A NEW BOARD OF EPIC PROPORTIONS

By Glenn S. Kubota

The introduction of the EPIC form factor at the March 2004 Embedded Systems Conference attracted considerable attention from the media and a groundswell of support from other embedded computer manufacturers. What was the reason for all of this scrutiny? The industry needed standardization of a form factor in this size for quite some time.

The PC/104 specification that defined a board size of 3.550 inches x 3.775 inches (90 mm x 96 mm) has been a standard since 1992. This creates a board area of 13.5 in^2 (86.4 cm^2). Recently adopted by the PC/104 Consortium, the EBX specification defined a board size of 5.75 inches x 8.0 inches (146 mm x 203 mm). Around since 1997, the EBX form factor has a board area of 46.0 in^2 (296.4 cm^2) that is more than three times the size of the PC/104 form factor. Many companies developed proprietary board sizes to fill this gap.

The same board size PC/104 and PC/104-*Plus* form factors work well for I/O expansion modules. Many systems use the EBX form factor for CPU boards and use PC/104 as an I/O mezzanine bus. In addition, many CPUs can be designed into the PC/104 form factor. However, the PC/104 size is not well suited for many modern CPUs.

Historically, most CPU chips ran off 5-volt power supplies. Since the PC/104 bus defined 5 volts as a standard supply, it was easy to supply to the CPU. However, as chip manufacturers shrank dies in order to increase wafer yields and decrease power requirements, the supply voltages decreased. Today, it is common to find 3.3V, 2.5V, 1.9V, 1.0V, and other voltages required in a CPU chip. Many designs require three or more voltages. The increased complexity of the power circuitry requires a substantial amount of board space that is easier and more economically feasible in a board size larger than PC/104.

Additionally, a proliferation of I/O types is now commonly expected from an embedded computer board. In the past, many CPU boards only needed to have the PC/104 signals and some serial ports. Now many CPUs have Ethernet, USB, video, disk drives, CardBus, and other interfaces. With the PC/104 form factor, many manufacturers had to use special high-density connectors in order to handle the large number of signals. This makes it more difficult for a user to interface with those connectors. With more space for I/O connectors, the EPIC form factor allows the use of more standard connectors.

EPIC form factor

The size of the EPIC form factor is 115 mm x 165 mm (4.528 inches x 6.496 inches). The total area of the board is 189.75 cm^2 (29.4 in^2). Figure 1 shows the EPIC board is almost exactly halfway between the area of the PC/104 form factor and the EBX form factor.

Four mounting holes in the corners of the EPIC board are the same size as the mounting holes on the PC/104 form factor. The diameter of the holes is 0.125 inches with a 0.250-inch diameter pad. Hardware used for mounting PC/104 cards can be used for mounting the EPIC board. Use all eight mounting holes to mount the EPIC board for the most mechanical stability.

Reserved areas

To maintain mechanical compatibility between different EPIC boards, the EPIC specification reserved a number of areas for

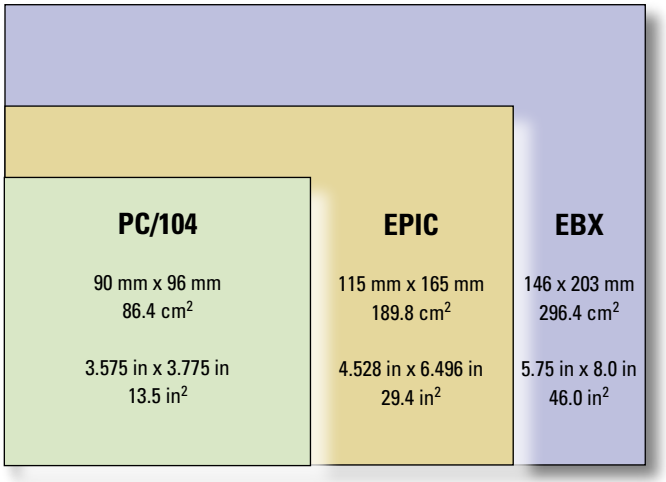

Figure 1

various devices, connectors, and boards. Figure 2 shows the defined zones for the CPU, I/O, and the PC/104 module.

Three zones are nominally reserved for I/O connectors. Zone 1 is on the south edge of the board and is split into Zones 1A and 1B.

- Zone 1A is the deepest of the I/O zones, with a depth of 1.078 inches (27.38 mm). This 2.121 inches (53.87 mm) wide zone accommodates deep connectors such as Ethernet and other PC-type connectors.
- Zone 1B is 3.725 inches x 0.700 inches (94.61 mm x 17.78 mm) and supports connectors such as 0.1-inch headers, terminal blocks, and USB, in addition to many others.

The east end of the board contains Zone 2 that is .325 inches (8.26 mm) deep and 3.878 inches (98.50 mm) wide. Connectors and their mates placed in Zone 2 should be less than .6 inches tall to avoid interfering with the connectors of any installed PC/104 expansion boards.

The north edge of the board contains Zone 3 that is 2.121-inch wide, the same width as Zone 1A. However, Zone 3 is 0.500 inches deep. Most of this area has no height restriction. A small .175-inch x 0.500-inch area is restricted to a height of 0.600 inches if a PC/104 module has been installed.

In addition to the I/O zones, there is a CPU and Power Zone that is 1.475 inches x 2.950 inches (37.47 mm x 74.93 mm). This area has no height restriction in order to accommodate CPU chips with tall heat sinks and fans. Many of today's high-speed CPUs require extensive cooling in order to operate reliably. This was often difficult to accomplish in the standard PC/104 board because of the restrictions brought about by the stacking height. The EPIC form factor avoids this limitation because it brings the CPU out from underneath the PC/104 stack.

The CPU and Power Zone also accommodates the power connector. This area was designated for the power connector because the CPU is probably the device that uses the most power on the board. By locating the power connector in this area, high currents to the CPU or to switching voltage regulators do not need to travel a long distance across the power planes of the PCB.

There are many different voltage requirements for different types of boards. Some combination of +5V, +12V, -12V, +3.3V, and other voltages may be required. Other signals that may be required are battery backup voltages or manual reset signals. Because the requirements vary so widely, there is not a specific connector that must be used for power. However, there is an appendix in the EPIC specification that has a couple of suggestions for power connectors. One is a pin and socket connector, while the other is a removable terminal strip.

PC/104 and PC/104-*Plus* expansion

The EPIC form factor currently uses PC/104 and PC/104-*Plus* boards for expansion. This allows for the addition of hundreds

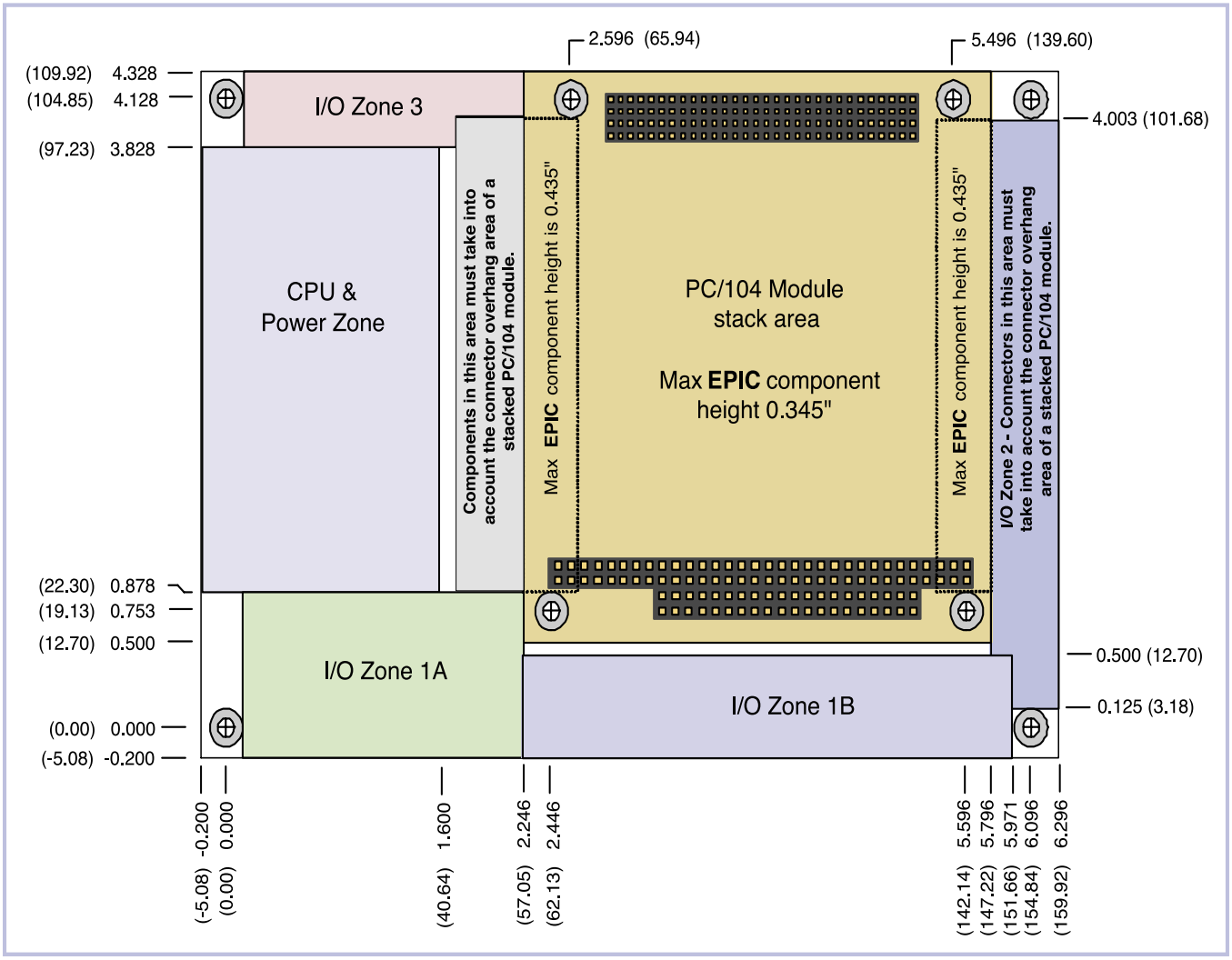

Figure 2

> *"Future expansion may require other types of interconnects and because of this, future phases of the EPIC spec will support other buses, such as PCI Express, while retaining backward compatibility in form factor and mounting hole placement."*

of different types of I/O to be added. Many data acquisition, digital I/O, serial port, modem, and timer/counter boards may be found on PC/104 boards. Higher speed I/O, such as digital signal processing boards or high-speed Ethernet, can be found on PC/104-*Plus* expansion boards. In addition, as these buses are derivations of the well established ISA (Industry Standard Architecture) and PCI (Peripheral Component Interconnect), custom I/O boards can be readily designed using available reference designs and documentation.

Both the PC/104 and the PC/104-*Plus* connectors are optional, and either one may be left off for designs that do not require it. For example, non-x86 architectures might implement only the PCI bus and thus only use the PC/104-*Plus* connector.

Future directions

The current *Phase One* implementation of the EPIC board can expand with PC/104 and PC/104-*Plus* boards. Future expansion may require other types of interconnects and because of this, future phases of the EPIC spec will support other buses, such as PCI Express, while retaining backward compatibility in form factor and mounting hole placement.

Conclusion

The EPIC specification clearly fills a need for a standard form factor between the PC/104 and EBX board sizes. There are already EPIC CPU boards available, including the SBC4495 from Micro/sys shown in Figure 3. This EPIC board includes an Atlas processor with GPS, data acquisition, and CardBus expansion. The standards established allow many more to follow. Clearly defined reserved areas, mounting holes, and expansion capability ensure that different EPIC boards may be installed into the same site without mechanical interference. Future phases of the EPIC specification will allow the technology to remain current, even as newer, faster buses become more prevalent. Because of all of these reasons, EPIC boards will continue to find their way into many current and future designs.

Figure 3

Glenn S. Kubota *is engineering manager for Micro/sys, Inc., a manufacturer of embedded PC boards. Glenn served on the technical committee that developed the EPIC specification.*

For further information, contact Glenn at:

Micro/sys, Inc.
3730 Park Pl. • Montrose, CA 91020
Tel: 818-244-4600
Fax: 818-244-4246
E-mail: gkubota@embeddedsys.com
Website: www.embeddedsys.com