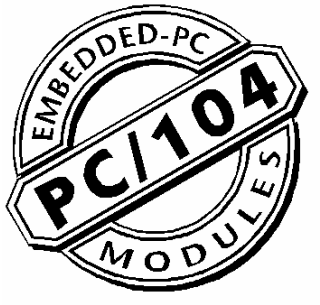

EBX Specification

In Review

March 2004

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EBX Specification

Release Version 1.1

July 9, 1997

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REVISION HISTORY

Version 1.0 — June 1, 1997:

a. Initial release.

Version 1.1 — July 9, 1997:

a. Corrected Ampro fax number in Section 1.

b. Corrected "shroud" part number in Table 1.

CONTENTS

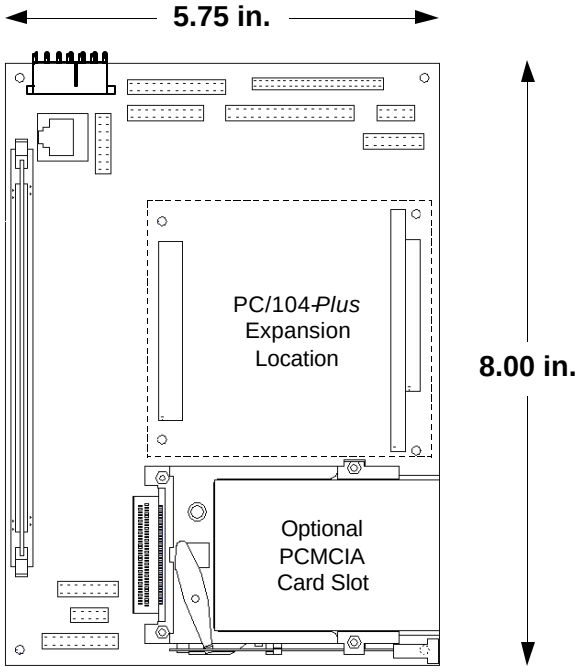
1. INTRODUCTION

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 new 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, Motorola and Ampro, to unify the embedded computing industry on a small footprint embedded single-board computer standard. Derived from the Ampro Little Board™ form-factor, 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.



EBX Form-factor

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 — IEEE P996, PC/104™, PCI, PC/104-*Plus*™, and

PCMCIA. IEEE P996 is the governing standard for the PC and PC/AT buses, informally known as the Industry Standard Architecture or "ISA." PC/104 places the P996 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. 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 legacy of PC/104, hosting 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 aligning of Ampro and Motorola, embedded computing industry leaders, 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:

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2. REFERENCE DOCUMENTS

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

> **IEEE P996 Draft Specification:** IEEE Standards Office, Piscataway NJ; phone 908-562-3825, fax 908-562-1571.
>
> **PC/104 and PC/104-*Plus* Specification:** PC/104 Consortium, Mountain View CA; phone 415-903-8304, fax 415-967-0995.
>
> **PCI Local Bus Specification:** PCI Special Interest Group, Hillsboro OR; phone 800-443-5177 or 503-693-6232, fax 503-693-8344, email info@pcisig.com.
>
> **PC Card Standard:** PCMCIA, San Jose CA; phone 408-433-2273, fax 408-433-9558, email office@pcmcia.org.

Technical references about the PCI and ISA buses themselves are available from numerous sources, including Annabooks (toll free 800-462-1042), the Computer Literacy Bookshops (408-435-0744), and others.

3. HORIZONTAL DIMENSIONS AND MOUNTING HOLES

Figure 1 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 1 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 1. Four of these are located in the corners of the EBX form-factor, and four others correspond to the PC/104-*Plus* module mounting locations defined by the PC/104-*Plus* specification. 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 1 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.

3.2 PC/104-*Plus* Expansion Stack Location

EBX provides a "PC/104-*Plus* Bus Compatible" module stack location as defined by the PC/104 and PC/104-*Plus* specifications. This location accepts either PC/104-*Plus* (PCI) or PC/104 (ISA) expansion modules, or a combination of both. Figure 1 defines the precise location of the PC/104-*Plus* expansion stack location, based on the location of the PC/104-*Plus* bus connectors and associated mounting holes. Refer to the PC/104 and PC/104-*Plus* specifications for information on the full electrical and mechanical specifications associated with this location.

3.2.1 PC/104-*Plus* 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. The second bus is the 120-pin PCI connector (J3), a high density pin-and-socket connector with 2mm pin-to-pin spacing. These bus connectors and their typical vendor part numbers appear in Table 1.

3.2.2 Stackthrough Bus Option

The PC/104-*Plus* specification defines ether stackthrough or non-stackthrough bus connectors. An EBX board may be populated with either of these bus options, as indicated in Table 1. 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".

3.2.3 PC/104-*Plus* Keep Out Area

EBX preserves the mandatory "keep out" areas defined by the PC/104-*Plus* specification.

Table 1. PC/104-*Plus* Bus Connectors

Connector	Stackthrough *	Non-stackthrough *
J1: 64-pin ISA	ESQ-132-39-S-D	ESQ-132-37-G-D
J2: 40-pin ISA	ESQ-120-39-S-D	ESQ-120-37-G-D
J3: 120-pin PCI	ESQT-130-02-G-Q-368 with shroud, ATS-30-Q	ESQT-130-03-M-Q-368
* NOTE: the connector part numbers indicated are from Samtec.		

4. VERTICAL CLEARANCE ZONES

The EBX form-factor is subdivided into zones which are intended for various interfaces and components. Each of these zones, and their associated functions, are defined in Figures 2 and 3 (Appendix A) and are described below. Each zone has a specified vertical dimension within which all

components of that zone must fit. Table 2 specifies the maximum component height within each EBX zone.

Figure 2 or 3 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 multivendor packaging.

Table 2. 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 7-pin EBX 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 Figure 4 (Module Dimensions) of 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 and PC/104-*Plus* module specifications. Components on the EBX board must not be too tall to fit beneath the I/O connectors of the PC/104 (*Plus*) module and must therefore conform to the height profile defined for this zone. Note that the PC/104 (*Plus*) module I/O connectors and mating cable connectors are expected to fit entirely within the two sets of horizontal boundaries indicated by "G" in Figures 2 and 3 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 2. 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 or PC/104-*Plus* 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 3. When fully inserted, the external edge of the PC Card is flush with the outside edge of the EBX board as indicated in Figure 3; the location of the center of the card is also indicated in Figure 3. Figure 1 indicates four

holes marked “B” that correspond to the location of the screws used to mount a specific PC Card connector, Berg part number 95547-XXX (or equivalent).

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

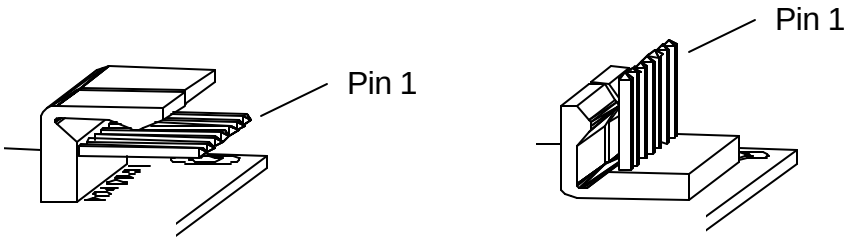
All components on the “secondary side” (bottom) of the EBX board, with the exception of the PC/104-*Plus* module area, must fit within this dimension. If the “stackthrough bus” option is employed, secondary side components in the PC/104-*Plus* module area must conform to the secondary side component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

The EBX power connector is a 7-pin locking connector. Two options are supported, right-angle and straight, as illustrated in the figure below. The power connector options are Molex part number 26-60-7070 for the right-angle, and 26-60-4070 for the straight (or equivalent). Figures 2 and 3 in Appendix A define the region where the power connector and its mating cable connector must be located. The figure below illustrates the orientation of the two power connector options on the EBX board.



Power Connector Placement

5.1 Mating Connector

The mating connector for either option of power connector consists of a shell and associated pins; these are Molex part numbers 09-50-8073 (shell) with appropriate pins, or equivalent.

5.2 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, PCMCIA, or the various supported I/O interfaces.

EBX boards are not obligated to use all these voltages. Specified input voltages on the pins of the 7-pin EBX power connector, and the associated maximum currents, are given in Table 3.

Table 3. Power Connector Pinout and Voltage Requirements

Supply	Connector Pin(s)	Maximum Voltage	Minimum Voltage
+12V	4	+12.6V	+11.4V
+5V	1, 7	+5.25V	+4.75V
+3.3V	5	+3.45V	+3.15V
Ground	2, 3, 6	---	---
Note: maximum current capacity is 7A per pin			

APPENDIX A

EBX DETAILED MECHANICAL DRAWINGS