Micron 5400 – The World's Most Advanced Data Center SATA SSD

Maintaining aging infrastructure can be expensive. One solution is to build new SATA-equipped servers or upgrade existing servers with the Micron 5400 SSD — the best storage for SATA environments.

The Micron 5400 SSD offers:

- 50% greater endurance and reliability ratings than the other leading data center SATA SSD[1]
- Performance that saturates 50 Gb/s networks[2]
- The industry's broadest portfolio of data center SATA SSDs[3]
- Eleven generations of data center SATA SSD stability[4]

The Micron 5400 SSD can help optimize every SATA socket in servers to get more out of workloads. It is a feature-rich, data center SSD designed to keep infrastructure going strong.

Figure 1: Micron 5400 data center SATA SSD

THE SATA SSD FOR THE DATA CENTER

Greater endurance and reliability ratings than the other leading data center SATA SSD

The Micron 5400 SSD offers up to 1.5 drive writes per day endurance and 3-million hour mean time to failure (MTTF) ratings. These are 50% higher than the ratings for the other leading data center SATA SSD.[5]

Performance that saturates common data center networks

Just 12 Micron 5400 PRO SSDs in a standard, 2U chassis can saturate two 25Gb network connections. This means that one half-full server could saturate common network connections – with room to grow.[6]

Industry's most advanced, broadest portfolio of data center SATA SSDs

The Micron 5400 SSD supports capacities ranging from a 240GB boot drive to 2.5-inch up to 7.68TB. It also supports TCG Opal, TCG Enterprise, and non-encrypted versions – all with power loss protection.[7]

Improved storage performance with 176-layer NAND

The Micron 5400 SSD uses Micron's industry-leading NAND in a data center SSD that combines 176 layers and independent word-line technology with CMOS under the Array (CuA) architecture. This new NAND helps enable faster booting and application responsiveness.[8]

11th-generation stability makes qualifications easy

Micron released its first data center SATA SSD in 2008. Since then, additional technological innovations have been incorporated through its ten prior generations of data center SATA SSDs, including:

- 6 Gb/s SATA interface
- Internal NAND redundancy (for enhanced reliability)
- Encryption with hardware-based acceleration
- Up to 8TB capacity, read-intensive and mixed-used options
- 3 million hour MTTF rating

Each of these generational changes and additions helped build a stable, reliable SSD that is easy to qualify.

1. Based on a comparison of public documents.
2. 50Gbs rated network bandwidth, 80% typical Ethernet efficiency. 24x 800GB Micron 5400 MAX SSDs 100% 128K sequential or write or 100% 4K random read or write performance
3. The Micron 5400 SSD is offered in 14 data center capacity/form factor combinations that include power loss protection and data path protection.
4. Micron's first data center, SATA SSD was released in 2008, see https://investors.micron.com/news-releases/news-release-details/micron-introduces-next-generation-realssdtm-solid-state-drives
5. Based on a comparison of public documents.
6. A standard 2U, 24-slot server offers 12 SSDs per U while a 10-slot, 1U server offers just 10 SSD per U. Non-standard servers may offer higher density.
7. No hardware, software, or system can provide absolute security under all conditions. Micron assumes no liability for lost, stolen, or corrupted data arising from the use of any Micron products, including hose products that incorporate any of the mentioned security features. Unformatted. 1GB = 1 billion bytes. Formatted capacity will be less.
8. Additional information is available here: https://www.micron.com/products/nand-flash/176-layer-nand

Greater endurance and reliability ratings than the other leading data center SATA SSD

Data center SSDs are commonly grouped into two broad endurance classes: read-intensive and mixed-use. Read-intensive SSDs are designed for workloads that read far more data than they write, while mixed-use SSDs are designed for workloads that write quite a bit of data. Mixed-use SSDs typically offer greater endurance than read-intensive SSDs.

SSD-rated wear value is often expressed as drive writes per day, or DWPD (the number of times an SSD can be fully written per day during its warranty period). Since many read-intensive workloads still write data, SSD endurance is an important consideration for both types of SSDs.

The Micron 5400 SSD offers 50% higher endurance ratings, specifically DWPD, than the other leading data center SATA SSD. SSDs with higher endurance ratings are designed to absorb more written data than SSDs with lower endurance ratings.

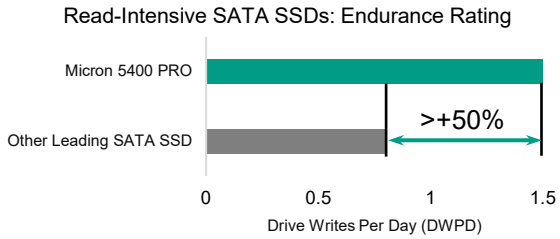


Figure 2a: Read-intensive SSD endurance ratings

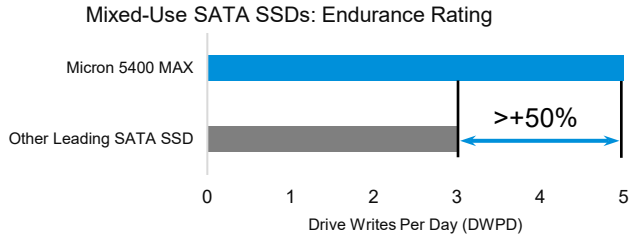


Figure 2b: Mixed-use SSD endurance comparison

Data center SSD reliability is expressed as “Mean Time To Failure” (MTTF) or as “Mean Time Between Failures” (MTBF); these are often used interchangeably. According to the Storage Networking Industry Association (SNIA) online dictionary, MTTF is “[t]he average time from start of use to first failure in a large population of identical systems, components, or device.”

Built on Micron’s extensive experience, the Micron 5400 SSD offers a 50% higher reliability rating (MTTF) than the other leading data center SATA SSD.

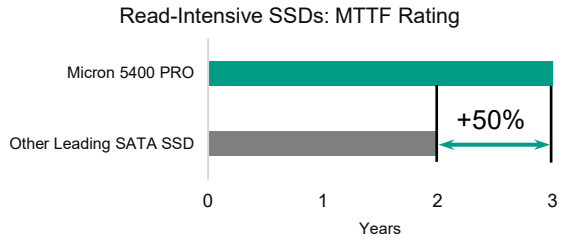


Figure 3a: Read-intensive MTTF ratings

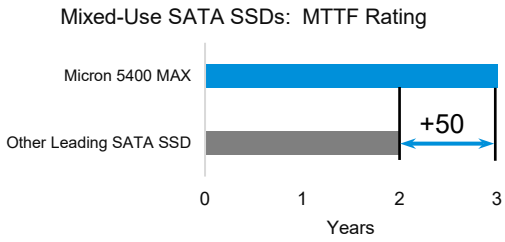


Figure 3b: Mixed-use MTTF ratings

MTTF ratings are useful since they can help estimate long term service costs due to failure replacement. MTTF is commonly used to express reliability.

Performance that saturates 50 Gb/s networks

All servers have CPUs, DRAM and networking along with storage, often SSDs. When we build a server, we do so to run some kind of workload on that server. Workloads run on CPUs, DRAM, and SSDs. Networking exists to get the information that the workload produces outside of the server so it can be used externally to the server. It’s important to understand that the workload converts data into information and that information leaves the server and is used via a network.

It is important to balance the network performance (how the information is communicated) and the SSDs used to generate and store the information. If we overbuy on our network (more network bandwidth than the SSDs can fill) the server cannot saturate that network and we have unutilized network capacity.

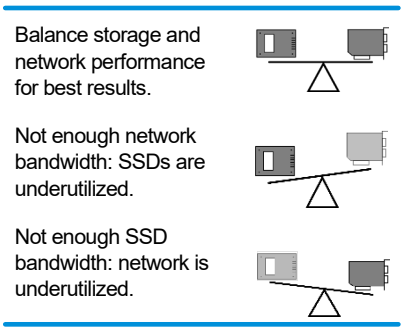


Figure 4: System balance

If the opposite is true — where we have far more storage bandwidth than the network can transport — then we end up with information that cannot be transmitted externally (we cannot get the information out of the server because the available storage bandwidth over-saturates the network bandwidth).

The best solution is to ensure that the SSD's capability to generate information (in conjunction with CPUs and DRAM) is balanced with the available network bandwidth. This helps ensure that all the workload information can get in to or out of the server and be used for business value purposes.

The blue-colored cells in Table 1 show the number of Micron 5400 SSDs needed to saturate common data center network bandwidth ratings (the number of SSDs depends on the network configuration and associated workload).[9] Even in the constraints of a legacy SATA architecture, the Micron 5400 is designed to perform where our customers need it.

Read-intensive Micron 5400 SSD	IO Type	Network Bandwidth 10GbE	25GbE	50GbE
1.92TB PRO	Sequential Read	3	6	12
	Sequential Write	3	7	13
	Random Read	4	9	17
	Random Write	10	24	47
3.84TB PRO	Sequential Read	3	6	12
	Sequential Write	3	7	13
	Random Read	4	9	17
	Random Write	11	26	51
7.68TB PRO	Sequential Read	3	6	12
	Sequential Write	3	7	13
	Random Read	4	9	17
	Random Write	33	81	161

Mixed-use Micron 5400 SSD	IO Type	Network Bandwidth 10GbE	25GbE	50GbE
800GB MAX	Sequential Read	3	6	12
	Sequential Write	3	7	13
	Random Read	4	9	17
	Random Write	5	12	24
1.6TB MAX	Sequential Read	3	6	12
	Sequential Write	3	7	13
	Random Read	4	9	17
	Random Write	5	13	25
3.2TB MAX	Sequential Read	3	6	12
	Sequential Write	3	7	13
	Random Read	4	9	17
	Random Write	9	23	45

Table 1: Micron 5400 SSDs to saturate common data center networks

Industry's most advanced, broadest portfolio of data center SATA SSDs

Because the Micron 5400 SSDs offer the industry's broadest portfolio of data center SATA SSDs, it gives organizations more options to get more out of every SATA socket in the server infrastructure. TCG Enterprise, TCG Opal, or non-SED security configurations are available for each model in the capacities and endurance ratings our customers need, making it easy to replace legacy hard disk drives (HDDs) and existing data center SATA SSDs. This broad range of options provides flexibility.

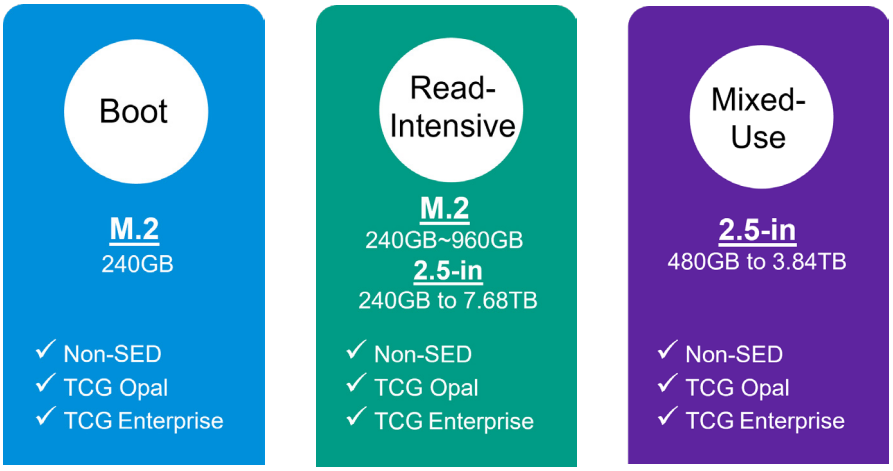


Figure 5: Micron 5400 SSD configurations

9. Values are calculated estimates based on Micron's published performance data and 80% network efficiency. Actual results may vary.

Standard Form Factors: Industry-standard M.2 (22x80mm) and 2.5-inch (7mm)

Endurance Ratings: The Micron 5400 is available in three endurance ratings.

- Boot: The boot version offers 1 Drive Write per Day endurance and an ideal 240GB capacity. It is an affordable option for SSD server boot.
- Read-intensive: An endurance rating designed to satisfy workloads that read far more than they write. The endurance rating is 0.6 to 1.5 DWPD.
- Mixed-use: An endurance rating designed to satisfy workloads that write a substantial amount of data. The endurance rating is 3 to 5 DWPD.

Security Options: Industry-standard security options include non-SED (ATA Security), TCG Opal, and TCG Enterprise to align to an organization's security needs.

Non-SED (standard ATA security, default): Provides basic protection by locking access to the drive using the ATA password. Often set and managed by the host system BIOS or UEFI.

TCG Opal (option): Supports pre-boot authentication (must supply a password for system to boot). TCG Opal SSDs are often used as boot drive for data center platforms.

TCG Enterprise (option): Advanced security management with multiple, self-generated keys corresponding to LBA ranges. A passkey manages the entire SSD with corresponding host-generated passwords.

176-layer NAND improves storage performance

Micron 176-layer NAND uses replacement gate (RG) technology, moving from separate insulators to a single insulator (Figure 6). This technique users fewer, lower strength electrical pulses to program data into the NAND. Fewer programming pulses mean less programming time, which can improve NAND write performance (Figure 6).

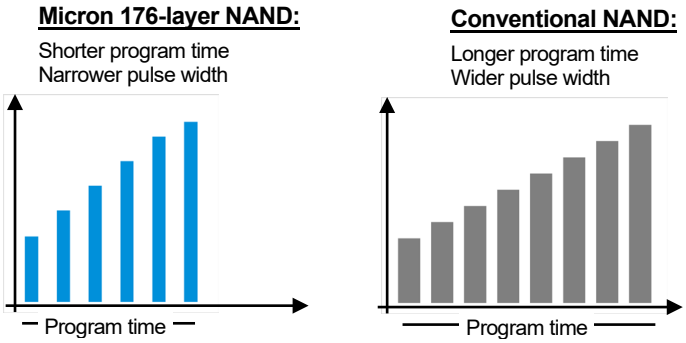


Figure 6: Improved power efficiency (through shorter NAND program times)

Micron CMOS under the array

Micron continues to place the controlling CMOS circuitry under the NAND array (referred to as "CuA" as seen in Figure 7), saving critical layout space.

NAND that does not use CuA technology locates the CMOS control circuitry beside the NAND array, which typically consumes more space than CuA without adding additional storage capacity.

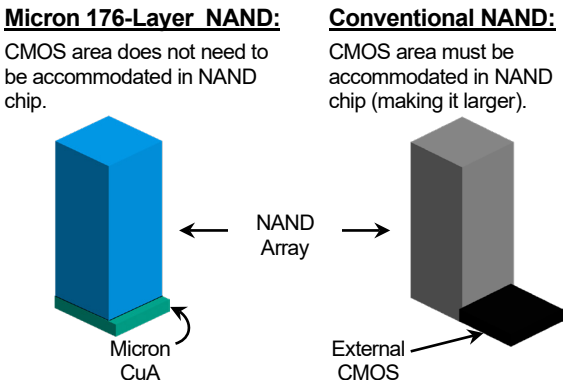


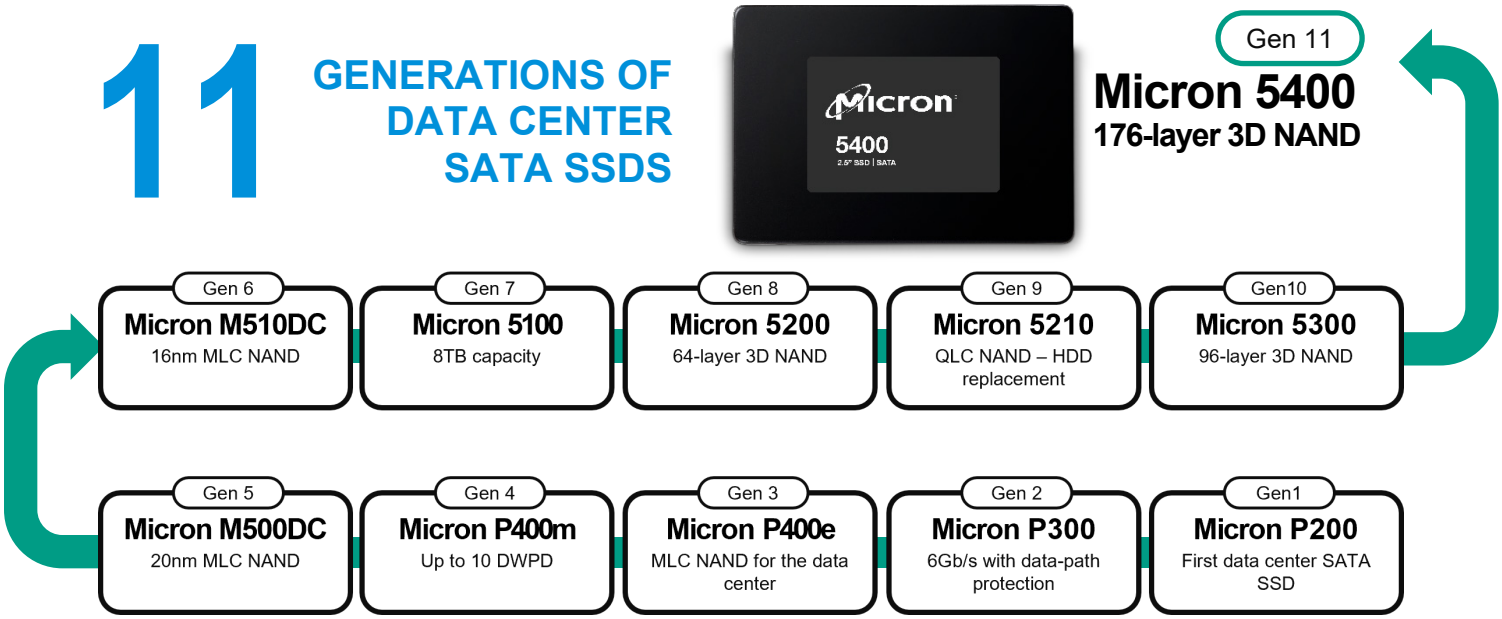
Figure 7: Micron CuA space savings compared to designs that do not use Micron CuA

11th-generation stability makes qualifications easy

Micron has been designing, building, and supporting data center SATA SSDs since its introduction of the Micron P200 in 2008. Data center needs have changed since this first-generation SSD and Micron's data center SATA SSDs have evolved right along with them — from the introduction of MLC NAND into data center SSDs in 2010 through multiple technological innovations (like NAND technology

improvements, enhanced security with hardware support and larger SSD capacity) over the ensuing generations.

The Micron 5400 SSD is Micron's 11th generation of data center SATA SSD. It is based on a proven and stable architecture that has been trusted for generations by major OEMs. Generations of experience help organizations qualify the Micron 5400 SSD with confidence, knowing that Micron has shipped millions of units based on the same architecture since 2017.[10]



Performance

The Micron 5400 SSD is the world's first 176-layer data center SATA SSD, built on Micron's stable and proven architectural foundation. Micron's data center SATA SSD experience was built over eleven generations. 176-layer NAND gives customers the best of both worlds — the advanced NAND combined with proven capability. Building SATA-based servers with the industry's most advanced data center SATA SSD simplifies the transition to flash-based storage with stability, simplicity, and performance.

10. Based on internal Sales data.

micron.com/5400