Balanced Technology Extended (BTX) Interface

Specification Update

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Revision History

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600565	1.1	• No change in the Content. Applied the latest Intel Template and formatted the document.	July 2018

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1 Introduction

The Balanced Technology Extended (BTX) interface specification was developed to provide standard interfaces and form factor definitions to address the electrical, thermal, and mechanical attributes of desktop computer systems. The specification is intended to allow for a wide variety of product differentiation that can be adapted to multiple applications and usage models.

This specification describes the critical mechanical and electrical interfaces for the design of chassis, motherboard, power supply, and other system components necessary for hardware vendors and integrators to build and integrate compliant components, systems, and devices that are interoperable with each other. The intention of this document is not to provide all requirements necessary to design any one of these components, but instead to provide standard interfaces for the components to be designed around.

The following table summarizes some of the key features enabled by the BTX specification.

Table 1-1. BTX Feature Summary

Features	Benefits
Low profile options	Easy integration in small and thin form factor systems
In-line core layout	Optimized for efficient system cooling
Scaleable board dimensions	Multiple system sizes and configurations
Structural board support mechanisms	Mechanical characteristics to support high-mass motherboard components

The following table details the interfaces defined in this specification and the section(s) that address each.

Table 1-2.Specification Quick Reference

Interfaces	Features Defining Interface	Related Sections(s)
Board/Chassis Interfaces	Motherboard geometry and mounting hole locations (mechanical)	Section 3.1
	Motherboard volumetric zones (mechanical)	Section 3.2
	Chassis volumetric zones (mechanical)	Section 3.2.2
	Rear panel chassis I/O locations and openings (mechanical)	Section 3.3.4 and Section 3.4.1
	Main power connector (electrical and mechanical)	Section 4

Interfaces	Features Defining Interface	Related Sections(s)
Board/Power Supply Interfaces	+12V power connector (electrical and mechanical)	Section 4
Chassis interfaces to other components	Chassis interface to SRM (mechanical)	Section 3.3.2
	Chassis interface to Thermal Module (mechanical)	Section 3.3.3

1.1 Terminology

The following table explains terms introduced in this specification.

Table 1-3. Terminology

Term	Description
Support and Retention Module (SRM)	System component that is assembled to the chassis beneath the motherboard to provide structural support for motherboard and components as well as retention for a thermal module.
Thermal Module	A system component with the primary role of dissipating heat from the core components. A typical thermal module includes a heatsink for the processor, an air mover such as an axial fan, and a duct to isolate and direct airflow through the system. The flexibility to adapt to many applications are offered through the option to integrate a range of cooling technologies and components to create a thermal module. Modules will be one of two types based on which Zone a component height maximum (Refer Figure 4) is selected: Type I (Standard Height) or Type II (Low Profile).

1.2 Reference Documents

The following table lists documents related to this specification.

Table 1-4. Related Documents

Document	Document No./Location
PCI Express* Specifications	http://www.pcisig.com/specifications/pciexpress/
Conventional PCI Specifications	http://www.pcisig.com/specifications/conventional/
ATX and microATX Specifications	http://www.formfactors.org

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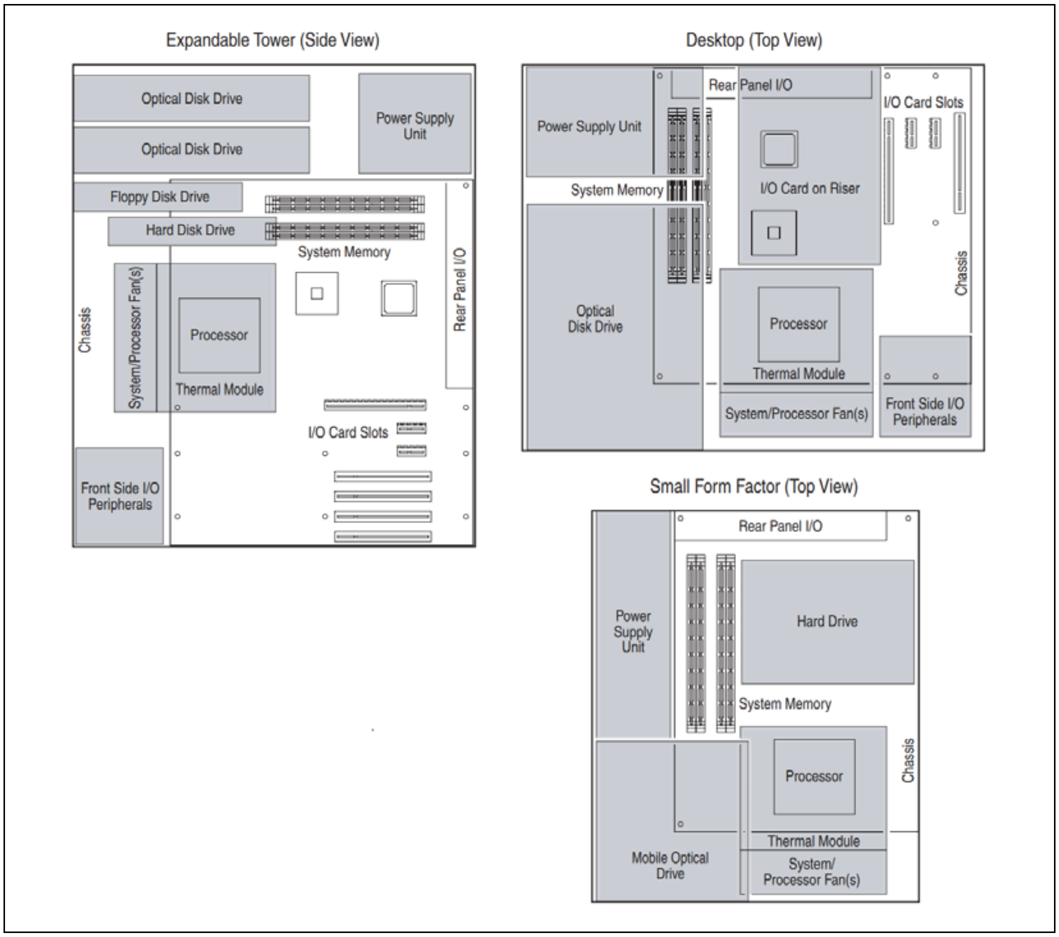
2 Form Factor Overview

This specification allows the processor, chipset, memory, add-in cards, and other components to be designed and located in a way that facilitates both efficient motherboard routing and cooling of the components. It also allows options for system layouts that can accommodate a range of profiles and sizes from compact systems and devices to large, very expandable systems.

The power supply connectors and interfaces are defined to be compatible with those defined for the ATX family of form factors. For more information on standard power supply definitions and the ATX form factor family, refer the references listed in Chapter 5.

The following figure shows three example of the many layouts possible with the BTX form factor.

Figure 2-1. Example BTX Board and System Layouts



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3 Mechanical Requirements

This chapter describes the mechanical requirements of BTX system components and the associated interfaces.

Reference Datums are maintained throughout the drawings in this chapter. The following table lists the Datums and the figure in which they are defined.

Table 3-1. Reference Datums

Datum	Defined
A	Figure 2
B	Figure 2
C	Figure 2
E	Figure 7
G	Figure 6
H	Figure 6
J	Figure 6
P	Figure 7

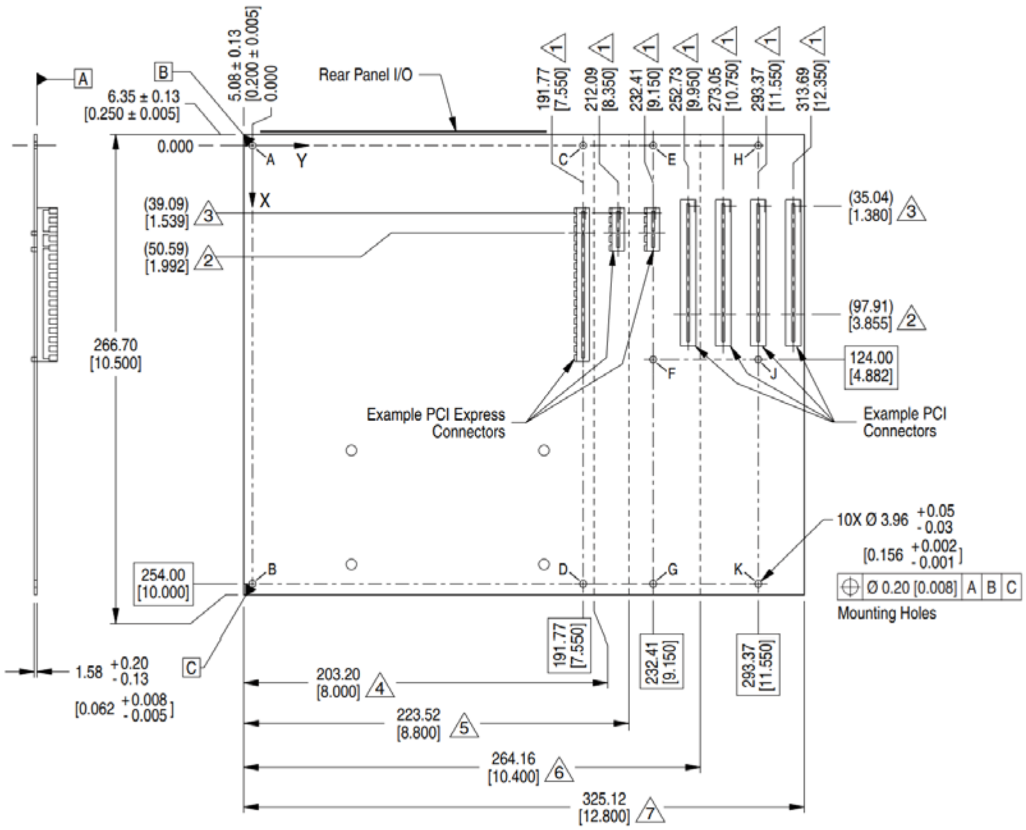
3.1 Motherboard Size and Mounting Hole Placement

A BTX board must adhere to the mechanical details depicted in Figure 2. All boards must be 266.70 mm deep. The board width may range from 203.20 mm to 325.12 mm as per the following table. The following table lists typical board sizes and the mounting holes required for the motherboard. A BTX chassis must provide mounting points and add-in card apertures in the rear panel for the largest board that it is intended to support.

Table 3-2. Board Size Options

Board Designation	Maximum Board Width	Maximum Number of Add-in Card Slots Available	Required Mounting Hole Locations	Notes
picoBTX	203.20 mm	1	A, B, C, D	
nanoBTX	223.52 mm	2	A, B, C, D	
microBTX	264.16 mm	4	A, B, C, D, E, F, G	
BTX	325.12 mm	7	A, B, C, D, E, F,G, H, J, K	

Figure 3-1. BTX Form Factor Board and Mounting Hole Dimensions



Notes:

1. Card connector slot centerline
2. Connector key centerline
3. Connector pin 1 reference
4. picoBTX board (maximum 1 slot)
5. nanoBTX board (maximum 2 slots)
6. microBTX board (maximum 4 slots)
7. BTX board (maximum 7 slots)
8. Tolerance unless otherwise noted ± 0.25 [0.010]

View Orientation Defined by Third Angle Projection

Add-in Card Connector X Direction Location

Card type	X 2	X 3
PCI 5V	97.91 [3.855]	(35.04) [1.380]
PCI 3.3V	49.64 [1.954]	(35.04) [1.380]
AGP 3.3V	83.11 [3.272]	(60.61) [2.386]
AGP 1.5V	103.11 [4.059]	(60.61) [2.386]
PCI Express	50.59 [1.992]	(39.09) [1.539]

3.2 Volumetric Zones

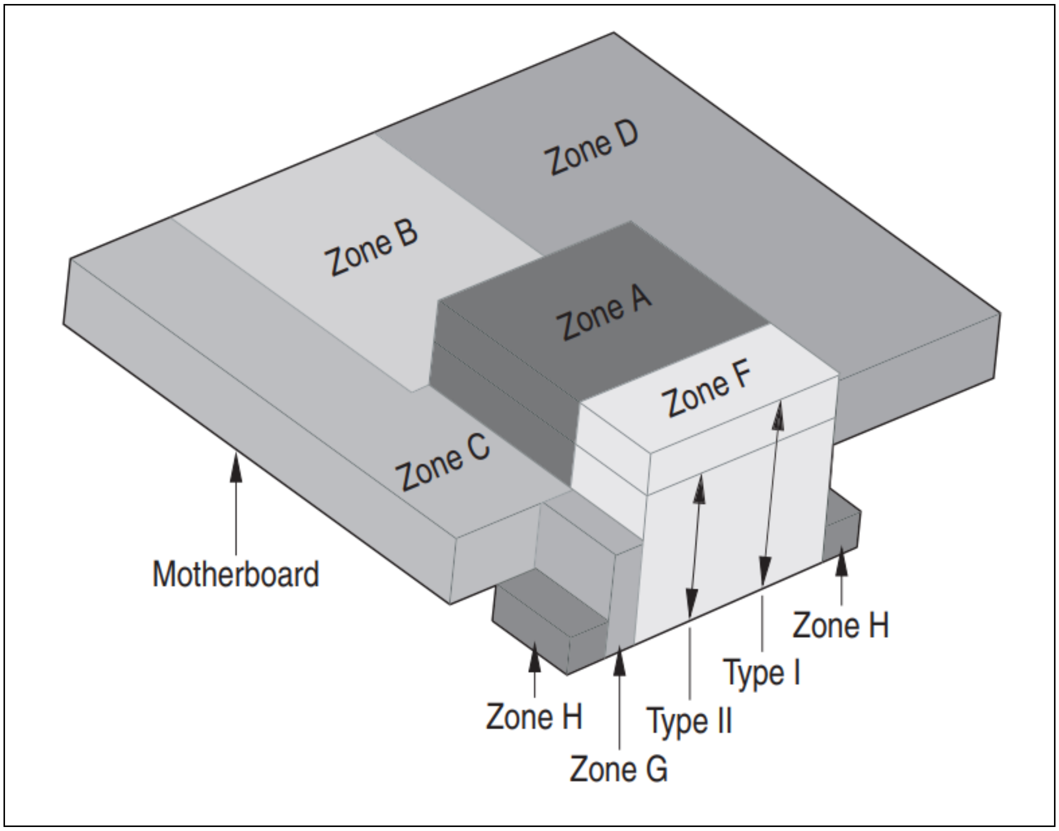
Volumetric zones are defined to provide a definition for mechanical requirements for each of the key system components areas. These definitions allow components in these areas to be designed separately and integrated without interface.

This section describes volumetric zones based from the motherboard planar (referred to as motherboard zones – Section 3.2.1), volumetric zones based from the chassis (referred to as chassis zones – Section 3.2.2), and the placement requirements for all system components with respect to the zones. These requirements ensure that key system components do not mechanically interfere when they are integrated into a system.

The following figure shows some of these zones. Zones A, B,C and D are motherboard zones and Zones F, G, and H are chassis zones. Not shown in this figure are chassis zones J and K (under the motherboard).

Note: Some zones, like Zone A and Zone F, have two heights associated with them. This is to accommodate the two types (heights) of thermal modules and the corresponding system designs. Type I (Standard Height) is intended to be utilized where space is available to maximize the volume available for the thermal module solution design, while Type II (Low Profile) is included as an option for designs where lower profile components in this area are highly valued.

Figure 3-2. Chassis and Motherboard Volumetric Zones (not all zones are shown)



3.2.1 Motherboard Volumetric Zones

Sections 3.2.1.1 and 3.2.1.2 define the footprint and height constraints that comprise the overall motherboard volumetric zones. All components in a BTX-compatible system must adhere to the motherboard volumetric zones according to the requirements in following table.

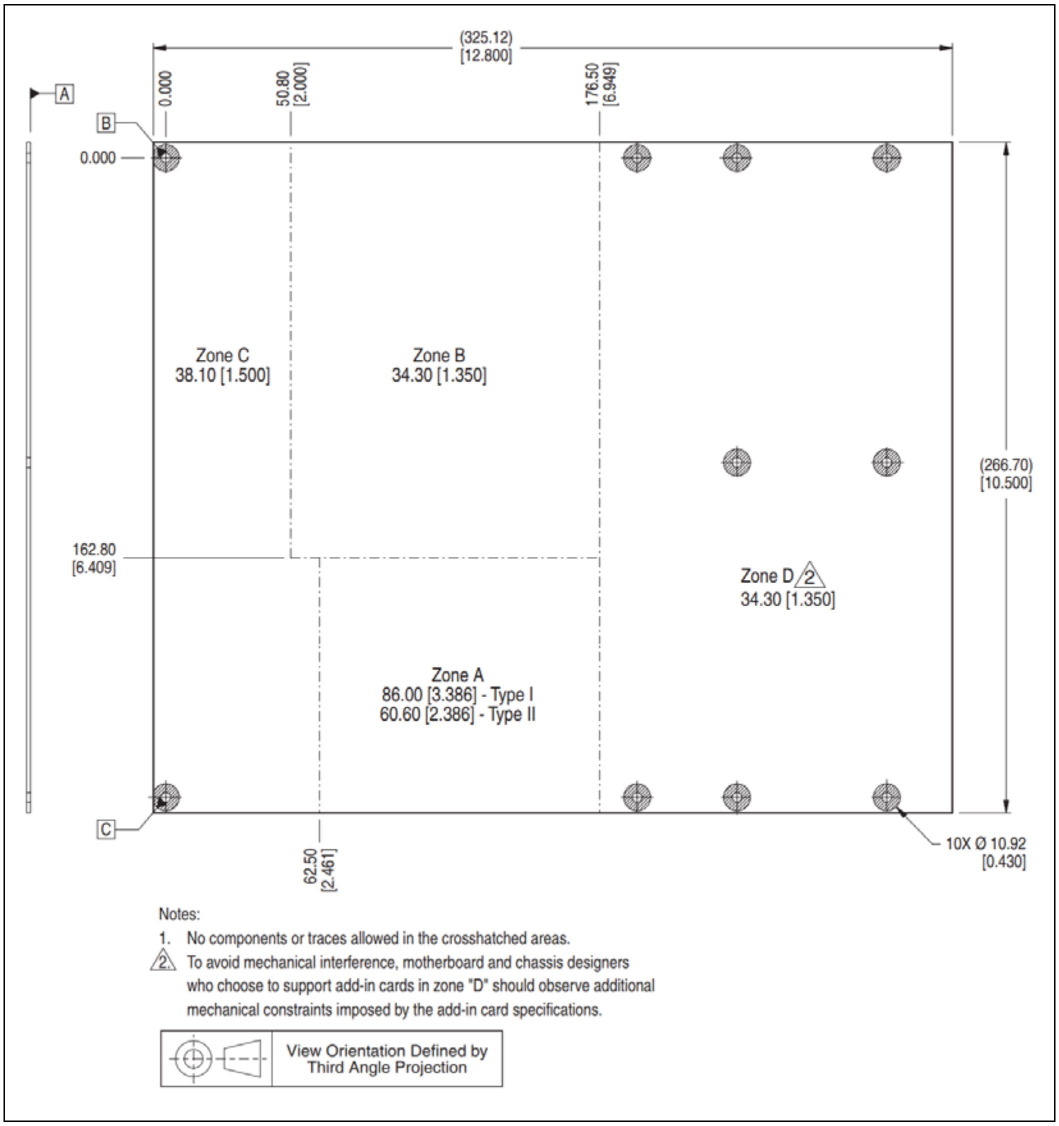
Table 3-3 Categories and Requirements for Motherboard Volumetric Zones

Category	Examples	Requirements
Motherboard components	Memory modules, processors, rear panel motherboard connectors, and rigid portions of motherboard-terminated cable assemblies, component heatsinks, and components soldered to motherboard	Must fit completely within the motherboard volumetric zones (primary and secondary side)
Chassis components	Chassis walls, chassis pan, motherboard mounting features, peripheral mounting brackets	Must not intersect the motherboard volumetric zone at any point. In addition, adequate clearance should be provided between the chassis, the motherboard volumetric and installed system components to avoid component interface and/or damage during shipping or other dynamic conditions
Transition components	Add-in cards, air ducts, Thermal Module, SRM, flexible cabling from the motherboard to other system components, motherboard EMC grounding features	May cross the outer boundary of the motherboard volumetric zone. Some of these components, such as add-in cards, may have their own mechanical volumetric specifications which should be considered by the designer in addition to those specified in this document. The thermal module can reside across multiple zones (typically Zones A, C, F, G and H). The thermal module should not intersect the top boundaries of any of the volumetric zones
Other System components	Disk drives, front panel cards, system power supply, and other system components not listed above	Must not intersect the motherboard volumetric zone at any point. In addition, adequate clearance should be provided between installed system components and the motherboard volumetric zone to avoid component interference and/or damage during shipping or other dynamic conditions

3.2.1.1 Motherboard Primary Side Volumetric Zones

Motherboard primary side volumetric zones are defined in following figure. All areas are defined from the top surface of the motherboard.

Figure 3-3. Motherboard Primary Side Volumetric Zone



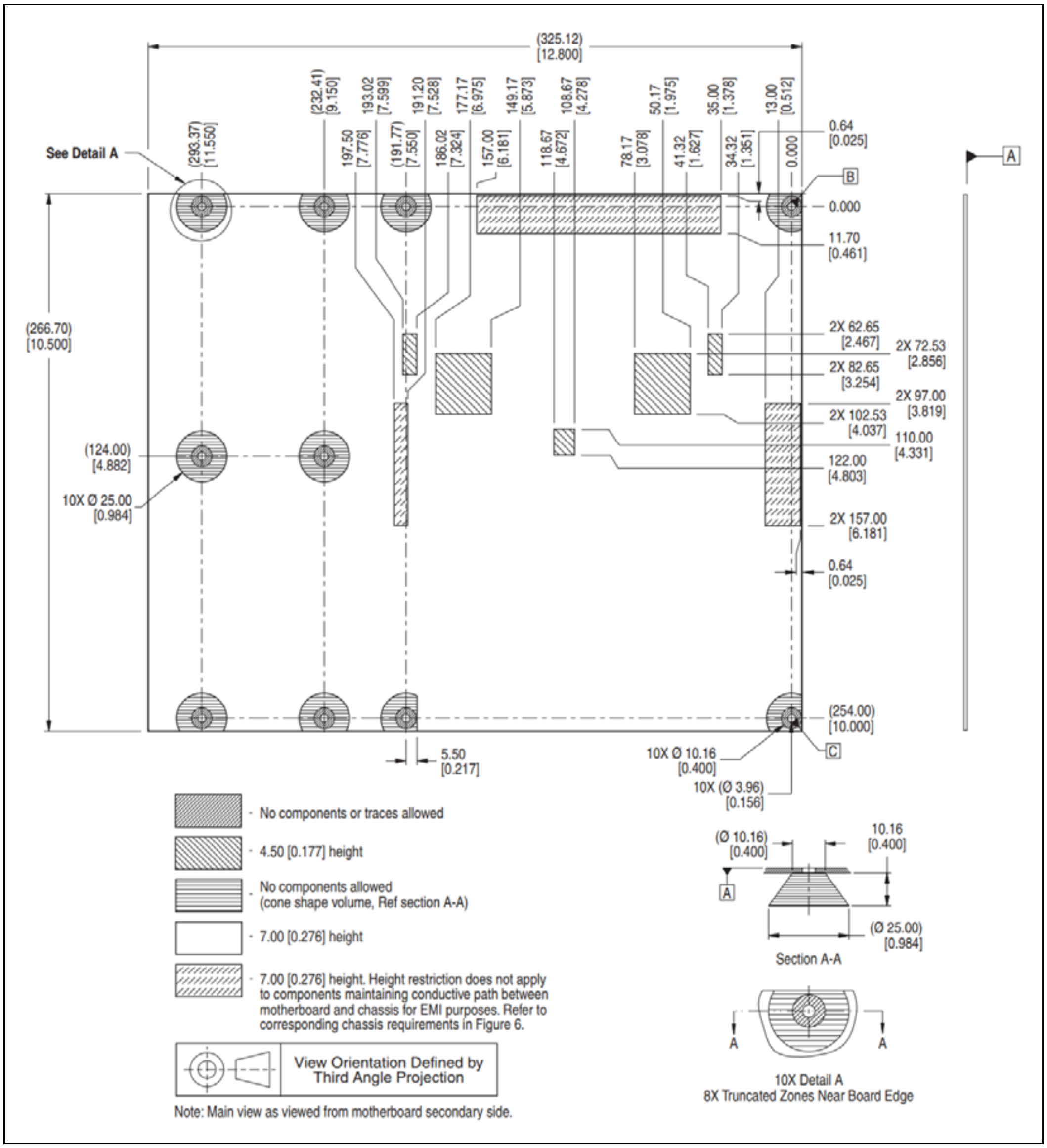
3.2.1.2 Motherboard Secondary Side Volumetric Zones

Motherboard secondary side volumetric zones are defined in following figure. All areas are defined from the bottom surface of the motherboard.

Also defined in the following figure are areas for inclusion of optional EMC features. If needed, EMC grounding features extending from the motherboard to the chassis should only be designed within these areas to ensure contact with the corresponding areas reserved in the chassis below the board for this purpose.

All zone boundaries are defined to avoid interface with components in the assembled condition. Additional clearances based on target assembly processes may need to be incorporated.

Figure 3-4. Motherboard Secondary Side Volumetric Zones



3.2.2 Chassis Volumetric Zones

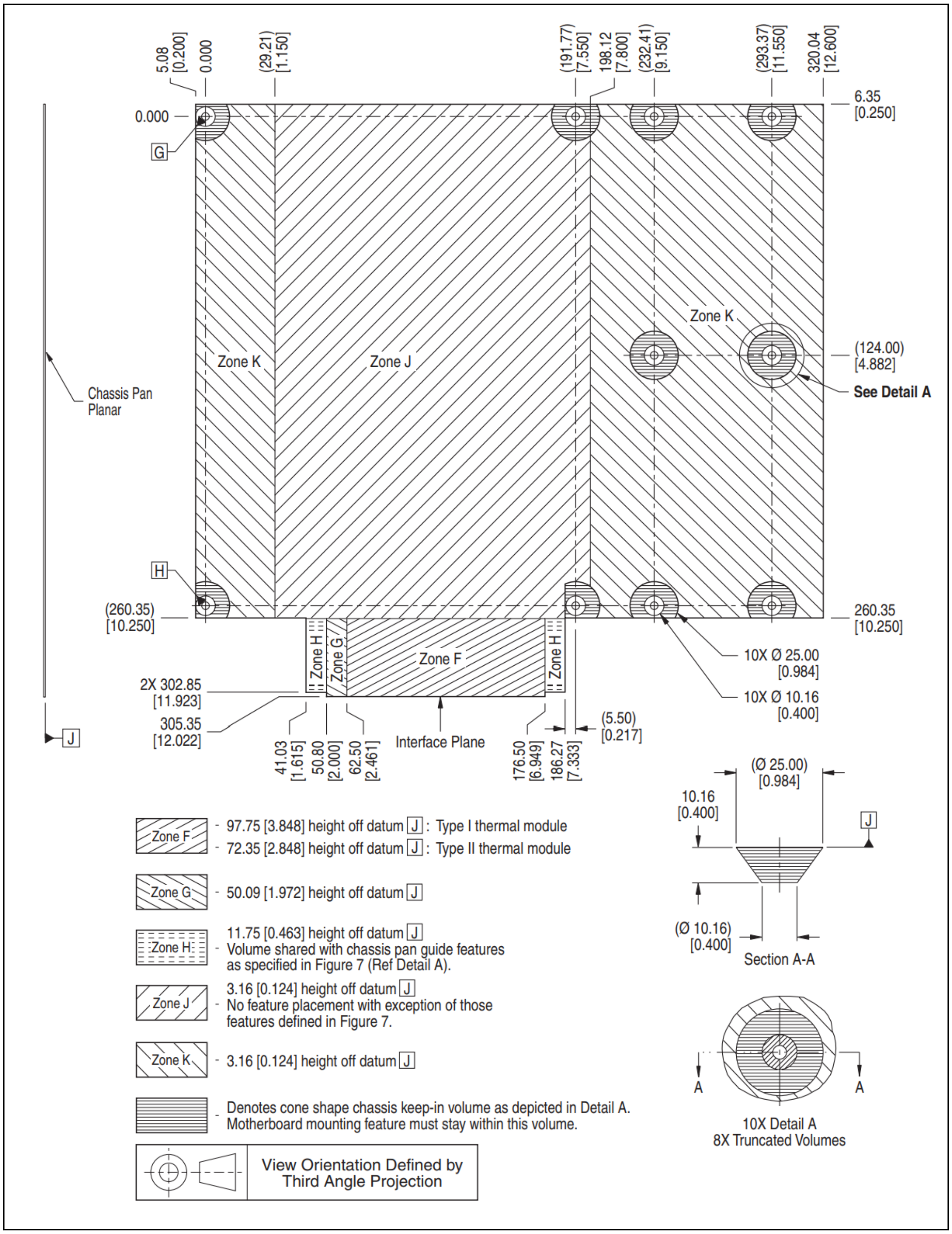
Figure 6 defines the footprint and height constraints that comprise the *chassis volumetric zones* as referenced from the top surface of the chassis pan. All components in a BTX-compatible system must adhere to the chassis volumetric zones according to the requirements in following table.

Note: Although Figure 6 shows the zones for the widest motherboard (seven slot board), rules for the portion of Zone K under Zone D scale according to the width of the motherboard being used. Requirements in this section do not affect the volume beyond the extensible edge of the motherboard that the system is designed to accommodate.

Table 3-4. Categories and Requirements for Chassis Zones

Category	Examples	Requirements
Motherboard components	Memory modules, processors, rear panel motherboard connectors and rigid portions of motherboard-terminated cable assemblies, component heatsinks, and components soldered to motherboard	Must not intersect any of the chassis volumetric zones at any point. In addition, adequate clearance should be provided between installed system components and the chassis volumetric to avoid component interface and/or damage during shipping or other dynamic conditions.
Chassis components	Chassis pan, board mounting features and drive bays	Must not intersect volumetric zones F, G, or H. Chassis features in Zone K must not cross the upper boundary of Zone K. Only the interface features called out in and are allowed in Zones F, G, H, and J. No other chassis features should intersect this zone. Board mounting features should stay within the zones specified for these features.
Transition components	SRM and Thermal Module	May cross the outer boundary of some chassis zones. Components such as an SRM may have their own requirements which should be considered by the designer in addition to these specified in this document.
Other System components	Disk drives and system power supply	Must not intersect any of the chassis volumetric zones at any point. In addition, adequate clearance should be provided between installed system components and the chassis volumetric to avoid component interface and/or damage during shipping or other dynamic conditions.

Figure 3-5. Chassis Volumetric Zones



3.3 Chassis Mechanical Interfaces

In addition to the other mechanical requirements in this specification, a BTX chassis should provide the interface features listed in following table.

Table 3-5. Chassis Mechanical Interface Requirements

Mechanical Interface Features	Reference
Areas on the chassis pan of interface with board EMC grounding features	Figure 7
Attach features for a Support and Retention Module (SRM)	Figure 7 and Figure 8
Common interface to a thermal module	Section 3.3.3, Figure 10
Rear panel aperture for interface with the motherboard rear panel connectors	Section 3.3.4, Figure 11

3.3.1 Chassis Interface for EMC Grounding

The chassis should allow areas as shown in following figure to interface with the grounding features on the motherboard. These areas must be unpainted and allowed conduction to chassis for grounding.

3.3.2 Chassis Interface to Support and Retention Module

A Support and Retention Module (SRM) is a system component that can be used to support an area of the motherboard and loads upon the motherboard such as loads associated with a thermal module. A SRM can reside in chassis volumetric zone J and also may share chassis zone K as well as the secondary side motherboard zone. A BTX chassis must include interfaces as defined by the features shown in the following figure to provide a standard interface for SRMs. Accordingly a SRM for a BTX chassis and motherboard should be designed to fit into a mate with these features. The interface between the SRM and the motherboard will vary depending on the motherboard and thermal module design.

Figure 3-6. Chassis Interface to SRM Requirements

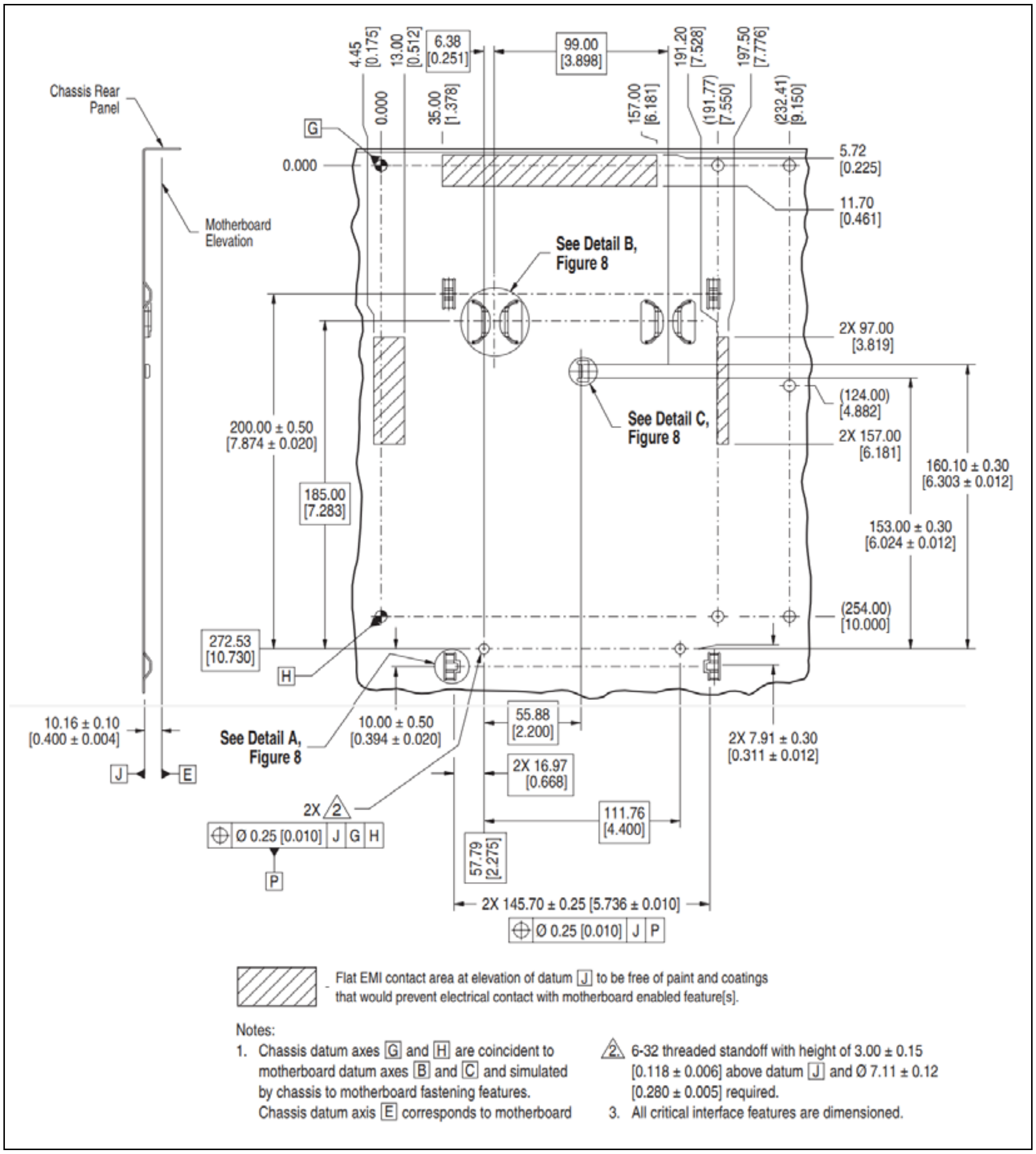
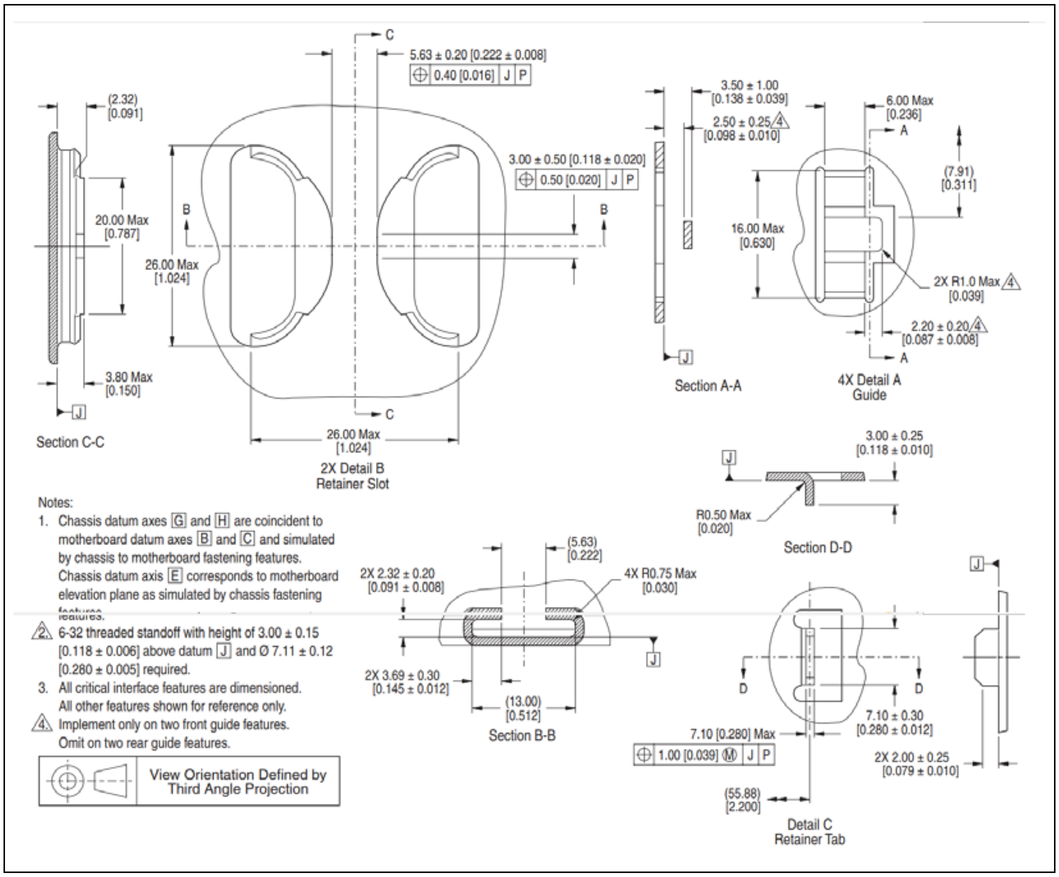


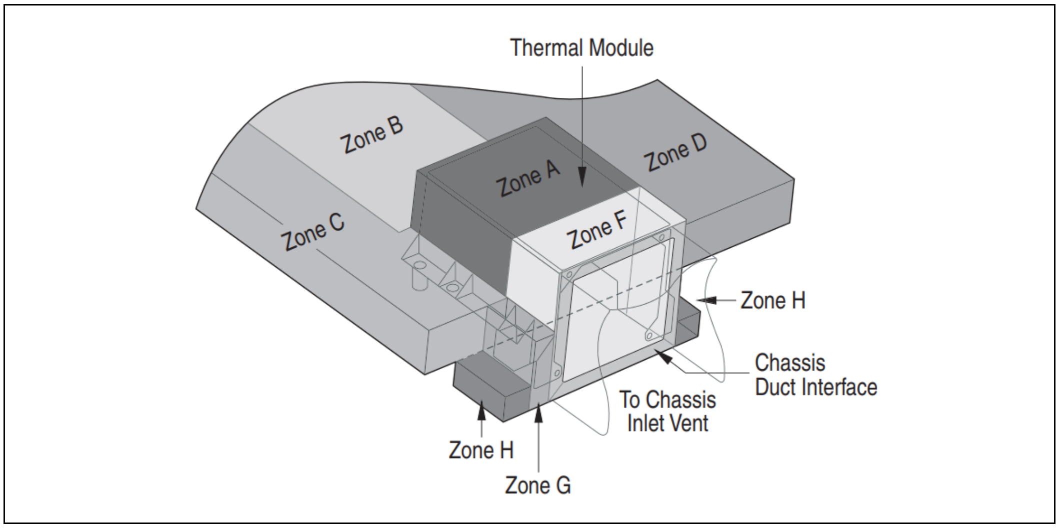
Figure 3-7. Chassis Interface to SRM Requirement Details



3.3.3 Chassis Interface to Thermal Module

In order to provide a standard interface between a thermal module and the chassis, a common physical interface plane and geometry are required. The following figure shows the relationship between the motherboard zones (Section 3.2.1), the thermal module, the chassis/thermal module interface, and the chassis zones (Section 3.2.2).

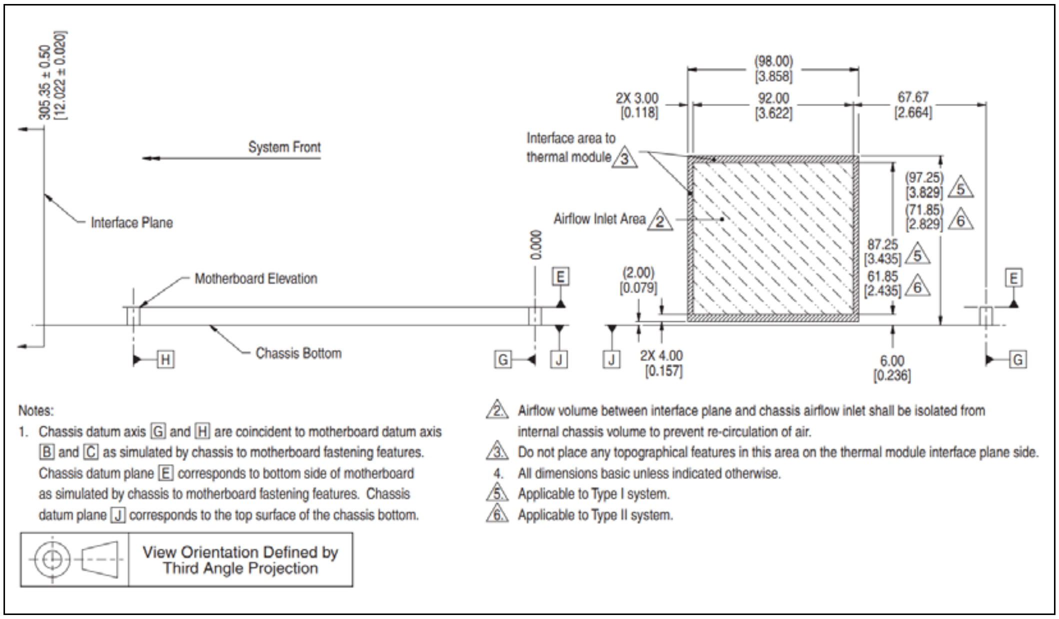
Figure 3-8. Chassis to Thermal Module Interface and Relation to Chassis and Motherboard Zones



The following figure defines a plane relative to both the motherboard datums as well as the surface geometry that should be provided on that plane by the chassis (and designed for the thermal module). The surface consists of a frame of minimum width around the window defined for airflow to the thermal module.

The primary purpose for this interface and connection is to provide external air from a vent in the chassis to the thermal module. For this reason, the air channel and the chassis vent should be designed so that there is minimal impedance to airflow from outside the chassis to the defined interface.

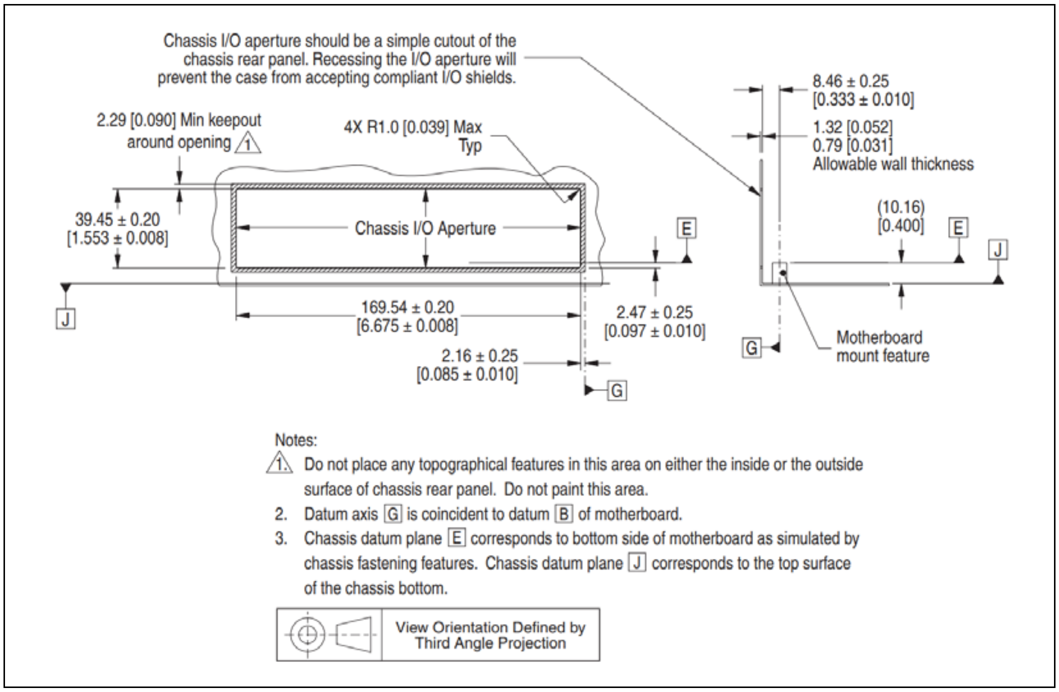
Figure 3-9. Chassis Requirements for Thermal Module Interface Definition



3.3.4 Chassis Real Panel I/O Interface Requirements

The following figure defines the chassis cutout window and associated margins for interface with the rear panel I/O shield.

Figure 3-10. Chassis Rear Panel I/O Interface Requirements

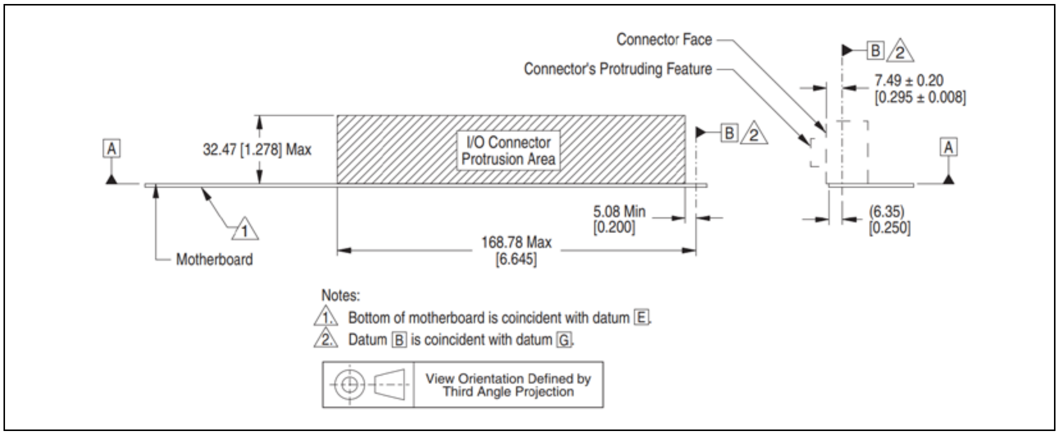


3.4 Motherboard Mechanical Interfaces

3.4.1 Motherboard Real Panel Interface Requirements

All rear panel external motherboard connectors (and their mating cable connectors) must pass through the motherboard rear panel I/O shield within the shaded window depicted in the following figure.

Figure 3-11. Motherboard Rear Panel I/O Interface Requirements



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4 Electrical Interface Requirements

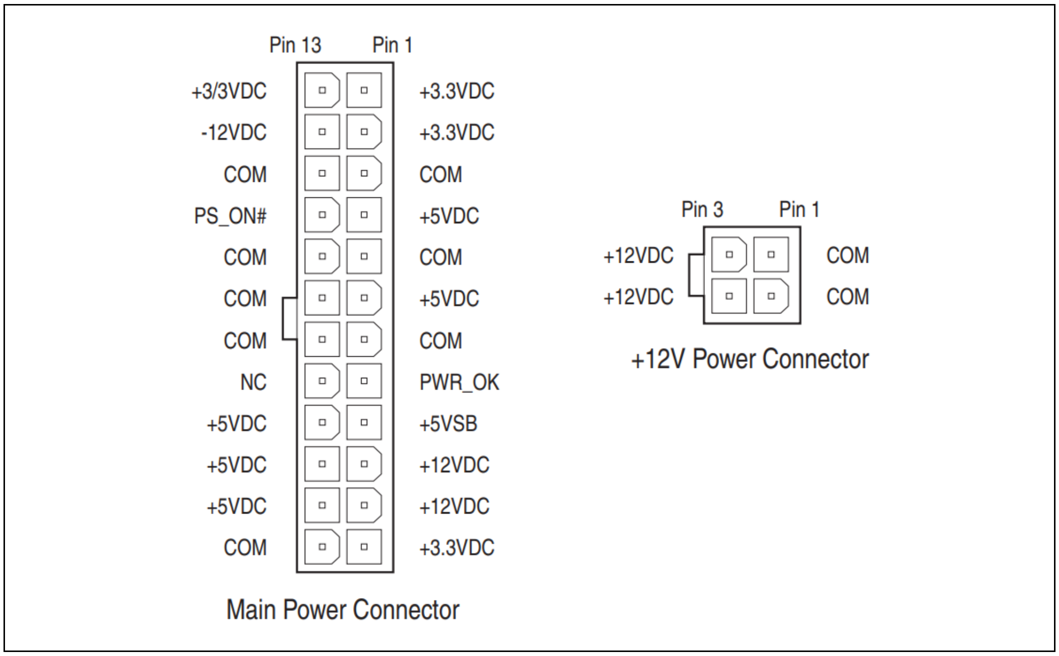
4.1 Motherboard Power Supply Connectors

The following figure defines the required pinout for the required connectors listed in following table. The connectors provide a standard interface between a BTX motherboard and a compatible system power supply. Further information on critical signals is defined in Section 4.2. For additional information on the design of compatible system power supplies, refer to the design guides at the location listed in Section 5.

Table 4-1. Power Supply Connectors

Connector Description	Status	Board Mounted Header	Mounting Power Supply Receptacle	Electrical Signal Implementation
Main Power Connector	Required on all motherboards	Molex+ 44206-0007 or equivalent	Molex+ 39-01-2240 or equivalent	Per Figure 13 and Section 4.2
+12V Power Connector	Required on all motherboards	Molex+ 39-29-9042 or equivalent	Molex+ 39-01-2240 or equivalent	Per Figure 13 and Section 4.2

Figure 4-1. Power Supply Connectors



4.2 Motherboard Power and Control Signal Definitions

4.2.1 +5VSB

+5VSB is a standby voltage supply that is active whenever AC power is present to the system power supply. It provides a power source for circuits that must remain operational when the three main DC outputs (+12VDC, +5VDC, +3.3VDC) are in a disabled state. Example uses include soft power control, Wake on LAN technology, wake-on-modem, intrusion detection, or suspend (sleep) state activities. The maximum current available from the +5VSB output depends on the design of the system power supply.

4.2.2 PS_ON#

PS_ON# is an active low, TTL compatible signal that allows the motherboard to enable the three main system power supply DC output rails (+3.3VDC, +5VDC, +12VDC). PS_ON# is pulled up to +5VSB via a 10 kΩ resistor internal to the system power supply.

When PS_ON# is pulled to TTL low, the DC outputs are enabled by the system power supply.

When PS_ON# is held to TTL high by the motherboard or left open circuited, the system power supply shall not deliver current at the main DC outputs and shall hold them at zero potential with respect to ground.

Table 4-2. PS_ON# Signal Characteristics

Category	Min.	Max.
V_{IL}, Input Low Voltage	0.1 V	0.8V
I_{IL}, Input Low Current, V_{in} = 0.4 V		-1.6 mA
V_{IH}, Input High Voltage, I_{in} = -200 µA	2.0 V	
V_{IH} open circuit, I_{in} = 0		5.25 V

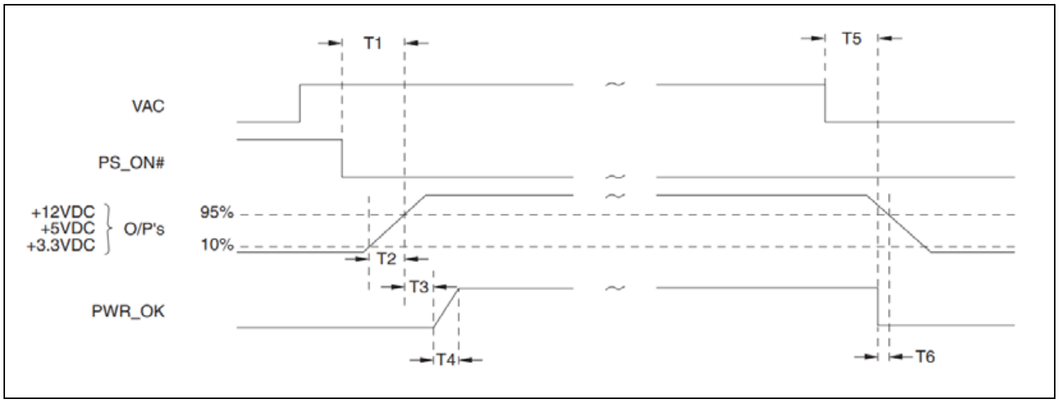
4.2.3 PWR_OK

PWR_OK is a power good signal asserted by the system power supply to indicate that the +5VDC, +3.3VDC, and +12VDC outputs are above the under voltage thresholds of the power supply. When this signal is asserted high, the system power supply has sufficient energy stored by the converter to guarantee continuous power operation for a minimum hold-up time per the system power supply's specification. Conversely, when one or more of the output voltages fall below their undervoltage threshold, or when mains power has been removed for a time sufficiently long so that power supply operation is no longer guaranteed beyond the holdup time, PWR_OK will be de-asserted to a low state by the power supply.

Table 4-3. PWR_OK Signal Characteristics

Parameter	Value
Signal type	+5V TTL compatible
Logic level low	<0.4V while sinking 4 mA
Logic level high	Between 2.4V and 5V output while sourcing 200 µA
High-state output impedance	1 kΩ from output to common
PWR_OK delay	100 ms < T_3 < 500 ms
PWR_OK rise time	$T_4 \leq$ 10 ms
AC loss to PWR_OK hold-up time	$T_5 \geq$ 16 ms
Power-down warning	$T_6 \geq$ 1 ms

Figure 4-2. Power Timing



4.2.4 Voltage Tolerances

The system power supply shall guarantee that the tolerances for the main DC outputs comply with the values listed in the following table, subject to the limits of the system power supply's specified capabilities.

Table 4-4 DC Output Voltage Tolerances

Voltage Rail	Tolerance
+3.3VDC	±5%
+5VDC	±5%
+12VDC	±5%
-12VDC	±10%
+5VSB	±5%

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5 Addition Information

For additional information beyond the requirements of this specification, refer to: http://www.formfactors.org.

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