EBX Specification

(Embedded Board, eXpandable)

Version 2.0

March 1, 2005

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REVISION HISTORY

Version 2.0 — January 13, 2005:

a. Initial release from PC/104 Embedded Consortium.
b. Adopted from EBX Specification 1.1.
c. Removed company-specific information.
d. Added references to the PC/104 Embedded Consortium.
e. Updated address information for the PC/104 Embedded Consortium.
f. Updated rev number.
g. Corrected section numbering.
h. Removed reference to IEEE P996 specification.
i. Updated contact information for reference documents.
j. Removed reference to recommended power connector.
k. Increased area for the power connector
l. Included the third PC/104, PC/104-Plus, and PCI-104 I/O area which overhangs the EBX board near the ISA connector

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1. INTRODUCTION

Until now, embedded system designers had to choose among off-the-shelf backplane solutions, desktop motherboards, and proprietary designs. Size and power consumption constraints hampered finding the right solutions for embedded deployment. Consequently, OEMs wanting to purchase off-the-shelf equipment to shorten time-to-market were often forced to develop proprietary solutions.

Standards are important to the embedded systems market. Popular backplane form-factors — including VME, CompactPCI™, Multibus™, STD32®, and passive backplane ISA — are well documented mechanical and electrical standards. Desktop motherboards, which fit certain high-end embedded applications, also follow standards such as Baby AT, LPX, ATX, and the NLX standard. All these standards allow vendors and OEMs to create products that are easily packaged in enclosures and readily expanded via open interfaces. However, none of these backplane-based standards satisfy the unique space, power, and reliability constraints of small embedded systems.

The availability of an embedded single-board computer (SBC) standard will ensure that embedded computing solutions can be designed into space constrained environments with off-the-shelf components. The embedded market constantly demands improvements in functionality and performance, while at the same time seeking size and cost reduction. The "Embedded Board, eXpandable" (EBX) standard creates the opportunity for solutions which fit the requirements of embedded system OEMs; takes advantage of trends in the embedded computing market; and offers the convenience, flexibility, risk reduction, and scalability of multi-sourced off-the-shelf products.

The "Embedded Board, eXpandable" (EBX) standard is the result of a collaboration between industry leaders to unify the embedded computing industry on a small footprint embedded single-board computer standard. The EBX combines a standard footprint with open interfaces. The EBX form-factor is small enough for deeply embedded applications, yet large enough to contain the functions of a full embedded computer system: CPU, memory, mass storage interfaces, display controller, serial/parallel ports, and other system functions.

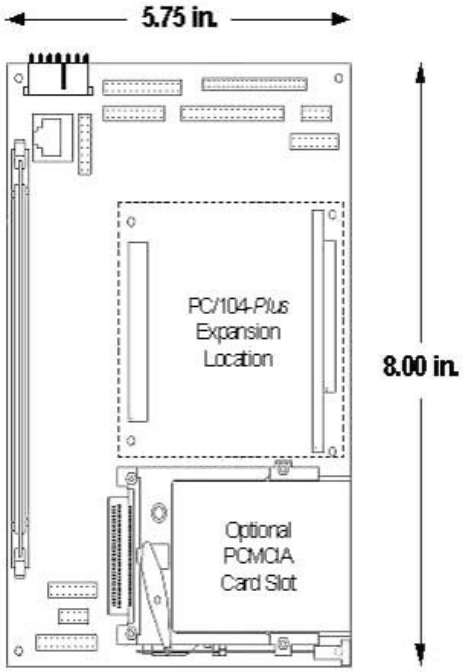

Figure 1. Example of possible EBX SBC layout

EBX boasts highly flexible and adaptable system expansion, allowing easy and

modular addition of functions not contained in standard product offerings. This EBX system expansion is based on popular existing industry standards — PC/104™, PCI, PC/104-*Plus*™, PCI-104™, and PCMCIA. PC/104 places the ISA bus on compact 3.6" x 3.8" modules with self-stacking capability. PC/104-*Plus* adds the power of a PCI bus to PC/104 while retaining the basic form-factor. PCI-104 removes the ISA bus from the PC/104-*Plus* to allow more board space for more components and connectors while maintaining a high-speed PCI expansion bus. For further expansion flexibility, PCMCIA offers access to PC Cards from the mobile and handheld computing markets.

The EBX standard integrates all these off-the-shelf standards into a highly embeddable SBC form-factor. EBX supports the stackable PC/104, PC/104-*Plus*, and PCI-104 giving it access to the wide variety of embedded system oriented expansion modules from hundreds of companies worldwide. PCMCIA brings the advantages of the latest portable and mobile system expansion technologies to embedded applications. Additionally, the EBX PCI infrastructure and PC/104-*Plus* expansion bus offer true processor independence and high performance standards-based system expansion.

EBX compliant boards have a form-factor large enough to implement a powerful SBC capable of hosting today's advanced operating systems, yet small enough to fit in the tight spaces of deeply embedded applications. This creates an exciting new opportunity for embedded system OEMs to standardize their designs and take advantage of off-the-shelf modules.

The EBX standard is open to continuing technology advancements, since it is both processor and payload independent. It creates opportunity for economies of scale in chassis, power supply, and peripheral devices. It defines how products interoperate by providing mechanical rules for mandatory features and recommended zones for flexible I/O options. These attributes combine to make EBX the right choice for embedded computing.

The adoption of the standard by the PC/104 Embedded Consortium brings stability to the embedded board market and offers OEMs assurance that a wide range of products will be available from multiple sources — now and in the future. The EBX specification is freely available to all interested companies, and may be used without licenses or royalties. For further technical information on the EBX standard, please contact:

PC/104 Embedded Consortium
www.pc104.org

2. REFERENCE DOCUMENTS

This EBX specification makes reference to, and is based on, the current versions of the following specifications:

PC/104 Version 2.5**, PC/104-*Plus*** Version 2.0**, PCI-104** Version 1.0:
PC/104 Embedded Consortium, www.pc104.org

PCI Local Bus Version 2.2:
PCI Special Interest Group, www.pcisig.com

PC Card Standard:
PCMCIA, www.pcmcia.org

Technical references about the PCI and ISA buses themselves are available from numerous sources, including RTC Books (www.rtcbooks.com), Mindshare (www.mindshare.com), and others.

3. HORIZONTAL DIMENSIONS AND MOUNTING HOLES

Figure 2 in Appendix A provides the detailed horizontal dimensions and mounting hole locations of the EBX form-factor. With the exception of the four holes labeled "B", all dimensions indicated in Figure 2 for board size and mounting holes are *mandatory*.

3.1. Horizontal Dimensions

The horizontal dimensions of an EBX board are 5.75 x 8.00 inches (146 by 203 mm).

3.2. Mounting Holes

Eight mounting holes are specified. These are marked "A" in Figure 2. Four of these are located in the corners of the EBX form-factor and four others correspond to the mounting locations common to all of the PC/104 Specifications. It is recommended that all eight defined mounting holes be used to provide rugged attachment of the EBX board to its enclosure or parent assembly.

Note that the four holes marked "B" in Figure 2 are optional. These holes are for the screws used to mount a typical PC Card slot connector that meets the mechanical requirements of EBX. The connector that matches these mounting holes is indicated in Section 4.9 of this document.

3.3. PC/104-*Plus*, PCI-104, and PC/104 Expansion Stack Location

EBX provides a module stack location as defined by the PC/104, PC/104-*Plus*, and PCI-104 specifications. This location accepts PC/104-*Plus* (PCI and ISA), PCI-104 (PCI), or PC/104 (ISA) expansion modules. Figure 2 defines the precise location of this area, the PC/104 ISA and PCI expansion connectors, and the associated mounting holes. Refer to the PC/104-*Plus* and PCI-104 specifications for information on the full electrical and mechanical specifications associated with this location.

3.3.1. Expansion Bus Connectors

PC/104-*Plus* defines two buses. One is the 104-pin ISA connector pair (J1/J2) which consists of 64-pin and 40-pin pin-and-socket headers with 0.1-in. pin-to-pin spacing. This bus is also found on the PC/104. The second bus is the 120-pin PCI connector (J3), a high-density pin-and-socket connector with 2mm pin-to-pin spacing. This bus is also found on the PCI-104.

3.3.2. Stackthrough Bus Option

The PC/104-*Plus* specification defines either stackthrough or non-stackthrough bus connectors. An EBX board may be populated with either of these bus options. When fitted with stackthrough bus connectors, the EBX board can be plugged onto another circuit board (often called a "baseboard") and treated like a single-board computer "macrocomponent".

3.3.3. PC/104-*Plus* Keep Out Area

EBX preserves the mandatory "keep out" areas defined by the PC/104, PC/104-*Plus,* and PCI-104 specifications.

4. VERTICAL CLEARANCE ZONES

The EBX form-factor is subdivided into zones that are intended for various interfaces and components. Each of these zones, and their associated functions, are defined in Figures 3 and 4 (Appendix A) and are described below. Each zone has a specified vertical dimension within which all components of that zone must fit. Table 1 specifies the maximum component height within each EBX zone.

Figure 3 or 4 will apply, depending on whether the Tall CPU or PC Card option is desired. Many EBX compliant boards have single board computer functions, including memory expansion, PC Card slots, Ethernet ports, mass storage and auxiliary ports, and CRT and LCD interfaces. EBX does not require all these functions, nor does it specify that they *must* appear in a particular location. However, observing these guidelines facilitates interoperability among multiple EBX form-factor products, such as compatibility with multi-vendor packaging.

Table 1. EBX Vertical Clearance Zones

Zone	Description	Max. Component Height (in.)
A	Memory expansion	1.5
B	Power connector	0.5
C	Video I/O (option) (includes mating connectors)	0.75
D	Misc. primary side components	0.75
E	General purpose I/O, tall region (includes mating connectors)	0.75
F	PC/104-*Plus* stack location (Primary and secondary side)	See PC/104-*Plus* spec
G	PC/104-*Plus* module I/O areas	0.6
H	Tall CPU (option) (includes heat sink)	1.2
I	PC Card slot (option)	0.6
J	General purpose I/O, low profile region (includes mating connectors)	0.5
---	Secondary side components	0.19
---	Board thickness	0.062

4.1. Zone A: Memory Expansion

Most EBX boards will require expansion memory, and this zone is recommended to allow the height profile necessary for industry standard SIMMs or DIMMs.

4.2. Zone B: Power Connector

The power connector and external mating connector are located in this zone. Refer to Section 5 of this specification for further information.

4.3. Zone C: Video I/O (Option)

Many EBX boards will provide onboard interface to CRT and/or flat panel displays. It is recommended that the I/O connectors for external display devices be located within this zone. Both the EBX board connectors and the typical mating cable connectors must fit within the defined height profile.

4.4. Zone D: Miscellaneous Primary Side Components

Any primary side components within this zone must fit within the defined height profile.

4.5. Zone E: General Purpose I/O, Tall Region

This zone is defined for I/O expansion interfaces for functions such as IDE, floppy, SCSI, keyboard, mouse, serial ports, parallel ports, etc. Both the EBX board connectors and the typical mating cable connectors must fit within the defined height profile.

4.6. Zone F: PC/104-*Plus* Expansion Stack Location

This zone is for the onboard PC/104-*Plus* expansion stack. For the required height profile within this zone, refer to the PC/104-*Plus* specification.

4.7. Zone G: PC/104-*Plus* I/O Areas

The two areas marked "G" correspond to the I/O connector areas of the PC/104, PC/104-*Plus,* and PCI-104 module specifications. Components on the EBX board must not be too tall to fit beneath the I/O connectors of the PC/104, PC/104-*Plus,* and PCI-104 modules and must therefore conform to the height profile defined for this zone. Note that the PC/104, PC/104-*Plus,* and PCI-104 modules I/O connectors and mating cable connectors are expected to fit entirely within the two sets of horizontal boundaries indicated by "G" in Figures 3 and 4 of Appendix A.

4.8. Zone H: Tall CPU (Option)

CPUs requiring a tall heatsink or fan attachment are recommended to be located in this zone, as defined in Figure 3. The defined height profile for this zone includes the CPU and its associated heatsink assembly. In this case, use of PC Cards will require a PC/104, PC/104-*Plus,* or PCI-104 expansion module or other external adapter.

4.9. Zone I: PC Card Slot (Option)

If an onboard PC Card expansion slot is used, its location should be as defined in Figure 4. When fully inserted, the external edge of the PC Card is flush with the outside edge of the EBX board as indicated in Figure 4; the location of the center of the card is also indicated in Figure 4. Figure 2 indicates four holes marked "B" that correspond to the location of the screws used to mount a specific PC Card connector.

4.10. Zone J: General Purpose I/O, Low Profile Region

This zone is defined for I/O expansion interfaces for functions such as IDE, floppy, SCSI, keyboard, mouse, serial ports, parallel ports, etc. Both the EBX board connectors and the typical mating cable connectors must fit within the defined height profile.

4.11. Secondary Side Components

All components on the "secondary side" (bottom) of the EBX board, with the exception of the PC/104-*Plus* module area, must fit within this dimension. If the "stackthrough bus" option is employed, secondary side components in the PC/104-*Plus* module area must conform to the secondary side component height requirements specified in the PC/104-*Plus* specification.

4.12. Board Thickness

This dimension specifies the thickness of the EBX PC board material.

5. POWER CONNECTOR AND POWER REQUIREMENTS

Figures 3 and 4 in Appendix A define the region where the power connector and its mating cable connector must be located. The power connector should be placed close to the top mating hole within the specified connector region.

The type of power connector placed at this location is defined by the designer of their specific EBX board.

5.1. Power Requirements

The EBX specification only defines the available input voltages; it does not specify any electrical requirements for any of the referenced standards such as PC/104, PC/104-*Plus*, PCI-104, PCMCIA, or the various supported I/O interfaces.

Specified input voltages are given in Table 2. EBX boards are not obligated to use all these voltages.

Table 2. Power Connector Voltage Requirements

Supply	Maximum Voltage	Minimum Voltage
+12V	+12.6V	+11.4V
+5V	+5.25V	+4.75V
+3.3V	+3.45V	+3.15V
Ground	---	---

APPENDIX A.

EBX DETAILED MECHANICAL DRAWINGS

Figure 2. EBX Detailed Mechanical Dimensions

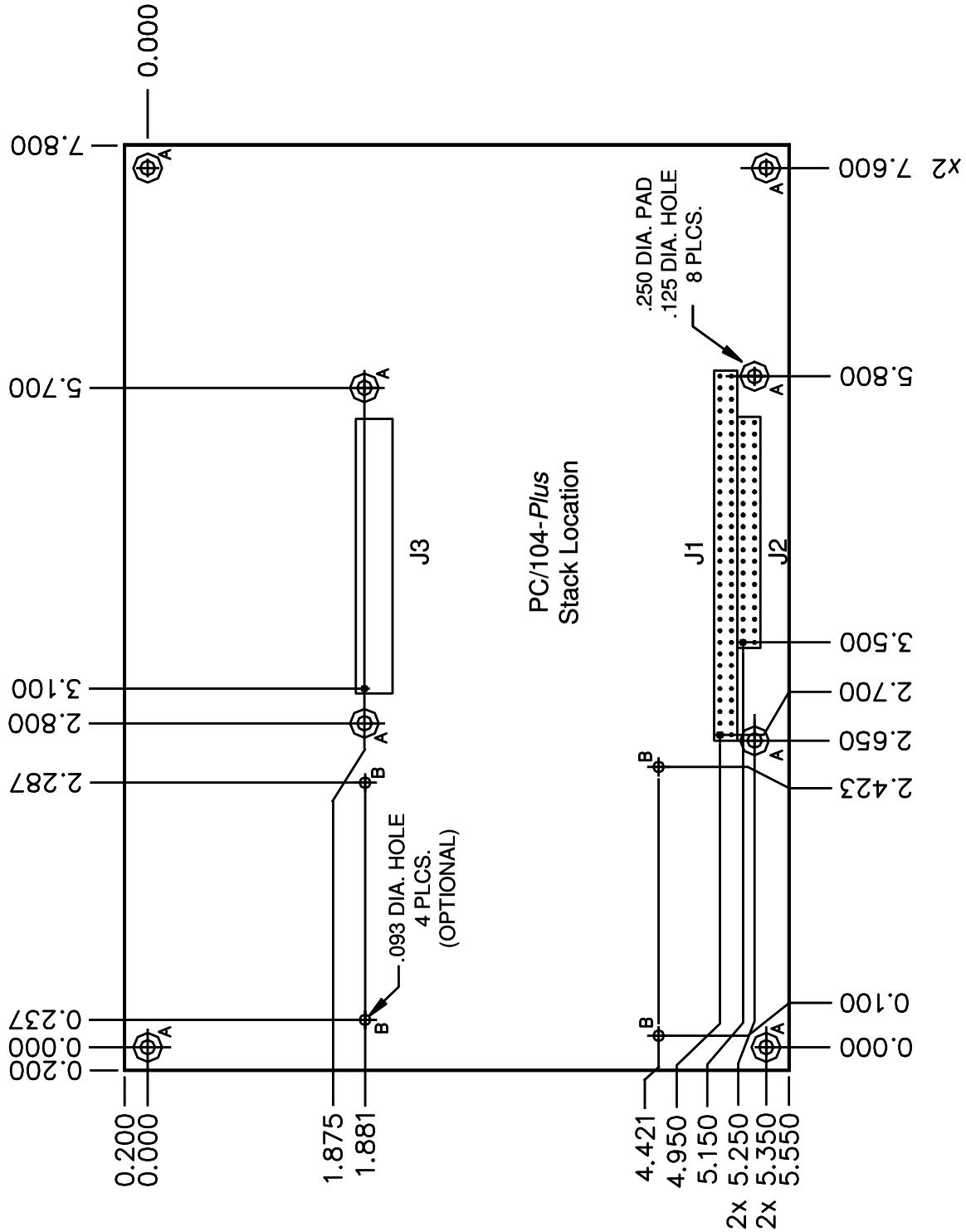

Figure 3. EBX Component Zones, Tall CPU Option

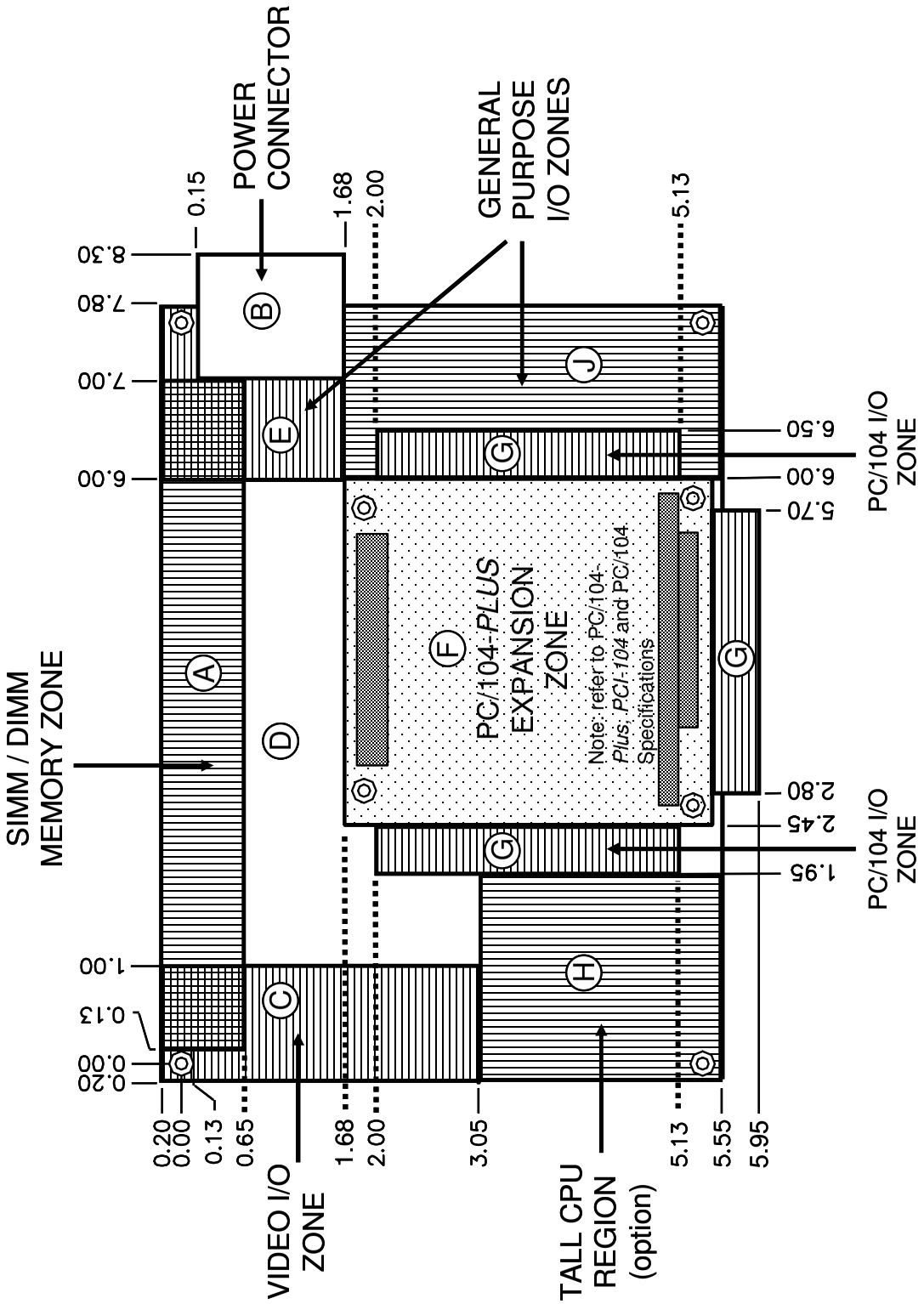

Figure 4. EBX Component Zones, PC Card Slot Option

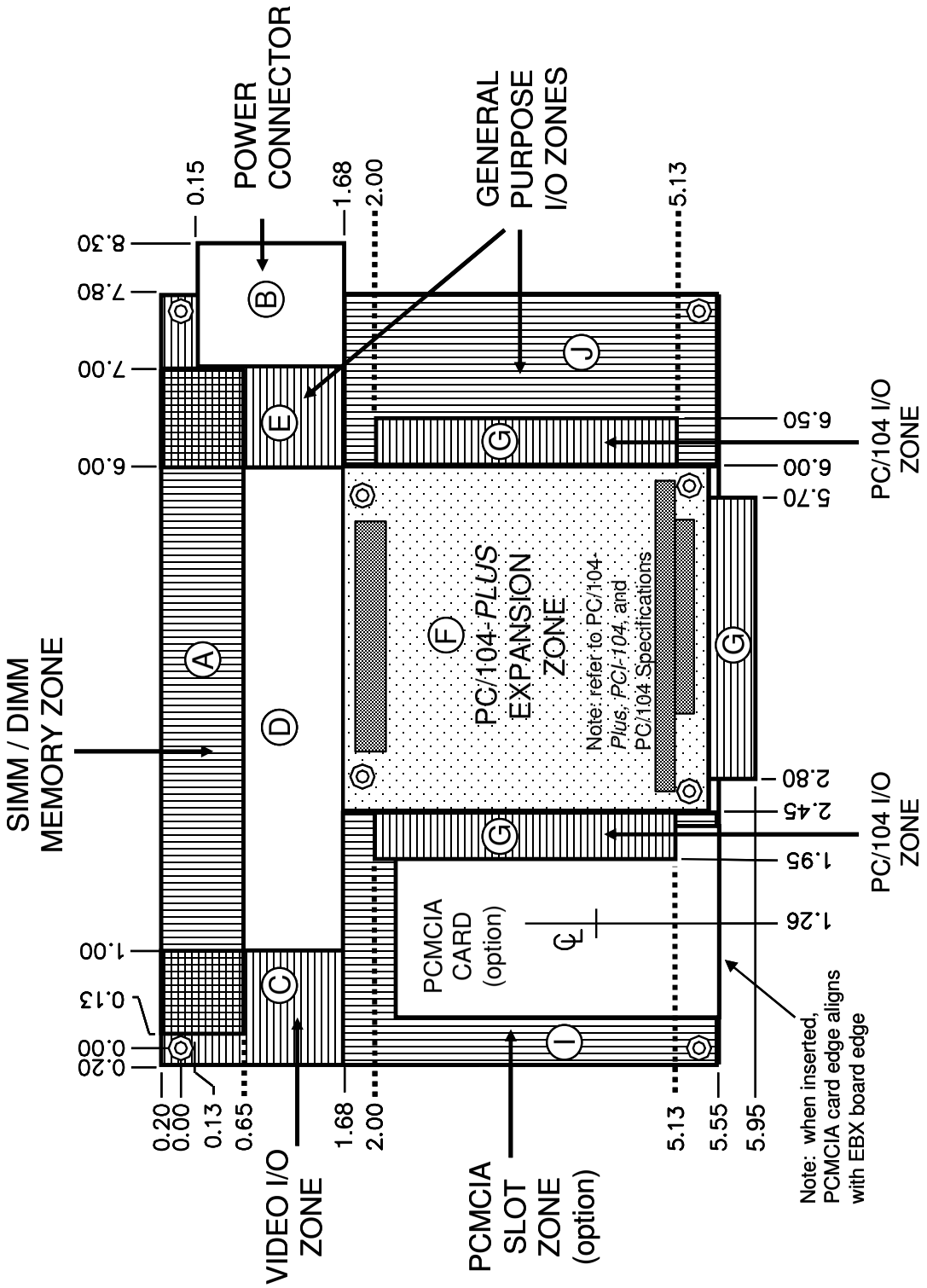

Figure 5. PCI Connector

NOTES:

1. PRESS FIT COMPLIANT PINS PER IEC 352-5 CAN BE USED INSTEAD OF SQUARE PINS AS SHOWN.
2. CONFIGURATION CAN BE MADE OF ONE OR MORE PIECES.

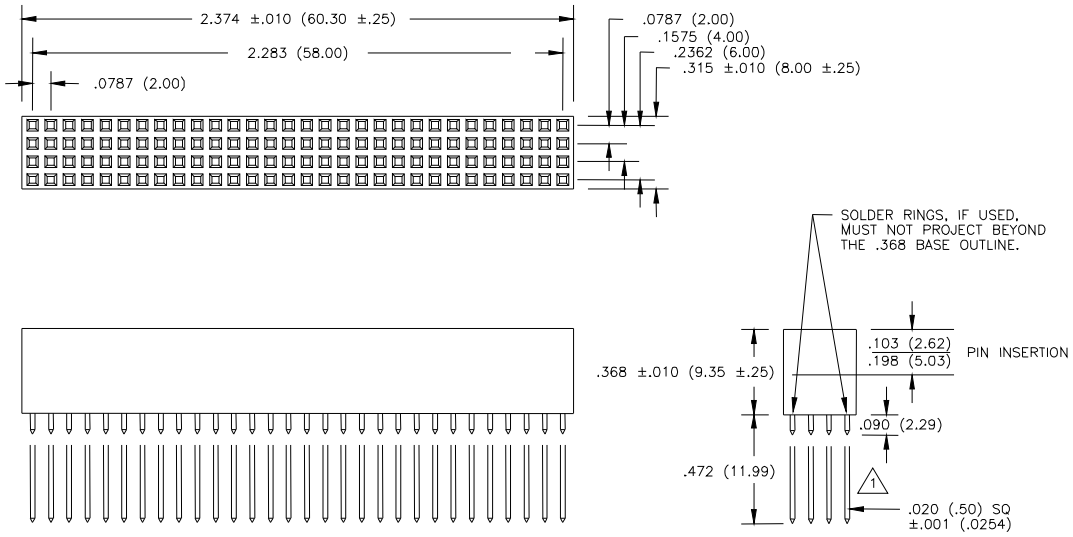

Figure 6. PCI Connector Shroud

NOTE:

1. LOCKING PEGS ARE NOT REQUIRED IF THE SHROUD IS PRESS FIT ONTO THE LONG CONNECTOR PINS OR OTHERWISE SECURED.

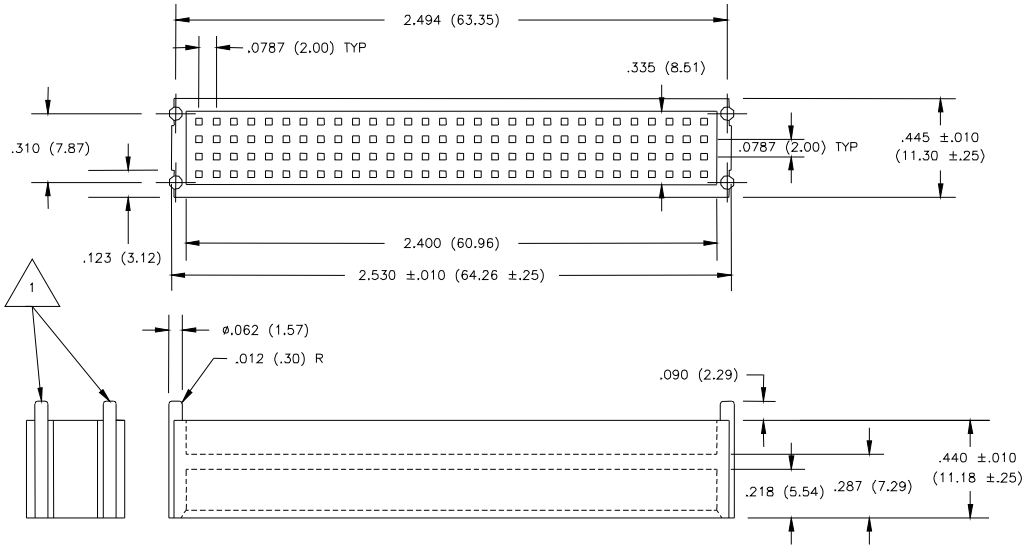

Table 3. PCI Connector Specifications

MATERIALS	
Housing:	High Temp Thermoplastic, UL Rated 94-V0
Contact:	Phosphor Bronze
Solder:	Tin-Lead (63-37), If Applicable
Solder Clip:	Aluminum Alloy, If Applicable
CONTACT FINISH	
Female Interface:	15 Microinches Minimum Hard Gold
Male Interface:	Gold Flash Minimum
Solder Tail:	100 Microinches Minimum Solder
Underplate:	50 Microinches Minimum Nickel
MECHANICAL PERFORMANCE	
Insertion Force:	2.5 Ounce Per Pin Maximum
Withdrawal Force:	1 Ounce Per Pin Minimum
Normal Force:	50 Grams Minimum (Per Beam)
Durability:	50 Cycles Minimum
Operating Temp:	-55° C To +85° C Minimum
ELECTRICAL PERFORMANCE	
Contact Resistance:	<30 Milliohms Maximum
Current Capacity:	1 Amp Continuous Per Pin
Dielectric Strength:	500 Vac
Insulation Resistance:	5,000 Megohms Minimum

Figure 7. 8-Bit and 16-Bit ISA Connector

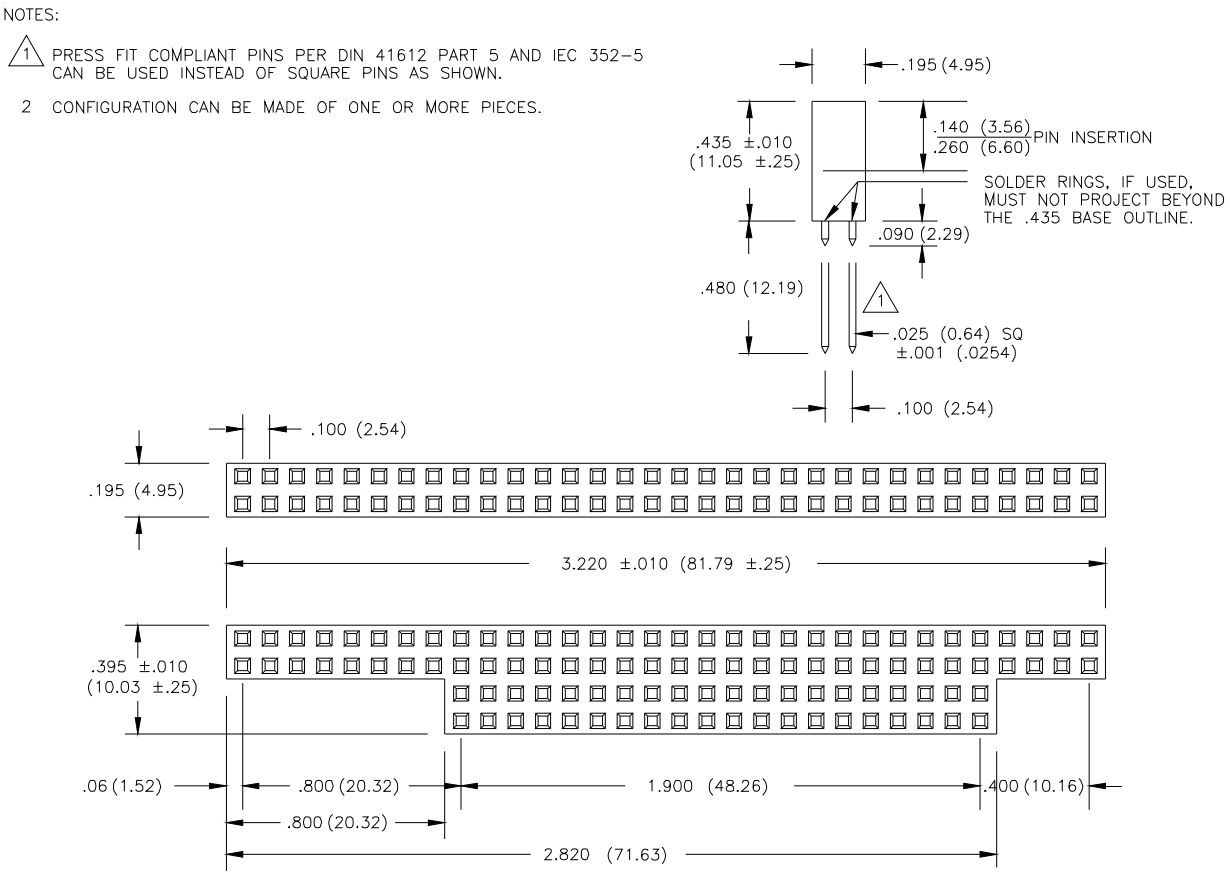

Table 4. 8-Bit and 16-Bit ISA Connector Specification

MATERIALS	
Housing:	High Temp Thermoplastic, UL Rated 94-V0
Contact:	Phosphor Bronze
Solder:	Tin-Lead (63-37), If Applicable
Solder Clip:	Aluminum Alloy, If Applicable
CONTACT FINISH	
Female Interface:	15 Microinches Minimum Hard Gold
Male Interface:	Gold Flash Minimum
Solder Tail:	100 Microinches Minimum Solder
Underplate:	50 Microinches Minimum Nickel
MECHANICAL PERFORMANCE	
Insertion Force:	3.5 Ounce Per Pin Maximum
Withdrawal Force:	1 Ounce Per Pin Minimum
Normal Force:	50 Grams Minimum (Per Beam)
Durability:	50 Cycles Minimum
Operating Temp:	-55° C To +85° C Minimum
ELECTRICAL PERFORMANCE	
Contact Resistance:	<30 Milliohms Maximum
Current Capacity:	1 Amp Continuous Per Pin
Dielectric Strength:	1000 Vac
Insulation Resistance:	5,000 Megohms Minimum