

**Enterprise Electronics Bay
Specification for 2008 Dual-Socket
Servers and Workstations**

Version 1.0.1

LEGAL TERMS AND CONDITIONS

Your access and use of this Specification is subject to the following Legal Terms and Conditions. Please read these Legal Terms and Conditions carefully. By accessing and using this Specification, you agree to comply with and be bound by these Legal Terms and Conditions. If you do not agree to comply with and be bound by these Legal Terms and Conditions, DO NOT access or use this Specification. The use of this Specification without agreement to these Legal Terms and Conditions may constitute copyright infringement in violation of 17 U.S.C. § 101, et. seq., the violation of which may result in civil and criminal liability.

1. Neither SSI Forum nor any member of SSI Forum makes any warranties or representations with regard to this Specification, and in particular does not warrant or represent that this Specification or any products made in conformance with this Specification will work in the intended manner. Neither SSI Forum nor any member of SSI Forum assumes any responsibility for any errors that this Specification may contain or have any liabilities or obligations for damages, including but not limited to special, incidental, indirect, punitive, or consequential damages, whether arising from or in connection with the use of this Specification in any way.
2. No representations or warranties are made that any product based in whole or part on this Specification will be free from defects or safe for use for its intended purpose. Any person making, using, or selling any such product does so at the person's own risk.
3. By accessing and using this Specification, you expressly acknowledge that this Specification is provided "AS IS," and that neither SSI Forum nor any member of SSI Forum is making any representations or extending any warranties of any kind, either express or implied, oral or written, including any warranty of fitness for a particular purpose, or any warranty or representation that this Specification or any product or technology utilizing this Specification or any subset of this Specification will be free from any claims of infringement of intellectual property, including patents, copyrights, and trade secrets, nor is SSI Forum or any member of SSI Forum assuming any other responsibilities whatsoever with respect to this Specification or such products.
4. Subject to these Legal Terms and Conditions, SSI Forum hereby grants you a non-exclusive, non-transferable, non-sublicensable copyright license to reproduce, distribute, and display this Specification as reasonably necessary to implement this Specification. No other license, express or implied, by estoppel or otherwise, to any other intellectual property right is granted to you by SSI Forum or by any member of SSI Forum under these Legal Terms and Conditions or by your use of this Specification.
5. You may not revise, alter, modify, make any derivatives of, or otherwise amend this Specification in any way.
6. Your use or implementation of this Specification does not imply in any way that you or any of your products have participated in any testing or certification programs or are in compliance with this Specification. Further, you acknowledge that SSI Forum has no obligation to develop any testing or certification programs to demonstrate your compliance with this Specification.
7. If you make any references or citations to this Specification, you must give SSI Forum full attribution and you must acknowledge SSI Forum's copyright in this Specification. You agree to include and retain SSI Forum's copyright notice (© Copyright 2010-2012 by SSI Forum. All rights reserved.) on each page of any part of this Specification that you reproduce.
8. You agree to include and retain these Legal Terms and Conditions (Paragraphs 1 - 9) on all copies of any part of this Specification that you create or reproduce.
9. These Legal Terms and Conditions are governed by the laws of the State of Oregon, without giving effect to any conflict-of-law principle that would result in the laws of any other jurisdiction governing this Agreement. Any action, suit, or proceeding arising out of the subject matter of this Agreement will be litigated in courts located in Multnomah County, Oregon. You consent and submit to the jurisdiction of any local, state, or federal court located in Multnomah County, Oregon.

*Product names are trademarks, registered trademarks, or servicemarks of their respective owners.

Intel is a trademark or registered trademark of Intel Corporation or its subsidiaries in the United States and other countries.

GLOSSARY

1. "Adopted" and "Adoption" means Intel's formal adoption and publication of the applicable SSI Specification.
2. "Affiliate" means any entity that is directly or indirectly controlled by, under common control with or that controls the subject party. For purposes of this definition, "control" means direct or indirect ownership of or the right to exercise: (a) greater than fifty percent (50%) of the outstanding shares or securities entitled to vote for the election of directors or similar managing authority of the subject entity; or (b) greater than fifty percent (50%) of the ownership interest representing the right to make the decisions for the subject entity.
3. "Compliant Portion" means only those specific portions of products (hardware, firmware, micro-code, software, or combinations thereof) that: (a) implement and are compliant with all relevant portions of the SSI Specification and that pass such compliance and interoperability tests that are promulgated by Intel from time to time; and (b) are within the bounds of the Scope.
4. "Necessary Claims" for each party to this Agreement means, with respect to a particular SSI Specification, any claim included in any patent, or in any continuation, continuation in part, divisional or other patent filing that claims priority therefrom, where such claim:
 - a. now or at any future time during the term of this agreement, is owned or controlled and licensable by such party or any of its Affiliates; and
 - b. in the absence of a license, would be infringed by at least one Compliant Portion because there is no commercially reasonable non-infringing alternative for implementing such Compliant Portion.
5. Notwithstanding the foregoing sentence, Necessary Claims do not include any claims
 - a. other than those set forth above even if contained in the same patent as a Necessary Claim; or
 - b. that read solely on any implementations of any portion of the SSI Specification that are not within the bounds of the Scope; or
 - c. that may be infringed by implementing any portion(s) of the SSI Specification that are specifically designated as "not licensed" or "optional", including examples and elements that are required for conformance with any such not licensed portions; or
 - d. that, if licensed, would require a payment of royalties by the licensor to unaffiliated third parties; or
 - e. if multiple SSI Specifications exist, that qualify as Necessary Claims for purposes of one or more other SSI Specifications, but not for purposes of this particular SSI Specification.
6. "Processor" means any integrated circuit or combination of integrated circuits capable of processing digital data, such as a microprocessor or coprocessor (including, without limitation, a math coprocessor, graphics coprocessor, or digital signal processor).
7. "Scope" those mechanical form factors, protocols, application program interfaces, de facto hardware interfaces, service provider interfaces, test procedures and/or data structures solely to the extent disclosed with particularity in the SSI Specification where the sole purpose of such disclosure is to enable interoperation, interconnection, interaction or communication between server systems in accordance with a SSI Specification. Notwithstanding the foregoing, the Scope shall not include:
 - a. Enabling Technologies. Any technologies that may be necessary to make or use any product or portion thereof that complies with a SSI Specification but are not themselves expressly set forth in a SSI Specification (e.g., semiconductor manufacturing technology, compiler technology, object oriented technology, basic operating system technology or the like)
 - b. Other Technologies. Any Processor, any intra-circuit bus, or any data bus (e.g., any X86 data bus implemented by a manufacturer to facilitate communications between the manufacturer's Processor and other components);
 - c. Externally Developed Specification. The implementation or use of other published specifications not developed for use by Intel but referred in the body of the SSI Specification even if required for compliance with the SSI Specification (e.g., the PCI specification); or
 - d. Non-Normative Portions of Final Specifications. Any portion of any product or any combination of products (or portions of products) that is not required for compliance with the SSI Specification.
8. "Specification or SSI Specification" means the applicable version number of an SSI Specification as Adopted by Intel. The first such version number and all subsequent major revision shall be described by Intel as being "version 1.0, 2.0, 3.0 etc." of the Final Specification. Minor revisions to the applicable version (in the nature of clarifications and error correction) shall be described by Intel as being "version X.x of the SSI Specification.

Revision History

Changes from 2008 Version 1.0 to 2008 Version 1.0.1

Updated revision identifier (minor revision number added). Added **Legal Terms and Conditions**.

Changes from Version 3.61 to 2007 Version 1.0

General – Combined EEB, TEB, and CEB into single specification

Section 1 – Revised text

Section 5 General – Some renumbering due to added/deleted sections

Section 5.1 – Added two new alternate mounting locations to support pedestal layouts, added maximum board depth for CEB, added rack riser connector, relabeled mounting locations to match ATX

Section 5.2 – Renumbered (formerly 5.3)

Section 5.2.1 – Added section to support rack component heights

Section 5.3.1.2 – Added second Processor Power Connector

Section 5.4 – Added section to support rack I/O riser

Section 6.1.1 – Added section to support rack I/O riser

Section 6.2 – Added keep-out dimensions for rack chassis

Section 6.3.1 – Added section to support 1U rack rear panel

Section 6.4 – Added section to support rack I/O riser

Section 6.6 – Edited and added content to support rack chassis

Changes from Version 3.6 to Version 3.61

Section 5.4.5 – Change 5VSB voltage callout to Front Panel Power to support sourcing as either 5V or 3.3V; editorial changes to figure notes to support implementation

Changes from Version 3.51 to Version 3.6

Section 5.1 – Removed holes **J** and **K** (no longer supported); updated text to reinforce that these ATX-legacy holes must not be used with defined processor locations and enabled thermal solution

Section 5.2 – Removed rear processor mounting locations from text and figure

Section 5.4.1.1 – Removed Common Plane pin-out

Section 5.4.1.2 – Removed Common Plane pin-out

Section 5.4.1.3 – Changed reserved pin to SMBAlert

Section 5.4.1.4 – Replaced 2x3 Workstation Power Connector with 2x2 12V Baseboard Power Connector (graphics card power is now delivered directly to the card).

Section 5.4.3 – Changed 3-wire fan header to 4-wire fan header, updated text and figure

Section 5.4.3.1 – New section detailing optional 6-wire fan header for hot-plug implementations

Section 5.4.5 – Changed Front Panel pin-out to update supported features (pins 4, 6, 8, 10, 19, and 21)

Changes from Version 3.5 to Version 3.51

Section 5.4.3 - Corrected Cooling Fan Pin-out Figure 10 (leads reversed, added fan-side connector for reference)

Changes from Version 3.0 to Version 3.5

Global – Rewritten and reorganized; new figures – all figures changed to common orientation; units changed to metric [English]

Section 1 – Revised text

Section 1.1 – new section to limit out-of-date content

Section 2 – Revised text

Section 3 – Revised and updated; links added

Section 3.1 – New section to clarify drawings

Section 4 – Revised text

Section 4.1 – Revised text

Section 4.2 – New section to establish common vocabulary

Section 5 – Rewritten and reorganized for board focus

Section 5.1 – Revised text; new figure to reflect standard orientation, maintain compliance with ATX, and eliminate mini-ATX holes (formerly B & G); PCI Express pin-1 dimensions added; holes relabeled

Section 5.2 – Formerly Appendix A; revised text; new drawing with combined front and rear locations; mounting locations for out-of-date processors removed

Section 5.3 – Formerly Section 5.2; rewritten with new figures for board-only keep-in; added secondary-side component clearance of 3mm [0.118"]; added PCI/PCI Express rear edge height restriction

Section 5.4 – Formerly Sections 5.3 and 5.5; revised text; new figures; processor split power plane connectors defined; VRM information added; fan connector placement and power level expectations added; rear I/O panel connector keep-in added; IPMB and ICMB connector definitions removed (see IMPI specification); hot plug PCI section removed

Section 6 – New section for chassis focus

Section 6.1 – New section to describe chassis requirement for baseboard and processor mounting

Section 6.2 – Formerly Section 5.2; rewritten with new figures for chassis keep-out with clearances

Section 6.3 – Formerly Section 5.5.1; revised text; new figure

Section 6.4 – New section for chassis stiffness constraints

Section 6.5 – New section to add chassis front panel considerations

Section 6.6 – Formerly Section 5.6; rewritten with new figures; formulas removed; out-of-date power and airflow numbers removed; zone definitions added; fan sizing and placement added

Section 6.7 – Formerly Section 5.7

Section 6.8 – New section for power supply cross-reference

Section 7 – Formerly Appendix D; revised text

Contents

1	Purpose.....	8
1.1	Scope	8
2	Conceptual Overview	8
3	Definitions / Terms / Acronyms.....	9
3.1	Drawing Note	9
4	General.....	10
4.1	Electronics Bay Overview	10
4.2	Nomenclature	10
5	Baseboard Requirements	11
5.1	Layout and Baseboard Mounting Holes.....	11
5.2	Volumetric Constraints	13
5.2.1	Rack Volumetric Constraints	15
5.3	Baseboard Connectors	16
5.3.1	Power Delivery	16
5.3.2	Rear Panel I/O	19
5.3.3	Front Panel I/O.....	20
5.3.4	Front Panel USB	21
5.3.5	Cooling Fan Pin-out	21
5.3.6	Chassis Intrusion Connector.....	23
5.3.7	Connector Placement	23
5.4	Riser Card Mechanicals	24
6	Chassis Requirements	25
6.1	Baseboard Mounting Locations	25
6.1.1	Riser Mounting Locations	25
6.2	Board Volumetric Keep-Out	26
6.3	Rear Panel I/O Aperture.....	27
6.3.1	1U Rear Panel I/O Aperture.....	28
6.4	Rear Panel Card Apertures.....	29
6.5	Front Panel.....	30
6.6	Electronics Bay Cooling	31
6.6.1	Thermal Design Philosophy.....	31
6.6.2	Pedestal Fan Sizing and Placement.....	32
6.6.3	Rack Fan Sizing and Placement.....	32
6.6.4	Fan Acoustics	33
6.6.5	Bezel	33
6.6.6	Cabling.....	33
6.7	Electromagnetic Interference Considerations, EMI	33
7	PSU Reference	34
8	Reference Configurations.....	35
9	Additional Information	38

Figures

Figure 1: Board Orientation and Nomenclature	10
Figure 2: Available Baseboard Mounting Holes.....	12
Figure 3: Baseboard Component Volume	13
Figure 4: Baseboard Maximum Component Height.....	14
Figure 5: Rack Board-Set Component Volume	15
Figure 6: P1 Baseboard Power Connector	16
Figure 7: Processor Power Connectors.....	17
Figure 8: Server Signal Connector.....	17
Figure 9: +12V Baseboard Power Connector	17
Figure 10: Baseboard I/O Connector Area	19
Figure 11: Standard Front Panel Connector.....	20
Figure 12: Front Panel USB Connector	21
Figure 13: Cooling Fan Connector.....	21
Figure 14: 6-Pin Cooling Fan Connector	22
Figure 15: Chassis Intrusion Connector	23
Figure 16: Riser Card Design (1U and 2U).....	24
Figure 17: Board (-set) Keep-Out Volume	26
Figure 18: Rear Panel I/O Aperture	27
Figure 19: 1U Rear Panel I/O Aperture	28
Figure 20: Example 1U I/O Shield	29
Figure 21: Rear Panel Card Apertures	29
Figure 22: Thermal Zone Definitions.....	31
Figure 23: Reference EEB Configuration	35
Figure 24: Reference TEB Configuration.....	36
Figure 25: Reference CEB Configuration	37

Tables

Table 1: Definitions, Terms, and Acronyms.....	9
Table 2: Baseboard Maximum Component Height Restrictions.....	14
Table 3: Rack Board-set Maximum Component Height Restrictions	15
Table 4: Connector Locations	23
Table 5: Riser Pin-1 Dimensions	24
Table 6: Chassis Minimum Keep-out Height	26
Table 7: Front Panel Features	30
Table 8: Fan Sizing Recommendation Summary	32
Table 9: Power Supply Cross-Reference	34

1 Purpose

The *Enterprise Electronics Bay Specification* (EEB) is intended to define a baseboard form factor and system interfaces to address industry issues in the design of servers and workstations today and in the future. These issues are primarily the ability to fit a baseboard, rich in features, into a chassis and have that chassis support adequate power and cooling. This specification encompasses board size, available mounting holes, ATX-style I/O aperture, and power and signal connectors. It also provides design suggestions for thermal management and electromagnetic interference containment.

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 in 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 and adds in some additional constraints due to reduced baseboard depth.

1.1 Scope

For clarity, this revision of the *Enterprise Electronics Bay Specification* is limited to the 2008 Intel® Xeon™ dual-socket platforms. Please refer to previous revisions for information on earlier platforms.

2 Conceptual Overview

The *Enterprise Electronics Bay Specification* 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

3 Definitions / Terms / Acronyms

Table 1: Definitions, Terms, and Acronyms

ATX	Baseboard form factor measuring 305mm x 244mm [12" x 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
EMC	Electromagnetic Interference Compatibility
EMI	Electromagnetic Interference
EMTS	Electrical, Mechanical, Thermal Specification (for processors)
EPS*, ERP*	SSI power supply form factors (www.ssiforum.org)
IPMI	Intelligent Platform Management Interface (developer.intel.com/design/servers/ipmi/)
PCI	Electrical interface and add-in card form factor specification (www.pcisig.org)
PCI Express	Electrical interface and add-in card form factor specification (www.pcisig.org)
PSU	Power Supply Unit
SATA	Serial ATA (www.serialata.com)
SCSI	Small Computer Systems Interface (www.t10.org)
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)

3.1 Drawing Note

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

4 General

This specification defines a recommended two-socket capable server and Workstation form factor. The Enterprise Electronics Bay has been adapted from the ATX form factor and is intended to enhance support for current and future processors, PCI and PCI Express expansion cards, and advanced memory requirements.

4.1 Electronics Bay Overview

The Electronics Bay is a volume for the baseboard that includes processors, memory, expansion cards, and all components residing on the baseboard. A chassis manufacturer using the specified chassis keep-out dimensions can be sure their enclosure will contain compliant baseboards using the specified baseboard keep-in dimensions.

The Specification defines these major features:

- Baseboard maximum volumetrics and mounting hole locations.
- Power and signal connector pin-outs.
- I/O aperture and dimensions that define its location.
- Chassis keep-out volume and board/processor mounting requirements

4.2 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. The board is divided into two sides: core side, where processors and memory are 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.

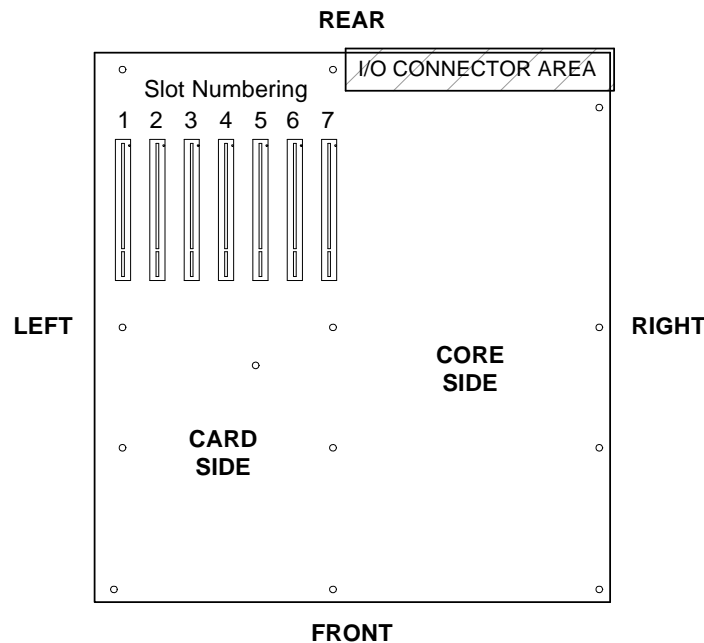


Figure 1: Board Orientation and Nomenclature

5 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).

5.1 Layout and Baseboard Mounting Holes

STATUS
Required

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 of PCI and PCI Express connectors are provided for reference as noted. Locations of adjacent slots are found by increasing or decreasing the horizontal dimension by 20.32mm (0.800”). 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 also 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 provide, 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.

The mounting locations defined represent the full compliment of attach points available in a compliant chassis. The baseboard designer can select the mounting locations required to provide the necessary support while accommodating component placement and routing constraints. Unused mounting locations are not populated in the chassis.

In addition to legacy mounting locations, this specification defines three additional mounting locations as alternatives when legacy holes cannot be utilized due to placement or routing constraints:

Location **H’** is recommended when location **H** is not usable.

Location **J’** is recommended when location **J** is not usable.

Location **Y’** is recommended when location **Y** is not usable.



NOTE

*The compliant baseboard is **not** required to utilize all of the mounting locations but cannot add any holes not specifically noted in Figure 2. 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.

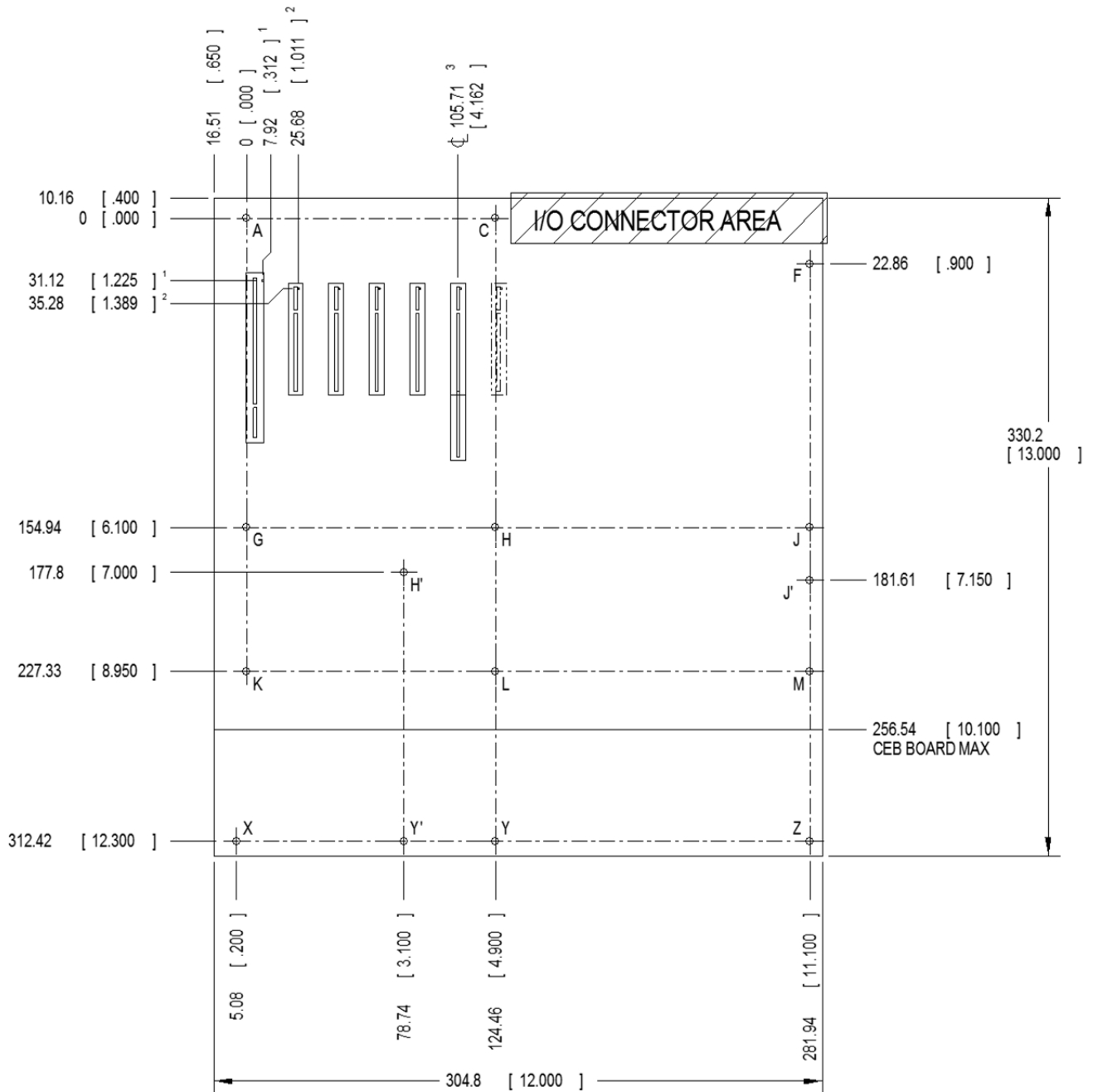


Figure 2: Available Baseboard Mounting Holes

Figure Notes:

- ¹ Denotes reference pin-1 dimensions of PCI connectors.
- ² Denotes reference pin-1 dimensions of PCI Express connectors.
- ³ Denotes the riser connector centerline dimension.

5.2 Volumetric Constraints

STATUS
Required

The *Enterprise Electronics Bay Specification* makes allowance for three different configurations:

- 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 shows a three-dimensional representation of the board volume. Figure 4 and the accompanying Table 2 dimension this maximum volume that must fully contain the baseboard and baseboard components – this includes processors, memory and memory riser cards, voltage regulators, and connectors. The volume does not contain mating connectors and cables or expansion cards.

The volumes provided do not account for baseboard thickness or clearance under 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.

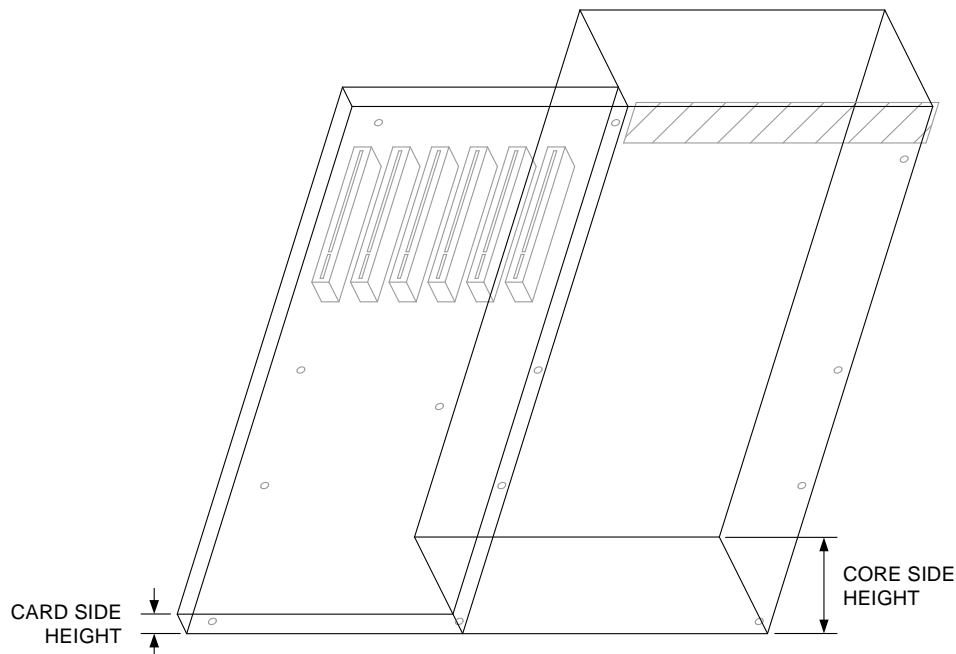


Figure 3: Baseboard Component Volume

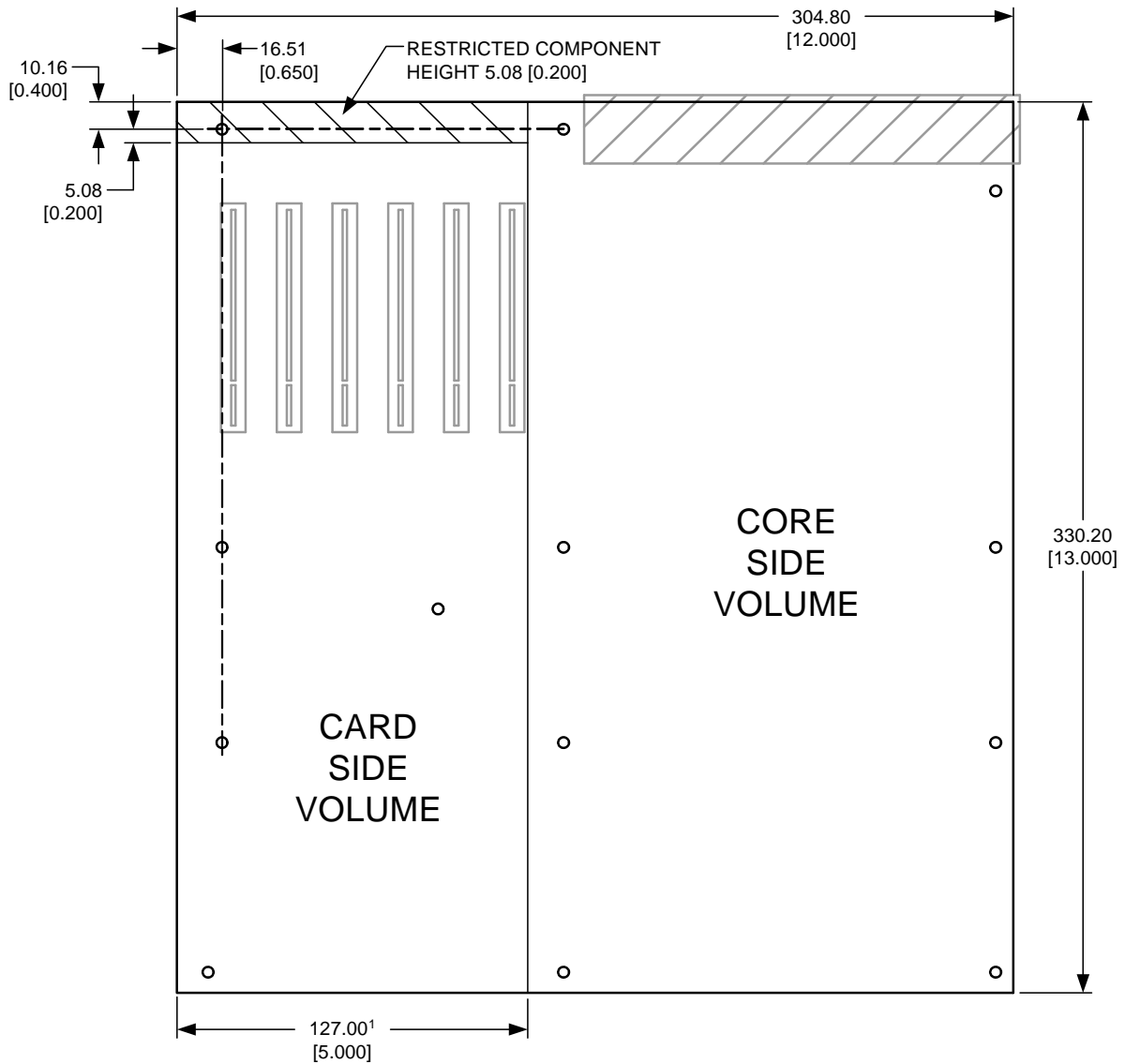


Figure 4: Baseboard Maximum Component Height

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	Core Side	Card Side	Typical Usage
EEB Case 1 & 2	76.20 [3.000"]	15.24 [0.600"]	Single (monoplanar) boards
EEB Case 3	152.40 [6.000"]	15.24 [0.600"]	Memory Riser Card(s), custom expansion boards

5.2.1 Rack Volumetric Constraints

STATUS
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 card. Design of the riser card is the responsibility of the board vendor; riser mechanical details may be found in Section 5.4. Boards targeted for 2U systems with direct-attach low-profile cards are defined as EEB Case 2 in Table 2

Figure 5 and the accompanying Table 3 provide the maximum three-dimensional volumes 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 does not contain mating connectors and cables.

The volumes provided do not account for baseboard thickness or clearance under 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.

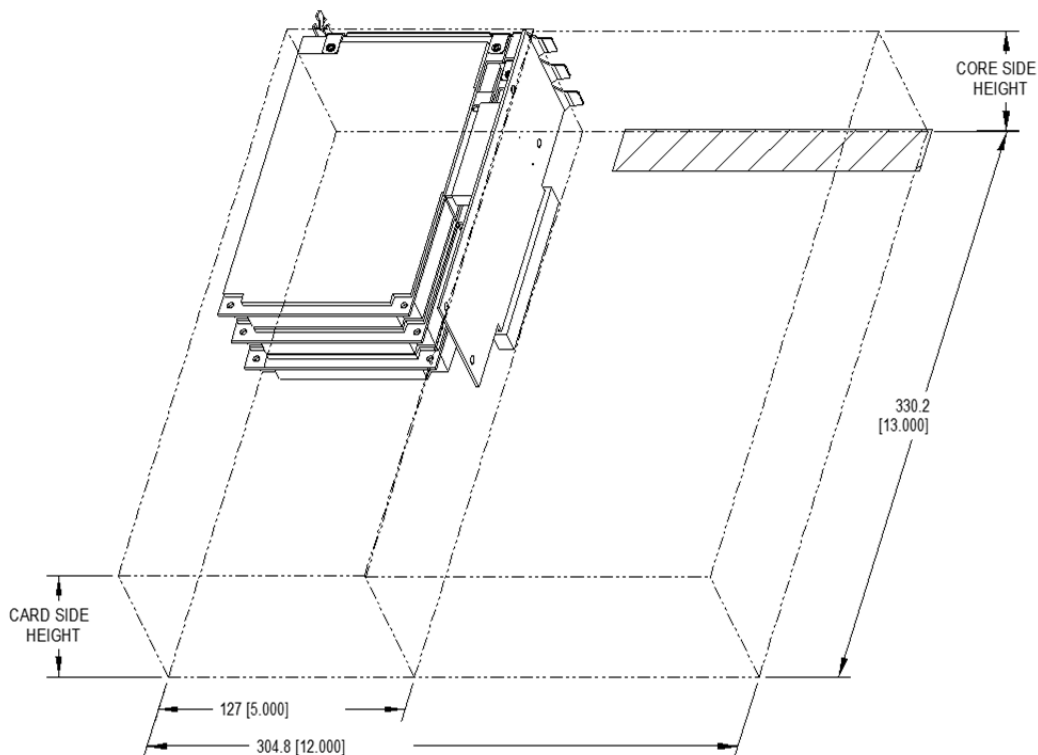


Figure 5: Rack Board-Set Component Volume

Table 3: Rack Board-set Maximum Component Height Restrictions

Board Type	Core Side	Card Side
TEB 1U	34.04 [1.340"]	36.00 [1.417"]
TEB 2U	76.20 [3.000"]	77.47 [3.050"]

5.3 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.

5.3.1 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 *Thurley Power Supply Design Guide (Thurley PSDG)*.

5.3.1.1 Baseboard Main Power Connector

STATUS
Required

24-pin Molex 44472 family or equivalent

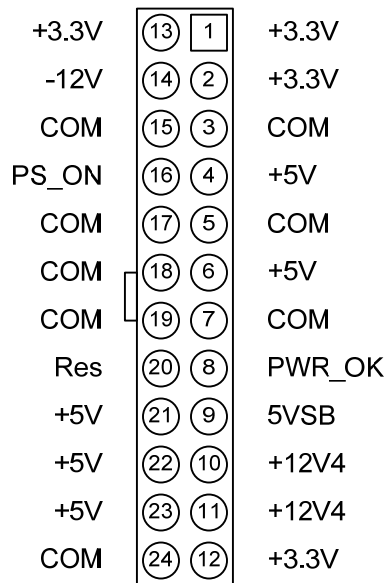


Figure 6: P1 Baseboard Power Connector

5.3.1.2 Processor Power Connectors

STATUS
Required

8-pin Molex 44472 family or equivalent

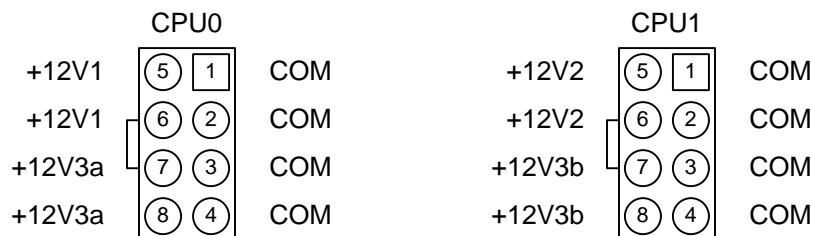


Figure 7: Processor Power Connectors

5.3.1.3 Server Signal Connector

STATUS
Optional

5-pin Molex 70545 or equivalent

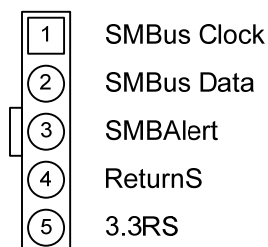


Figure 8: Server Signal Connector

5.3.1.4 +12V Baseboard Power Connector

STATUS
Optional

4-pin Molex 39-29-9042 or equivalent

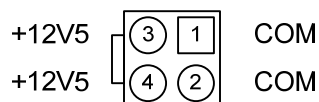


Figure 9: +12V Baseboard Power Connector

5.3.1.5 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. Power should be delivered to the rails only if the PS_ON signal is held at ground potential.

5.3.1.6 PWR_OK

PWR_OK is a power good signal and should be asserted high by the power supply to indicate that all the outputs are within the regulation limits of the power supply. When any output voltage falls below regulation limits or when AC power has been removed for a time sufficiently long that power supply operation is no longer guaranteed, PWR_OK will be de-asserted to a low state. The recommended electrical and timing characteristics of the PWR_OK signal are provided in the *Thurley Power Supply Design Guide*.

5.3.1.7 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.

5.3.2 Rear Panel I/O

STATUS
Required

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 10 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.

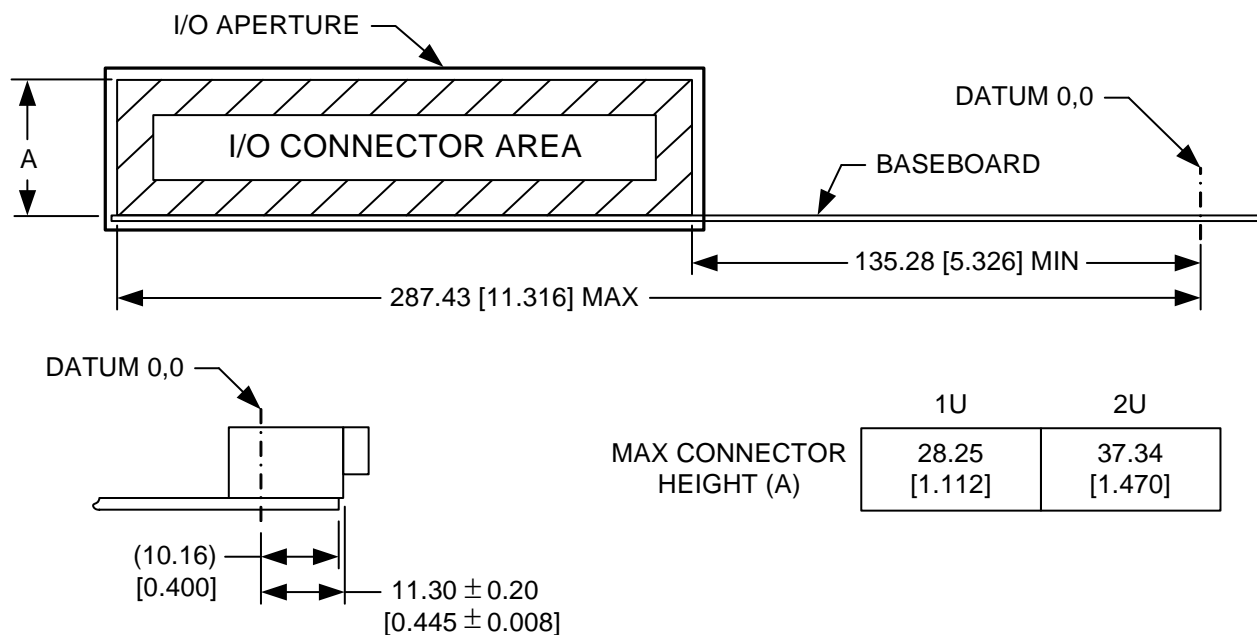


Figure 10: Baseboard I/O Connector Area

5.3.3 Front Panel I/O

STATUS
Recommended

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 11 provides the recommended minimum front panel features for an entry server or workstation. Additional features (such as system ID switch/LED) 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

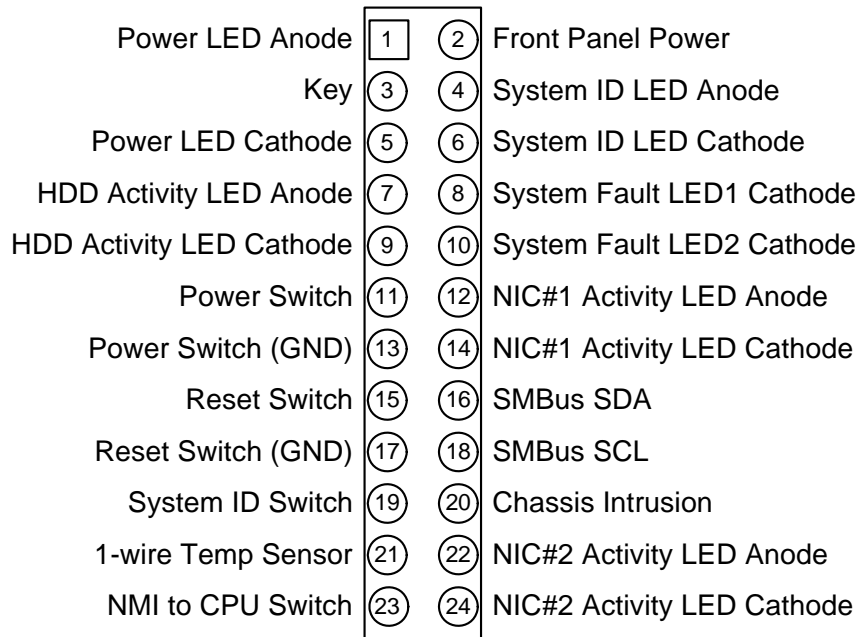


Figure 11: Standard Front Panel Connector

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 resistor 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

5.3.4 Front Panel USB

STATUS
Recommended

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

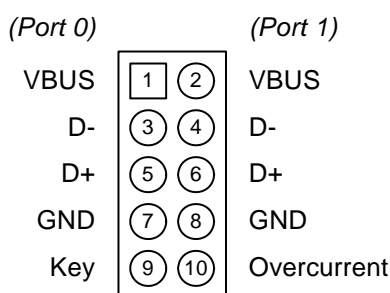


Figure 12: Front Panel USB Connector

5.3.5 Cooling Fan Pin-out

STATUS
Required

Figure 13 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. That is, an older 3-wire fan will plug into a 4-wire fan header (but will run at full RPM), while a 4-wire fan will plug into an older 3-wire fan header (but may or may not have fan speed control depending on the baseboard implementation).

4-pin Molex 47053-1000 or equivalent



Figure 13: 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/REV1_2_Public.pdf.

5.3.5.1 Hot-Plug Cooling Fan Pin-out

STATUS
Optional

Figure 14 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. 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 14: 6-Pin Cooling Fan Connector

5.3.5.2 Cooling Fan Connector Locations

STATUS
Recommended

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.

5.3.6 Chassis Intrusion Connector

STATUS
Recommended

Figure 15 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

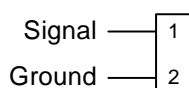


Figure 15: Chassis Intrusion Connector

5.3.7 Connector Placement

STATUS
Recommended

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
Power connectors	Right edge of the core side
Fan connectors	See Section 5.3.5
Memory connectors	Core side
Memory riser connector	Card slot 6 or slot 7
Front Panel I/O connector	Front of the card side
Front Panel USB connector(s)	Front of the card side
Chassis Intrusion Connector	Left rear edge of the card side
Floppy Disk Drive Connector	Front of the card side
ATA/SATA Connector(s)	Front of the card side
SCSI Connector(s)	Left front edge of the card side
IPMI Connector(s)	Card side

5.4 Riser Card Mechanicals

STATUS
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 16. 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.

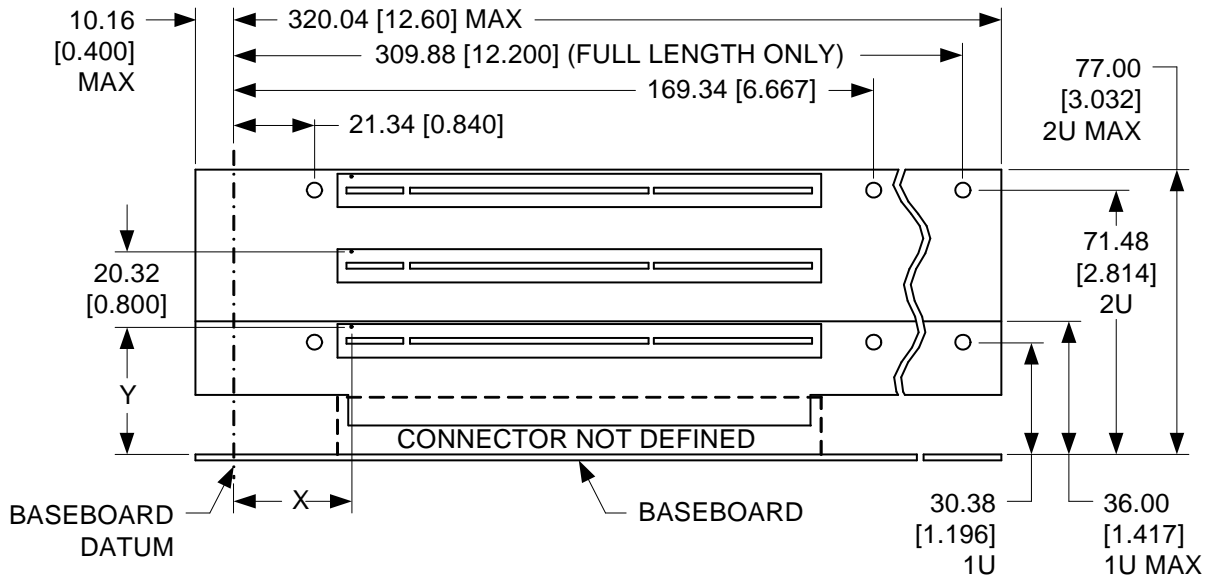


Figure 16: Riser Card Design (1U and 2U)

Figure Note:

Lower mounting holes for 1U riser only

Table 5: Riser Pin-1 Dimensions

Pin-1 Dimensions	X	Y
PCI Connector	31.12 [1.225]	34.57 [1.361]
PCI Express Connector	35.28 [1.389]	32.00 [1.260]

6 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.

6.1 Baseboard Mounting Locations

STATUS
Required

The compliant chassis must support all the mounting points shown in Figure 2 (page 12). 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.*

6.1.1 Riser Mounting Locations

STATUS
TEB

In order to support standardization of risers, this specification has defined a recommended riser card form-factor and location. The riser is located in Slot 6 (see Section 5.1). The riser mechanical details and mounting locations are provided in Section 5.4.

6.2 Board Volumetric Keep-Out

STATUS
Required

Figure 17 and Table 6 provide the recommended chassis volumetric keep-out for three 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 to ensure compatibility with single-processor (UP) designs and possible future dual-processor (DP) designs. In some cases these keep-outs may not be achievable. In such cases, the board volumetric (see Section 5.2) should provide the minimum dimensions.

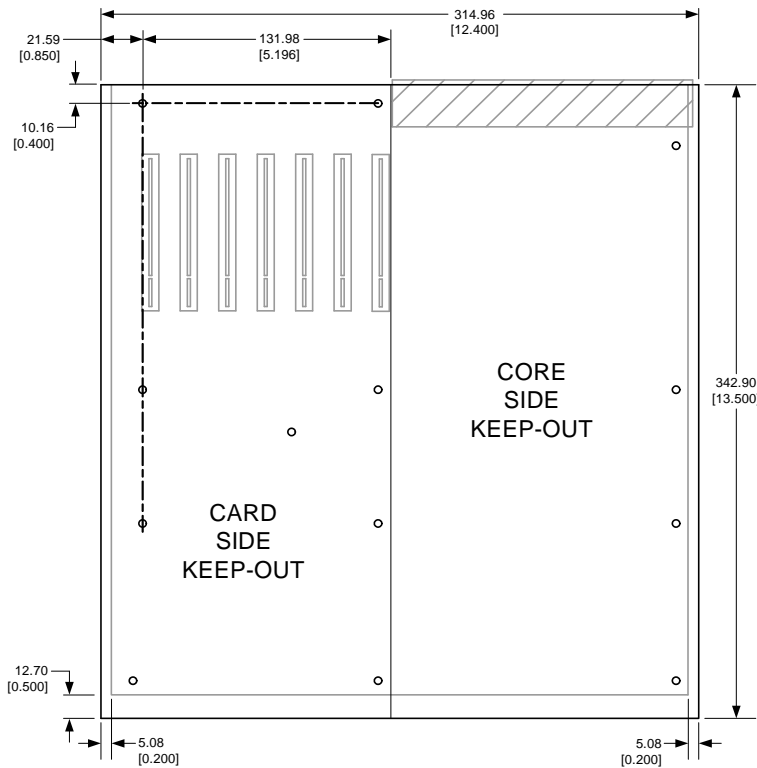


Figure 17: Board (-set) Keep-Out Volume

Figure Note:

3.00mm [0.118"] minimum back-side clearance required for both core and card sides

Table 6: Chassis Minimum Keep-out Height

Chassis Type	Core Side	Card Side	Typical Usage
EEB Case 1	76.20 [3.000"]	120.65 [4.750"]	Standard pedestal
EEB Case 2	76.20 [3.000"]	76.20 [3.000"]	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

6.3 Rear Panel I/O Aperture

STATUS
Required

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 18 shows the I/O aperture. The 1U chassis uses a reduced-height aperture found in Section 6.3.1.

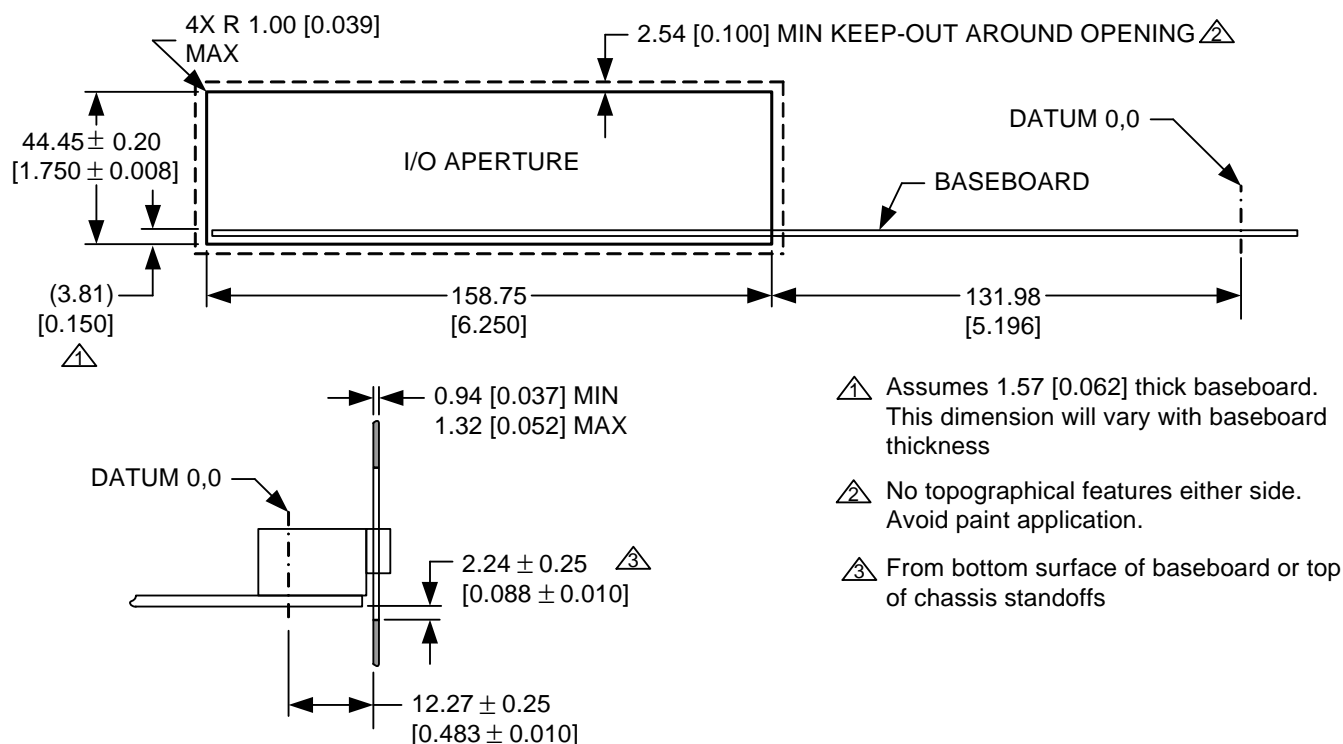


Figure 18: Rear Panel I/O Aperture

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.

6.3.1 1U Rear Panel I/O Aperture

STATUS
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.

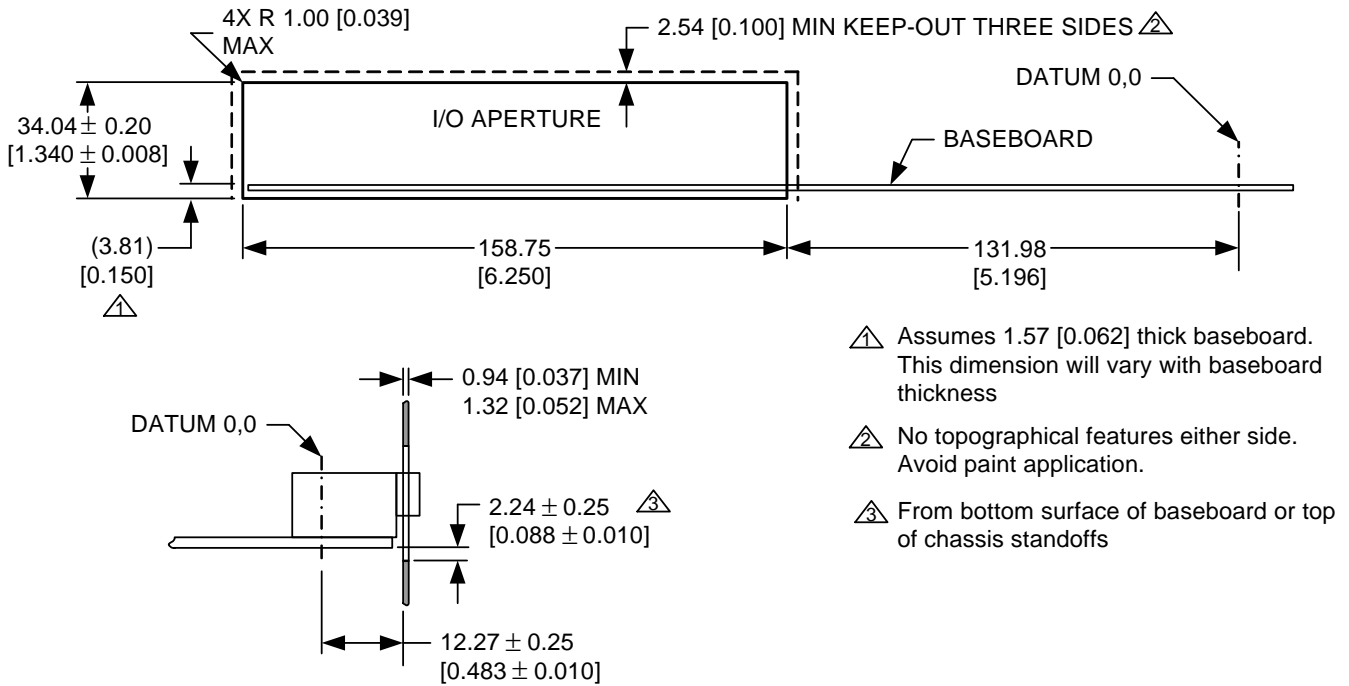


Figure 19: 1U Rear Panel I/O Aperture

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.

6.3.1.1 Example 1U I/O Shield

Figure 20 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.

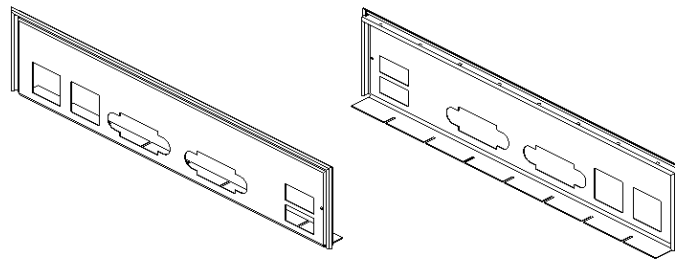


Figure 20: Example 1U I/O Shield

6.4 Rear Panel Card Apertures

STATUS
TEB

Riser Card Design (1U and 2U) Figure 16, Section 5.4 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 16).

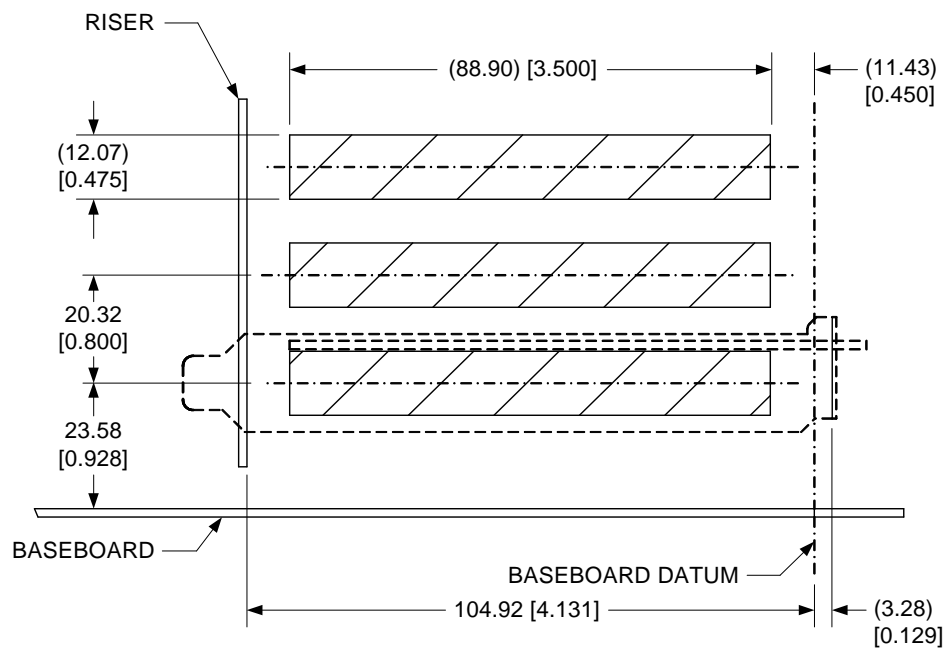


Figure 21: Rear Panel Card Apertures

6.5 Front Panel

STATUS
Recommended

In order to support the recommended Front Panel Connector defined in Figure 11 and the Front Panel USB connector defined in Figure 12, Table 7 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 7: 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 (2)	Optional
System ID LED	Optional
Chassis Intrusion	Optional
SMBus SDA	Optional
SMBus SCL	Optional

6.6 Electronics Bay Cooling

STATUS
Recommended

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 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.

6.6.1 Thermal Design Philosophy

The thermal design philosophy for a pedestal chassis is to create four distinct thermal zones, or partitions, within the chassis. Figure 22 shows the major components of a typical system and the four zones recommended for thermal design.

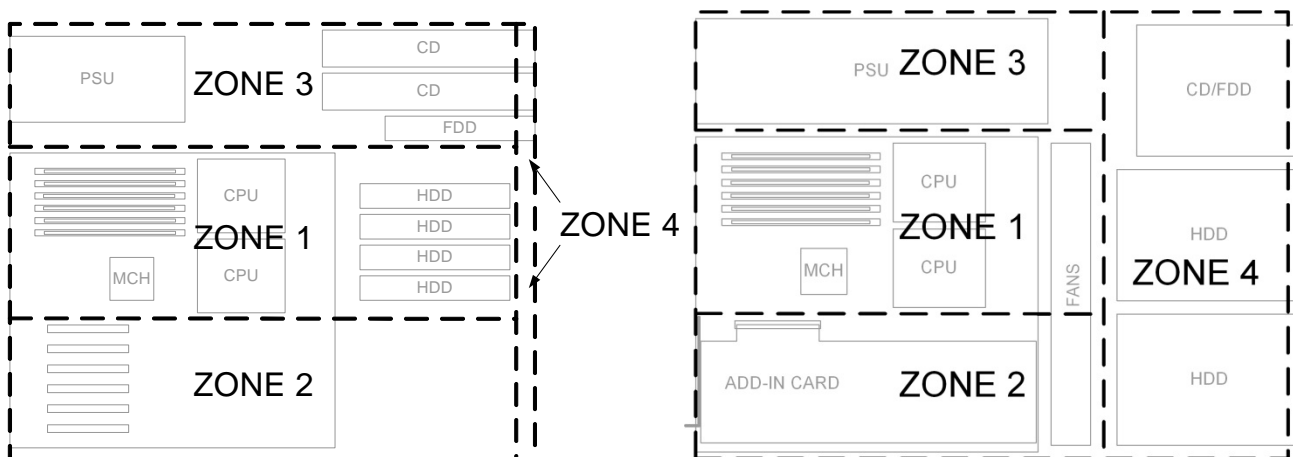


Figure 22: Thermal Zone Definitions

- **Zone 1** is the core side of the baseboard and includes the processors and memory. Depending on system configuration, this zone may also contain hard disk drives.
- **Zone 2** is the card side of the baseboard and includes PCI and PCI Express add-in cards and video cards when present. Depending on system configuration, this zone may also contain hard disk drives.
- **Zone 3** contains the power supply and often also includes external devices such as optical drives and floppy disk drives.
- **Zone 4** consists of the bezel and all chassis venting.

6.6.2 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 drive (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 8: Fan Sizing Recommendation 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

6.6.3 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 pressure drop 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 thick. Five or more fans are generally required, with four of those fans dedicated to core-side (processor) cooling.
- 2U chassis can accommodate up to 80mm fans; these are usually 38mm thick. Three or more fans are generally required with two of those fans (and sometimes part of the third) dedicated to core-side (processor) cooling

6.6.4 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.

6.6.5 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.

6.6.6 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.

6.7 Electromagnetic Interference Considerations, EMI

STATUS
Recommended

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.

7 PSU Reference

STATUS
Recommended

The chassis designer must consider the power supplies to be supported. These power supplies are described in the *Thurley Power Supply Design Guide (Thurley 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 9 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 9: Power Supply Cross-Reference

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

8 Reference Configurations

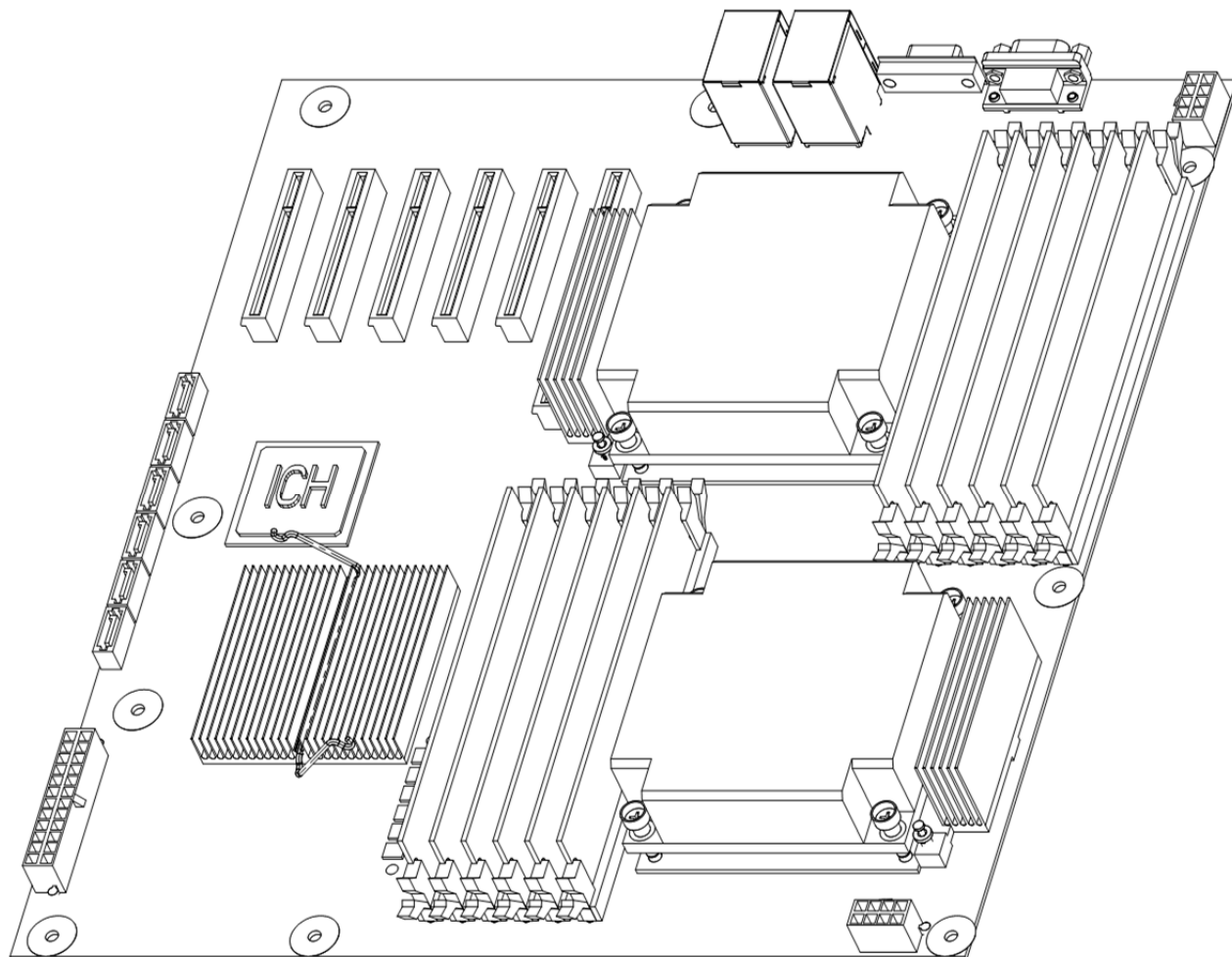


Figure 23: Reference EEB Configuration

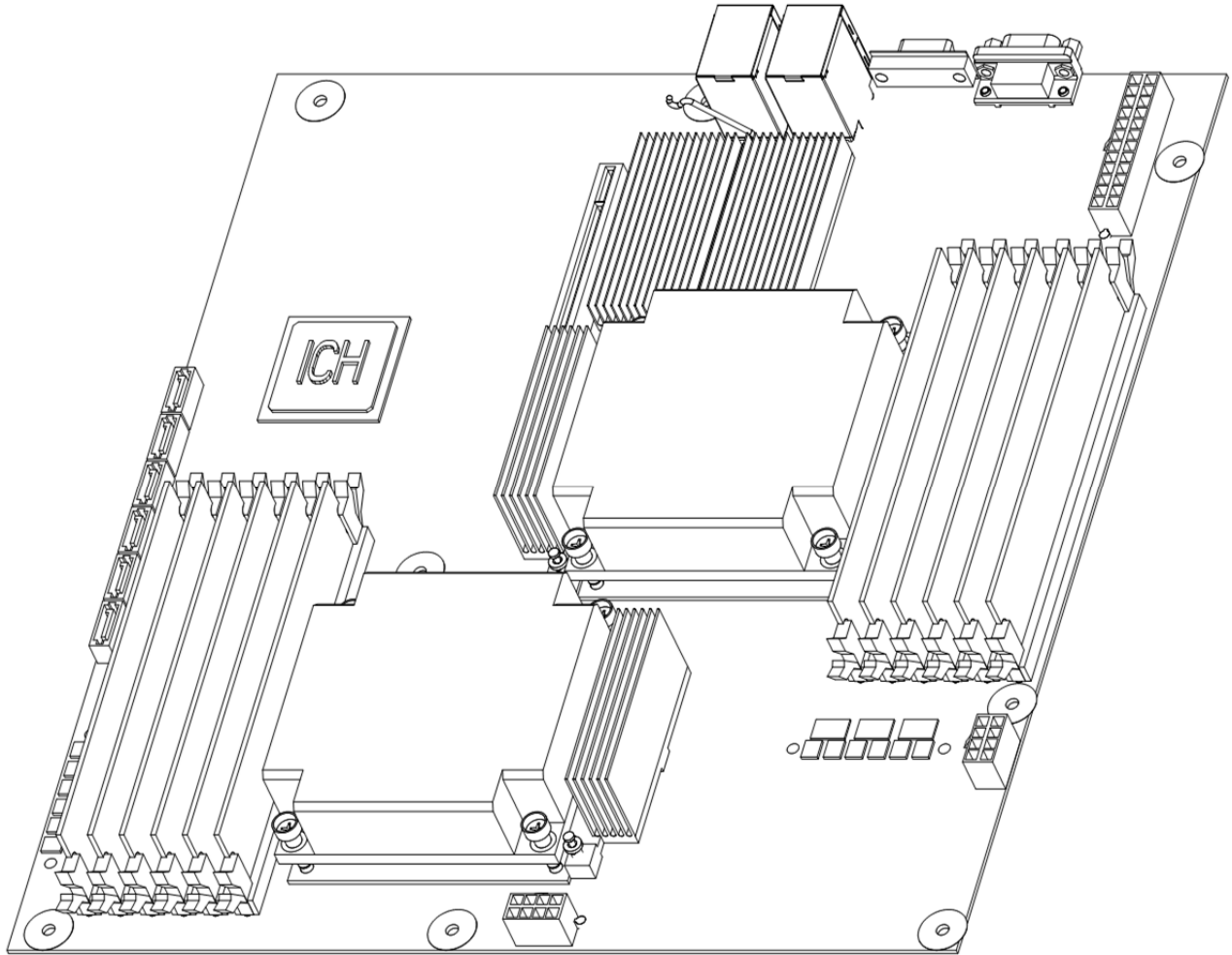


Figure 24: Reference TEB Configuration

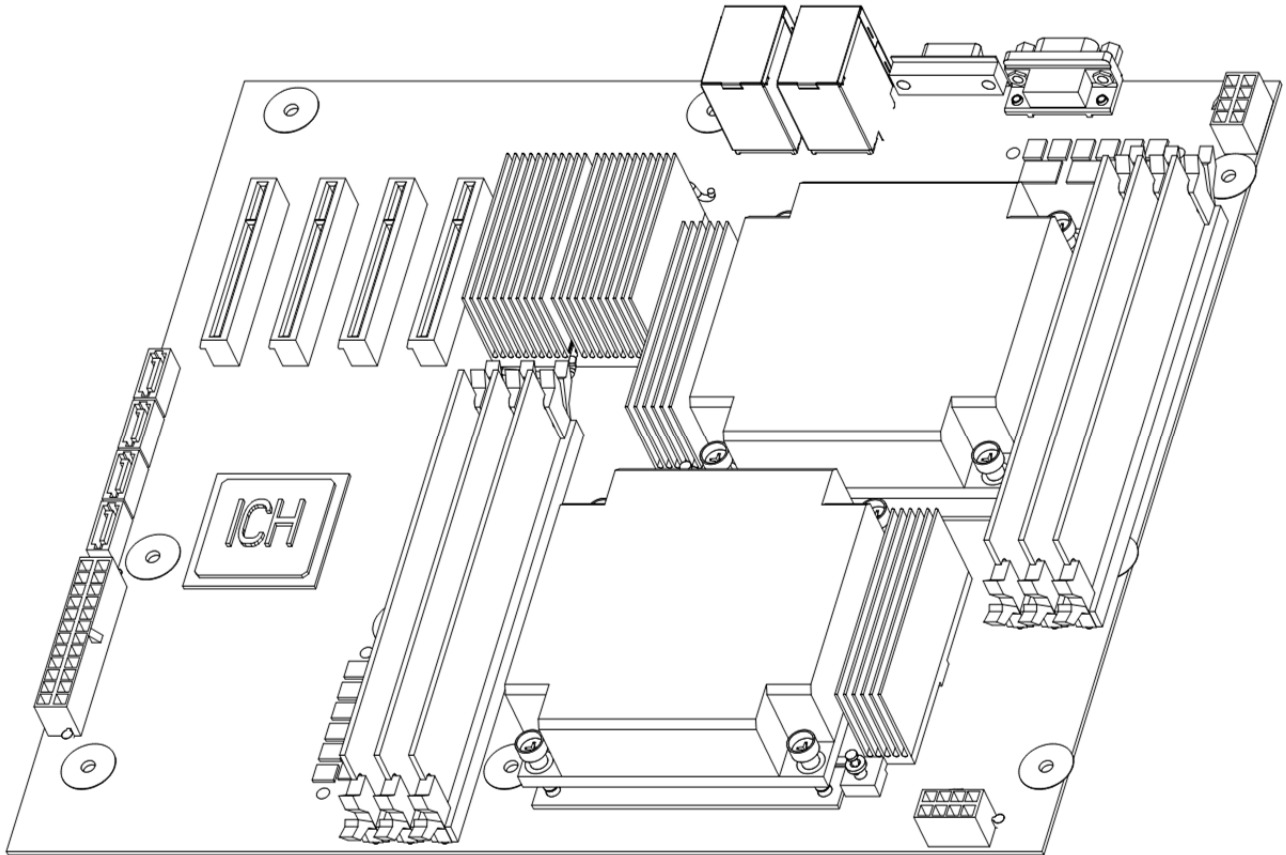


Figure 25: Reference CEB Configuration

9 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

Other information may be found at the following websites:

- *ATX Specification*, www.formfactors.org
- *Windows NT™ Server Design Guide*, www.microsoft.com/hwdev/serverdg.htm
- *Intelligent Platform Management Bus (IPMI) Communications Protocol Specification*, developer.intel.com/design/servers/ipmi
- *PCI and PCI Express specifications*, www.pcisig.com
- *Universal Serial Bus Specification*, www.usb.org

This specification references connectors from the following suppliers:

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