Enterprise Electronics Bay Specification for 2011 Dual-Socket Servers and Workstations

Version 1.0.1

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Revision History

Revision Number	Description	Revision Date
1.0	Release	Feb, 2010
1.0.1	Updated Terms and Conditions for general public availability	April 2012

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1 Introduction

The *Enterprise Electronics Bay Specification* (EEB) evolved from the *ATX Specification* and was created to address the following major areas:

- Support for dual processor solutions and for current and future processor, chipset, and memory technologies
- Defined power connectors optimized for higher power and standardized between the Electronics Bay and compliant power supplies
- Defined volume restrictions and airflow strategies that simplify chassis design, eliminate interference problems, and help ensure proper cooling
- Enhanced board and chassis interchangeability for reduced time-to-market
- Reduced material, manufacturing, and development costs
- Flexibility to allow adopters to differentiate and add value

The *Enterprise Electronics Bay* Specification (EEB) defines a baseboard form factor and system interfaces for the design of servers and workstations.

This specification also includes special considerations for rack implementations, a sub-set known as *Thin Electronics Bay* (TEB). TEB leverages the majority of the EEB specification requirements and adds some additional constraints due to reduced system heights inherent in rack chassis.

This specification also includes special considerations for small-form-factor dual-processor implementations, a sub-set known as *Compact Electronics Bay* (CEB). CEB leverages the majority of the EEB specification requirements with a reduced baseboard depth.

1.1 Scope

For clarity, this version of the *Enterprise Electronics Bay Specification* is limited to the 2011 Intel® Xeon™ dual-socket platforms. Please refer to previous versions for information on earlier platforms.

1.2 New for 2011

This release of the Enterprise Electronics Bay Specification introduces several new mounting locations to provide board designers with greater flexibility in platform configuration and feature set.

1.3 Nomenclature

To provide a common orientation and vocabulary, Figure 1 provides the naming convention that is used throughout this specification. This orientation envisions the baseboard horizontal as if on a work surface with the baseboard I/O connectors facing away. For pedestal servers, the board is divided into two sides: core side, where processors and memory are typically located, and card side, where the add-in cards are located. Add-in card slot numbering is provided as a common reference between board and chassis. Processor designation and memory connector numbering is left to the board designer.

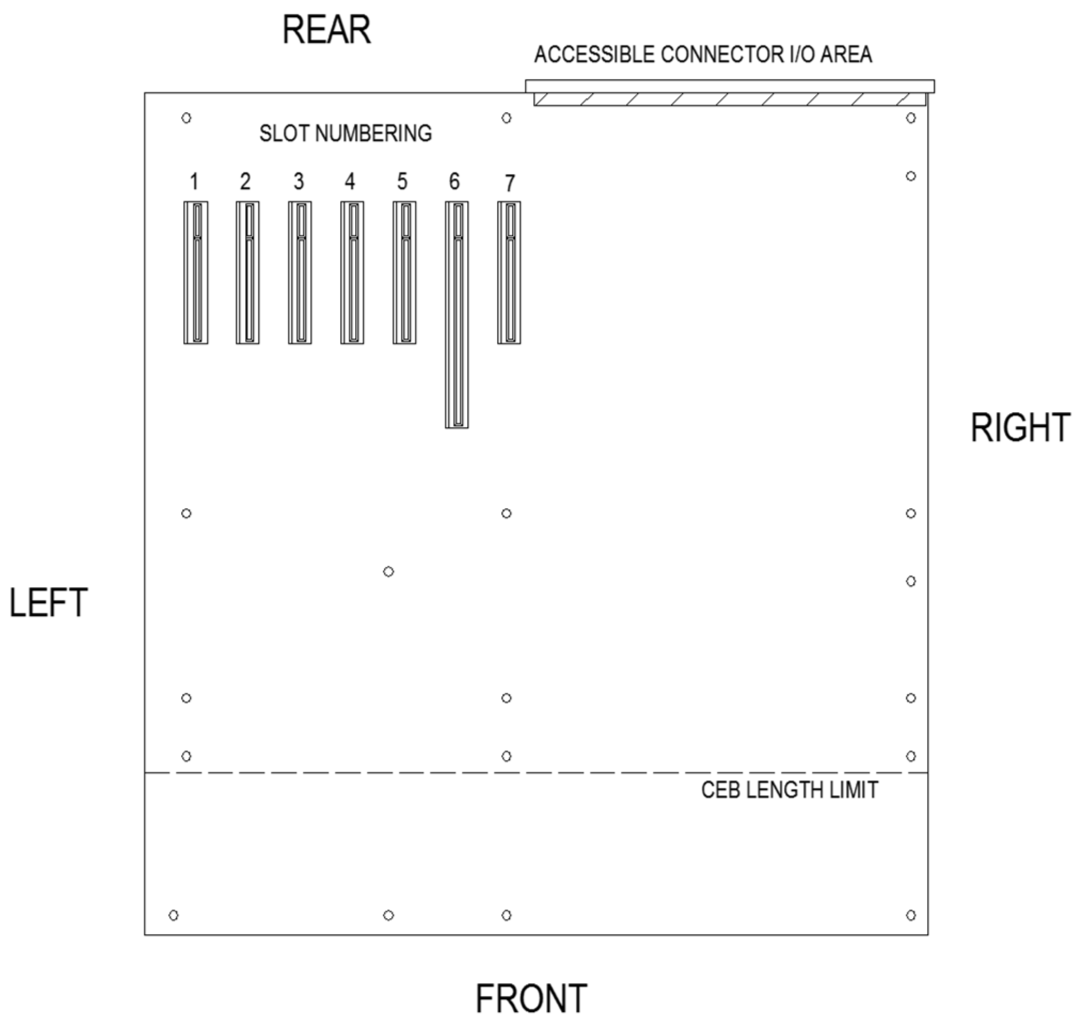


Figure 1: Board Orientation and Nomenclature

1.4 Drawing Note

All figures are in millimeters [inches] unless otherwise specified. Figures are not to scale

1.5 Definitions / Terms / Acronyms

Table 1: Definitions, Terms, and Acronyms

ATX	Baseboard form factor measuring 305mm x 244mm [12” × 9.6”] (www.formfactors.org)
EEB	Enterprise Electronics Bay; this specification (www.ssiforum.org)
Electronics Bay	Chassis volume and mechanical interface required to support a standard baseboard unit containing the processor, chipset, graphics, graphics controller, and memory
EN	Entry market segment
EMC	Electromagnetic Interference Compatibility
EMI	Electromagnetic Interference
EP	Efficient Performance market segment
EPS*, ERP*	SSI power supply form factors (www.ssiforum.org)
IPMI	Intelligent Platform Management Interface (developer.intel.com/design/servers/ipmi/)
PCI Express	Electrical interface and add-in card form factor specification (www.pcisig.org)
PSU	Power Supply Unit
SATA	Serial ATA (www.serialata.com)
SMBus	System Management Bus
SSI	Server System Infrastructure (www.ssiforum.org)
TEB	Thin Electronics Bay; rack version of this specification (www.ssiforum.org)
U	A server rack unit of measure equal to 44.45 mm [1.750”]
USB	Universal Serial Bus (www.usb.org)

1.6 Additional Information

Other SSI specifications, integration checklists, product postings, reference gauges, and promoter companies can be found on the SSI website at: www.ssiforum.org

For detailed information on Intel processors and chipsets: developer.intel.com

This specification references connectors from the following suppliers:

- AMP (Tyco Electronics): www.tycoelectronics.com
- FCI: www.fci.com
- Foxconn: www.foxconn.com
- Molex: www.molex.com
- Lotes: www.lotes.cc

2 Baseboard Requirements

This section is directed primarily at baseboard and board-set developers, but may also prove interesting to chassis developers and system integrators. This section describes the requirements and constraints of the baseboard (also known as a motherboard).

2.1 Layout and Baseboard Mounting Locations

REQUIRED: ALL

The baseboard is based on the ATX form factor 'stretched' to 305mm x 330mm [12" X 13"], a size sometimes known as "extended ATX" or "full ATX". This represents the maximum size of the baseboard, though smaller sizes (including notched-out areas) are possible. The baseboard datum is the same mounting hole referenced in the *ATX Specification* Version 2.2, located in the rear-left corner of the board. Mounting location designation is also common between the specifications where applicable.

Figure 2 provides the maximum board outline and available mounting locations and represents add-in card connectors evenly spaced at a 20.32mm [0.800"] pitch. Pin-1 dimensions for PCI Express connectors are provided. The slot 7 connector is not generally available on two socket baseboards and is shown as a phantom outline. The connector layout shown is an example only.

Figure 2 illustrates a larger connector in the slot 6 location. This is the riser location for TEB baseboards, supporting horizontal full-height add-in cards extending to the left on the riser. The centerline dimension to this connector is provided, though details on the connector type and pin-out are left to the baseboard design; the riser is the responsibility of the baseboard vendor.

Figure 2 also illustrates a smaller board depth utilized for small form factor products known as CEB. This 305mm x 266.7mm [12" X 10.5"] board size is targeted for value segments leveraging desktop chassis solutions and shorter-depth rack implementations.

Figure 2 highlights a clearance area along the front edge of a full-sized board. Particularly dense baseboards may be forced to place DIMM connectors at the very edge of the baseboard. The latches of these connectors may open beyond the footprint of the baseboard. Board designers should be aware that this allowance exists, and chassis designers should accommodate the restriction, which may also be used for board insertion/extraction clearance.

In addition to legacy mounting locations, this specification defines additional mounting locations as alternatives when legacy holes cannot be utilized due to placement or routing constraints. Each alternate location is designed as a prime of the legacy location: for instance, **F'** is the alternate location when **F** cannot be utilized. In some designs, neither the legacy location nor its alternate may be implemented

NOTE

The compliant baseboard is ***not*** *required to utilize* ***all*** *of the mounting locations but cannot add any holes not specifically noted. Mounting locations that are not utilized will be unpopulated in the chassis – no special restrictions are required for the board in these unused locations.*

For rack-mounted designs, difficulty in implementing removable stand-offs in the chassis requires some level of communication between the board and chassis developer regarding which mounting locations will be utilized. This interaction is necessary to maintain mounting flexibility in product design.

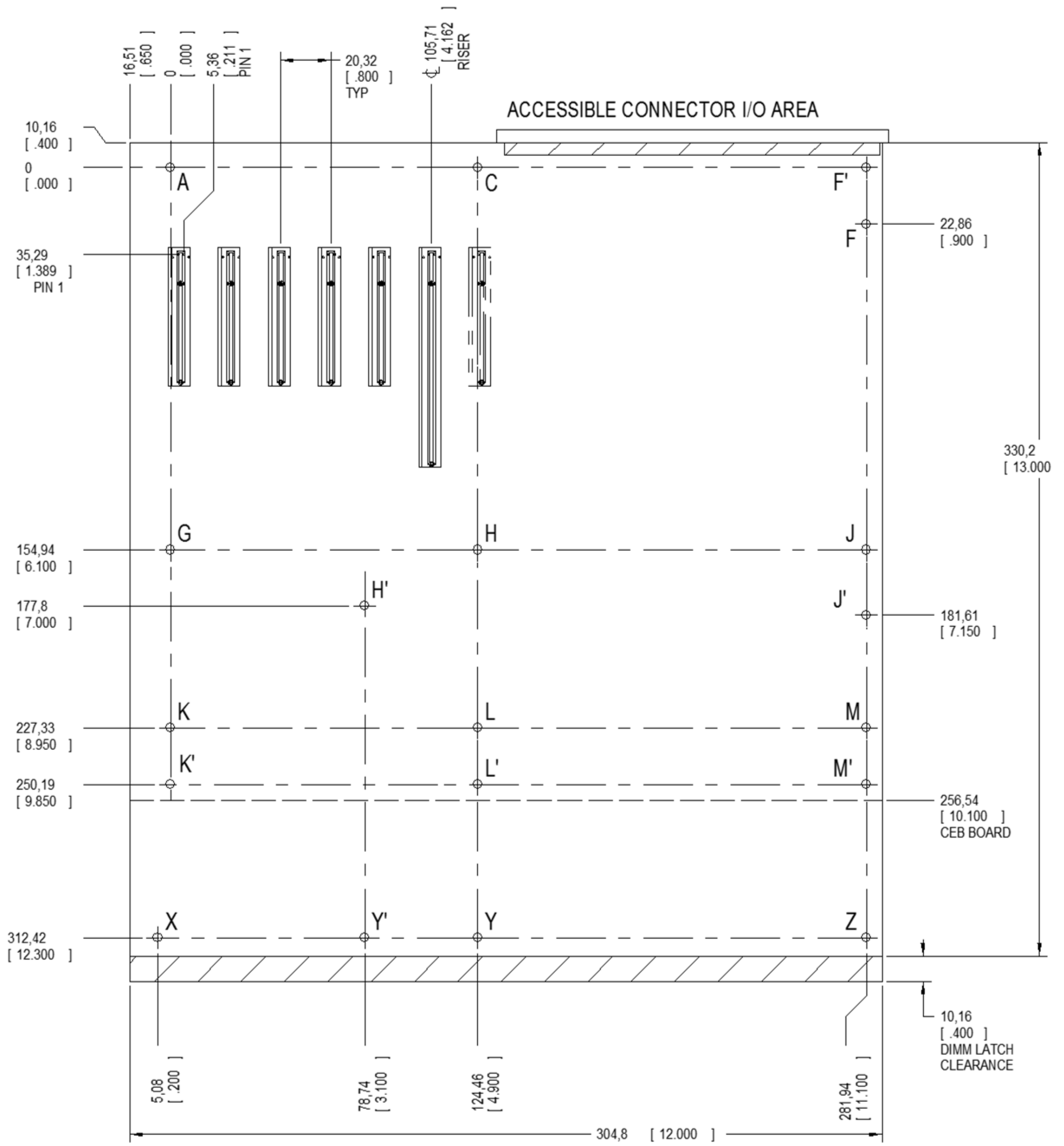


Figure 2: Available Baseboard Mounting Locations

2.2 Component Height Constraints

REQUIRED: EEB / CEB

The *Enterprise Electronics Bay Specification* makes allowance for three different configurations for EEB and CEB board designs:

- Case 1 represents the common pedestal implementation of standard core components with discrete memory and full-height add-in cards
- Case 2 represents the 2U-capable implementation of standard core components with discrete memory and low-profile add-in cards
- Case 3 represents a maximum high-end implementation which may include non-standard core components, memory risers, and custom add-in cards

Case 1 & 2 utilize a common board volumetric and accommodate most monoplanar baseboards; they differ only in the type of add-in cards that are installed at the system level. Case 3 utilizes a much larger board volumetric to accommodate multi-board sets that implement memory on tall riser cards and baseboards with unusually tall components.

Figure 3 and the accompanying Table 2 dimension the maximum heights available for baseboard components – this includes processors, memory and memory riser cards, voltage regulators, and connectors. The defined volume does not contain mating connectors and cables or expansion cards.

The heights provided are from the top of the baseboard. A baseboard thickness of 1.57mm [0.062”] nominal is highly recommended to ensure baseboard features mate properly to corresponding chassis features. A secondary-side clearance of 3.00mm [0.118”] is available for leads and backside components.

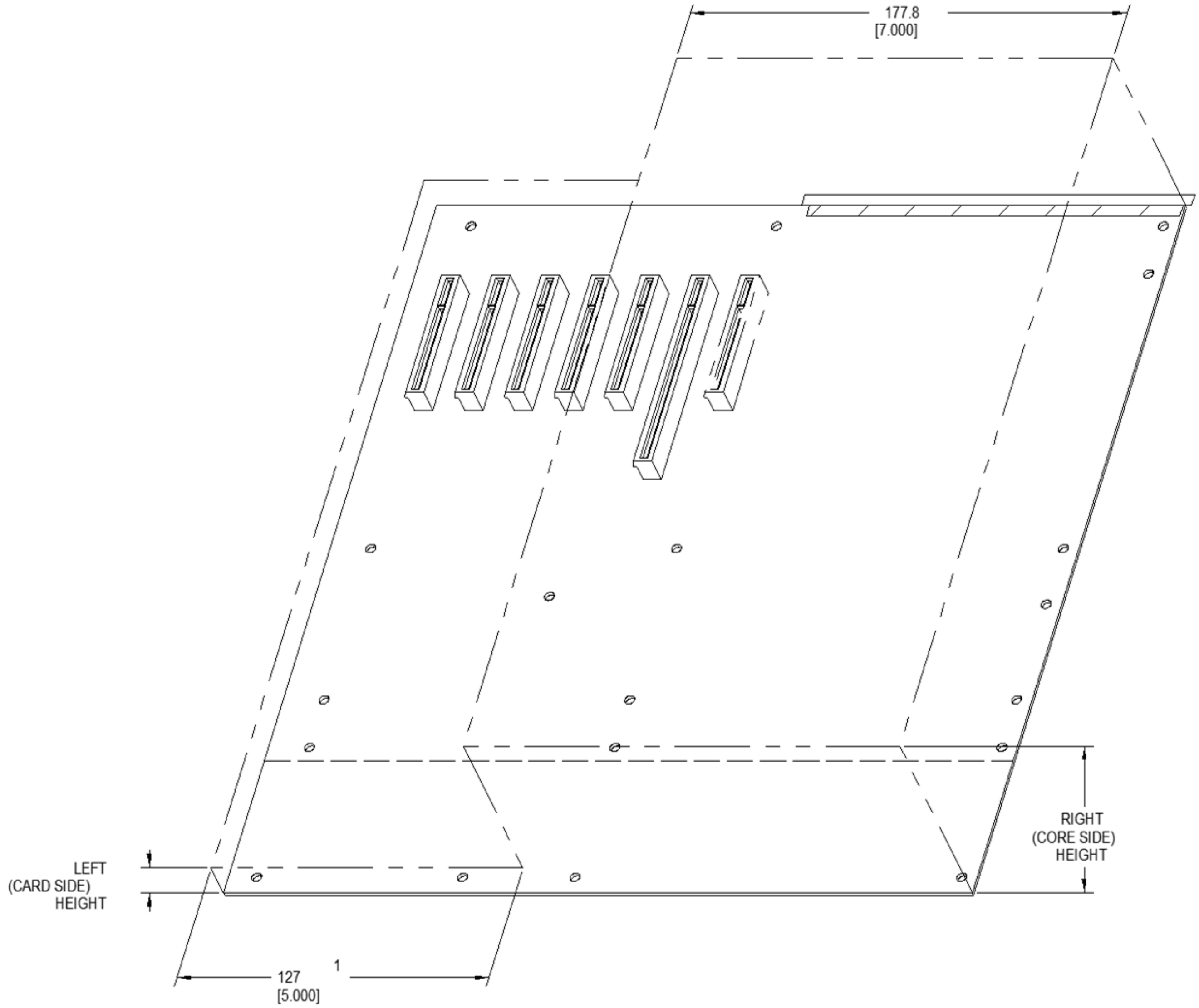


Figure 3: Baseboard Maximum Component Height

Figure Note:

[1] This dimension assumes support for six add-in cards. Boards with fewer or more cards may reduce or increase this dimension accordingly at a 20.32mm [0.800"] increment, to a maximum of seven cards. This allows an increase in core area when fewer cards are supported and vice-versa.

Table 2: Baseboard Maximum Component Height Restrictions

Board Type	Left (Card) Side	Right (Core) Side	Typical Usage
Case 1 & 2	15.24 [0.600"]	76.2 [3.000"]	Single (monoplanar) boards
Case 3	15.24 [0.600"]	152.4 [6.000"]	Memory Riser Card(s), custom expansion boards

2.2.1 Rack Height Constraints

REQUIRED: TEB

Rack products require a modified board volumetric to support 1U and 2U systems. The volumetric is extended to include add-in cards implemented via a slot 6 riser. Design of the riser card is the responsibility of the board vendor; riser mechanical details may be found in Section 2.4. Boards targeted for 2U systems with direct-attach low-profile cards are defined as EEB Case 2 in Table 2

Figure 4 and the accompanying Table 3 provide the heights that must fully contain all board-set components – this includes the baseboard components described above as well as the I/O riser and add-in cards. The volume defined does not contain mating connectors and cables.

The heights provided are from the top of the baseboard. A baseboard thickness of 1.57mm [0.062”] nominal is highly recommended to ensure baseboard features mate properly to corresponding chassis features. A secondary-side clearance of 3.00mm [0.118”] is available for leads and backside components.

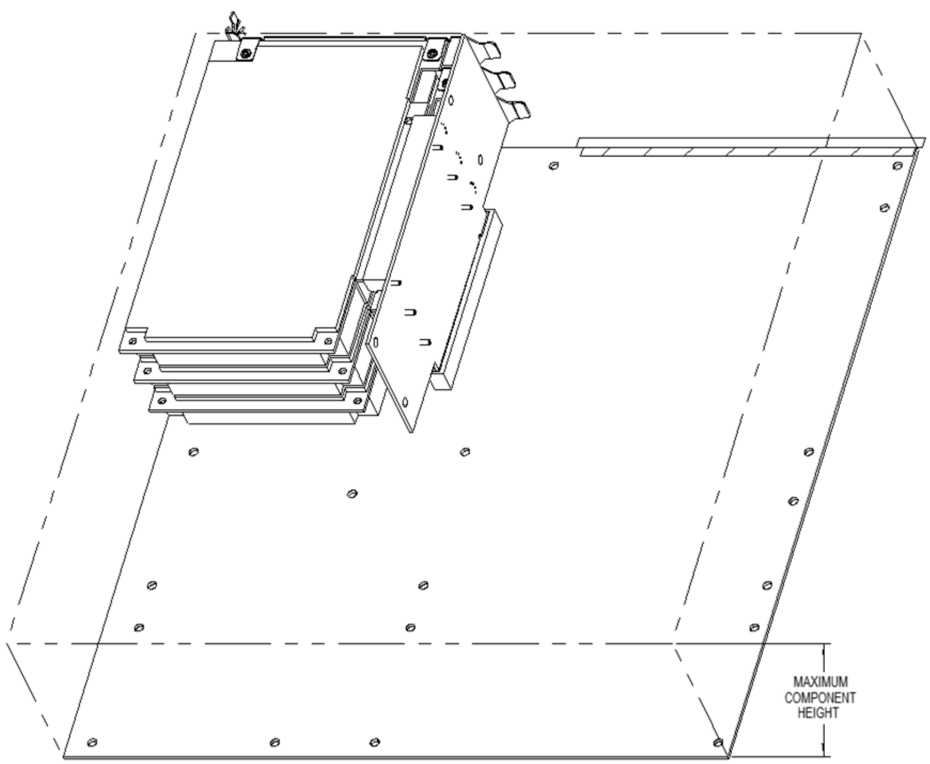


Figure 4: Rack Board-Set Component Height

Table 3: Rack Board-set Maximum Component Height Restrictions

Board Type	Max Height
TEB 1U	36 [1.417”]
TEB 2U	77 [3.030”]

2.3 Baseboard Connectors

The following sections provide definition, pin-out, and location information for most baseboard connectors. Compliance status is provided for each connector. All connector pin-outs are from a top or overhead view.

2.3.1 Power Delivery

The power connectors required for compliance to the *Enterprise Electronics Bay* Specification are illustrated below. An optional signal connector provides SMBus management features to the power supply. An optional 2x2 power connector provides additional +12V power to the baseboard or an auxiliary board if required.

To meet 240VA electrical hazard limit requirements, separate power rails must be used for each twelve-volt rail (+12V1, +12V2, etc). Systems that do not have a 240VA requirement may combine any or all of the 12V power rails.

5VSB is designated as standby voltage and is present whenever AC power is present

Additional information and signal definitions may be found in the latest *SSI Power Supply Design Guide (PSDG).*

2.3.1.1 Baseboard Main Power Connector

REQUIRED: ALL

24-pin Molex 44472 family or equivalent

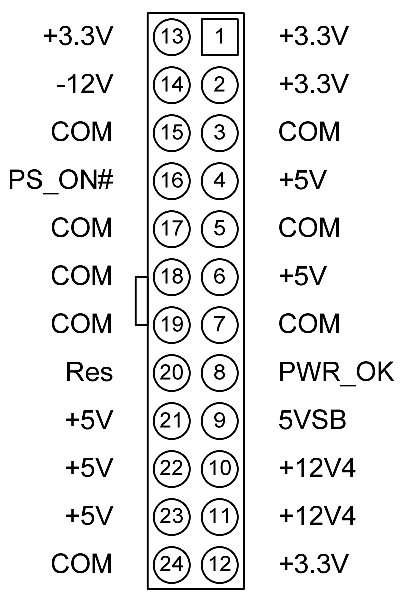


Figure 5: P1 Baseboard Power Connector

2.3.1.2 Processor Power Connectors

REQUIRED: ALL

8-pin Molex 44472 family or equivalent

Figure 6: Processor Power Connectors

2.3.1.3 Server Signal Connector

OPTIONAL: ALL

5-pin Molex 70545 or equivalent

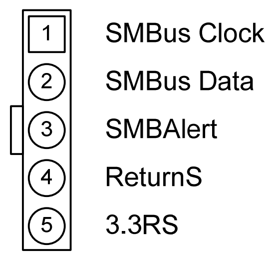


Figure 7: Server Signal Connector

2.3.1.4 +12V Baseboard Power Connector

OPTIONAL: ALL

4-pin Molex 39-29-9042 or equivalent

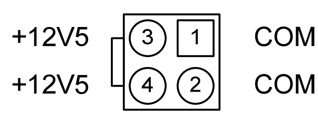


Figure 8: +12V Baseboard Power Connector

2.3.1.5 PS_ON#

PS_ON# is an active-low signal that turns on all the main power rails including +3.3V, +5V, +12V, and –12V power rails. When this signal is held high by the baseboard or left open circuited, outputs of the power rails (except 5VSB) should not deliver current and should be held at a zero potential with respect to ground. The recommended implementation is a 22KΩ pull-up resister to 5VSB. Power should be delivered to the rails only if the PS_ON# signal is held at ground potential. Details are provided in the latest *SSI Power Supply Design Guide.*

2.3.1.6 PWR_OK

PWR_OK is a power good signal and should be asserted high by the power supply to indicate that the +3.3V and +5V outputs are above the undervoltage thresholds of the power supply. When this signal is asserted high, there should be sufficient energy stored by the converter to guarantee continuous power operation within specification. Conversely, when the output voltages fall below the undervoltage threshold, or when mains power has been removed for a time sufficiently long so that power supply operation is no longer guaranteed, PWR_OK should be de-asserted to a low state. The recommended electrical and timing characteristics of the PWR_OK signal are provided in the latest *SSI Power Supply Design Guide.*

Motherboards should be designed so the signal timings recommended in the *SSI Power Supply Design Guide* are used. Using these recommendations will help drive the industry to an acceptable standard.

2.3.1.7 SMBus Communication (Clock, Data, SMBAlert#)

The series bus to the power supply for FRU and PMBus information shall be compatible with the SMBus 2.0 high power DC specification. The clock, data and SMBAlert# lines shall operate at 3.3V with pull-up resistors on the motherboard. Refer to the SMBus 2.0 High-Power DC specification for details.

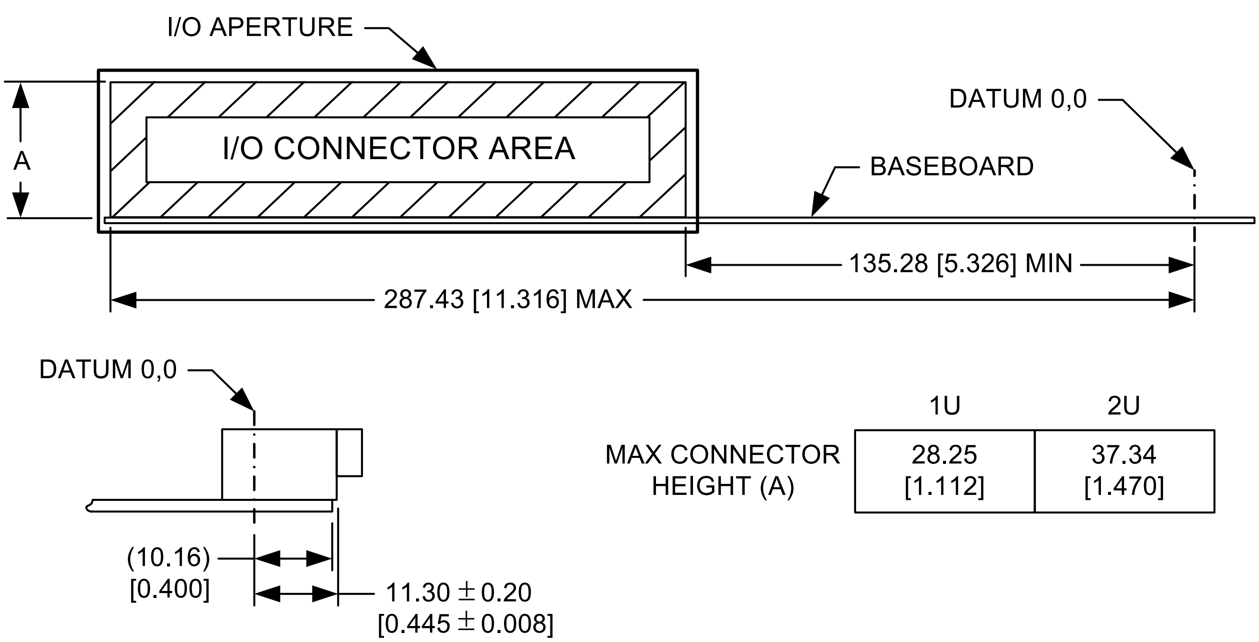
2.3.1.8 Remote Sense

The power supply may have remote sense for the +3.3V (3.3RS) and return (ReturnS) if the Optional Server Signal Connector is implemented. The remote sense return (ReturnS) is used to regulate out ground drops for all output voltages. The 3.3V remote sense (3.3RS) is used to regulate out drops in the system for the +3.3V output.

2.3.2 Rear Panel I/O

REQUIRED: ALL

The *Enterprise Electronics Bay* specification provides a rear panel aperture to accommodate board-mounted I/O connectors such as serial, LAN, or integrated video. The aperture is identical to the *ATX Specification* for pedestal and 2U chassis, while the 1U aperture is reduced to accommodate the shorter chassis. Figure 9 details the I/O connector area, which is slightly smaller than the I/O aperture; this is to ensure clearance for the I/O shield. Values for 1U and 2U/pedestal maximum connector heights are provided. All baseboard I/O connectors faces should be placed 11.30mm [0.445”] from the reference datum. Individual connector positioning within the I/O connector area is left to the baseboard designer.



	1U	2U
MAX CONNECTOR HEIGHT (A)	28.25 [1.112]	37.34 [1.470]

Figure 9: Baseboard I/O Connector Area

2.3.3 Front Panel I/O

RECOMMENDED: ALL

The front panel provides mounting and electrical connection for switches and indicators that are accessible from the chassis front; these may be individual components or integrated onto a system board. Figure 10 provides the recommended front panel features for a server or workstation. Additional features may be appended to the end of this connector.

The baseboard connector should not be shrouded or polarized.

24-pin Foxconn HC1912G-D5 or equivalent

Power LED Anode	1	2	Front Panel Power
Key	3	4	System ID LED Anode
Power LED Cathode	5	6	System ID LED Cathode
HDD Activity LED Anode	7	8	System Fault LED1 Cathode
HDD Activity LED Cathode	9	10	System Fault LED2 Cathode
Power Switch	11	12	NIC#1 Activity LED Anode
Power Switch (GND)	13	14	NIC#1 Activity LED Cathode
Reset Switch	15	16	SMBus SDA
Reset Switch (GND)	17	18	SMBus SCL
System ID Switch	19	20	Chassis Intrusion
1-wire Temp Sensor	21	22	NIC#2 Activity LED Anode
NMI to CPU Switch	23	24	NIC#2 Activity LED Cathode

Figure 10: Standard Front Panel Connector

Figure Notes:

- All signals are implemented as “Low-True” logic
- Power to LEDs *except fault* can be sourced from +3.3, +5, or 5VSB; a current-limiting resister should be implemented on the baseboard to adjust LED power to maintain consistent illumination across all LEDs
- System Fault LEDs shall be sourced from Front Panel Power, pulled up by a 50-ohm current limiting resistor
- Front Panel switches should utilize low true signals that are activated when a momentary switch applies ground
- SMBus must use Front Panel Power signaling level; there should be no SMBus pull-ups on the front panel

2.3.4 Front Panel USB

RECOMMENDED: ALL

The USB 2.0 front panel connector can support multiple USB ports (USBFP_0,1…USBFP_N) that can be routed via cable to the front panel. Each 2 x 5 header supports two ports. For an odd number of ports, the lower numbered or even port should be enabled (Port 0, 2, 4, etc). In the physical layout where a dual-stack USB connector is used, arranging the ports such that the lower connector is the first port to be enabled allows for a single-port, single-connector implementation without modifying the electrical design.

10-pin AMP 147471-1 or equivalent

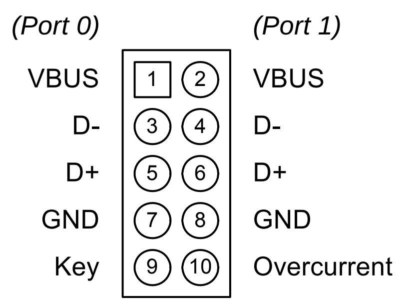


Figure 11: Front Panel USB Connector

2.3.5 Cooling Fan Pin-out

REQUIRED: ALL

Figure 12 depicts the standard 4-wire cooling fan connector pin-out. The connector is keyed to prevent damage to the baseboard and fan due to misalignment during insertion. Fans are 12V nominally rated with fan speed modulated by the control signal. The Sense signal is a fan tachometer output signal with two pulses per revolution. The Control signal is a 25kHz Pulse Width Modulated (PWM) signal from the baseboard control circuitry.

The 4-wire fan is forward and backward compatible to the 3-wire fan with possible reduced functionality.

4-pin Molex 47053-1000 or equivalent

Figure 12: Cooling Fan Connector

Additional information on 4-wire fan implementation details and PWM control circuitry requirements can be found at http://www.formfactors.org/developer/specs/4_Wire_PWM_Spec.pdf.

2.3.5.1 Hot-Plug Cooling Fan Pin-out

OPTIONAL: ALL

Figure 13 depicts the standard 6-wire cooling fan connector pin-out for hot-plug applications. The connector is keyed to prevent damage to the baseboard and fan due to misalignment during insertion. This connector typically interfaces to a chassis fan module to support hot-plug fan implementations. The first four pins are identical to the 4-wire fan above. The Presence pin is used by the system to determine a fan service event. The LED pin is used by the system to light an indicator on the fan for service identification.

The 6-wire fan is forward and backward compatible to both the 4-wire and 3-wire fan, though some functionality is lost.

6-pin Lotes YBA-WAF-016-006 or equivalent

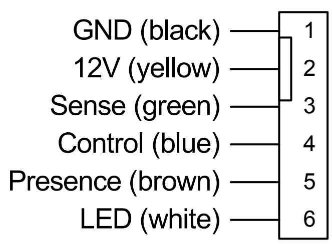


Figure 13: 6-Pin Cooling Fan Connector

2.3.5.2 Cooling Fan Connector Locations

RECOMMENDED: ALL

It is recommended that baseboard designs targeted for pedestal chassis make provisions for at least five fan connectors:

- One connector adjacent to each processor
- One connector towards the rear of the board
- Two connectors towards the front of the board

Boards targeted for rack-optimized chassis may require three additional fan headers along the front of the board, as these systems generally have a bank of smaller fans to provide the required airflow.

2.3.6 Chassis Intrusion Connector

RECOMMENDED: ALL

Figure 14 shows the standard chassis intrusion connector pin-out. The chassis intrusion switch type is Normal Open, that is, held in the closed position when the door being monitored is closed. Chassis intrusion may use a number of switches connected in series so that any switch becoming open is detected as a chassis intrusion; one end of the series chain is grounded and the other end is pulled up to standby voltage and monitored by the baseboard management controller. A chassis intrusion can be detected when the system has been shut down but AC power is still available.

2-pin Foxconn HF06021-P1 or equivalent

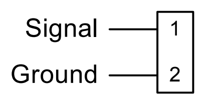


Figure 14: Chassis Intrusion Connector

2.3.7 Connector Placement

RECOMMENDED: ALL

Table 4 lists recommended connector locations. The exact connector location is left to the judgment of the baseboard designer and the system integrator.

Refer to Figure 1 for orientation.

Table 4: Connector Locations

Connector Type	**Recommended Location**
Main Power connector	Left edge of the baseboard
Processor Power connectors	Adjacent to the Processor VR
Fan connectors	See Section 2.3.5
Memory riser connector	Card slot 6 or slot 7
Front Panel I/O connector	Front of the baseboard
Front Panel USB connector(s)	Left edge of the baseboard
Chassis Intrusion Connector	Left rear edge of the baseboard
SATA Connector(s)	Left edge of the baseboard
SAS Connector(s)	Left edge of the baseboard

2.4 Riser Card Mechanicals

RECOMMENDED: TEB

To support add-in cards in 1U systems and to support full height add-in cards in 2U systems, cards must be supported parallel to the baseboard and connected via a riser card. In order to interface with chassis, the card location is fixed by this specification and the riser mechanical constraints are defined in Figure 15. The riser has been defined to provide component keep-out clearance between the horizontal add-in card on the riser and unpopulated add-in card connectors on the baseboard – this enables the design of dual-purpose boards that support both standard pedestal system configurations and high-density rack-optimized 1U and 2U system configurations.

Only the riser mechanical requirements are defined by this specification. The electrical interface and baseboard connector definition is left to the board designer to meet individual platform requirements and enable innovation. The riser is therefore the responsibility of the board designer, while this specification ensures the riser is accommodated in compliant chassis.

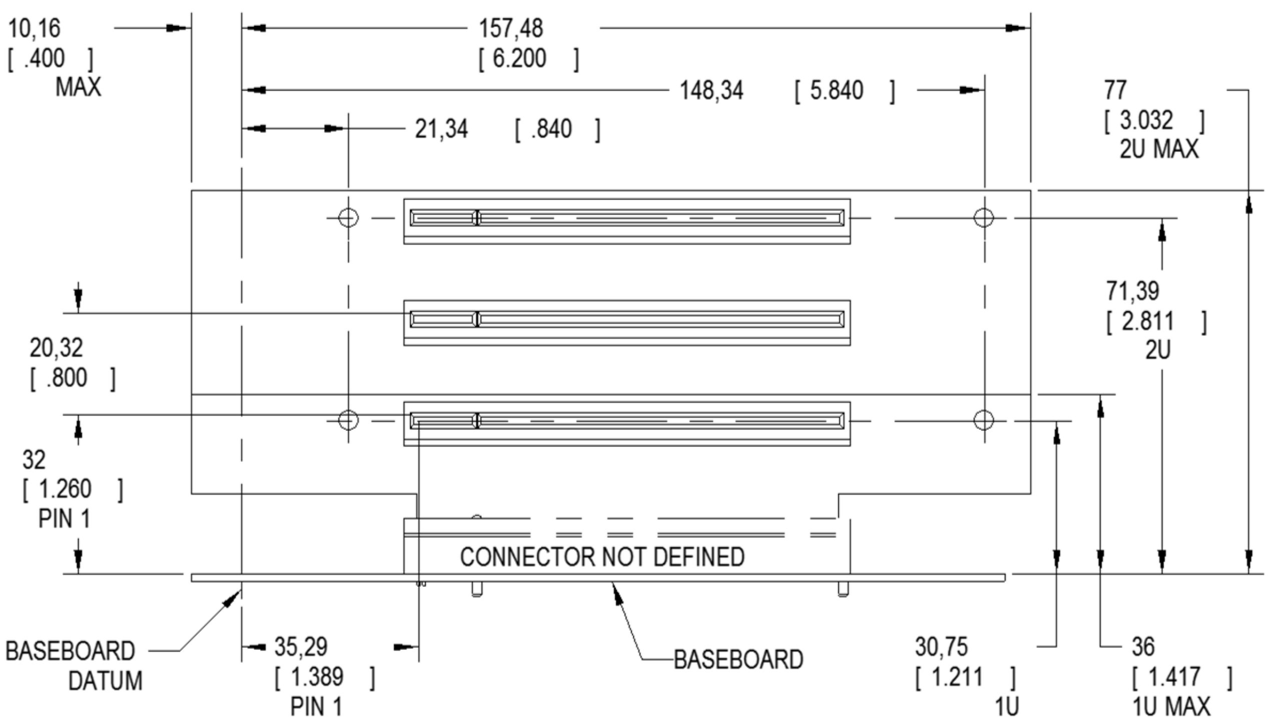


Figure 15: Riser Card Design (1U and 2U)

Figure Note:

Lower mounting holes for 1U riser only

3 *Chassis Requirements*

This section is directed primarily at chassis developers, but may also prove interesting to board developers and system integrators. This section describes the requirements and constraints of the chassis.

3.1 Baseboard Mounting Locations

REQUIRED: ALL

The compliant chassis must support all the mounting points shown in Section 2.1 (page 9). These attach points must:

- receive a #6-32 threaded fastener
- provide a minimum 3.00mm [0.118”] clearance from the bottom surface of the baseboard to the chassis mounting plane
- not exceed 7.11mm [0.280”] diameter at each location

Threaded stand-offs are typical for pedestal implementations: 0.250” or 6mm stand-offs are recommended. For rack chassis, 4mm or 0.156” stand-offs are recommended.

NOTE

*A pedestal (EEB) chassis must support **all** the mounting locations specified with removable mounting features (typically threaded stand-offs). The chassis may add additional mounting locations, provided they are also removable.*

*For rack (TEB) chassis, removable attach mechanisms (such as threaded stand-offs) are **highly desired**. Chassis with fixed, non-removable attach points are advised to work with board partners to minimize interference problems.*

3.1.1 Riser Mounting Locations

REQUIRED: TEB

In order to support standardization of risers, this specification has defined a riser card form-factor and location. The riser is located in Slot 6 (see Section 2.1). The riser mechanical details and mounting locations are provided in Section 2.4.

3.2 Board Volumetric Keep-Out

REQUIRED: ALL

Figure 16 and Table 5 provide the recommended chassis volumetric keep-outs for all system configurations. The chassis keep-outs include add-in cards (low-profile or standard according to system type) and maintain support for seven card slots. In cases where these keep-outs are not achievable, the board volumetric (see Section 2.2) should provide the minimum dimensions. A 3mm [0.118”] backside clearance is required.

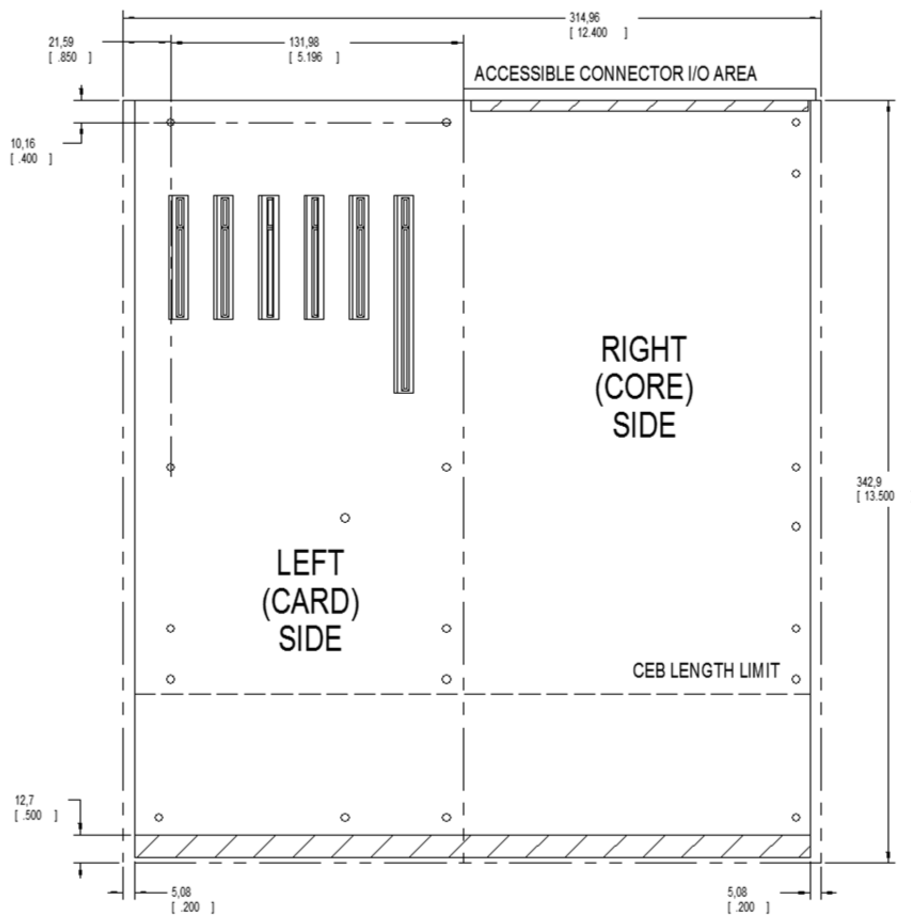


Figure 16: Board (-set) Keep-Out Volume

Table 5: Chassis Minimum Keep-out Height

Chassis Type	Left (Card) Side	Right (Core) Side	Typical Usage
EEB Case 1	120.65 [4.750”]	82.55 [3.250”]	Standard pedestal
EEB Case 2	77.67 [3.058”]	77.67 [3.058”]	2U with low-profile add-in cards
EEB Case 3	158.75 [6.250”]	158.75 [6.250”]	Performance pedestal
TEB 1U	36.58 [1.440”]	36.58 [1.440”]	1U with full-height riser
TEB 2U	77.67 [3.058”]	77.67 [3.058”]	2U with full-height riser

3.3 Rear Panel I/O Aperture

REQUIRED: ALL

The I/O aperture described here is suited for pedestal and 2U rack chassis and is identical to the *ATX Specification*. Because the same dimensions are used, a baseboard manufacturer can leverage common I/O configurations and create a shield that works in any chassis that meet either specification. Figure 17 shows the I/O aperture. The 1U chassis uses a reduced-height aperture found in Section 3.3.1.

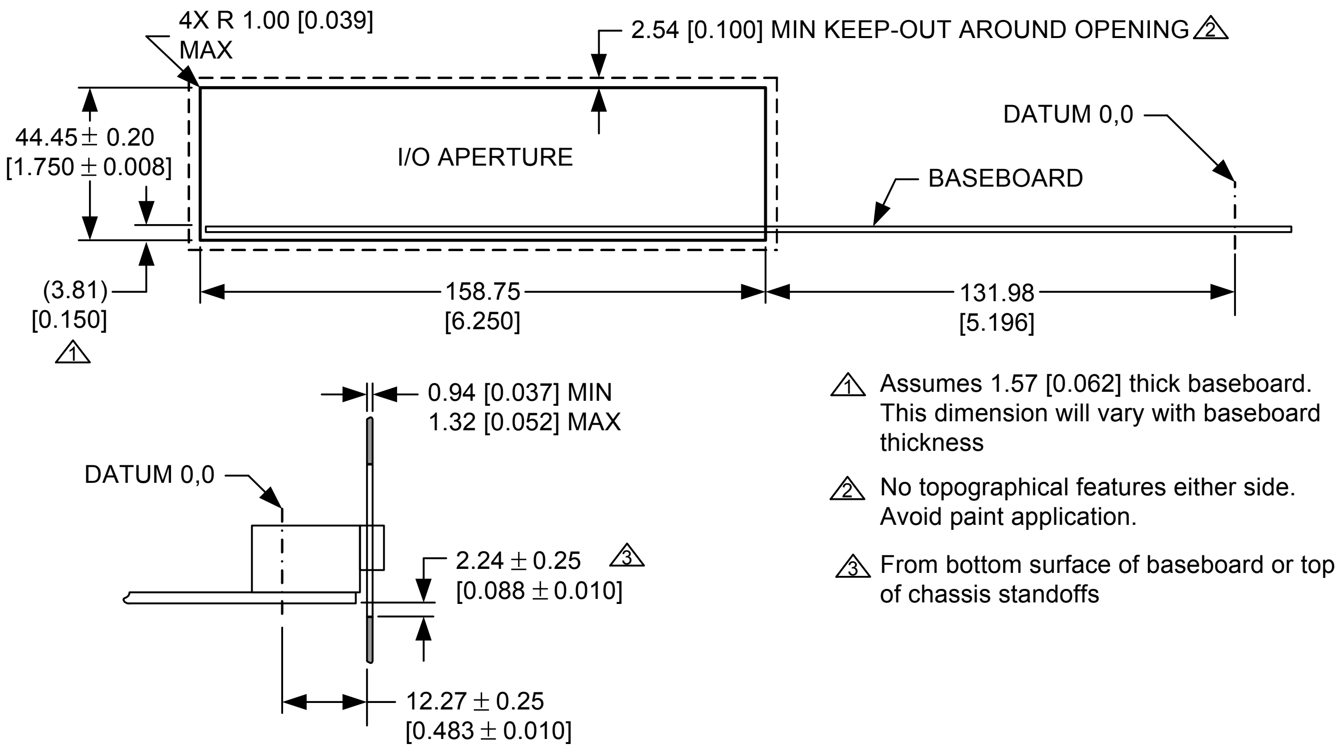


Figure 17: Rear Panel I/O Aperture

The I/O aperture should be a simple cut-out of the chassis rear panel without indentation, folded edges, or other topographical features. A radius of 1mm [0.039"] maximum is allowed for tooling considerations. The chassis rear panel should be 12.27mm [0.483"] from the baseboard datum.

The 2.54mm [0.100"] keep-out zone around the I/O aperture should be clear and free of paint on both the inside and outside surfaces; this allows proper grounding of the I/O shield.

3.3.1 1U Rear Panel I/O Aperture

RECOMMENDED: TEB

The 1U rear panel I/O aperture is lower overall to accommodate the reduced chassis height of 1U, and it implements a different interface across the lower edge to accommodate the reduced chassis-to-board offset (typically 3mm [0.118]). Exact definition of this shield is not part of this specification, though an example design is provided.

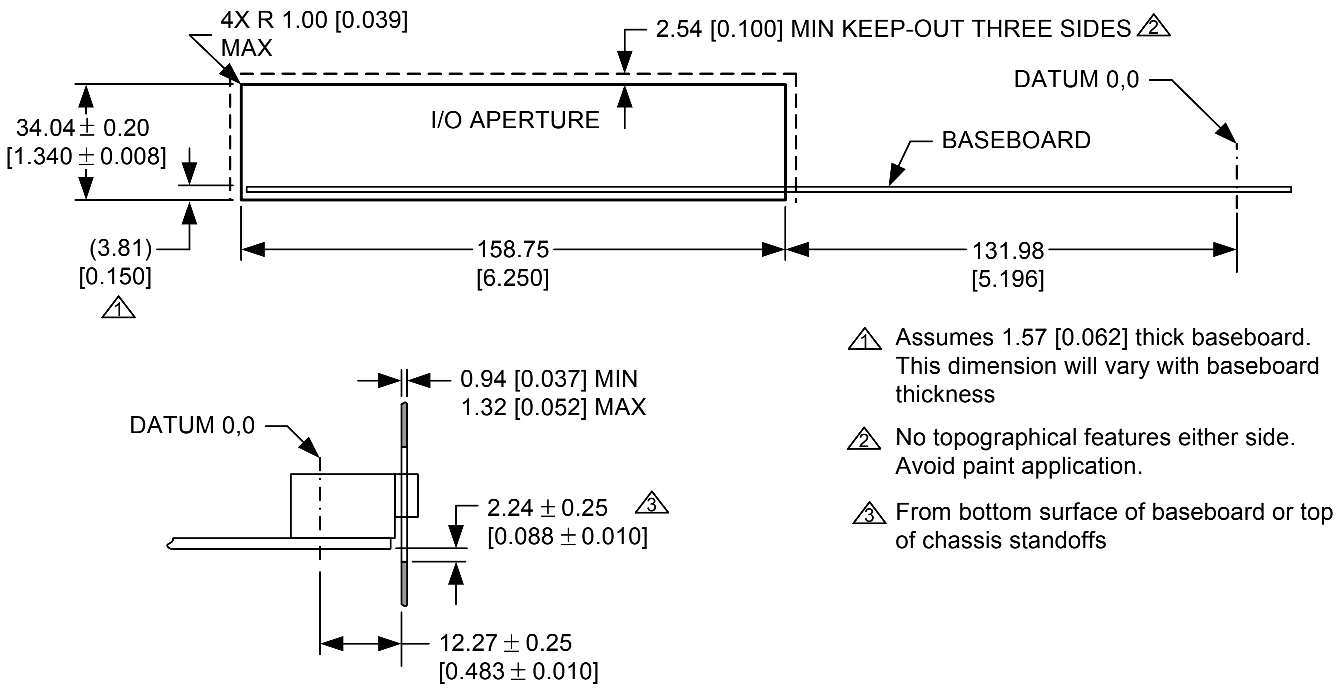


Figure 18: 1U Rear Panel I/O Aperture

The I/O aperture should be a simple cut-out of the chassis rear panel without indentation, folded edges, or other topographical features. A radius of 1mm [0.039"] maximum is allowed for tooling considerations. The chassis rear panel should be 12.27mm [0.483"] from the baseboard datum.

3.3.1.1 Example 1U I/O Shield

Figure 19 below provides a pictorial representation of an I/O shield for the 1U I/O aperture above. This example I/O shield uses an ATX-like interface on three sides and an extended flange on the bottom. Details of the shield geometry and its interface to the chassis are left to the chassis supplier.

The connector configuration shown is for example only.

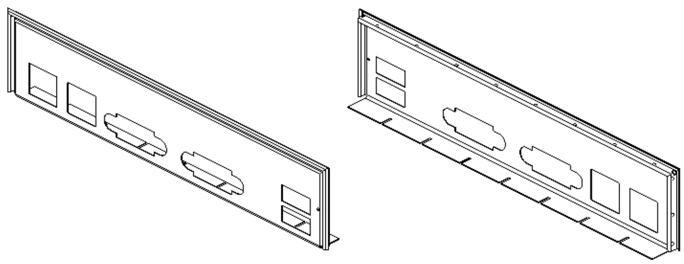


Figure 19: Example 1U I/O Shield

3.4 Rear Panel Card Apertures

REQUIRED: TEB

Riser Card Design (1U and 2U) Figure 15, Section 2.4 locates the rear panel card apertures for use with the recommended riser card. PCI card I/O keep-outs are provided for reference – chassis suppliers should apply their own allowances for clearances, tolerances, and gaskets. Only the lowest aperture is used with 1U systems.

Chassis should also provide support for the riser card mounting as shown on the riser card drawing (Figure 15).

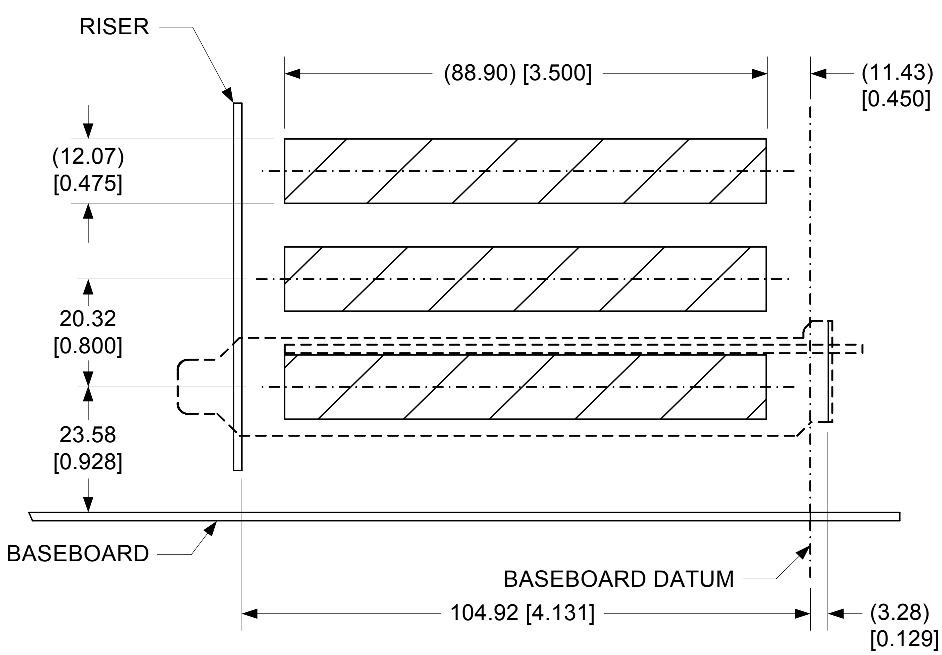


Figure 20: Rear Panel Card Apertures

3.5 Front Panel

RECOMMENDED: ALL

In order to support the recommended Front Panel Connector defined in Figure 10 and the Front Panel USB connector defined in Figure 11, Table 6 describes the front panel features support by the chassis. Status for each feature is defined within the table. The Front Panel may consist of individual components or an integrated system board. Location is left to each individual chassis, but cables should be sized to reach anywhere along the front third of the baseboard.

Table 6: Front Panel Features

Component	Status
Power Switch	Recommended
Power LED	Recommended
HDD Activity LED	Recommended
NIC#1 Activity LED	Recommended
USB (2 ports min.)	Recommended
Reset Switch	Recommended
Temperature Sensor	Optional
NMI to CPU Switch	Optional
NIC#2 Activity LED	Optional
System Fault LED (Qty 2)	Optional
System ID LED	Optional
Chassis Intrusion	Optional
SMBus SDA	Optional
SMBus SCL	Optional

3.6 Electronics Bay Cooling

RECOMMENDED: ALL

System thermal performance is a complex relationship between the board, chassis, fans, power supply, and other components. The system integrator must be responsible for sound system thermal design in the selection and configuration of these components. However, it is the chassis designer's responsibility to provide accommodation for expected thermal design requirements such as proper fan placement and mounting.

This section provides the foundation for chassis design thermal support focused on pedestal and rack chassis implementations. It is intended to cover most systems using active or passive processor cooling. Redundant cooling configurations tend to be highly integrated and are beyond the scope of this specification.

3.6.1 Thermal Design Philosophy

The thermal design philosophy for a chassis is to create four distinct thermal zones, or partitions, within the chassis. Figure 21 shows the major components of a typical system and the four zones recommended for thermal design.

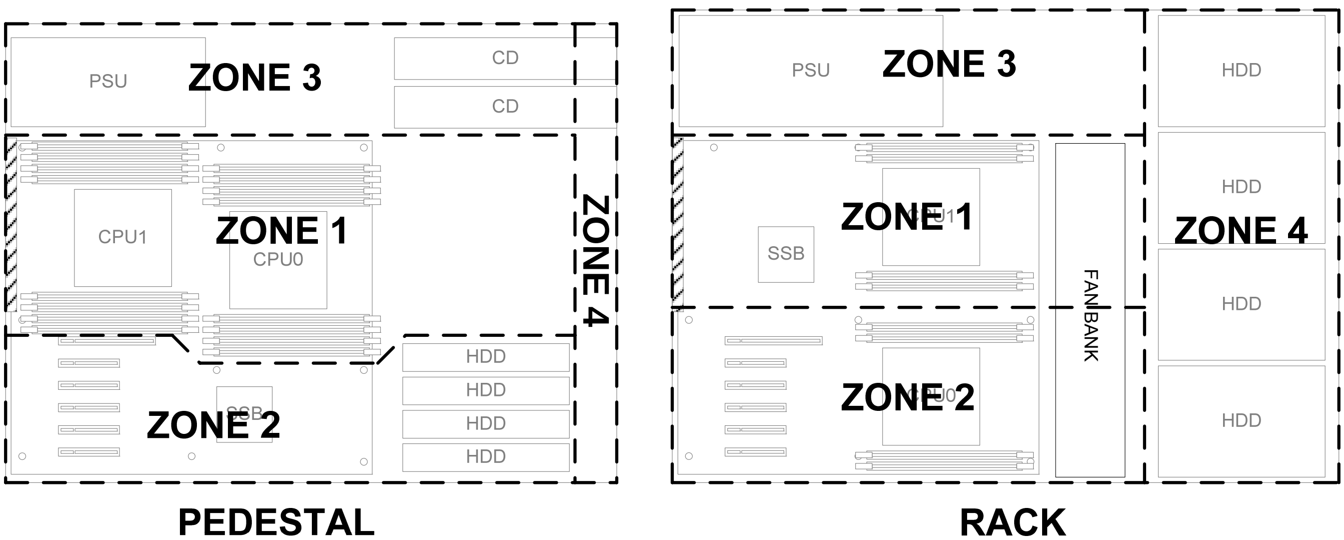


Figure 21: Thermal Zone Definitions

- **Zone 1** is the core side of the pedestal baseboard and includes the processors and memory. For rack-optimized designs, this zone contains one of the processor-memory sub-assemblies and baseboard I/O.
- **Zone 2** is the card side of the pedestal baseboard and includes PCI Express add-in cards and video cards when present. For rack-optimized designs, this zone contains one of the processor-memory sub-assemblies and add-in cards.
- **Zone 3** contains the power supply and often also includes external devices such as optical drives.
- **Zone 4** consists of the bezel and all chassis venting, and includes HDDs for rack designs.

3.6.2 Pedestal Fan Sizing and Placement

A wide variation of configurations is possible within the entry server and workstation segments, even within the same chassis. Fan mounting that can accommodate some variation in fan size offers the best opportunity for the system integrator to achieve a cost/performance balance. With some forethought, the chassis designer may be able to provide this flexibility without a cost increase.

For **Zone 1** cooling, an exhaust fan mounted on the rear panel over the I/O aperture is very common. Due to the high thermal loads in the core area, 120mm fan mounting is recommended with accommodation for both 25mm- and 38mm-thick fans. Additional fan support upstream of the board is also highly desirable, particularly for passive processor heat sinks; this is commonly a 120mm x 38mm fan between the board and hard disk drives (if present in this location).

For **Zone 2** cooling, a single fan upstream of the add-in cards is generally sufficient. Thermal loads in a light-duty server may require no more than a 92mm x 25mm fan, while performance workstations may require up to a 120mm x 38mm fan. The ability to accommodate 92mm and 120mm fan sizes with 25mm or 38mm thicknesses provides maximum thermal design flexibility.

For **Zone 3** cooling, the fan(s) internal to the power supply are generally sufficient. For chassis configurations where hard disk drives are added to this thermal zone, an additional fan may be required.

Zone 4 does not require cooling, but rather acts as an impediment to the cooling of the other three zones. In bezel design and in vent sizing and placement, the chassis must balance the requirements of Industrial Design, airflow and pressure drops, and EMI containment.

Table 7: Pedestal Fan Sizing Summary

Thermal Zone	Typical Components	Fan Size Recommendation
Zone 1	Baseboard core side, hard disk drives	• One 120mm
Zone 2	Baseboard card side, add-in cards	• One 92mm or 120mm
Zone 3	Power supply, external drives	• PSU internal fan
Zone 4	Bezel and chassis venting	• Not applicable

3.6.3 Rack Fan Sizing and Placement

The tight space constraints of the rack-optimized chassis usually dictate fan sizing and placement. It is common to use the largest diameter fan available to meet the system cooling needs, and the thickest fans commonly available are generally needed to overcome the large impedance within the system.

Cooling fans are placed in a row along the front edge of the baseboard, referred to as the fan bank.

- 1U chassis can accommodate 40mm fans; these are usually 28mm or 56mm thick. Four or more fans are generally required.
- 2U chassis can accommodate up to 80mm fans; these are usually 38mm thick. Three or more fans are generally required.

3.6.4 Fan Acoustics

Like thermal performance, system acoustic performance consideration is the responsibility of the system integrator. However, there are steps the chassis designer can take to enable lower acoustic levels, particularly in the mounting of fans.

- Air rushing through a fan creates noise. By placing fan mounts within the chassis, the noise is better contained than by placing fans on the outer surfaces; this is particularly true for fans mounted to the front of the chassis, closest to the operator.
- Fan rotation also transfers vibrations into the chassis, which can be carried and amplified through the structure. Soft-mounted fans (e.g. rubber-mounted) transfer less noise into the chassis.
- Fan blades spinning near-by fixed geometry introduces additional noise. Providing some clearance to the inlet and exhaust of the fan can reduce this source of noise – the inlet of the fan is particularly sensitive, as the hub mounting of the fan already provides some clearance on the exhaust side.

3.6.5 Bezel

The bezel may be thought of as an air plenum that directs air from outside the chassis into the chassis perforations. A poorly designed bezel will inhibit system thermal performance by restricting airflow into the chassis and will increase the overall system impedance.

The chassis designer must balance the constraints of bezel design and the cosmetic requirements against the system airflow requirements.

3.6.6 Cabling

Good cable management is necessary to ensure good system thermal performance. To aid the system integrator in routing cables so they do not impede airflow, the chassis designer should include cable management features or attach points for cable stays. Simple cable clips or channels can often be added to fan mounts, card guides, or other structural pieces at minimum or no cost.

3.7 Electromagnetic Interference Considerations, EMI

RECOMMENDED: ALL

The Electromagnetic Interference (EMI) performance of a system is determined by the degree of noise suppression designed into the baseboard and the provisions for electromagnetic interference containment in the chassis design, including placement of internal subsystems and cables.

In recent years, marketing requirements have changed for computer servers. Requirements now call for compliance to more stringent electromagnetic interference compatibility (EMC) limits such as the *CISPR-22* European standard or the U.S. *FCC "B"* standard. These more restrictive standards, along with higher processor and video frequencies, call for additional chassis containment provisions. The basic design principles have not changed, but the shorter wavelengths call for more frequent ground contacts and shorter apertures in the chassis design.

The baseboard needs to tie into the chassis with the lowest electrical impedance possible. Therefore, the need for metal standoffs and grounded mounting holes is imperative. Baseboard mounting features must provide reliable ground paths to the chassis structure—this is the responsibility of the baseboard designer.

4 PSU Reference

RECOMMENDED: ALL

The chassis designer must consider the power supplies to be supported. These power supplies are described in the latest *SSI Power Supply Design Guide (PSDG)* available on the SSI website (www.ssiforum.org). Information on power levels, dimensions, mounting constraints, and cable options is available for each form-factor. Table 8 provides a cross-reference between system configuration and power supply form-factor. The chassis designer should identify which power supply form-factors will be supported, then consult the relevant section(s) for necessary details.

Table 8: Power Supply Cross-Reference

System Configuration	Power Supply Form-Factor
Standard Pedestal	EPS12V
Redundant Power Pedestal	ERP12V
1U Standard Power	EPS1U
1U Redundant Power	ERP1U
2U Standard Power	EPS2U
2U Redundant Power	ERP2U

5 Reference Configurations

5.1 Reference EEB Configuration for EN Processors

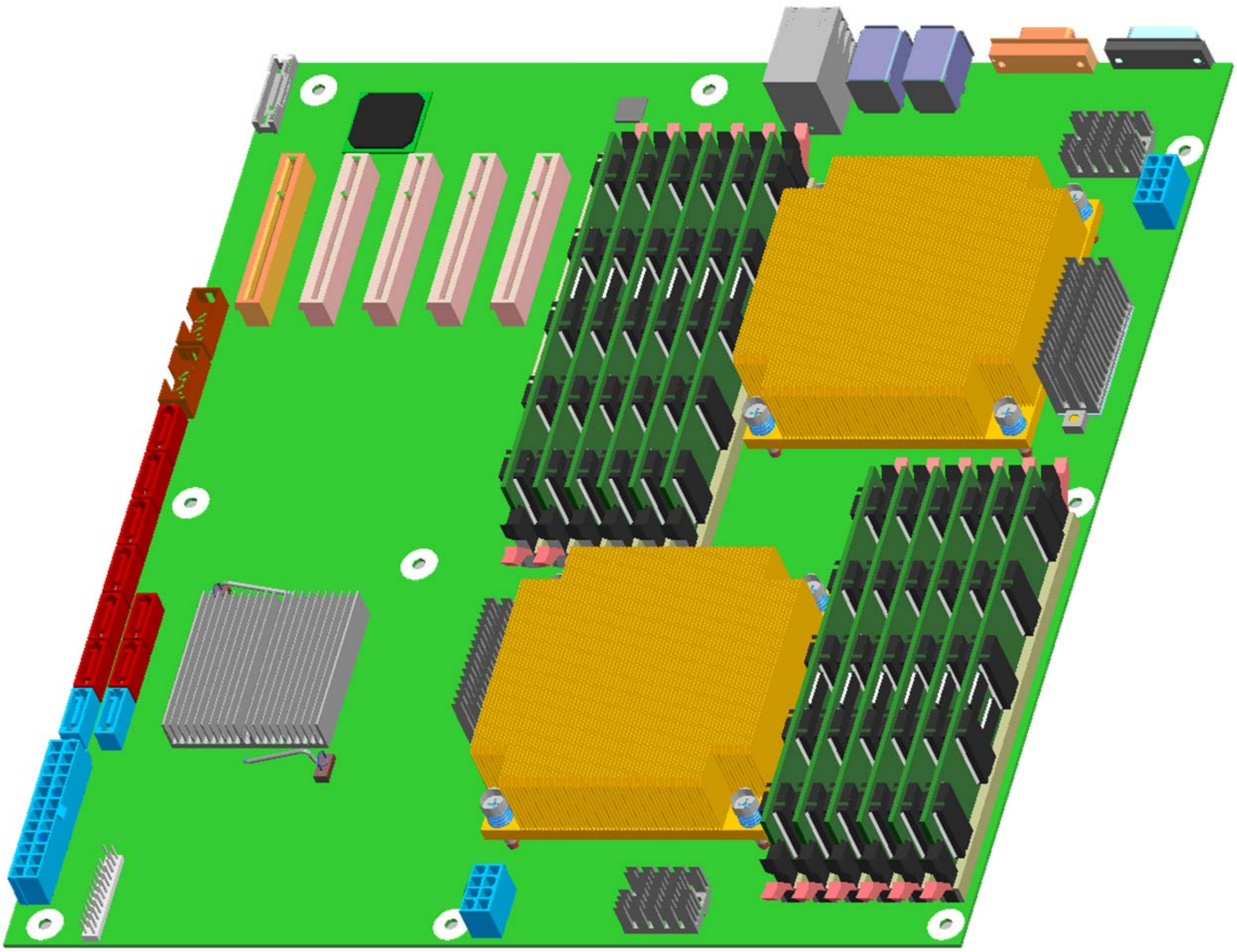


Figure 22: Reference EN EEB Configuration

5.2 Reference EEB Configuration for EP Processors

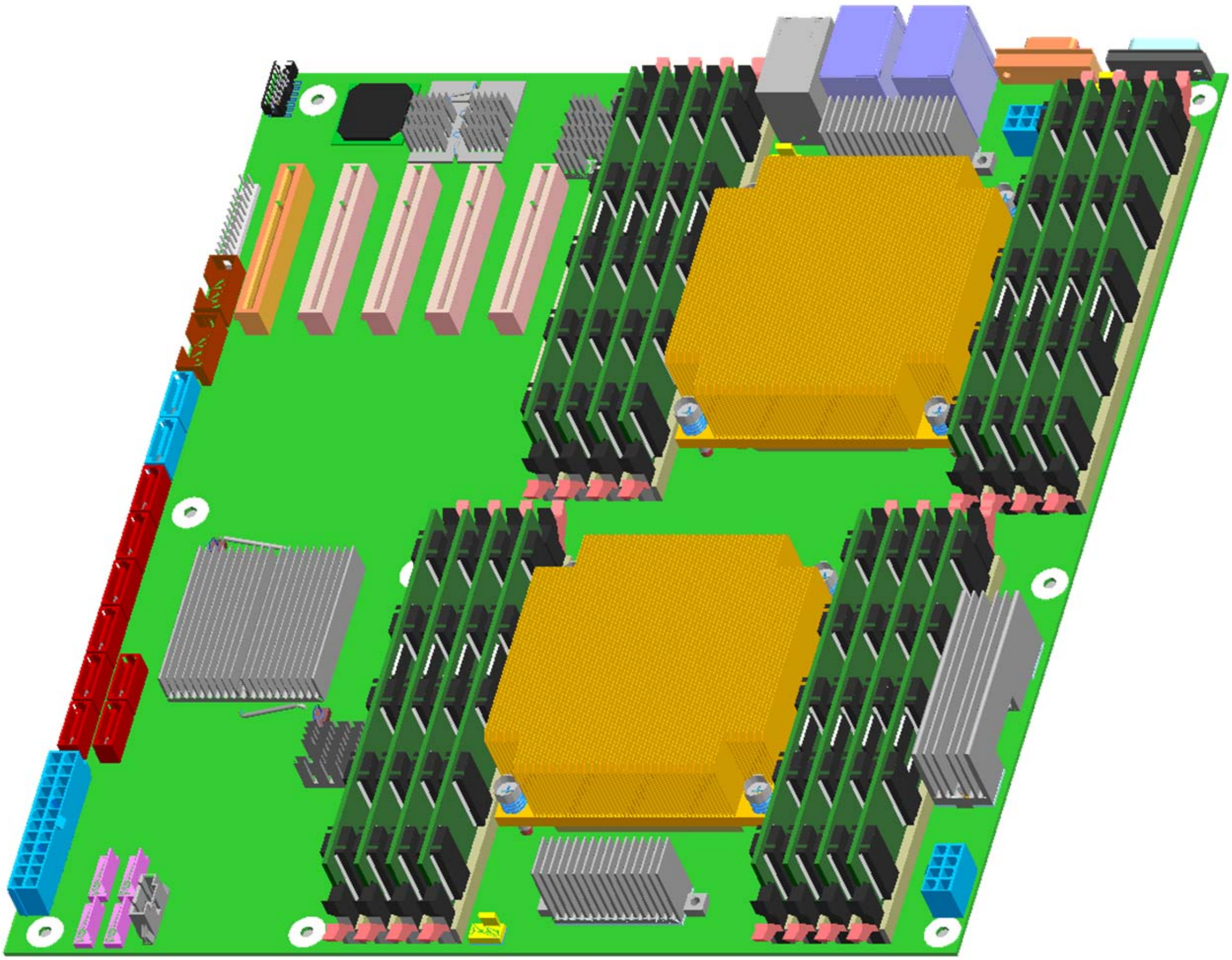


Figure 23: Reference EP EEB Configuration

5.3 Reference TEB Configuration for EN Processors

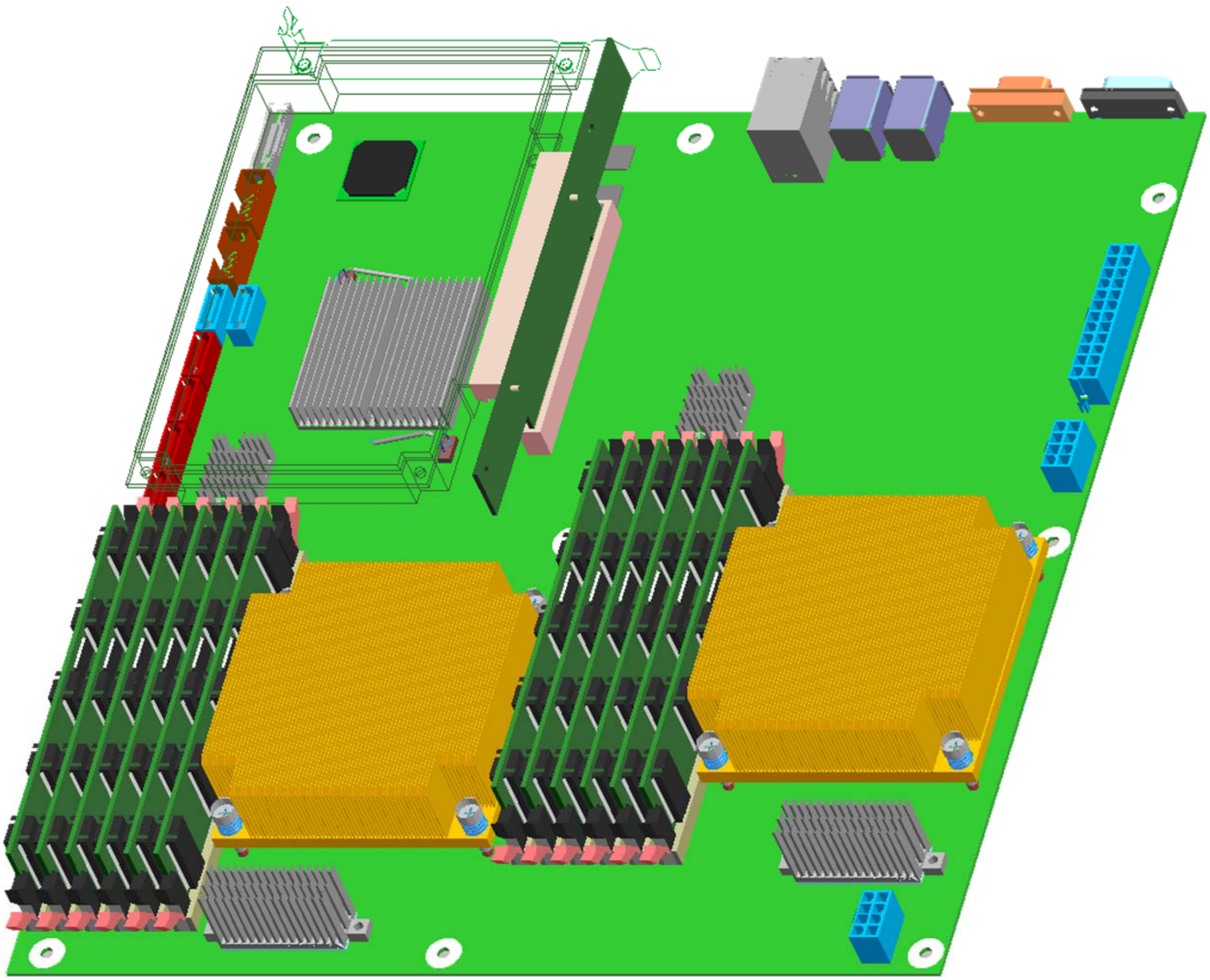


Figure 24: Reference EN TEB Configuration

5.4 Reference TEB Configuration for EP Processors

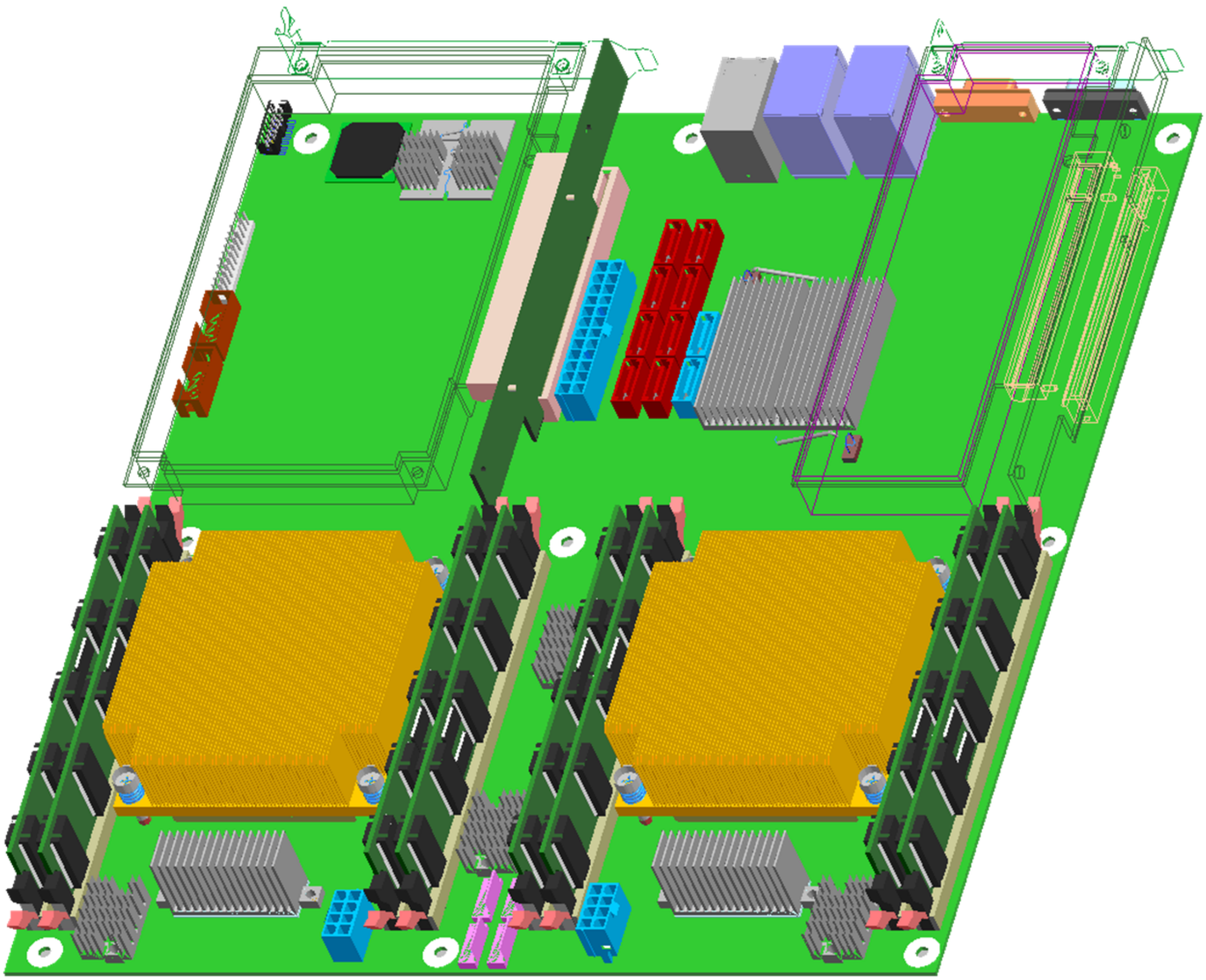


Figure 25: Reference EP TEB Configuration

5.5 Reference CEB Configuration for EN Processors

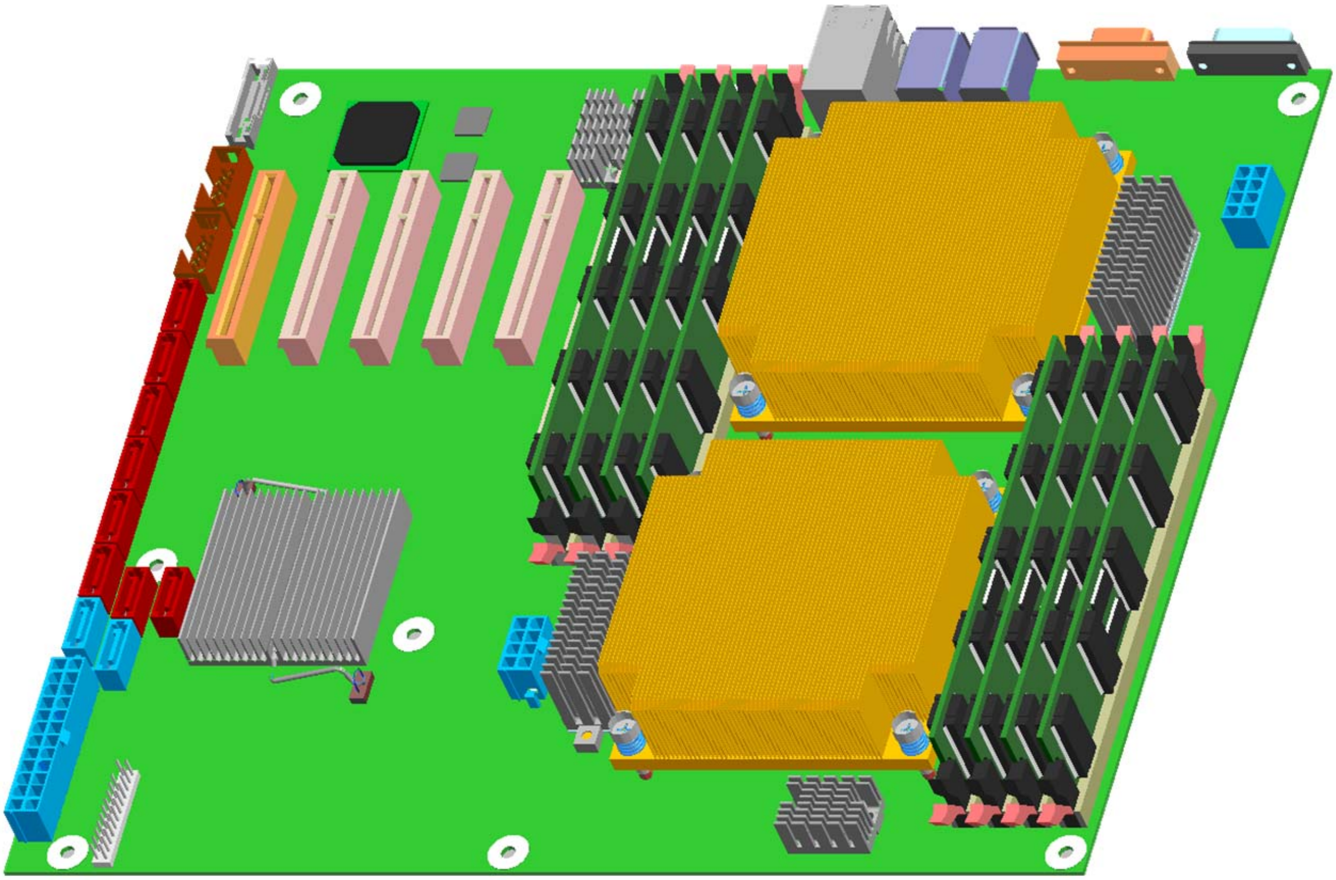


Figure 26: Reference EN CEB Configuration

