancy Support | • | | • | | | • | | • | | | • | | • | | | • | | • | | | Note 11 |
| Power Supply | Power Supplies | See Tool | | | | | See Tool | | | | | See Tool | | | | | See Tool | | | | | Note 5 |
| Intel® Xeon® processor E5-2400 product family | EN,80W,4C (E5-2403, E5-2407) | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | Notes 4 |
| | EN,60W,6C (E5-2430L) | • | • | • | • | | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | Notes 4 |
| | EN, 95, 6C (E5-2420, E5-2430, E5-2440) | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | Notes 4 |
| | EN,70W,8C (EN2450L) | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | Notes 4 |
| | EN,95W,8C (EN-2450, EN-2470) | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | Notes 4 |
| Memory Type (See notes 8 and 9) | Dual Rank x8 Normal and LV, Quad Rank x8 LV | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | Notes 7,8 |
| | Dual Rank x4 Normal and LV | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | Notes 7,8 |
| | Quad Rank x8 Normal | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | Notes 7,8 |
| | Quad Rank x4 Normal and LV | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | Notes 7,8 |
| | Load Reduced DIMM | • | • | • | | | • | • | • | | | • | • | • | | | • | • | • | • | | Notes 4,7,8 |
| Add-in Cards (See note 2) | Riser #1 - Bottom Slot (1U riser and 2U riser) | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | |
| | Riser #1 - Middle Slot (2U riser) | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | |
| | Riser #1 - Top Slot (2U riser) | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | |
| | Riser #2 - Bottom Slot (1U riser and 2U riser) | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | Note 2 |
| | Riser #2 - Middle Slot (2U riser) | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | Note 2 |
| | Riser #2 - Top Slot (2U riser) | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | |
| I/O Modules (See note 3) | Intel® Integrated RAID Modules (Mezzanine cards) | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | |
| | AXX10GBTWLIOM - Dual 10GBASE-T IO Module | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | Note 3 |
| | AXX10GBNIAIOM - Dual SFP+ port 10GbE IO Module | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | |
| | AXX1FDRIBIOM - Single Port FDR Infiniband IO Module | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | |
| | AXX2FDRIBIOM - Dual Port FDR Infiniband IO Module | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | Note 3 |
| | AXX4P1GBPWLIOIM - Quad Port 1GbE IO Module | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | |

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| | | Base System SKUs: R2312BBxxxx R2224BBxxxx | | | | | Base System SKUs: R2216BBxxxx | | | | | Base System SKUs: R2308BBxxxx | | | | | Base System SKUs: R2208BBxxxx | | | | | Notes |
|--------------------------------------------------|-------------------------------------------------------------------|-------------------------------------------------|----------|----------|----------|----------|----------------------------------|----------|----------|----------|----------|----------------------------------|----------|----------|----------|----------|----------------------------------|----------|----------|----------|----------|---------------|
| ASHRAE | Classifications | 25° C | A2 | A2 | A3 | A4 | 25° C | A2 | A2 | A3 | A4 | 25° C | A2 | A2 | A3 | A4 | 25° C | A2 | A2 | A3 | A4 | |
| | Max Ambient | 25° C | 35° C | 35° C | 40° C | 45° C | 25° C | 35° C | 35° C | 40° C | 45° C | 25° C | 35° C | 35° C | 40° C | 45° C | 25° C | 35° C | 35° C | 40° C | 45° C | Note 1 |
| Intel® Xeon Phi™ or Non-Intel GPGPU (See note 7) | Intel® Xeon Phi™ or non-Intel GPGPU w/Active cooling: up to 300W | | | | | | • | • | | | | • | • | | | | • | • | | • | | Note 6 |
| | Intel® Xeon Phi™ or non-Intel GPGPU w/Active cooling : up to 225W | | | | | | • | • | | | | • | • | | | | • | • | | • | | Note 6 |
| | Non-Intel GPGPU w/Passive cooling: up to 75W | | | | | | • | • | • | | | • | • | • | | | • | • | • | | | |
| | Intel® Xeon Phi™ or non-Intel GPGPU w/Passive cooling: up to 300W | | | | | | | | | | | | | | | | | | | | | Not supported |
| | Intel® Xeon Phi™ or non-Intel GPGPU w/Passive cooling: up to 245W | | | | | | | | | | | | | | | | | | | | | Not supported |
| | Intel® Xeon Phi™ or non-Intel GPGPU w/Passive cooling: up to 225W | | | | | | | | | | | | | | | | | | | | | Not supported |
| RAID Battery Backup | AXXRSBBU9 (rated to 45°C) | • | • | • | | | • | • | • | | | • | • | • | | | • | • | • | | | |
| | AXXRMFBU2 (rated to 55°C) | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | Note 9 |
| | Cache Offload Module (rated to 55°C) | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | Note 9 |
| Internal SSD | Rated to 60°C | • | • | | | | • | | | | | • | | | | | • | | | | | Note 10 |
| | Rated to 70°C | • | • | • | | | • | • | • | | | • | • | • | | | • | • | • | | | Note 10 |

Glossary

| Word/Acronym | Definition |
|------------------|---------------------------------------------|
| ACA | Australian Communication Authority |
| ANSI | American National Standards Institute |
| BMC | Baseboard Management Controller |
| BIOS | Basic Input/Output System |
| CMOS | Complementary Metal-oxide-semiconductor |
| D2D | DC-to-DC |
| EMP | Emergency Management Port |
| FP | Front Panel |
| FRB | Fault Resilient Boot |
| FRU | Field Replaceable Unit |
| I ² C | Inter-integrated Circuit bus |
| LCD | Liquid Crystal Display |
| LPC | Low-pin Count |
| LSB | Least Significant Bit |
| MSB | Most Significant Bit |
| MTBF | Mean Time Between Failure |
| MTTR | Mean Time to Repair |
| NIC | Network Interface Card |
| NMI | Non-maskable Interrupt |
| OTP | Over-temperature Protection |
| OVP | Over-voltage Protection |
| PCI | Peripheral Component Interconnect |
| PCB | Printed Circuit Board |
| PCIe* | Peripheral Component Interconnect Express* |
| PCI-X | Peripheral Component Interconnect Extended |
| PFC | Power Factor Correction |
| POST | Power-on Self Test |
| PSU | Power Supply Unit |
| RAM | Random Access Memory |
| RI | Ring Indicate |
| SCA | Single Connector Attachment |
| SDR | Sensor Data Record |
| SE | Single-Ended |
| THD | Total Harmonic Distortion |
| UART | Universal Asynchronous Receiver Transmitter |
| USB | Universal Serial Bus |
| VCCI | Voluntary Control Council for Interference |
| VSB | Voltage Standby |

Reference Documents

See the following documents for additional information:

- *Intel® Server Board S2400BB Technical Product Specification*
- *Intel® Server Board S2400BB Product Family Spares/Parts List and Configuration Guide*
- *Intel® Server System R2000BB Service Guide*
- *Intel® Server System R2000BB Quick Installation Guide*
- *Intel® S2400BB Product Family Power Budget and Thermal Configuration Tool*
- *BIOS for EPSD Platforms Based on Intel® Xeon Processor E5-4600/2600/2400/1600 Product Families External Product Specification*
- *EPSD Platforms Based On Intel Xeon® Processor E5 4600/2600/2400/1600 Product Families BMC Core Firmware External Product Specification*
- *Intel® RAID Expander Card RES2SV240 Hardware Users Guide*
- *Intel® Remote Management Module 4 Technical Product Specification*
- *Intel® Remote Management Module 4 and Integrated BMC Web Console Users Guide*
- *Intel® Server Board S2400BB, Intel® Server System R1000BB, Intel® Server System R2000BB Monthly Specification Update*
- *Intel Integrated RAID Module RMS25PB040, RMS25PB080, RMS25CB040, and RMS25CB080 Hardware / Installation Users Guide*
- *Intel® Raid Maintenance Free Backup Unit AXRMFBU2 User's Guide*
- *Intel® Local Control Panel for EPSD Platforms Based on Intel® Xeon® Processor E5 4600/2600/2400/1600/1400 Product Families Technical Product Specification. (Intel document order number G83726-001)*