
SSD mSATA vs. PCI Express

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The connector is similar in appearance to a PCI Express Mini Card interface,[56] but is not electrically compatible; the data signals (TX±/RX± SATA, PETn0 PETp0 PERn0 PERp0 PCI Express) need a connection to the SATA host controller instead of the PCI Express host controller.

Mini-SATA (mSATA)

See also: PCI Express § Mini-SATA (mSATA) variant

An mSATA SSD on top of a 2.5-inch SATA drive

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SFF-8784 connector

SFF-8784 connector[57]

Bottom Top

Pin Function Pin Function Pin Function Pin Function

1

Ground

6

Unused

11
Ground
16
+5 V

2
Ground
7
+5 V
12
B+ (transmit)
17
Ground

3
Ground
8
Unused
13
B? (transmit)
18
A? (receive)

4
Ground[d]
9
Unused
14
Ground
19
A+ (receive)

5
LED
10
Ground
15
+5 V
20
Ground

Slim 2.5-inch SATA devices, 5 mm (0.20 inches) in height, use the twenty-pin SFF-8784 edge connector to save space. By combining the data signals and power lines into a slim connector that effectively enables direct connection to the device's printed circuit board (PCB) without additional space-consuming connectors, SFF-8784 allows further internal layout compaction for portable devices such as ultrabooks.[57]

Pins 1 to 10 are on the connector's bottom side, while pins 11 to 20 are on the top side.[57]

SATA Express

Two SATA Express connectors (light gray) on a computer motherboard; to the right of them are common SATA

Main article: SATA Express

SATA Express, initially standardized in the SATA 3.2 specification,[58] is an interface that supports either SATA or PCI Express storage devices. The host connector is backward compatible with the standard 3.5-inch SATA data connector, allowing up to two legacy SATA devices to be connected.[59] At the same time, the host connector provides up to two PCI Express 3.0 lanes as a pure PCI Express connection to the storage device, allowing bandwidths of up to 2 GB/s.[28][60]

Instead of the otherwise usual approach of doubling the native speed of the SATA interface, PCI Express was selected for achieving data transfer speeds greater than 6 Gbit/s. It was concluded that doubling the native SATA speed would take too much time, too many changes would be required to the SATA standard, and would result in a much greater power consumption when compared to the existing PCI Express bus.[61]

In addition to supporting legacy Advanced Host Controller Interface (AHCI), SATA Express also makes it possible for NVM Express (NVMe) to be used as the logical device interface for connected PCI Express storage devices.[62]

M.2 (NGFF)

Size comparison of mSATA (left) and M.2 (size 2242, right) SSDs

Main article: M.2

M.2, formerly known as the Next Generation Form Factor (NGFF), is a specification for computer expansion cards and associated connectors. It replaces the mSATA standard, which uses the PCI Express Mini Card physical layout. Having a smaller and more flexible physical specification, together with more advanced features, the M.2 is more suitable for solid-state storage applications in general, especially when used in small devices like ultrabooks or tablets.[63]

The M.2 standard is designed as a revision and improvement to the mSATA standard, allowing for larger printed circuit boards (PCBs) to be manufactured. While mSATA took advantage of the existing PCI Express Mini Card form factor and connector, M.2 has been designed to maximize usage of the card space, while minimizing the footprint.[63][64][65]

Supported host controller interfaces and internally provided ports are a superset to those defined by the SATA Express interface. Essentially, the M.2 standard is a small form factor implementation of the SATA Express interface, with the addition of an internal USB 3.0 port.[63]

U.2 (SFF-8639)

U.2, formerly known as SFF-8639. Like its predecessor it carries a PCI Express electrical signal, however U.2 uses a PCIe 3.0 x4 link providing a higher bandwidth of 32 Gbit/s in each direction.

PCI Express Mini Card

A WLAN PCI Express Mini Card and its connector

PCI Express Mini Card (also known as Mini PCI Express, Mini PCIe, Mini PCI-E, mPCIe, and PEM), based on PCI Express, is a replacement for the Mini PCI form factor. It is developed by the PCI-SIG. The host device supports both PCI Express and USB 2.0 connectivity, and each card may use either standard. Most laptop computers built after 2005 use PCI Express for expansion cards; however, as of 2015, many vendors are moving toward using the newer M.2 form factor for this purpose.

Due to different dimensions, PCI Express Mini Cards are not physically compatible with standard full-size PCI Express slots; however, passive adapters exist that allow them to be used in full-size slots.[18]

Physical dimensions

Dimensions of PCI Express Mini Cards are 30 × 50.95 mm (width × length) for a Full Mini Card. There is a 52-pin edge connector, consisting of two staggered rows on a 0.8 mm pitch. Each row has eight contacts, a gap equivalent to four contacts, then a further 18 contacts. Boards have a thickness of 1.0 mm, excluding the components. A "Half Mini Card" (sometimes abbreviated as HMC) is also specified, having approximately half the physical length of 26.8 mm.

Electrical interface

PCI Express Mini Card edge connectors provide multiple connections and buses:

PCI Express ×1

USB 2.0

SMBus

Wires to diagnostics LEDs for wireless network (i.e., Wi-Fi) status on computer's chassis

SIM card for GSM and WCDMA applications (UIM signals on spec.).

Future extension for another PCIe lane

1.5 V and 3.3 V power

Mini-SATA (mSATA) variant

Despite sharing the Mini PCI Express form factor, an mSATA slot is not necessarily electrically compatible with Mini PCI Express. For this reason, only certain notebooks are compatible with mSATA drives. Most compatible systems are based on Intel's Sandy Bridge processor architecture, using the Huron River platform. Notebooks like Lenovo's ThinkPad T, W and X series, released in March–April 2011, have support for an mSATA SSD card in their WWAN card slot. The ThinkPad Edge E220s/E420s, and the Lenovo IdeaPad Y460/Y560 also support mSATA.[19]

Some notebooks (notably the Asus Eee PC, the Apple MacBook Air, and the Dell mini9 and mini10) use a variant of the PCI Express Mini Card as an SSD. This variant uses the reserved and several non-reserved pins to implement SATA and IDE interface passthrough, keeping only USB, ground lines, and sometimes the core PCIe ×1 bus intact.[20] This makes the "miniPCIe" flash and solid-state drives sold for netbooks largely incompatible with true PCI Express Mini implementations.

Also, the typical Asus miniPCIe SSD is 71 mm long, causing the Dell 51 mm model to often be (incorrectly) referred to as half length. A true 51 mm Mini PCIe SSD was announced in 2009, with two stacked PCB layers that allow for higher storage capacity. The announced design preserves the PCIe interface, making it compatible with the standard mini PCIe slot. No working product has yet been developed.

Intel has numerous desktop boards with the PCIe ×1 Mini-Card slot which typically do not support mSATA SSD. A list of desktop boards that natively support mSATA in the PCIe ×1 Mini-Card slot (typically multiplexed with a SATA port) is provided on the Intel Support site.[21]

Dell Mini 9 910 8GB PCI-Ee SSD Solid State Drive D154H

\$13.99

+ \$21.21

Dell X422G Stec 16GB Internal Solid State Drive

\$12.95

+ \$38.00

SANDISK 32GB SSD mSATA Micro Sata SDSA5DK-032G...

\$16.29

New X422G X422G for DELL IDE/PATA PCIE SSD 16GB So...

\$19.95

+ \$67.25

Dell 32GB PCI-e mSATA SSD Solid State Drive MZMPA032...

\$22.50

+ \$14.65

Dell inspiron 14" 14z-5423 32GB SSD Solid State Drive...

\$27.29

+ \$14.71