SUMIT Industry Standard Module™ (SUMIT-ISM) SPECIFICATION

Revision 1.0

August 25, 2009

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Revision History

Revision	Issue Date	Comments
1.0	8/25/09	Initial Release

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1.0 Introduction

1.1 SUMIT™ expansion on ISM™ makes SUMIT-ISM™

The Stackable Unified Module Interconnect Technology (SUMIT™) Specification defines the electrical and connector characteristics of a stackable expansion bus for single-board computers and expansion modules. SUMIT defines two identical 52-pin connectors ("A" and "B"), which together carry up to 6 lanes of PCI Express, four USB 2.0 ports, ExpressCard™ support, a LPC (low pin count) parallel bus, SPI/uWire and SMBUS/I^2C serial buses plus various power and ground supplies. SUMIT specifies only connectors and signals. It is independent of a board's form factor.

An Industry Standard Module (ISM) is defined as a 90mm x 96mm board outline plus mounting holes, without regard to bus expansion. ISM modules are small, rugged, easy-to-use, and scalable. They provide powerful building blocks for diverse applications and markets. With a variety of industry standard interfaces available, ISM boards can be stacked on top of one another to expand or customize system solutions. This reduces cost and bulk while increasing mounting and packaging options for small form factor embedded systems.

Specifying how to support SUMIT expansion on the ISM form factor defines SUMIT-ISM. Hence, a SUMIT Industry Standard Module (SUMIT-ISM) CPU board is a 90mm x 96mm size board that supports an embedded processor and one or two SUMIT QMS connectors, providing the option to stack one or more SUMIT-ISM I/O modules above the CPU. A SUMIT-ISM I/O board is also a 90mm x 96mm module that provides expansion I/O along with one or two SUMIT QMS/QFS connector pairs on the top and bottom of the module respectively to allow the module to stack above a SUMIT-ISM CPU, or in fact any SBC / CPU board supporting SUMIT-ISM expansion such as EBX, EPIC or custom SBCs, while also allowing another SUMIT-ISM I/O board to stack above it. This Specification defines a specific location for the SUMIT connectors as well as an area left for legacy board-to-board interconnects.

SUMIT-ISM is based upon the ISM umbrella concept which provides coherence to the many different boards that are available in this industry standard footprint. This concept includes:

1. Decoupling form factor from expansion interfaces.
2. Fitting circuitry without extending beyond the board outline.
3. Enabling flexible expansion bus and I/O connectorization.
4 Top- and bottom-side component height restrictions.
5. Allowing bus combinations that were previously undefined and unnamed.

Through the SUMIT interface, SUMIT-ISM incorporates the PCI Express and USB serial buses that were developed for desktop and mobile environments

while leveraging them for use in embedded, medical, and industrial applications. SUMIT-ISM enables a stackable, I/O-centric, multi-board solution for compact embedded systems. SUMIT-ISM provides a solution that is neither processor architecture nor chipset dependent. SUMIT-ISM boards can be SBCs, stackable CPU and I/O cards, and even computer-on-modules (COMs).

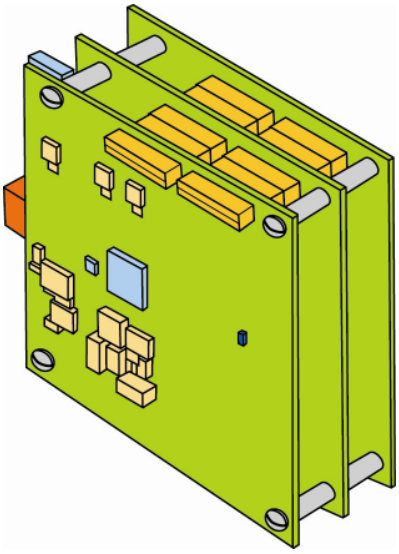

Figure 1: A SUMIT-ISM™ three board stack of modules

Even though SUMIT-ISM modules can be constructed with SUMIT connectors alone, special configurations have also been defined to support expansion with legacy PC/104 form factor modules. These modules became very popular due to their ease of use, low profile (horizontal rather than vertical installation), simple design, and huge variety of I/O boards from vendors worldwide. However, as newer technology and faster high-speed serial buses have been developed and become standard in use by the commercial PC, it was necessary for the SUMIT-ISM definition to create a bridge from the past to future.

The philosophy behind SUMIT-ISM preserves legacy investments while adding an upward performance migration path, paving the way for small, rugged, scalable and reliable computer systems for the long haul. This is done by allowing the continued use of the legacy PC/104 connectors in their existing locations, and re-using established physical dimensions and mounting holes.

1.2 Audience

This document is written for design engineers that understand the basics of SUMIT, ISM, small form factor single board computers, and the serial buses that are collectively supported by that Specification. It specifies the connector

mounting location and stacking conventions for single board computers and I/O expansion.

Since SUMIT-ISM supports high-speed serial bus signals, care must be exercised with respect to best layout practice for high-speed signals. Please reference industry standard organizations' and special interest groups' websites listed in this specification for their design and layout recommendations. Also visit the SFF-SIG website for the current SUMIT and ISM specifications, application notes, and any design guides that may be available.

1.3 Related Organizations and Documentation

For the PC/104, PC/104-Plus, PCI-104, EBX and EPIC Specifications

PC/104 Consortium
1712 Devonshire Road
Sacramento, CA 95864 USA
Phone: +1-916-270-2016
Email: info@pc104.org
www.pc104.org

For SUMIT connector information

Samtec, Inc.
520 Park East Boulevard
New Albany, IN 47151-1147 USA
Phone: +1-812-944-6733
Fax: +1-812-948-5047
Email: standards@samtec.com
www.samtec.com/search/sumit.aspx

For the SUMIT and ISM Specifications

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2.0 Acronyms and Terms

ISM	Abbreviation for Industry Standard Module
PC/104	This is a self-stacking, 3.6 x 3.8-inch computer module with a 64 and 40 contact connector for small form factor applications of the PC and PC/AT buses for embedded applications.

PCI-104	This is a module with a 120-pin, 2mm stacking connector on the PC/104 form factor with the 32-bit PCI local bus.
QMS/QFS	The SUMIT micro high-speed connector system.
SBC	Abbreviation for Single Board Computer.
Stackable	The ability to stack multiple cards on top of another to create a system without the need to use a backplane to connect the power, control, and data busses.
SUMIT™	Stackable Unified Module Interconnect Technology.
SUMIT-ISM	It is defined as the addition of SUMIT connectors on an ISM module plus component height limits.

3.0 SUMIT Industry Standard Module (SUMIT-ISM)

The physical dimensions of an ISM (Industry Standard Module) can be found in the ISM Specification available from the Small Form Factor Special Interest Group (SFF-SIG) at *www.sff-sig.org*. This specification defines a 90mm x 96mm board size with four fixed mounting holes and flexible expansion zones. SUMIT-ISM is defined by adding a fixed location for the SUMIT connectors plus component height limits consistent with the SUMIT Interface Specification, also available from SFF-SIG at www.sff-sig.org.

A SUMIT-ISM module maintains the same module physical dimensions and mounting holes as ISM. This is important for efficiency and integration of standard packaging and mounting in OEM equipment so that system design and original equipment manufacturers can preserve their non recurring engineering (NRE) investment.

3.1 SUMIT Connector Physical Placement

The physical placement locations for the SUMIT A and SUMIT B connectors (as defined in the SUMIT Interface Specification) on a SUMIT-ISM module are shown in Figure 2.

In addition to the basic 90x96 mm footprint, SUMIT-ISM allows logic and I/O connectors to be placed within the optional 0.5-in. expansion zones. These zones are shown in the cross hatched areas in Figure 2. This allows the option to either use right-angle connectors that overhang the basic board edges or extending the circuit board when vertical / non-overhanging connectors are used. Any connector overhang must not exceed the edge of the expansion zone.

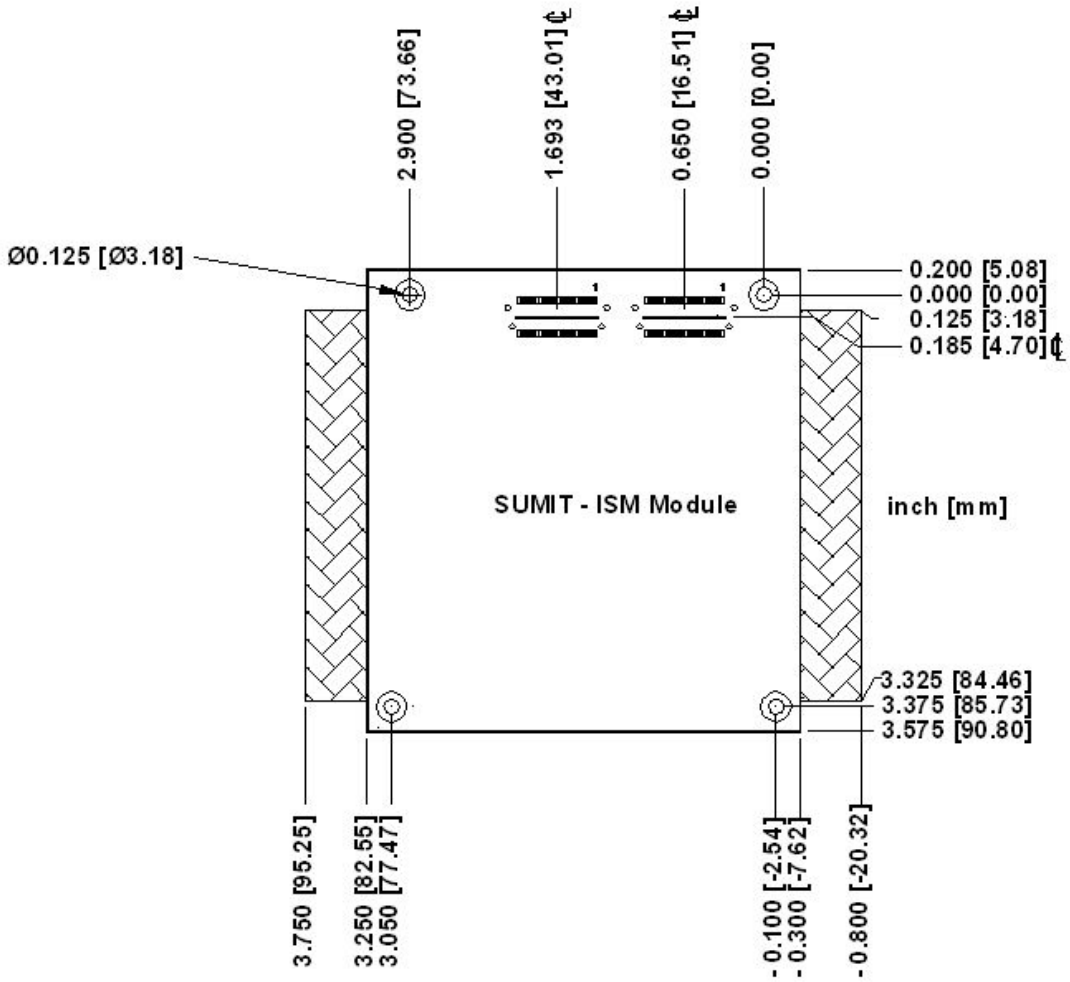

Figure 2: SUMIT™ connector placement on a SUMIT-ISM module with expansion zones on both ends

3.2 SUMIT Interface

The SUMIT specification defines three configuration alternatives based on having the SUMIT A connector alone, the SUMIT B connector alone, or both SUMIT connectors present on a board. The controlling document is the SUMIT specification published and maintained by the SFF-SIG (www.sff-sig.org).

- Configuration A -- consisting of the SUMIT A connector, only
- Configuration AB -- consisting of both the SUMIT A & B connectors
- Configuration B -- consisting of the SUMIT B connector, only

A SUMIT-ISM CPU board typically uses one or two 52-pin connectors in either the SUMIT A or SUMIT AB configurations based on interface bus requirements and cost considerations (i.e. The SUMIT A connector is mandatory; however,

the SUMIT B connector is optional). All SUMIT-ISM compatible processor boards that wish to support SUMIT AB I/O expansion modules must either include both SUMIT A and SUMIT B connectors or must respect a keep-out area where the missing B connector would be located. This keep-out area has a maximum height restriction of 5.08 mm (0.200-in). Failure to include the keep-out area may prohibit I/O modules with both SUMIT A and SUMIT B connectors from being used with SUMIT A CPU boards. Note however, that SUMIT AB I/O modules that require signals on the SUMIT B connector can never be used with a SUMIT A CPU board. The following chart summarizes the compatibility of SUMIT-ISM I/O modules with SUMIT-ISM CPU modules from a connector configuration standpoint.

		CPU	
		SUMIT A	**SUMIT AB**
I/O	**SUMIT A**	OK	OK
	SUMIT AB	OK if SUMIT B signals not used	OK

The QFS/QMS Micro High Speed Series is a 0.635 mm (0.0250-inch) pin pitch connector as defined in the SUMIT specification is used for SUMIT-ISM. It is a 1-bank, terminal assembly that provides a ground blade in the center of the connector. Gold plated pins are mounted in a double row configuration. A total of 52 pins are available per connector. With two connectors in the SUMIT AB configuration, a total of 104 pins are available. The connector is rugged so as to support industrial application environments. For more information on these connectors, go to www.samtec.com/search/sumit.aspx

Only the top QMS connector is used on SUMIT-ISM CPU boards. The bottom QFS connector is not used. Both QMS and QFS connectors are used on SUMIT-ISM I/O modules.

Certain chipsets do not support all the I/O interfaces defined on a SUMIT A and B connectors. If a vendor's SUMIT-ISM CPU board does not or cannot support one or more of the interfaces, it should be clearly marked in their data sheet and technical manuals using the label defined in the latest SUMIT specification.

3.2.1 Board-to-Board Spacing

The board-to-board spacing is 15.24 mm (0.600-in) and is measured from the top of one board to the bottom of the next board in the stack. This is the mated height of the QMS/QFS pair, as well as that of the appropriate standoff (spacer) length for mounting boards together. A total of four 3.18 mm (0.125-inch) inside

diameter holes are defined for threaded spacers that are used to provide accurate board separation and rigidity.

15.24mm (0.600-in) spacers are required in all four SUMIT-ISM mounting holes to insure rigidity of the stack. This also helps to make sure that the SUMIT connectors are properly mated and that SUMIT-ISM boards are neither over- nor under-inserted into their mating connectors.

Component height on the top side of a board should not exceed 11.05 mm (0.435-in). The component height on the bottom of a board should not exceed 2.54 mm (0.100 inches) to prevent board-to-board interference while in a stack.

3.2.2 Connector Placement

The QMS is the top-side connector and the QFS is the bottom-side connector for SUMIT-ISM-based boards. “Top side” generally refers to the upward facing side of the circuit board for CPU boards and expansion boards. This is commonly the major component side of the board. “Bottom side” refers to the opposite I/O board side. Only the top QMS connector is used on SUMIT-ISM CPU boards. The bottom QFS connector is not used. Both QMS and QFS connectors are used on SUMIT-ISM I/O modules.

3.2.3 Stack Direction

The stack is assembled in one direction only. It is “up” from the processor board (SBC), which is defined herein as the bottom board in the stack. A processor board may require the SUMIT-ISM I/O module(s) to stack on the reverse side from the major components. But the stack may only proceed in one direction.

Simultaneous upward and downward stacking is not supported by SUMIT-ISM. This is to preserve the point-to-point routing nature of PCI Express and USB, while removing the significant additional cost and complexity necessary to implement processor and I/O expansion cards with this feature for the vast majority of applications.

However, if a processor board requires SUMIT-ISM module(s) to stack opposite from the major components, placement of the SUMIT AB connector must be reoriented respective to the “bottom” side of the board. This ensures that standard SUMIT-ISM expansion modules stack as normal, just opposite to that of the major components on the processor. But the stack may only proceed in one direction.

3.2.4 Stacking Order of Expansion Boards

The stacking order for the SUMIT-ISM modules is significant. SUMIT-ISM AB I/O modules must be the first boards in the stack above the CPU. SUMIT A or

SUMIT B I/O modules are stacked above the SUMIT AB modules. Note that both SUMIT A and SUMIT B I/O modules cannot be used in the same system.

Hence, a SUMIT-ISM I/O expansion module with a PCIe x4 lane must be closest to the root SBC. Next would be a SUMIT-ISM expansion module(s) with a PCIe x1 lane. Stacked above that would be any SUMIT-ISM I/O modules which use USB, SPI/uWire, SMBus/I²C, and/or LPC modules. Finally, any legacy modules (see below) would be on the top of the stack.

4.0 Legacy Configuration Options

SUMIT-ISM supports a legacy option for use with PC/104 or PCI-104-compatible I/O modules for long life cycle applications. Its purpose is to offer both a bridge and easy migration path for current and existing designs needing to interface to these stackable I/O modules. PC/104 is a repackaged, stackable version of the PC Industry Standard Architecture (ISA) bus whereas PCI-104 is the stackable parallel PCI bus. The signal definitions and timing information for these two buses may be obtained from the PC/104 Consortium.

The PC/104 and PCI-104 buses have gained worldwide adoption as industry standard system expansion interfaces for small, modular systems. There are many I/O cards available that offer a wide variety of I/O interface solutions especially for embedded applications. Therefore, SUMIT-ISM defines the Legacy Type 1 and Legacy Type 2 options for designers wishing to incorporate PC/104 or PCI-104 modules and enclosures into their system. A Legacy Type 1 board supports the legacy 104-pin PC/104 connector in addition to the SUMIT A or AB connectors and a Legacy Type 2 board supports the legacy 120-pin PCI-104 connector in addition to the SUMIT A or AB connectors.

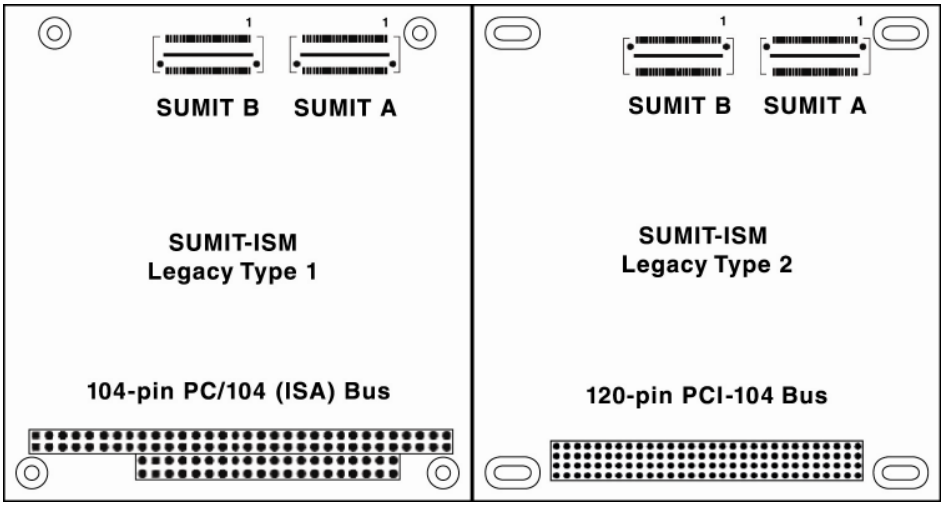

Figure 3: Comparison of SUMIT-ISM Legacy Type1 and Type 2 layouts.

In both cases, the SUMIT-ISM module has the same physical dimensions and mounting hole areas as a PC/104 card. The controlling parent documents for the PC/104, PC/104-*Plus*, and PCI-104 Specifications are available from the PC/104 Consortium.

4.1 SUMIT-ISM Legacy Type 1

In the Legacy Type 1 case, the, SUMIT-ISM board has the SUMIT connectors located in the same general area where the 120-pin PCI-104 bus connector was placed on a PC/104-*Plus* module. Therefore, only PC/104 I/O cards can be supported in a Legacy Type 1 configuration. The PC/104 connector is the same connector as defined in the PC/104 Specification and has the same placement, pin assignments, functions, and electrical signaling levels.

The mechanical dimensions and connector placement for a Legacy Type 1 SUMIT-ISM module is shown In Figure 4. The location and placement of the legacy PC/104 connector is the same as defined in the PC/104 specification. The SUMIT A and B connectors are located as defined earlier in this document.

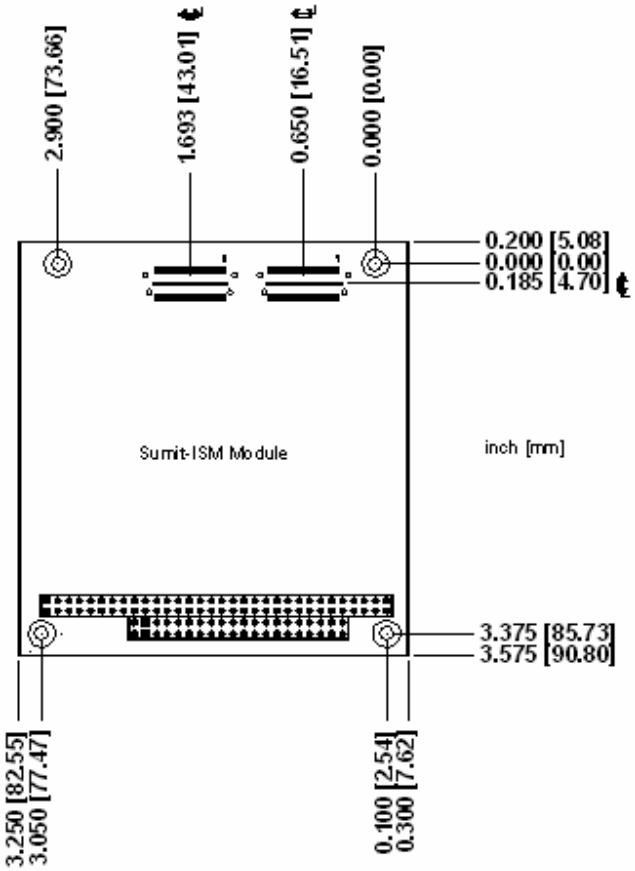

Figure 4: SUMIT Type AB connector placement on a Type 1 SUMIT-ISM module with a legacy PC/104 connector

If PC/104 modules are used in a SUMIT-ISM Legacy Type 1 board stack, then a stack-through PC/104 connector must be present on all of the SUMIT-ISM I/O cards used between the PC/104 modules and the host SUMIT-ISM SBC. Note that the legacy PC/104 modules must be the top boards in the stack, above all SUMIT-ISM I/O modules.

4.2 SUMIT-ISM Legacy Type 2

In the Legacy Type 2 case, the SUMIT-ISM board has the SUMIT connectors located in the same general area where the 104-pin ISA bus connector was placed on a PC/104 or PC/104-*Plus* module. Therefore, only PCI-104 I/O cards can be supported in a Type 2 legacy configuration. The 120-pin PCI-104 bus connector is the same connector as defined in the PC/104-*Plus* and PCI-104 specifications, and has the same placement, pin assignments, functions, and electrical signaling levels.

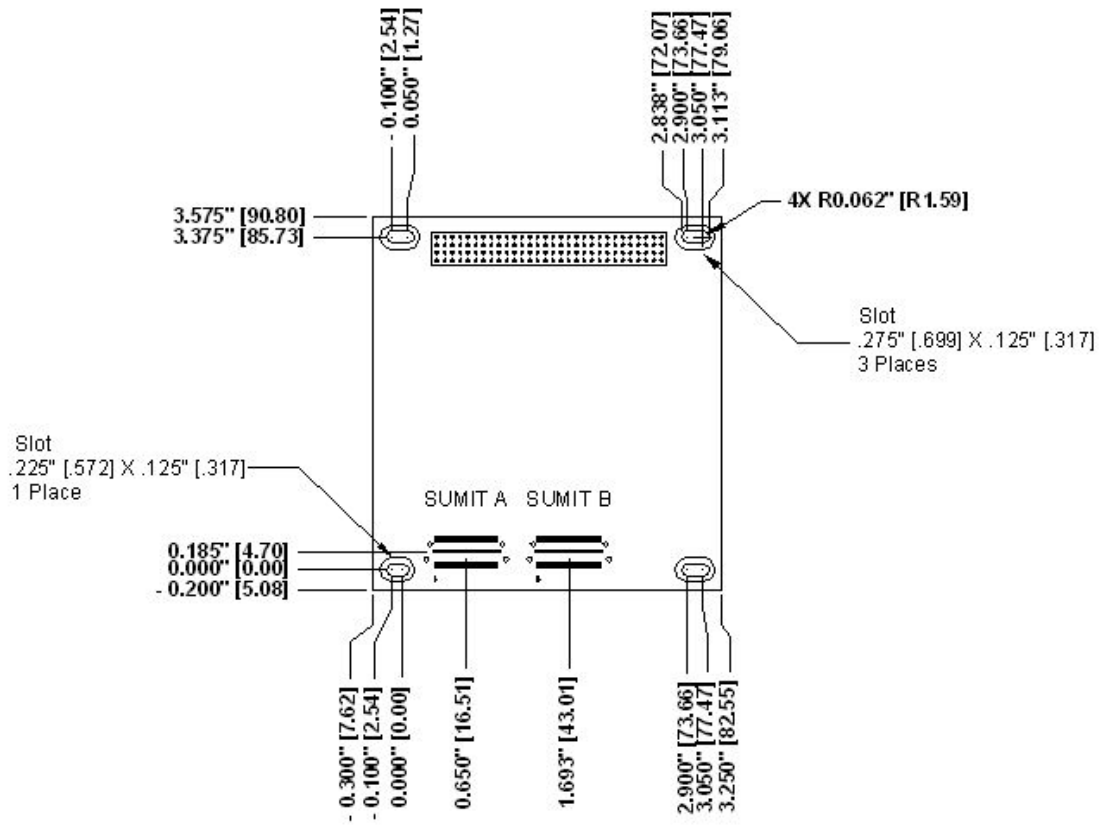

Figure 5: SUMIT Type AB connector on a Type 2 SUMIT-ISM module with legacy PCI-104 connector

The mechanical dimensions and connector placement for a Legacy Type 2 SUMIT-ISM module is shown In Figure 5. The location and placement of the legacy PCI-104 connector is the same as defined in the PC/104-*Plus* and PCI-

104 Specifications. The SUMIT A and B connectors are located as defined earlier in this document.

If PCI-104 modules are used in a SUMIT-ISM Legacy Type 2 board stack, then a stack-through PCI-104 connector must be present on all of the SUMIT-ISM I/O cards used between the PCI-104 modules and the host SUMIT-ISM SBC. Note that the legacy PCI-104 modules must be the top boards in the stack, above all SUMIT-ISM I/O modules.

4.3 Why SUMIT-ISM Legacy Type 2's mounting holes are slotted

SUMIT-ISM I/O modules and Legacy Type 1 modules have their SUMIT connectors positioned along the same edge of the ISM module form factor. Legacy Type 2 modules, on the other hand, have their SUMIT connectors positioned on the opposite edge of the ISM module form-factor, so that the Legacy Type 2 PCI-104 connector can pair with the PCI-104 connector that originated on the opposite edge of the PC/104 form-factor.

Because the ISM mounting hole pattern like that of the legacy PC/104 standard is asymmetrical, a Type 2 module form factor has been defined with a *slotted* hole pattern. This allows SUMIT-only modules as well as Legacy Type 1 modules (with the PC/104 connector depopulated) to coexist within a Legacy Type 2 stack. Similarly, Legacy Type 2 modules (with the PCI-104 connector depopulated) may coexist within a Legacy Type 1 stack. This allows I/O manufacturers to create a single design that will operate in multiple stack configurations by simply populating or not populating the PC/104 or PCI-104 connectors. However within mixed stacks, legacy PC/104 and PCI-104 cards cannot be used because the PC/104 or PCI-104 buses are not passed through to the top of the stack.

Since Type 2 modules have slotted mounting holes, the recommended chassis or enclosure mounting hole pattern is that of SUMIT-only and Legacy Type 1 modules.

5.0 SUMIT-ISM as I/O for other board form factors

SUMIT-ISM modules can be stacked together for a small system solution or used as I/O expansion modules for a larger host single board computer. Consequently, SUMIT-ISM (SUMIT-only, Legacy Type 1 and Legacy Type 2), can also be used as stackable, I/O expansion modules for EBX, EPIC, other standardized SBC form factors, or and custom board level embedded computers.

As with the above definitions for Legacy Type 1 and Type 2, the incorporation of the SUMIT interface basically replaces either the 120-pin PCI-104 or the 104-pin PC/104 connector with a 104-pin SUMIT connector pair. None of the dimensions, I/O zones, or mounting hole locations of an EPIC or EBX SBC form

factor board need to change other than the use of slotted mounting holes when SUMIT Type 2 is the primary expansion format.

This results in more I/O interface options and higher bandwidth while requiring less real estate for the connectors. Plus, it aligns well with the ultra low power chipsets from the Intel Atom™ and VIA Nano™ microprocessor families.

6.0 Power

The SUMIT specification provides for expansion module power to be supplied through both connectors on designated pins. It is up to the system integrator to ensure that the power the processor supplies to the SUMIT connector(s), the number of modules, and total power consumption for all modules are reconciled and conform to the system available resources. It is assumed that the processor board itself is powered from a connector separate from either SUMIT connector.

SUMIT-ISM SBC boards must supply +5 volts to the SUMIT connector(s) while +3.3 volts and +12 volts are optional. This applies only to SBC's but does not require an I/O card to use all the voltages. It is a power supply source issue to accommodate a variety of possible I/O cards on a stack with their different interface requirements. This does not imply that certain SUMIT interface signals be +5 volt tolerant.