SUMIT Next generation interconnect for stackable embedded computing modules.

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The embedded computing marketplace is as fragmented as it is diverse. With the advent of high-speed serial buses like PCIe and USB, it has forced both suppliers and users of stacking I/O board to think about how to support them. A new connector specification called SUMIT™ which is an acronym for Stackable Unified Module Interconnect Technology has been designed to deliver a form factor-independent interconnect that accommodates I/O boards small and large, fast and slow, simple and complex.

Rather than defining a board form factor, SUMIT specifies an enabling connector technology that can be implemented easily across standard and custom SBCs. SUMIT emphasizes cost per pin, pin density, and signal integrity through the connector, using much less board space than previous solutions. The rugged, cost-effective, and easy-to-assemble connector has plenty of bandwidth headroom to enable long-term product availability.

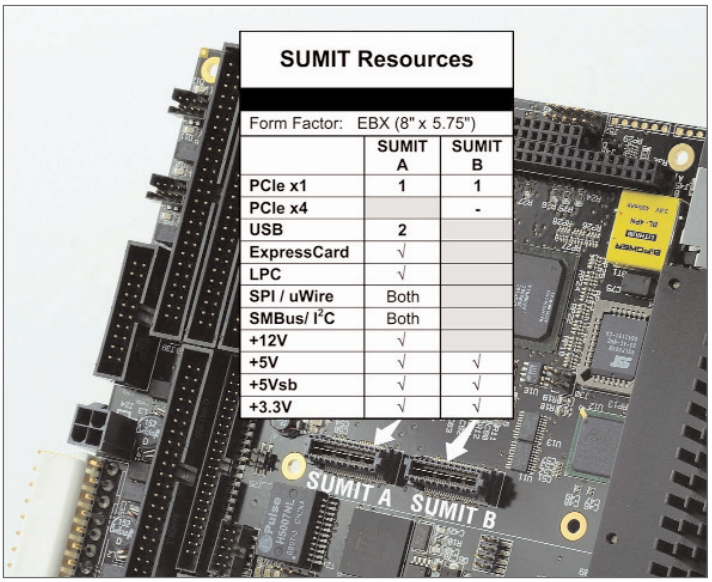
SUMIT is the creation of a trade organization called SFF SIG for Small Form Factor Special Interest Group. It was formed in the fall of 2007 with a charter to develop and promote specifications to help manufacturers and integrators of electronic equipment reduce the overall size of their next-generation systems.

The philosophy of the SFF SIG is to embrace the latest technologies available for long-lifecycle systems while maintaining legacy compatibility to enable easy transitions to next-generation interfaces. The SFF-SIG's specifications are intended to accommodate today's and tomorrow's lower power and more highly integrated processors, chipsets, and memory based on 90-nm, 65-nm, and 45-nm processes, as well as robust higher-density connectors and the high-speed serial interfaces that are replacing parallel interfaces of the past.

The word SUMIT is pronounced "sum it". The current version is revision 1.5 and defines two 52-pin, high-speed connectors capable of supporting PCI Express and USB data rates as well as other moderate speed interfaces for I/O expansion. It provides the basis for a stackable, I/O-centric multi-board solution that is processor architecture and chipset independent. The specification contains support for very low power and ultra mobile processors which support "green" computing initiatives for compact embedded systems.

SUMIT supports the following I/O connectivity technologies:

- Two PCI Express x1 links
- One PCI Express x4 link or four additional PCIe x1 links
- Four USB channels
- One ExpressCard channel
- Two SPI/uWire channels
- System Management Bus (SMbus/I²C)
- Low Pin Count (LPC) bus with SERIRQ
- Reset and Wake On LAN (WAKE)



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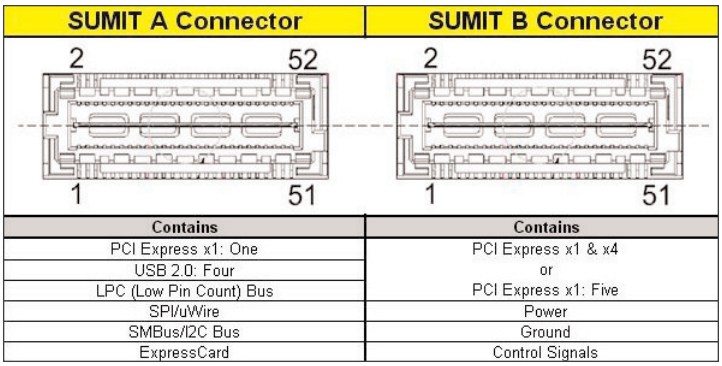
With all these features, SUMIT-based expansion I/O modules enable small, rugged, and reliable computer systems that are powerful, easy-to-use, cost-effective, and scalable. Low cost, high performance computer systems can be built for a variety of different embedded applications. These application areas include transportation, medical, industrial automation, Mil/COTS, homeland security, energy, and communications sectors.



Contains	Contains
PCI Express x1: One	PCI Express x1 & x4
USB 2.0: Four	or
LPC (Low Pin Count) Bus	PCI Express x1: Five
SPI/uWire	Power
SMBus/I2C Bus	Ground
ExpressCard	Control Signals

I/O resources available with SUMIT connectors.

SUMIT Connector Technology

SUMIT is built on a very small, dense, high-speed connector containing 52 pins arranged in two rows. A ground blade is incorporated between the rows to help provide the impedance control that is critical for handling high data rates. The Samtec QFS/QMS Micro High Speed Series of pin-and-socket connectors, with a pin pitch of 0.635mm (0.0250-inch) meet SUMIT's requirements for density, signal integrity and ruggedness. Actual signal integrity test results demonstrate that a stack of four modules will support data rates of 5 GT/s which is required for PCI Express Generation 2.

The connectors are small, rugged and engineered to work with standoffs in a multi-board stack. Taking up a small fraction of the board real-estate required by traditional pin-and-socket connectors, SUMIT connectors consume only 4% of the total board area of a 90x96mm card yet offers tremendous bandwidth and I/O connectivity. On a single 52-pin high-speed SUMIT-A connector, it supports one x1 PCI Express™ lane, four high-speed USB 2.0 interfaces, LPC (Low Pin Count) Bus, SPI/uWire, SMBus/I²C Bus, and ExpressCard™ signals. A second identical 52-pin SUMIT-B connector supports one additional x1 PCI Express lane, one x4 PCI Express lane plus additional power, ground, and control signals.

The total number of pins for both connectors is 104 and its configuration is referred to collectively as SUMIT Type AB. The second connector is used for applications requiring more channels and higher bandwidth. Notice that the PCIe x4 lane can alternatively support four PCIe x1 lanes for a total of six PCIe x1 lanes when both SUMIT connectors are used.

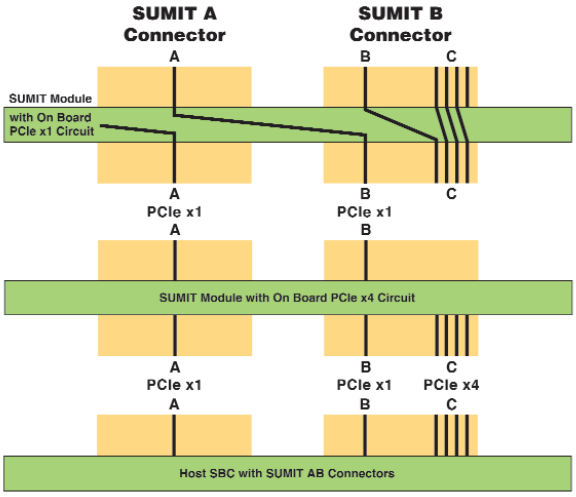
SUMIT-enabled expansion modules must include the SUMIT Type A connector. All expansion boards must either include both SUMIT Type AB connectors or must include a keep out area where the Type B connector is located, both top and bottom. This keep out area has a maximum height restriction of 5.08mm (0.200-in). This keep out area is to ensure that modules with both SUMIT Type AB connectors can plug into modules with only a SUMIT Type A connector without interference.

PCI Express Routing

Great care has been taken with the design and specification of SUMIT connector placement to make sure that the high frequency signals can be easily routed according to the PCI Express guidelines with the few-est number of vias both on the CPU and the I/O cards.

Routing signals up a board stack can be a challenging task, especially when it comes to high-frequency signals. PCI Express in particular requires careful consideration when laying out a processor or I/O expansion board. In fact, for any extremely high-speed differential signaling environment, the symmetry of the circuit is of utmost importance. Matching each segment pair length, matching left hand and right hand turns for the pair, placing vias or components symmetrically in the signal path, and routing the trace pair symmetrically to these features are critical to minimize impedance, reflection, and flight time mismatches that degrade signal quality at these frequencies.

Also, each PCI Express x1 link utilizes an auto-alignment topology routing up the stack in which links that are used by the expansion card are automatically selected and the remaining unused signals are simply shifted to the lower link's pins on the top connector for use by the next board. This passing of signals "up the bus" is analogous to the way PCI interrupts have been routed in a rotating method on PC motherboards for more than a decade. Cards can use one or more links from their connector while the remaining links are routed to the next board or connector, justified back to the first pin. All expansion modules are exactly the same from the connector pin definition perspective.



PCI Express link alignment on SUMIT-ISM modules.

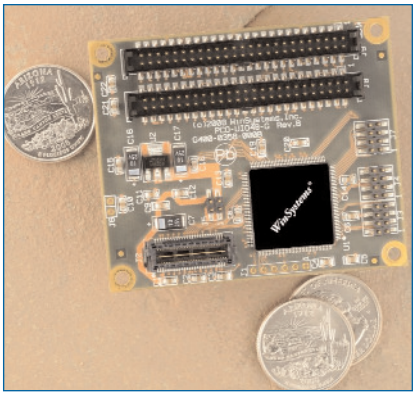
One of the design features of stacking SUMIT-based I/O expansion modules is to not require any jumpers for address or slot alignment. This would be required due to the nature of implementing a point-to-point architecture in a self stacking design compared to previous generations of parallel bus technologies using through-hole stacking connectors.

By contrast, SUMIT uses a pair of surface mount connectors that allows one or more PCI Express x1 controllers to be mounted on an I/O expansion module. This feature allows automatic link alignment which eliminates the need for jumpers or special stacking order. Boards not supporting PCI Express simply pass all signals straight up the stack from one connector to another.

An SUMIT-based expansion module with a single x1 PCI Express controller is always wired to Link A on the "bottom" side connector. On the "top" connector, Link A will be wired from Link B on the bottom connector. Link B has no connections on the top connector of a card consuming and shifting up either PCIe x1 signals. A SUMIT expansion module that consumes the x4 PCI Express link has no connections on the top connector for these pins. When not using the x4 link, the signals are passed straight up the bus from top to bottom. When passing through any PCIe x1 link, associated clock and presence detect pins for that link are also passed up directly or auto aligned with the parent signals. This same concept of lane shifting applies to the USB lines as well.

Applying SUMIT

Even though SUMIT defines the high speed connectors and their respective signal assignments, it does not address the specific location (placement) requirements for the connectors on any specific form factor boards. Only the relative location of one connector to the other is specified to ensure proper routing of signals that are passed from one connector to another as they continue up in a stacked architecture. Therefore, SUMIT can be used to support a single mezzanine card or to allow multiple boards on a self-supporting stack. This flexibility has allowed the connector to be designed into a number of different custom and standard-size base boards including Pico-ITXe, EBX, EPIC, and the 90x96mm Industry Standard Module (ISM).



SUMIT A connector application on a 60x70mm Pico-I/O module.

For SUMIT-based I/O expansion, there are two standard module form factors: Pico-I/O and SUMIT-ISM. Pico-I/O boards measure 60x72mm while SUMIT-ISM boards measure 90x96mm. The board area for Pico-I/O is exactly half the area of SUMIT-ISM. Both module types are small, rugged, easy-to-use, and scalable. Either solution provides powerful I/O building blocks and that can be stacked on top of one another or used as a mezzanine. This reduces cost and bulk while increasing mounting and packaging options for small form factor embedded systems.

The Bottom Line

SUMIT creates an inclusive next-generation vehicle for compact embedded computers, providing a common set of well-supported low-, medium- and high-speed serial interfaces. The connector specified by SUMIT is both robust and low cost, and it satisfies a broad gamut of performance requirements: ranging from an A-only implementation of a simple, low-speed serial bus to a high-bandwidth A/B implementation with two x1 and one x4 PCI Express lanes. That's a set of characteristics that can satisfy a broad slice of embedded applications and provide an answer to the fragmentation of the embedded computing world today.

For the SUMIT specification, visit www.winsystems.com/index_specs.cfm.

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