Micron 7600 NVMe™ SSD RocksDB Performance[1]

Even if you haven't heard of RocksDB, there's a good chance that you've used it. RocksDB is a high-performance "behind the scenes" database used by many popular applications we interact with daily.

Social media: Facebook uses RocksDB to fetch and display the latest real-time posts, comments, and likes.[2]

Professional networking: LinkedIn relies on RocksDB to manage users' feeds and recent activity and display the latest posts and comments.[2]

Streaming services: Netflix uses RocksDB for quick data handling, reducing buffering and ensuring smooth playback during peak times.[3]

Ride-hailing: Uber uses RocksDB to power its message store, efficiently managing messages with increasing index numbers.[4]

These everyday use cases highlight the versatility and reliability of RocksDB in handling multiple data-intensive tasks.

This technical brief delves into the performance, response time, and power efficiency results of competitive mainstream data center drives running RocksDB. The Micron 7600 NVMe SSD is compared to the Samsung PM9D3a and the Kioxia CD8P-R to show how each SSD impacts the performance of RocksDB operations and how much power is consumed.[5]

Micron 7600 SSD (E3.S 1T, E1.S, U.2)

Key findings

The Micron 7600 SSD consistently demonstrates higher maximum performance, better application responsiveness (latency), and superior power efficiency than the other two mainstream, data center NVMe SSDs evaluated.

Random read

This workload randomly reads data from an existing database. The Micron 7600 SSD achieves up to:

21% **Higher maximum performance**

59% **Better 99th percentile latency**

78% **Better power efficiency**

Random read while writing

This workload uses multiple threads for reading and one thread for writing. The Micron 7600 SSD achieves up to:

21% **Higher maximum performance**

76% **Better 99th percentile latency**

79% **Better power efficiency**

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1. This document uses the terms performance and operations per second interchangeably.
2. See this page on GitHub for additional details on these and other RocksDB use cases.
3. See this blog by Artem Krylysov to learn more.
4. See this Uber engineering blog for additional information.
5. Micron used the db_bench benchmark for testing. Additional information about this benchmark is available at https://github.com/EighteenZi/rocksdb_wiki/blob/master/Benchmarking-tools.md. Differences are calculated as ((superior value) / (inferior value) – 1), expressed as a percentage. SSD comparisons are based on currently in-production and available Gen5 mainstream data center SSDs with read-intensive endurance, from the top five competitive suppliers of OEM data center SSDs by revenue as of February 2025, as per the Forward Insights analyst report, "SSD Supplier Status Q1/25". Micron labs did all the testing.

Why test power efficiency in addition to performance?

Micron is dedicated to sustainability and reducing technology's environmental impact. By developing high-performance, energy-efficient products, Micron enables data center designers, OEMs, system builders, and purchasing teams to create more efficient platforms, contributing to a sustainable future for all.[6]

Figures 1 and 3 show higher performance (operations per second) farther to the right on the horizontal axis, while response time (99% latency)[7] increases upward along the vertical axis. Each point in each figure represents results at a specific thread count (16, 32, 64, 96, and 128; thread counts above 128 were not tested).

Figures 2 and 4 show performance on the horizontal axis and SSD power consumption (in watts) along the vertical axis, enabling energy efficiency calculations for each data point. These are expressed in database operations per second per watt. The greatest difference between the Micron 7600 SSD and its competitors is again highlighted.

Random read: This workload randomly reads data from an existing database

The Micron 7600 SSD, Samsung PM9D3a, and Kioxia CD8P-R performance and 99% latency results are shown in Figure 1. Power efficiency results are shown in Figure 2. Table 1 shows the values and calculations used (see Table 4 in Appendix 1 for all test data).

Random read workload analysis

Performance: The most significant performance difference is highlighted in Figure 1, where the thread count = 96. At this point, the Micron 7600 SSD shows 892,202 operations per second, the Samsung PM9D3a shows 735,914, and the Kioxia CD8P-R shows 735,861. This equates to a maximum performance improvement of 21% for the Micron 7600 SSD[8], demonstrating 59% better latency.

Power efficiency: The Micron 7600 SSD also demonstrates superior power efficiency with a maximum improvement of 78% at this thread count, as seen in Figure 2.

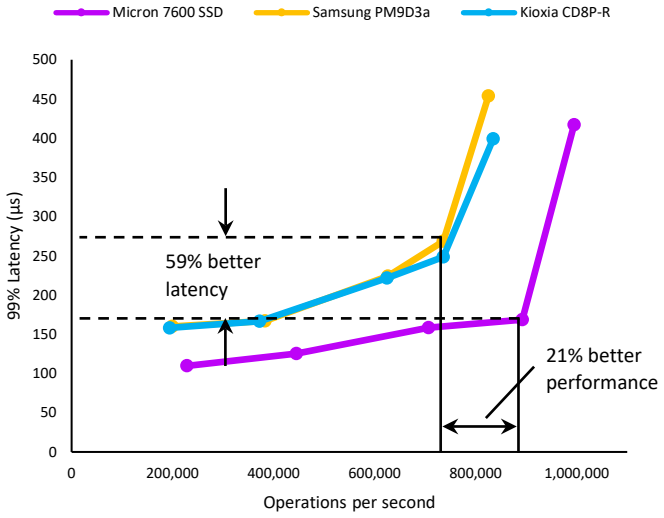

Figure 1: Random read performance and 99% latency

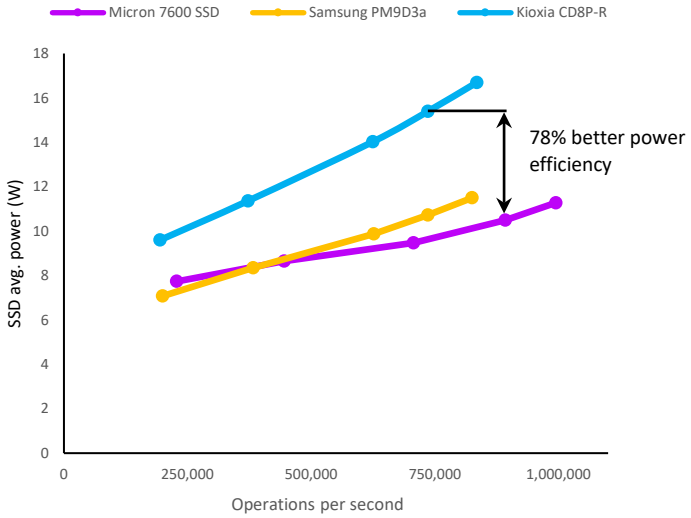

Figure 2: Random read power efficiency

Random read	Micron 7600 SSD	Samsung PM9D3a	Kioxia CD8P-R	Calculation
Performance	892,202 ops/s	735,914 ops/s	735,861 ops/s	(892,202 / 735,861) – 1 = 0.21 = up to **21%**
99% latency	169µs	268µs	249µs	(268 / 169) – 1 = 0.59 = up to **59%**
Power efficiency	84,966 ops/s per W	68,578 ops/a per W	47,794 ops/s per W	(84,966 / 47,794) – 1 = 0.78 = up to **78%**

Table 1: Random read calculated maximum difference values

6. Learn more about Micron's commitment to sustainability here https://www.micron.com/about/sustainability.
7. 99% latency is often referred to as quality of Service (QoS). It is a measure of the full span of response times by IO completion percentages. In other words, QoS shows at what time value a given percent of the IOs will complete. See https://www.snia.org/europe/news/understanding-datacentre-workload-quality-service for additional information.
8. Example calculation: ((892,202 operations per second divided by 735,861 operations per second)) - 1 = 0.21, a 21% improvement.

Random read while writing: This workload uses multiple threads for reads and one thread for writes.

The Micron 7600 SSD, Samsung 9D3a, and Kioxia CD8P-R performance and 99% latency results are shown in Figure 3, and power efficiency results are shown in Figure 4 for this workload. Table 2 shows the values and calculations used.

Random read while writing workload analysis

Performance: The largest performance difference is highlighted in Figure 3, where the thread count = 96. At this point, the Micron 7600 SSD shows 754,416 operations per second, the 9D8a shows 625,956, and the CD8P-R shows 632,715. This equates to a maximum % performance improvement of 21% for the Micron 7600 SSD. At this same point, the Micron 7600 SSD demonstrates 76% better 99% latency.

Power efficiency: The largest power efficiency difference occurs when thread count = 128, as highlighted in Figure 4. Micron 7600 SSD also demonstrates superior power efficiency with a maximum improvement of 79% at this thread count, as seen in Figure 4.

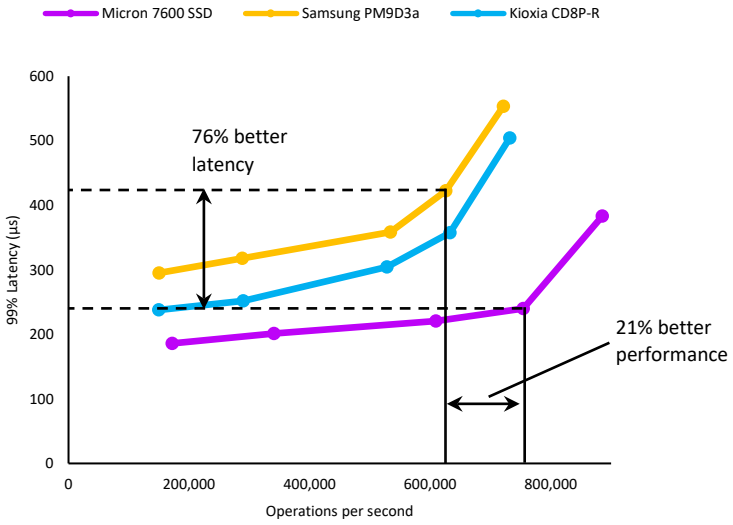

Figure 3: Read while writing performance and 99% latency

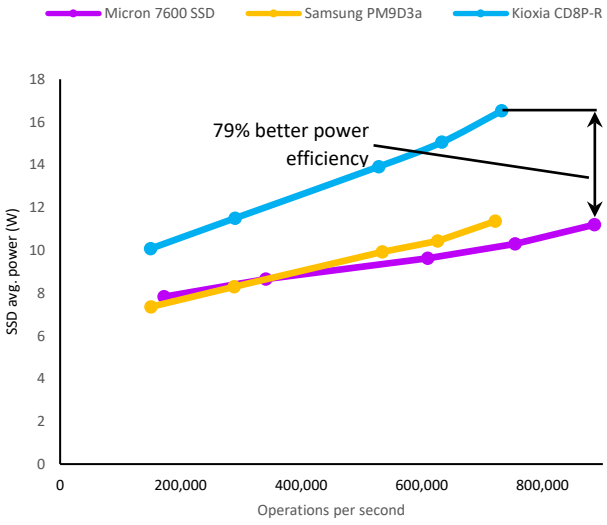

Figure 4: Read while writing power efficiency

Read while writing	Micron 7600 SSD	Samsung PM9D3a	Kioxia CD8P-R	Calculation
Performance	754,416 ops/s	625,956 ops/s	632,715 ops/s	(754,416 / 625,956) – 1 = 0.21 = up to **23%**
99% latency	240µs	422µs	358µs	(422 / 240) – 1 = 0.76 = up to **76%**
Power efficiency	79,113 ops/s per W	63,504 ops/s per W	44,311 ops/s per W	(79,113 / 44,311) – 1 = 0.79 = up to **79%**

Table 2: Read while writing calculated maximum difference values

Conclusion

RocksDB has proven to be a versatile database, powering many popular applications that we use every day. The Micron 7600 SSD RocksDB test results show that this SSD delivers:

- Higher performance: The Micron 7600 SSD can deliver more database operations per second in both tested workloads. Performance is crucial for data-intensive tasks.
- Better 99% latency: The Micron 7600 SSD completed database operations faster and more consistently. This is important for maintaining the quality of service (QoS) and helping ensure applications respond quickly and consistently.
- Superior power efficiency: The Micron 7600 SSD consumes less power while delivering higher performance. This can help reduce operational costs and contribute to sustainability efforts.

Appendix 1: Performance data summary

	Micron 7600 SSD			Samsung 9D3a			Kioxia CM8-R		
Threads	ops/s	99% latency	Watts	ops/s	99% latency	Watts	ops/s	99% latency	Watts
16	228,176	110µs	7.7	199,319	160µs	7.1	194,180	158µs	9.6
32	445,366	124µs	8.7	382,698	167µs	8.4	372,338	166µs	11.4
64	706,929	159µs	9.5	626,278	224µs	9.9	624,672	222µs	14.0
96	892,202	169µs	10.5	735,914	268µs	10.7	735,861	249µs	15.4
128	994,719	417µs	11.3	825,305	454µs	11.5	834,537	399µs	16.7

Table 3: Random read: Database OPS/s and 99% latency

	Micron 7600 SSD			Samsung 9D3a			Kioxia CM8-R		
Threads	ops/s	99% latency	Watts	ops/s	99% latency	Watts	ops/s	99% latency	Watts
16	172,007	186µs	7.8	150,154	295µs	7.4	149,989	238µs	10.1
32	340,903	201µs	8.7	288,496	318µs	8.3	290,198	252µs	11.5
64	609,341	220µs	9.6	533,847	359µs	9.9	528,284	304µs	13.9
96	754,416	240µs	10.3	625,956	422µs	10.4	632,715	358µs	15.1
128	885,709	383µs	11.2	721,339	554µs	11.4	731,964	504µs	16.5

Table 4: Read while writing: Database OPS/s and 99% latency

How we tested

We used db_bench to benchmark RocksDB performance. According to the RocksDB wiki, db_bench was enhanced by RocksDB from prior work related to LevelDB. The tool was later enhanced to support additional options (a list of supported db_bench workloads is available on GitHub).

Server Hardware Configuration	
Server	Supermicro AS-1115CS-TNR
CPU	AMD EPYC™ 9654 96-Core Processor
Memory	768GB Micron DDR5 (12 x 64GB, 1 DPC – limited to 256GB via kernel parameters)
Server Storage	Micron 7600 SSD configuration: 1x Micron 7600 PRO 7.68TB NVMe SSD Samsung configuration: 1x Samsung PM9D3a, read-intensive, 7.68TB NVMe SSD Kioxia configuration: 1x Kioxia CD8P-R, read-intensive, 7.68TB NVMe SSD
Boot Drive	Micron 7450 960GB M.2 NVMe SSD
RocksDB version	8.1.1
OS	Ubuntu 20.04
Kernel	5.4.0-214-generic

Table 5: Server hardware configuration

Server Software Configuration	
Filesystem	XFS Version: 5.0.0 Mount options: “noatime,discard” Mount point: /mnt_db/nvme

Table 6: Server filesystem configuration

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