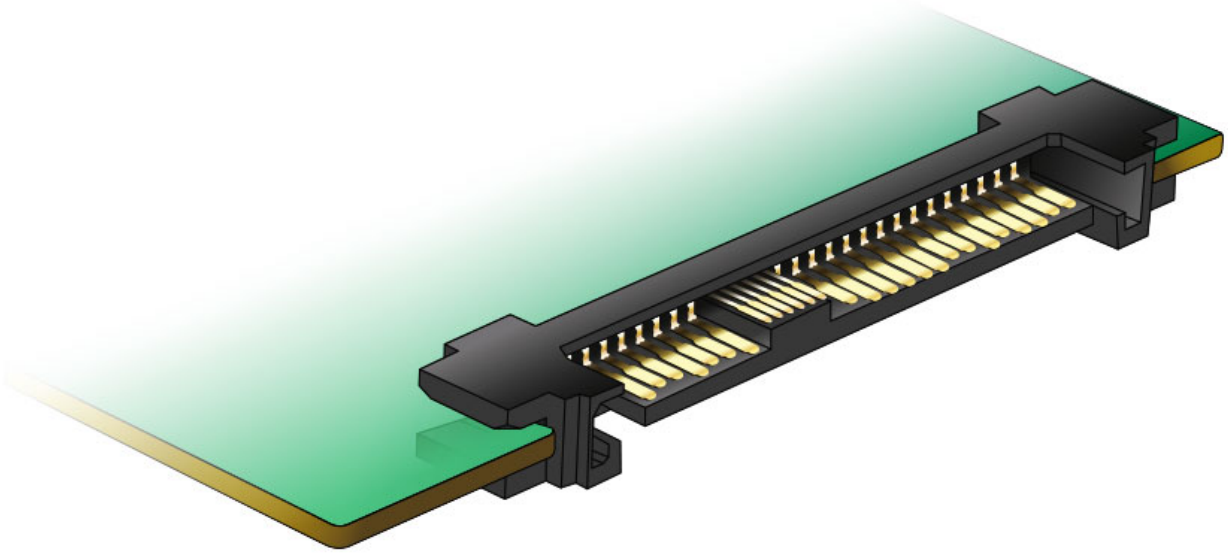
U.2 and NVMe - To speed up the PC performance

An important factor for PC performance is the hard disk or SSD that is implemented. Then again, what matters here are two things: the **interface technology** and the **data transfer protocol**. In the following the interface **U.2** and the data transfer protocol **NVMe** will be explained in more detail.

After that it will be shown how far U.2 and NVMe play a role for the SSD or, to say it in general words, in which ways these technologies influence the **operating speed** of the PC. - Finally there are shown some **Delock examples** of adapters, converters and cable from the U.2 / NVMe product range.



The U.2 interface

The technologies in detail

1. The U.2 interface

U.2 is applied for **NVMe SSDs in 2,5" format**. Initially, this interface was labeled as SFF-8639. In 2015 the SSD Form Factor Working Group (SFFWG) decided on the simpler name U.2 that also goes well with the established M.2 interface.

In the area of workplace PCs the U.2 interface is not even widely used at present. For **conversion** there are **M.2 to U.2 adapters** or **PCIe to U.2 plug-in cards** available. The converters have a SFF-8643 socket; for connection a suitable U.2 cable with SFF-8639 or SFF-8643 plug has to be used. In contrast

to SATA Express, the U.2 interface makes use of **additional pins** that support the **transport of four PCIe lanes**.

2. The NVMe protocol

NVM Express (= NVMe) is a more sophisticated **data transfer protocol for the PCIe bus** and successor of AHCI (Advanced Host Controller Interface) that was published in 2011 for the first time. NVMe stands for **Non-Volatile Memory Express**, which means a protocol for persistent storage media. It isn't limited to SSDs but is designed for persistent memory in general.

When NVMe was developed the focus was an **optimized command management** (submission und completion). Because of the high speed of PCIe SSDs it was also paid attention that as much as possible commands can be processed parallel. Thanks to the **more efficient way to distribute commands**, the latency (time delay) is significantly reduced. As a result, the **sequential read and write performance** of data is **improved**.

To say it simple: the faster the "waiting" CPU can receive data, the sooner these data can be passed on, which means: the faster the PC is working.

In which ways do U.2 and NVMe influence the PC performance?

HDD versus SSD

The working speed of a PC is considerably defined by the storage media on which system software and programs are installed. These days, customary hard disc drives (HDDs) are being replaced by SSDs more and more. **SSD** stands for **Solid State Drive resp. Disc**. SSDs have no longer movable mechanical components like HDDs, for example read head or magnetic disc.

Storage processes at SSDs run purely electronical. There are no longer easily damageable engine suspension and read-write-mechanics at SSDs which makes these **much more robust and shock-resistant**, so SSDs are suitable for **mobile applications** in particular. Further advantages are **very short access times, silent operation, low weight, low power consumption and few waste heat**. That's especially important for notebooks and other mobile devices and supports also a long battery life.

SSD and U.2 / NVMe

Classic hard discs, already limited in their memory speed by the mechanical structure, are still using the SATA connector and the AHCI data transfer protocol. As said above, **SSDs in itself are considerably faster than HDDs**, indeed. But now the used **interface technology** and **data transfer protocol** can act as speed brake furthermore. Practically said: SSDs via SAS or SATA that use the AHCI protocol do not reach the speed optimum.

Via SATA connected SSDs with AHCI have data transfer rates up to maximal 0.6 GB/s. SSDs with PCIe-3.0 connector and AHCI get to speeds of about 1 GB/s, once they use one transmission channel (= 1 lane).

Let's suppose the use of four lanes, the speed would theoretically quadruple and get to 4 GB/s. Practically, that's now made possible by the use of **PCIe SSDs which work with the NVMe protocol**, whereby the current **speed optimum** is reached.

DATA TRANSFER RATES BY COMPARISON

Memory	Speed
HDD	~ 0,1 GB/s
SSD (AHCI) with SATA connector	~ 0,5 - 0,6 GB/s
SSD (AHCI) with PCIe connector	~ 1 GB/s (1 lane)
SSD (NVMe) with PCI connector	~ 4 GB/s (4 lanes)

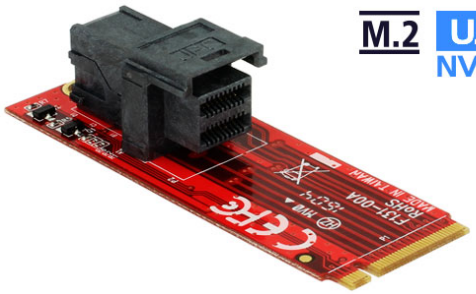
Finally, in case a NVMe SSD in 2.5" format shall be applied instead of a plug-in card that can be plugged directly into the M.2 or PCIe slot, the **U.2 interface** comes into play. In place of the direct way, the **PCIe bus can be connected via a U.2 cable**. So the **support of four PCIe lanes** is ensured again.

PCIe SSDs with NVMe provide following

- Large quantity of data are faster transferred
- Operating system boots faster
- Programs start faster
- System react faster

Delock product examples in the area of U.2 and NVMe

Adapters

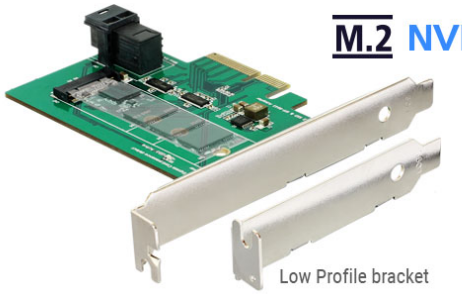


→ Item 62721

Adapter M.2 Key M > SFF-8643 NVMe

- **Connectors:**
  1 x 67 Pin M.2 Key M male
  1 x 36 Pin SFF-8643 female
- Interface: PCIe (2 or 4 lanes)
- Form factor: M.2 2260
- Suitable for M.2 Slot with key M based on PCIe
- Compatible to PCI Express V3.0
- Data transfer rate up to 32 Gbps

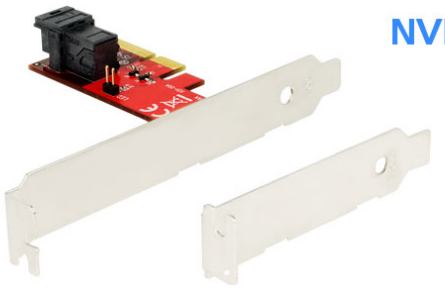
- Supports NVM Express (NVMe)
- Operating temperature: -10 °C ~ 85 °C



→ Item 89517

PCI Express Card > 1 x internal NVMe M.2 PCIe / 1 x internal SFF-8643 NVMe

- **Connectors:**
  1 x 67 pin M.2 key M slot
  1 x PCI Express x4, V3.0
  1 x 36 pin SFF-8643 female
- Interface: PCIe
- Supports M.2 modules in format 2280, 2260, 2242 and 2230 with key M or key B+M based on PCIe
- Maximum height of the components on the module: 1.35 mm,
  application of double-sided assembled modules supported
- Power supply via PCI Express
- Maximum output current: 4 A
- Supports NVM Express (NVMe)
- Short circuit protection, over heating protection

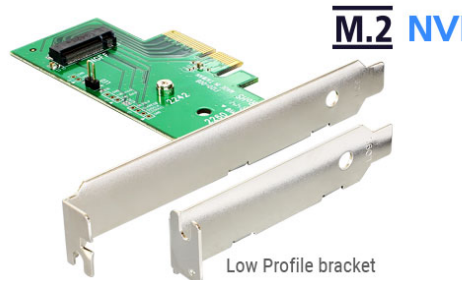


→ Item 89535

PCI Express x4 Card > 1 x internal SFF-8643 NVMe

- **Connectors:**
  1 x 36 pin SFF-8643 female
  1 x PCI Express x4, V3.0
  1 x 2 pin LED pin header male
- Data transfer rate up to 12 Gbps
- Supports NVM Express (NVMe)

Converters

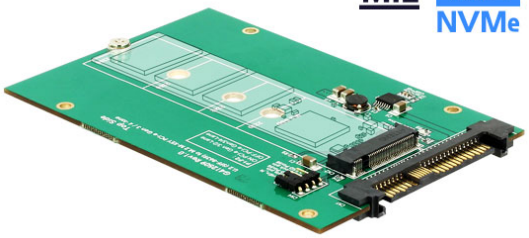


→ Item 89370

PCI Express Card > 1 x internal M.2 NVMe

- **Connectors:**
  1 x 67 pin M.2 key M slot
  1 x PCI Express x4, V3.0
  1 x LED pin header
- Interface: PCIe
- Supports M.2 modules in format 2280, 2260 and 2242 with key M or key B+M based on PCIe
- Maximum height of the components on the module: 1.5 mm,

application of double-sided assembled modules supported
- Bootable, from UEFI Version 2.3.1
- Supports NVM Express (NVMe)



→ Item 62696

Converter U.2 SFF-8639 > M.2 NVMe Key M

- **Connectors:**
  1 x U.2 SFF-8639 male >
  1 x 67 pin M.2 key M slot
- Interface: PCIe (2 or 4 lanes)
- Supports M.2 modules in format 2280, 2260, 2242 and 2230 with key M or key B+M based on PCIe
- Maximum height of the components on the module: 1.5 mm, application of double-sided assembled modules supported
- Jumper for 2 or 4 lanes setting M.2 SSD
- LEDs for power and activity
- Supports NVM Express (NVMe)
- Short circuit protection, in-rush current suppression, over heating protection

→ Item 62704

3.5" Converter SATA 22 pin / SFF-8643 NVMe > 1 x M.2 Key M + 1 x M.2 Key B

- **Connectors:**
  1 x SATA 6 Gb/s 22 pin female (for SATA SSDs)
  1 x 36 pin SFF-8643 female (for PCIe SSDs 2 or 4 lanes)
  1 x 67 pin M.2 key M slot (PCIe SSD)
  1 x 67 pin M.2 key B slot (SATA SSD)
- Interface: SATA / PCIe (2 or 4 lanes)
- Supports M.2 modules in format 2280, 2260, 2242 and 2230 with key M or key B+M based on PCIe or SATA
- Maximum height of the components on the module: 1.5 mm, application of double-sided assembled modules supported
- SATA 15 pin power connector always necessary
- LEDs for power and activity
- Supports NVM Express (NVMe)
- Maximum output current: 4 A (PCIe) and 3 A (SATA)

Cables

→ Item 84819

Cable SFF-8643 male > U.2 SFF-8639 male + SATA power connector

- **Connectors:**
  SFF-8643 male >
  U.2 SFF-8639 male + SATA 15 pin power connector
- Data transfer rate up to 2 GB/s (PCI Express rev. 2.0)
  resp. 4 GB/s (PCI Express rev. 3.0)
- Supports NVM Express (NVMe)
- Cable gauge:
  30 AWG data line
  24 AWG power line
- Length (without connectors):
  Data cable ca. 50 cm
  Power cable ca. 5 cm

Also available as → Item 84821 with data cable length ca. 75 cm

→ Item 84822

Cable SFF-8643 male angled > U.2 SFF-8639 male + SATA power connector

- **Connectors:**
  SFF-8643 male angled >
  U.2 SFF-8639 male + SATA 15 pin female
- Data transfer rate up to 2 GB/s (PCI Express rev. 2.0)
  resp. 4 GB/s (PCI Express rev. 3.0)
- Supports NVM Express (NVMe)
- Cable gauge:
  30 + 32 AWG data line
  18 + 24 AWG power line
- Length (without connectors):
  Data cable ca. 75 cm
  Power cable ca. 10 cm

→ Item 84829

Extension cable U.2 SFF-8639 male > U.2 SFF-8639 female

- **Connectors:**
  U.2 SFF-8639 male >
  U.2 SFF-8639 female
- Data transfer rate up to 2 GB/s (PCI Express rev. 2.0)
  resp. 4 GB/s (PCI Express rev. 3.0)
- Supports NVM Express (NVMe)
- Cable gauge:
  30 AWG data line

24 AWG power line
- Length (without connectors) ca. 50 cm

Also available as → Item 84830 with cable length ca. 100 cm

→ Item 83387

Cable Mini SAS HD SFF-8643 > Mini SAS HD SFF-8643

- **Connectors:**
  Mini SAS HD SFF-8643 male
  Mini SAS HD SFF-8643 male
- 12 Gb/s Serial Attached SCSI (SAS) specification
- Data transfer rate up to 12 Gb/s
- Cable gauge: 30 AWG
- Cable for internal connection
- Cable length (without connectors) ca. 100 cm

Also available as → Item 83386 with cable length ca. 50 cm

→ All Delock **U.2 / NVMe** products at a glance