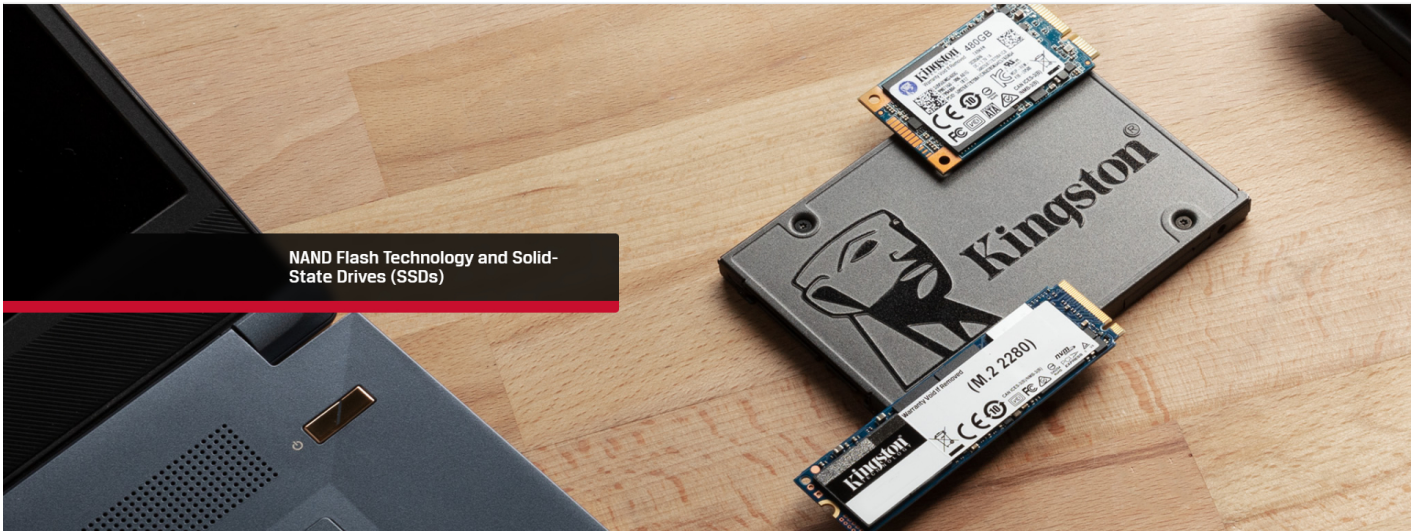




NAND Flash Technology and Solid-State Drives (SSDs)

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If you own a **USB flash drive** or SD card, you already own products that incorporate flash memory, also known as NAND flash. Globally, NAND flash consumption has exploded over the last five years and new products, such as SSDs, are now making significant inroads into enterprise computing devices from notebooks, desktops, workstations and servers.

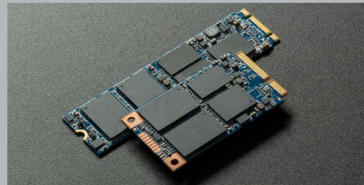
Here's a quick break down on what you need to know about NAND flash memory.

Non-Volatile NAND Flash Memory

One of the benefits of NAND flash is its non-volatile storage of data. Unlike DRAM memory which must be powered continuously to retain data, NAND memory retains data even when the power is off – making it ideal as storage for portable devices.

Types of NAND Flash

There are currently five types of NAND flash memory storage and the difference between each type is the number of bits each cell could store. Each cell can store data – one bit per cell for SLC NAND, two bits per cell for MLC, three bits per cell for TLC, four bits per cell for QLC, and five bits per cell for PLC. So, SLC NAND would store a "0" or "1" in each cell, MLC NAND would store "00", "01", "10", or "11" in each cell, and so forth. These five types of NAND offer different levels of performance and endurance characteristics at a range of price points with SLC being the higher performing and most costly in the NAND market. [Learn more about the differences between types of NAND.](#)



3D NAND

In 3D NAND, multiple layers of memory cells are stacked vertically along with interconnections between the layers. Stacking multiple layers of memory cells into vertical layers creates larger storage capacity while having a smaller footprint and boosts performance by enabling shorter overall connections for each memory cell. It also lowers the cost per byte compared to 2D NAND. 3D NAND flash devices could utilize MLC, TLC or QLC designs.



NAND Cell Wear Leveling

NAND cells are not designed to last forever. Unlike DRAM, their cells will wear out over time as the write cycles are more taxing than read cycles. NAND storage devices have a limited number of write cycles, but wear leveling manages the wear and tear of the cells carried out by the flash controller that always resides on the device. All USB flash drives, SD cards and SSDs have a NAND controller that manages the NAND flash and performs functions such as wear leveling and error correction.

To prolong the life of NAND storage devices, the NAND Flash controller ensures that all data written is spread evenly across all physical blocks of the device as to not wear-out one area of the NAND faster than another.

Solid-State Drives (SSDs)

In the past few years, the cost of NAND flash dropped enough to make new primary storage devices such as solid-state drives possible for client systems and servers. SSDs are direct replacements for the hard disks (or standard disk spinning hard drives) in computers with compatible interfaces such as SATA or SAS.

SSDs offer significant performance and durability advantages over standard hard drives. SSDs have no moving parts; they are all semiconductor devices. Because of this, SSDs do not suffer from mechanical latencies like hard drives do, and without moving parts, SSDs can be subjected to much more shock and vibration than a hard drive which makes them ideal for a broad range of portable and mobile applications.

NAND Flash Technology and Solid-State Drives (SSDs) - Kingston Technology

In years past, solid-state drives were designed with DRAM memory chips and were expensive, making them suitable only for demanding server applications.

Today, with lower costs of NAND flash, SSDs are being used in a variety of applications ranging from consumer to enterprise and military computing.

SSD Endurance

Kingston uses NAND flash memory with an endurance rating designed for the workload of an SSD. This allows Kingston to offer a variety of SSDs for an application at a competitive price point.

Kingston's Client and Enterprise SSDs come with a lifetime endurance rating to help match the SSD for the intended workload. For Client SSDs, Kingston provides a TBW (Terabytes Written) specification that enables users to predict the useful life of the SSD in their application.

Kingston Enterprise SSDs are rated similarly with a TBW specification as well as a DWPD (Drive Writes Per Day) specification that is based on the TBW and warranty period of the SSD. For example, a 1TB SSD that has an endurance rating of 1DWPD means that a user can write 1TB of data per day to the SSD for 5 years. The TBW/DWPD specification is a tool for corporate customers who deploy Kingston SSDs in their enterprise environments as part of their IT infrastructure planning.

Kingston provides a software utility called, "KSM" (Kingston Storage Manager) to track SSD life expectancy. Think of it as a gas gauge in a car where the user can periodically check the status of the SSD.



SSD Performance

Most Client systems are no longer limited by processor performance. They are almost always limited by storage. Hard drives have access latencies in milliseconds, while SSDs operate in hundreds of microseconds.

An SSD can deliver new life and high performance even on systems that are a few years old (if they have a SATA compatible interface). A Windows®-based system can see its boot-up times cut from many minutes to one or less, making an SSD a performance storage upgrade. Overall, it often delivers the best performance increase of any upgrade to a system.

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Solid State Drives

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Capacity Range

- ☐ 240GB - 256GB (4)
- ☐ 480GB - 512GB (9)
- ☐ 960GB - 1TB (12)
- ☐ 1.92TB - 2TB (9)
- ☐ 3.84TB - 4TB (8)
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Form Factor

Interface

Use

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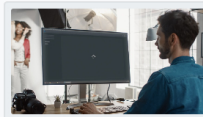
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2/3

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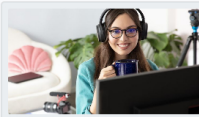
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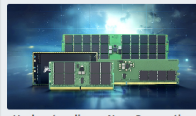
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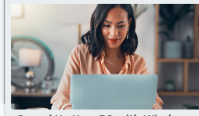
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