The ExpressCard™ Standard – The Next Generation PC Card Technology
October 2003 – Copyright PCMCIA

In 2004 a new generation of PC platforms offering higher performance and scalability will be launched. These improvements are due to the introduction of PCI Express as a system bus. In support of this PCMCIA has introduced a new standard for hot swappable system modules which it believes will replace 'CardBus' as the preferred solution for end user add-ins. This new ExpressCard technology is designed to allow a broader range of applications at a lower cost than CardBus and has been embraced by both desktop and notebook system manufacturers.

Introduction

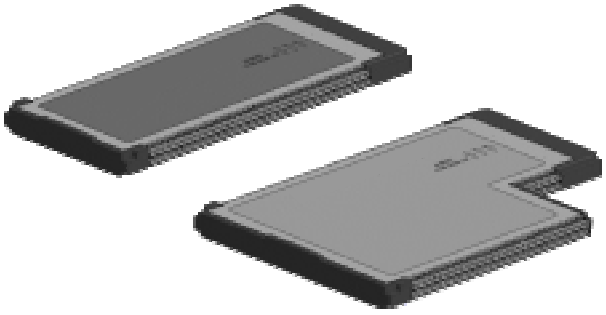
The ExpressCard standard gives the user a very easy way to add hardware or media to his system. The ExpressCard module can be plugged in or removed at almost any time, and unlike traditional add-in cards for desktop computers, it does not require any tools. ExpressCard technology provides desktop and mobile computer users a consistent, easy, reliable and non-threatening way to connect devices into their systems.

Illustrated here are ExpressCard slot and module concepts for both mobile and small-form-factor desktop computing platforms

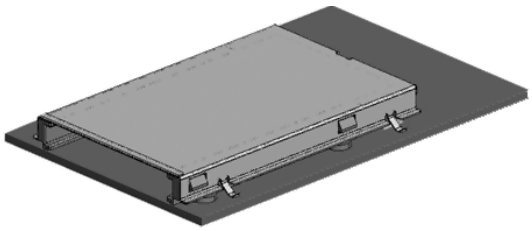
ExpressCard technology replaces conventional parallel buses for I/O devices with scaleable, high-speed serial interfaces. It allows developers to create modules using PCI Express* for their highest performance applications, or to use USB* to take advantage of the wide range of USB silicon that is already available. Irrespective of the bus technology that the module vendor chooses, the end user experience will be the same. There will be no external indications to the end user of which underlying bus the module is using.

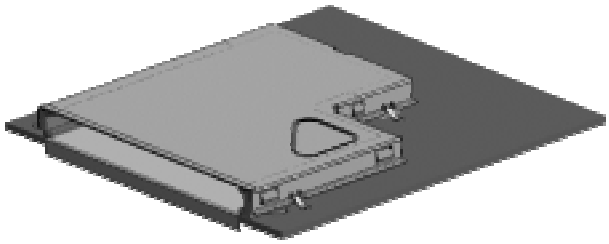
Module form-factors

There are two standard formats of ExpressCard modules: the ExpressCard/34 module which is 34 mm wide and the ExpressCard/54 module characterized by its 54 mm width. Both module formats are 5 mm thick, the same as the Type II PC Card. The standard module length is 75 mm, which is 10.6 mm shorter than a standard PC Card. ExpressCard/34 modules and ExpressCard/54 modules both use the same connector interface.



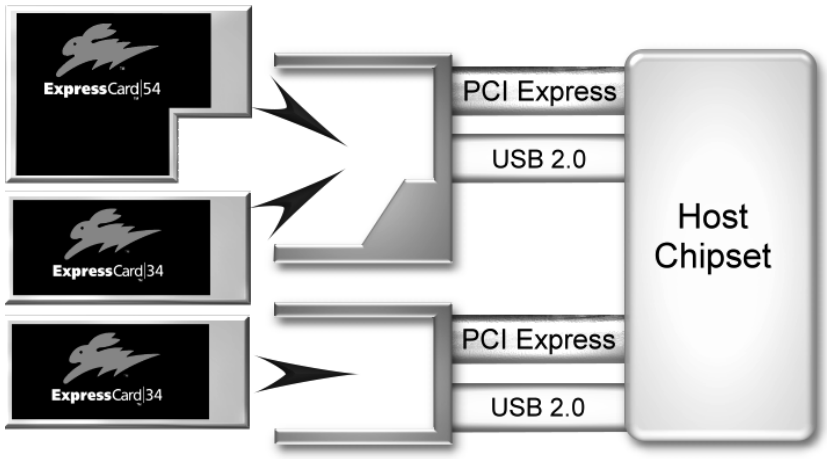
The ExpressCard Standard also allows extended module formats (not shown here) to provide ExpressCard module developers the facility to integrate features such as LAN and phone line connectors, or Antennas for wireless cards into the body of their products.





The two sizes of ExpressCard modules give system manufactures a degree of flexibility that they did not have with earlier module standards. While the ExpressCard/34 device is better suited to smaller systems, the wider ExpressCard/54 module can accommodate applications that will not physically fit into the narrower ExpressCard/34 form factor. Examples include SmartCard readers, Compact Flash readers, and 1.8" disk drives. The ExpressCard/54 module also provides extra space for components and can dissipate more thermal energy than the smaller module. This may make it a natural choice for higher performance and first generation applications. However, the module manufacturer who can fit his application into the narrow module will have the advantage that that particular module will work in both types of ExpressCard slot.

The socket which can accommodate the ExpressCard/54 module can also support an ExpressCard/34 device. To improve the ease-of-use this slot includes a novel guidance feature which is designed to steer ExpressCard/34 modules into the connector socket. It is also worth pointing out that the dimensions are such that inserting a CardBus card into an ExpressCard slot or vice versa will not damage either part.



The ExpressCard architecture is modular and extensible, allowing for multiple slots as illustrated here.

In any multi-slot host implementation, all slots provide equivalent I/O interface functionality and the choice of which slot to use for any given module is irrelevant. Both module formats afford access to the same I/O interface performance and source power although the larger ExpressCard/54 module provides the application nominally 140% the internal volume and 160% the thermal dissipation capacity of the ExpressCard/34 module.

The Connector

A common beam-on-blade style connector is used for both module and the corresponding host connector accommodates the insertion of either module. The blade contacts are located on the ExpressCard module and are designed for high durability and reliability. The connectors are designed to be capable of 10,000 card insertion and removal cycles.

The Interface

Each slot of the ExpressCard host interface must support a single PCI Express lane (x1) operating at the baseline 2.5 Gbps data rate, in each direction, as defined by the PCI Express Base Specification 1.0a as published and maintained by the PCI Special Interest Group (PCI-SIG). The ExpressCard host interface must also support the low-, full- and high-speed USB data rates as defined by the USB 2.0 Specification as published and maintained by the USB Implementers Forum (USB-IF). Support of both interfaces is a condition for being an ExpressCard-compliant host platform.

An ExpressCard module may use one or both of the standard interfaces depending on the application requirements.

The ExpressCard host interface – List of Signals

Signal Group	Signal	Direction	Description
PCI Express	PETp0, PETn0 PERp0, PERn0	Input/Output	PCI Express x1 data interface: 1 differential transmit pair and 1 differential receive pair
	REFCLK+ REFCLK-	Input	PCI Express differential, spread-spectrum reference clock
	PERST#	Input	PCI Express functional reset
Universal Serial Bus (USB)	USBD+ USBD-	Input/Output	USB 2.0 serial data interface
SMBus	SMBDATA SMBCLK	Input/Output Input/Output	SMBus management channel
System auxiliary signals	CPPE#	Output	PCI Express module detection and power control
	CPUSB#	Output	USB module detection and power control
	CLKREQ#	Output	Used to indicate when REFCLK is needed (PCI Express-only)
	WAKE#	Output	PCI Express function initiated wake event
Power & Ground	+3.3V		Primary voltage source
	+3.3VAUX		Auxiliary voltage source
	+1.5V		Secondary voltage source
	GND		Return current path

To assist in applications that require special sideband system management features, ExpressCard host systems may also connect a two-wire SMBus interface to the slot. If available, ExpressCard modules may provide support for such features as remote alerting and sideband radio control.

The following table summarizes the power supply limits for any given ExpressCard module. For purposes of the following table, the definition of 'Average' is the averaged steady-state maximum current consumption for the given module application. 'Max' is defined as the absolute maximum value that may be measured outside of the initial in-rush current that is allowed during the power ramp-up period.

ExpressCard module power supply limits

Supply	Limits	Notes
+3.3V[1]	1000 mA – Average 1300 mA – Max	Primary supply voltage
+3.3VAUX[1]	250 mA – Average 275 mA – Max	Auxiliary supply voltage; this current is also available during the power saving D3 state with wakeup enabled
	5 mA – Average	Auxiliary supply voltage during the power saving D3 state with wakeup disabled
+1.5V	500 mA – Average 650 mA – Max	Secondary supply voltage

1. The average current combined across both +3.3V and +3.3VAUX rails shall not exceed a total of 1000mA. The maximum total current across all power rails combined shall not exceed a total of 1750mA.

All ExpressCard modules, independent of the amount of power drawn from the host system, shall not exceed the thermal power limits defined for modules: 1.3W for ExpressCard/34 modules and 2.1W for ExpressCard/54 modules. Thermal limits are based on an assumption of uniformly heated module with a maximum case temperature of 90ºC in a host environment of 65ºC, and consider heating due to adjacent modules.

Hot Plug Functionality and Power Management

ExpressCard technology is designed to allow users to install and remove modules at anytime, without having to switch their system off. This hot plug functionality is a well established part of the CardBus and USB usage models and is also supported by PCI Express. By relying on the auto-detection and configuration of the native I/O buses (PCI Express and USB 2.0), ExpressCard technology can be implemented on a host system without an external slot controller. It simply needs a device to control power to the slot based on a simple, wired, module presence detection scheme.

Regarding power management, both PCI Express and USB natively support features that allow for module applications to be placed in very low power states while maintaining the ability to detect and respond to wakeup requests. Examples of how these features may be used by an ExpressCard application include receiving network messages via a wireless communications module that come in while the PC is in a sleep state. Effective use of these features is the key to creating high-performance applications which are both power and thermally efficient.

Relationship to the PC Card Standard

The PC Card Standard, which defines the 16-bit PC Card and the popular CardBus™ technology, were the first and second generations of card standards developed by PCMCIA. The ExpressCard standard represents the third.

As host systems move to a PCI Express based architecture, we expect ExpressCard technology to replace CardBus on the notebook and become broadly available on desktop platforms, especially the smaller form factor 'sealed box' designs.

For More Information

For more information on ExpressCard technology and becoming a member of PCMCIA please contact:

PCMCIA
2635 North First Street Suite 209
San Jose
CA, 95134
USA

Tel: 408-433-2273

www.pcmcia.org, www.expresscard.org

