



PC/104 Embedded Consortium

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What is PCI/104-Express™?

Introduction

The PCI/104-Express specification establishes a standard to use high speed PCI Express® bus in embedded applications. It was developed by the PC/104 Embedded Consortium and adopted by member vote in March 2008. The PC/104 Consortium chose PCI Express® because of its full PC market adoption, performance, scalability, and growing silicon availability worldwide. It provides a new high-performance physical interface while retaining software compatibility with existing PCI infrastructure.

Incorporating the PCI Express bus within the industry proven PC/104 architecture brings many advantages for embedded applications including fast data transfer, low cost due to PC/104's unique self-stacking bus, high reliability due to PC/104's inherent ruggedness, and long term sustainability.

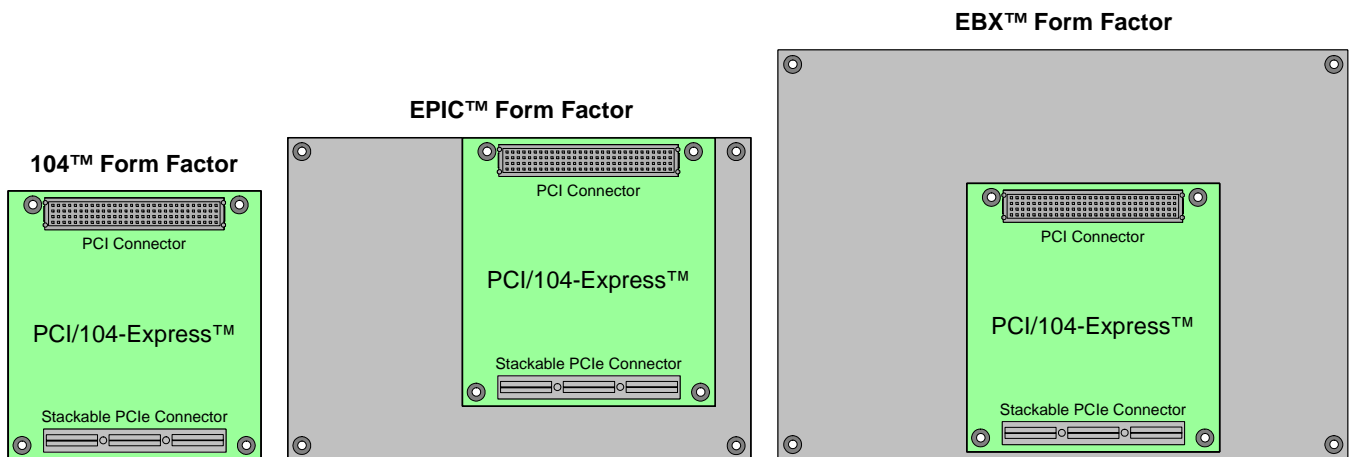
Background

The main objective in defining an addition of PCI Express to PC/104 was to preserve the attributes that have made PC/104 so successful in embedded applications, namely:

- Compact 3.6 by 3.8 inches (90 x 96 mm) module size
- Self-stacking expands without backplanes or card cages
- Rugged, reliable connectors reliable in harsh environments
- Four-corner mounting holes resistance to shock and vibration
- Fully PC compatible reduced development costs and time-to-market

In addition, it was important that a stackable form of PCI Express take into consideration backward compatibility with current Embedded Consortium specifications and form factors. The design had to support automatic detection of up or down stacking and had to have automatic link shifting to allow simplified, universal add-on module designs.

The PCI/104-Express design approach provides a consistent and interchangeable path for the stackable PC architecture across the PC/104 Embedded Consortium's 104, EPIC, and EBX form factors.



PCI/104-Express Specification Overview

PCI Express bus connector:

- Four x1 PCIe® Links
- One x16 PCIe Link (optionally configurable as two x8 Links, two x4 PCIe Links, or two SDVO Interfaces)
- Power: +3.3V, +5V, +12V, and ATX power and control signals +5V Standby, Power supply on, and Power OK
- SMBus

PCI-104 PCI Bus connector:

- PCI Bus: 32-bit, 33 MHz, Four Bus Master capable (same as on PC/104-Plus and & PCI-104)
- Power: +3.3V, +5V, +12V, -12V, +5V Standby, Power Supply On, and PME for ATX power supply

Here is a brief summary of the basic specs of PCI/104-Express modules:

- | | |
|---|---|
| • Number of PCI Express modules per stack | 4 x1 and 1 x16 (host may configure as two x4 or x8) |
| • Stack direction | Stack up or stack down |
| • Data throughput PCI bus | 132 M Bytes/sec (26 times ISA) |
| • Data throughput single x1 Link | 500 M Bytes/sec (4 times PCI) |
| • Data throughput x16 Link | 8,000 M Bytes/sec (60 times PCI) |
| • Total data throughput all Links | 10,000 M Bytes/sec (75 times PCI) |
| • PCI Express bus power +5V power capability | 84 watts |
| • PCI Express bus power +12V power capability | 100 watts |

PCI/104-Express Connector

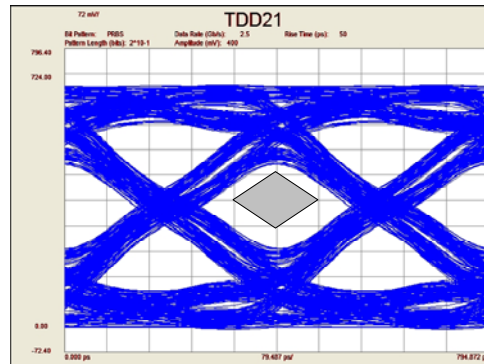
The PCI Express connector was specifically designed for the PC/104 Embedded Consortium to match the PC/104 standard 0.600 inch (15.24mm) stacking height and standoff tolerances. It was then tested to ensure it meets the PC/104 durability expectations and PCI Express signal integrity requirements. There will be multiple suppliers.



PCI Express Top Connector



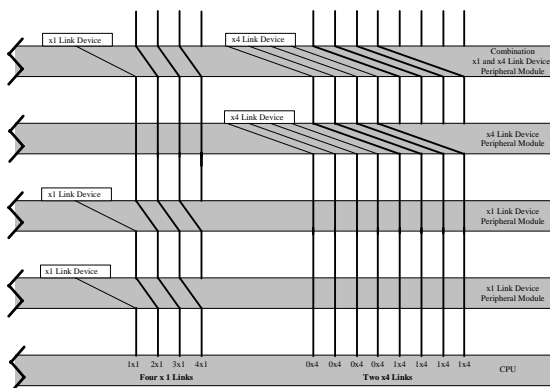
PCI Express Bottom Connector



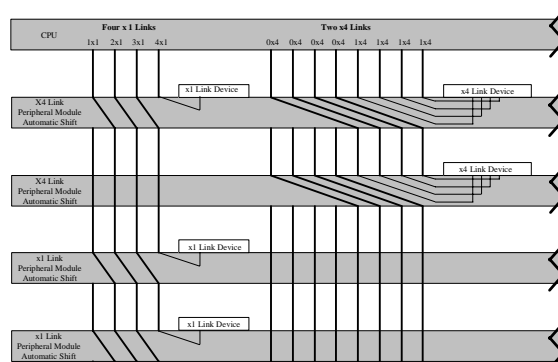
Signal Integrity Test Result

Link Shifting Stack Examples

Link shifting allows universal add-in card design and automatic PCI Express link assignment.



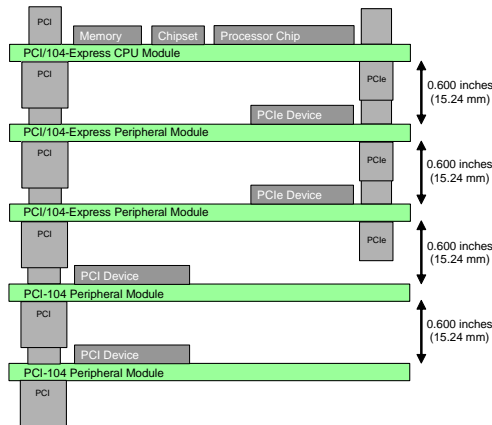
Automatic Link Shifting Stack-Up Example



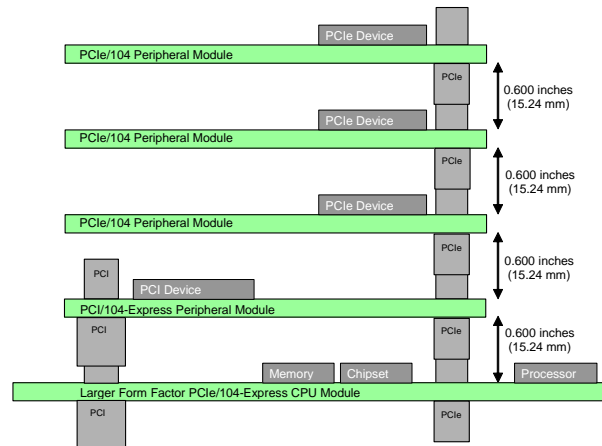
Automatic Link Shifting Stack-Down Example

Up or Down Stack Configuration Examples

The flexibility and expandability of the bus and mechanical layout allow many different stack configurations to support an array of diverse project requirements. See full specification for more examples.



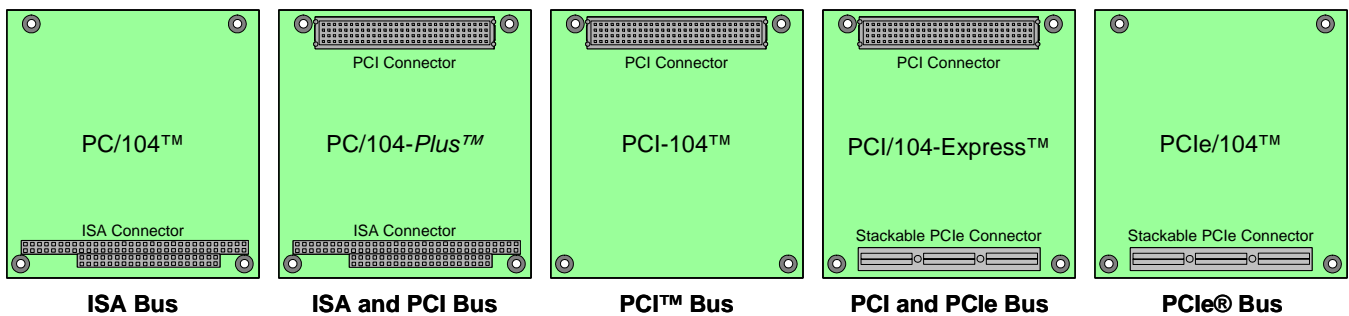
Stack-DOWN Configuration Example



**Stack-UP Configuration Example
with Large Form Factor Host Baseboard**

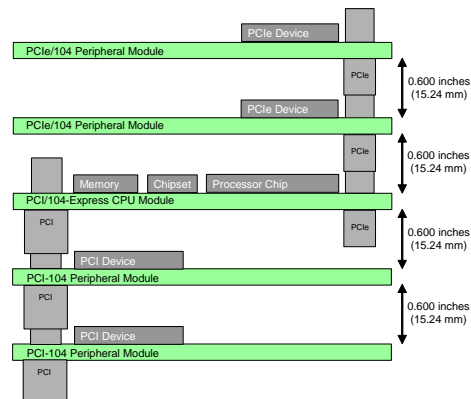
PC/104 Bus Evolution

PC/104 stackable embedded PCs have followed the desktop PC leveraging on the hardware and software support developed for this popular platform.

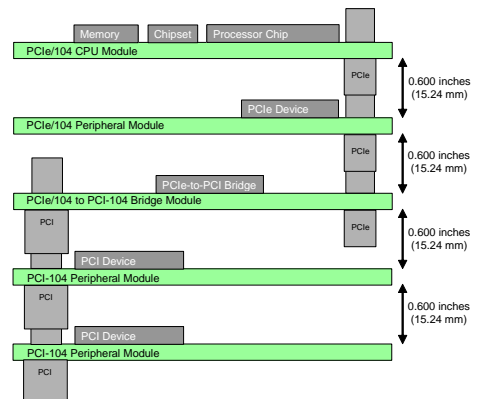


PCIe/104™

PCIe/104 is PCI/104-Express without the PCI bus. Since PCI Express is based on PCI technology, a PCI Express to PCI Bridge is a straightforward. A comparison between a PCI/104-Express CPU and Stack and a PCIe/104 CPU and stack shows that both easily support PCI Express and PCI add-in cards.



PCIe/104-Express CPU with PCIe/104 stack up and PCI stack down



PCIe/104 with PCIe/104 to PCI Bridge

Current Status of the PCI/104-Express Standard

The specification was adopted by PC/104 Embedded Consortium member vote in March 2008. Numerous companies have announced development and support for PCI/104-Express. Products demonstrated or under development include high performance single-board computers, 1Gbit Ethernet, high performance data acquisition and control interfaces, PCI bus adapters and bridges, and packet switches to provide expansion beyond 6 add-in cards.

Copies of the PCI/104-Express Specification are available to individuals and companies developing embedded systems. For further information, contact the PC/104 Embedded Consortium at www.pc104.org.

Other PC/104 Specifications

The PC/104 Embedded Consortium maintains the PC/104™, PC/104-Plus™, and PCI-104™ specifications on the 104™ form factor as well as the specifications for the EPIC™ and EBX™ form factors.

PC/104 is the original specification. It defined the 104 form factor at 3.550 x 3.775 inch (90.17 x 95.89 mm) with a stacking ISA bus. There are 8-bit (XT) and a 16-bit (AT) versions.

PC/104-Plus added PCI bus to classic PC/104 on the 104 form factor. 132M Bytes per second transfer rate made high speed processing possible in rugged embedded systems while the ISA bus allowed use of the extensive infrastructure of embedded modules.

PCI-104 actually existed in the PC/104-Plus specification, but it didn't have a name. Instead of calling it "PC/104-Plus PCI only" forever, the consortium decided to give it its own specification and PCI-104 was born with only a PCI bus on the 104 form factor.

While not much new was happening in PC bus architecture, the consortium adopted two form factor specifications.

EPIC (Embedded Platform for Industrial Computing) was the first to be introduced. At 4.528 x 6.496 inches (115.00 x 165.00 mm), it is larger than the 104 form factor and allows room for tall cooling solutions for high end processors and space for standard PC style I/O connectors.

EBX (Embedded Board, eXpandable) is the original 5¼ inch form factor of many single board computers. At 5.750 x 8.000 inches (146.05 x 203.20 mm) it has room for a complete computer with standard I/O and memory DIMMs but still features PC/104-Plus expansion for flexibility and expandability.

Where Does PCI/104-Express Fit?

The PCI/104-Express & PCIe/104 specifications continue to following the desktop PC and the path provided by the major chipset manufacturers.

- **PC/104** supports ISA only
- **PC/104-Plus** supports PCI and ISA
- **PCI-104** supports PCI only

And now

- **PCI/104-Express** supports PCI Express and PCI
- **PCIe/104** supports PCI Express only

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