SMALL FORM FACTORS

Express104 Modules Upgrade PC/104 Installed Base with SUMIT Interface

The new SUMIT interface is a highly flexible, modular, well-engineered approach that is independent of form factor or processor architecture. A first example of its utility is in the new Express104 specification.

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Change. This appears to be the operative word for 2008. While most of us think of this word in a political context this year, this is also the year of change for embedded design engineers using small form factor boards. We've had it pretty good in this community—the technology has been highly stable for over 20 years. Sure we've seen evolution in processors, increasing performance dramatically, accessing much greater amounts of memory and using less power. But the fundamental elements in the construction of off-the-shelf board-based embedded applications have really changed very little.

This stability is derived from the outstanding longevity of underlying bus architectures. The venerable ISA bus, dating to 1982 and updated only once, to PCI, in the mid-1990s, still provides an effective, simple, easy-to-implement interconnect architecture for I/O expansion. Sadly, in desktop and industrial motherboards, ISA is finally reaching the end of the line because it simply uses too many pins. And PCI may quickly follow ISA to its demise.

Popular board form factors associated with the ISA and PCI interfaces have also achieved incredible stability and longevity. The popular desktop PC motherboard form factors based on the initial ATX standard and PC plug in expansion cards have remained virtually unchanged for years, although reduced size versions have become available. The implementations for embedded applications through PC/104, EBX and more recently EPIC form factors, have achieved equal or even greater stability and longevity. However, with the changes rampant on the bus side of the equation, new looks also need to be taken at the associated form factors and standards that drive this portion of the embedded community.

Voting Members	
Ampro	AMPRO
Congatec	congatec
Octagon Systems	OCTAGON SYSTEMS
VersaLogic	VERSALOGIC CORPORATION
Via	VIA embedded
WinSystems	WinSystems
General Members	
Arbor	
Diamond Systems	
General Standards	
Portwell	
Samtec	
Seco	
Silicon Systems	

Figure 1 Current Small Form Factor SIG membership.

All in Favor Say "Aye"

As we approach the middle of 2008, the community of board suppliers has

been working to address the issues of evolution of their technologies for more than two years. The complexity of the issues, the strong desire for investment protection and easy migration from legacy solutions, and the sheer number of people with ideas about how to proceed, have made this a much more protracted and complicated process than ever before. It appears that multiple approaches will reach the market, placing the burden on OEM design engineers to understand the different approaches and to make their own independent decisions regarding the appropriate technology to incorporate in their new product designs.

This decision is critical, as this market may not be able to sustain two different technology approaches over the long term. Dual approaches place an incredible burden on I/O module vendors to have to offer two different versions of each and every product offering. One of these new technologies based on older 3-chip chipset technology is probably going to drop by the wayside, resulting in a stunted lifetime and leaving OEMs who chose that approach high and dry in the middle of their product lifecycle.

EPIC Inventors Reunite

Just like in the political situation in this year of change, there is an upstart entrant in the technology race for new embedded designs. This is one that you may not have heard of before, but one that merits your close attention and consideration when defining a technology approach to your next embedded design. This article will help explain the design philosophy behind the SUMIT interface, how it helps you migrate gracefully from existing PC/104, EBX and EPIC designs, and why it provides you with the very best solution for continued stability and long lifecycle products.

Climb the Mountain, Avoid Crevasses

To fully understand SUMIT, you should obtain a copy of the specification from the Small Form Factor Special Interest Group (SFF-SIG). Compare SUMIT to other board evolutionary approaches and make your own decisions regarding which technology will stand the tests of time and market pressure. And just like

Figure 2a Detailed pin definitions for SUMIT connector A.

the political situation, beware of selecting the technology with the famous name, just because you have heard of it before. This choice impacts your product's success and longevity, so even more than your choice of a candidate, this choice merits your careful study.

The Stackable Unified Module Interconnect Technology (SUMIT) interconnect standard is the output of a relatively new standards organization, the Small Form Factor Special Interest Group (SFF-SIG), officially formed in late 2007 and supported today by leading embedded suppliers including board, connector and component manufacturers. Among the SFF-SIG leaders are the companies that brought the original PC/104, EBX and EPIC standards to the industry. The current membership of the SFF-SIG is shown in Figure 1.

The fundamental goals established to guide the creation of the SUMIT standard were:

1. Support the implementation of a stackable architecture that could effectively replace a homogeneous PC/104 stack as well as PC/104 expansion on a larger form factor single board computer, such as EBX and EPIC.
2. Separate the interconnect standard (connector and pin definitions) from the board mechanical / form factor standard (size, mounting holes) to ease the evolution of the interface standard to multiple form factor standards.
3. Enable a graceful migration from ISA and PCI-based PC/104 stacks without the burden of multiple bridge devices and potential issues of software compatibility.
4. Support multiple high-speed and low-speed bus technologies, including PCI Express, USB 2.0, LPC, SPI and I^2C, with a path to PCI Express Generation 2 and USB 3.0 in the future.

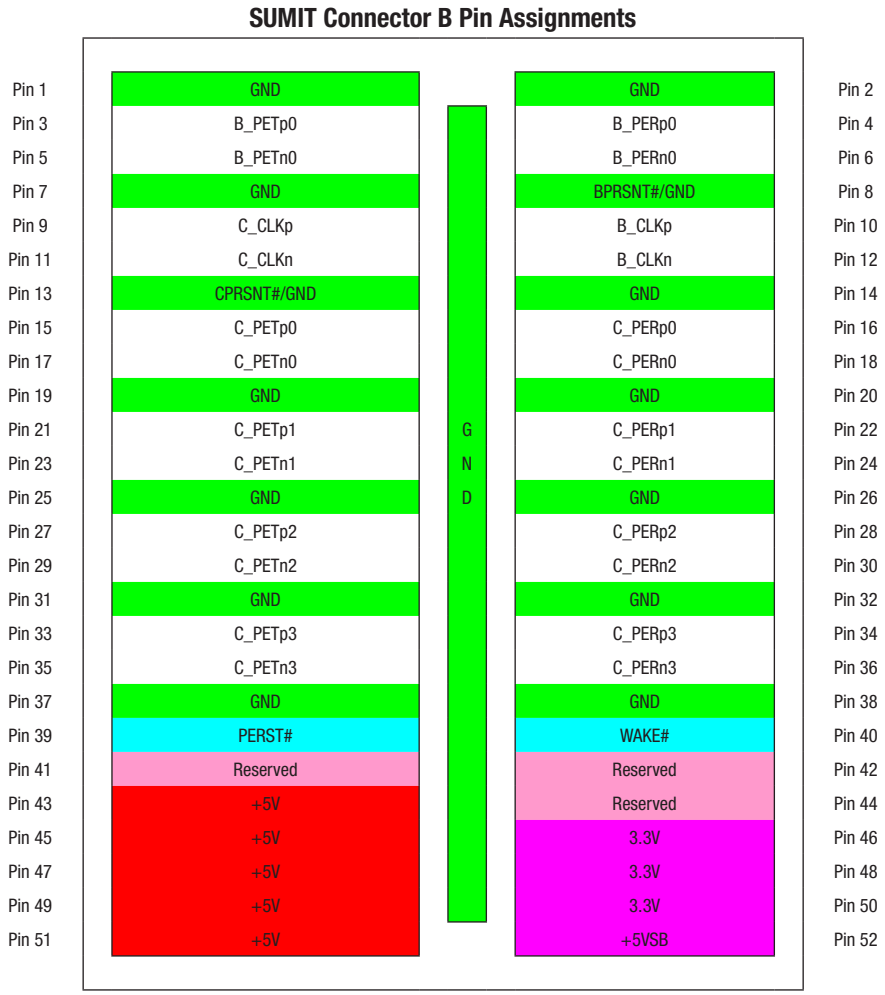

Figure 2b Detailed pin definitions for SUMIT connector B.

5. Provide a flexible, modular solution with a simple, easy-to-implement entry point that consumes little board space, along with a "full boat" implementation for high-performance systems
6. Take board layout and routing issues into account to ensure that products built to the specification can achieve the necessary performance levels without resorting to special tricks, shortcuts or other dubious engineering practices that can reduce product reliability and increase costs.

The resulting interface specification is the result of several man-years of effort by some of the best and most creative engineering talent in our industry. The concepts embodied in the specification have been tested and vetted through a broad set of reviews and implementation of multiple test beds. The standard defines a connector type and pin definition. It incorporates two high-density (0.025" pin pitch) 52-pin connectors that may be implemented separately or together depending on the feature content required in the resulting product.

Latest Low-Power Technology

Connector A incorporates one x1 PCI Express lane, three USB 2.0 "lanes," the LPC bus, an I^2C / SMB interface and an SPI interface as well as control, power and ground signals. Connector B incorporates one x1 PCI Express lane and one x4 PCI Express lane along with additional control, power and ground signals. A system may be implemented with Connector A only, Connector B only, or both Connectors A and B. These configurations are known as SUMIT-A, SUMIT-B and SUMIT-AB respectively. The pin definitions for connectors A and B are shown in Figure 2.

The connectors chosen for the SUMIT interface are a key element to meet the goals set for the specification. Using the Samtec Q2 family, these connectors offer a unified internal ground interface to improve routing characteristics while providing for efficient use of the 52 pins. The SUMIT interface incorporates connectors placed on both the top and bottom surface of the PCB, enabling the stacking architecture familiar from the PC/104 world.

The flexibility and broad applicability of the SUMIT interface should now become clear. A simple PCI Express expansion system can be easily implemented with a SUMIT A configuration. This configuration also enables easy migration for existing PC/104 (ISA!) applications by providing the LPC bus (and Serial IRQ – SIRQ signal) on the connector. It also enables simple, low-cost expansion through the use of LPC Super I/O devices for adding common legacy system elements such as serial ports or PS/2 keyboard / mouse interfaces. Finally, SUMIT A also enables a unique USB expansion scheme, allowing USB target devices to be placed on the stack. For more complex, higher performance PCI Express requirements, the SUMIT B interface includes both a x1 lane and a x4 lane.

The SUMIT interface is optimized for the latest 2-chip (CPU plus single chip "chipset"), x86 silicon from Intel and VIA, rather than earlier PCI Express chipsets such as the Intel 915 family, introduced over three years ago, which requires three chips for similar functionality. In technology "dog years," 3.5 years is more than half of a typical 5-year processor and chipset lifecycle commitment, and is the difference between performance / power efficiency and inefficiency. In the world of small form factors, there just isn't room for an extra large IC.

Note that SUMIT does not incorporate x16 PCI Express video expansion capability. There are three reasons for this. First, there is a high pin cost and cooling solution cost for this very specialized usage that has limited applicability in embedded applications. Second, the video capability integrated into modern chipsets continues to improve with each generation, meeting the needs of an increasing number of applications and eliminating the need for an external graphics chip. Finally, for those desktop-style applications like digital signage, imaging and gaming, x16 connector standards are already established, such as the vertical desktop slot, Nvidia's MXM low-profile connector for notebook comput-

ers and PICMG's COM Express standard. There is no justification and no ecosystem of boards for a fourth solution.

Unified I/O Across Form Factors

As mentioned, SUMIT is an interface specification that is form factor and board independent. To speed the initial adoption of the SUMIT specification, the SFF-SIG has simultaneously announced a "new" form factor standard called Express104. This form factor is mechanically identical to PC/104 in overall size and mounting holes. It specifies locations for both SUMIT A and SUMIT B connectors, enabling all three configurations to be constructed. The connectors are placed in such a way that the PC/104 ISA connector can also be placed on the board, enabling direct and immediate migration from an existing PC/104 ISA stack. The Express104 form factor standard is shown in Figure 3.

The time for change is upon us in this election year. As PCI Express has grown in pervasiveness over the past few years, many embedded designers have played the "if-I-don't-look-it-may-go-away" game, hoping not to have to deal with the complex migration to PCI Express-based systems. But PCI Express won't go away. And embedded OEMs need to start to deal with the realities of how systems will be built in the future. There are choices. It is important that you understand the choices so that you can make an informed decision on the future designs of your medical, military, instrumentation or control applications. ◢

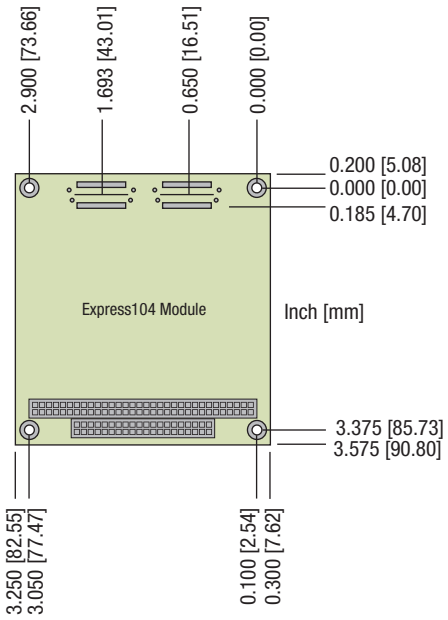

Figure 3 The new Express104 specification defines placement of the SUMIT connectors while leaving room to include the ISA connector in order to include legacy PC/104 modules.

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