PASCARI

X200Z

White Paper

PHISON

Phison PASCARI X200Z:
Extreme SSD Endurance and Performance for the Data Center

SSDs are a critical part of all modern data center designs, offering significantly higher performance, higher reliability, lower power requirements, and the increased data density that's helping to power the artificial intelligence revolution. But not all SSDs are equally adept at all workloads.

The highest capacity drives currently use QLC NAND to provide up to 122 TB of storage, balancing capacity against lower performance. The Pascari X200Z bridges the gap, offering extreme performance and endurance thanks to its use of modernized SLC NAND that allows up to 60 drive writes per day (DWPD). That's 701 petabytes of writes in total for the 6.4 TB model, or 384 TB per day. It's the equivalent of writing 4.44 GB of data to the drive every second of every day for five years straight.

The Pascari X200Z enterprise SSD excels as a caching drive on tiered storage, insulating lower endurance QLC drives from the heaviest traffic. It's also a great choice for the most demanding high-speed trading, real-time analytics, and artificial intelligence workloads. And all of this comes with a drive that supports current state-of-the-art features including a PCIe Express 5.0 interface, NVMe 2.0, and numerous data encryption and protection standards.

Historical flash NAND development overview

The first SSDs came to market over 15 years ago, using Single-Level Cell (SLC) NAND. It provided high performance and endurance for the time but also limited maximum drive capacity. Initial SSDs shipped with sizes ranging from just 16 GB to as much as 40 GB in the early days, compared to existing hard disk storage solutions that already offered 2 TB of storage — over fifty times the capacity of the largest SSDs in 2010. But SSDs had a massive performance advantage, thanks to the lack of moving parts, with access times measured in microseconds rather than milliseconds.

Over the interceding years, SSDs transitioned from SLC NAND to Multi-Level Cell (MLC) NAND that stored two bits per cell, doubling the capacity. Then SSDs moved to Triple-Level Cell (TLC) and Quad-Level Cell (QLC) NAND solutions, tripling and quadrupling the number of bits stored per NAND cell. However, while TLC and QLC offer much higher drive capacities, the NAND cells wear out more quickly.

Erasing and then programming a NAND cell to hold data causes a slight degradation in the silicon structures each time. Early SLC NAND offered up to 25,000 program-erase (PE) cycles per cell. MLC reduced that to 10,000 PE cycles, TLC NAND solutions typically offer 3,000–5,000 PE cycles, and QLC NAND delivers just 1,000–1,500 PE cycles. Wear leveling algorithms help combat the reduction in PE cycles, so even a QLC drive won't wear out for years with moderate use, but servers and data centers under heavy load can require much higher endurance levels.

The Pascari X200Z rewinds the clock on NAND and endurance, writing to modern TLC NAND solutions that are configured by Phison's custom firmware to operate in a pseudo-SLC (pSLC) mode. The latest TLC NAND chips support a variable size pSLC cache, where initial writes to the NAND have access to up to one-third the total TLC NAND capacity, as determined by the SSD controller and firmware. Once the pSLC cache gets filled with data, incoming writes go directly to TLC blocks, while at the same time rewriting data from the pSLC cache into TLC blocks. This slows down performance and increases latency in write-heavy scenarios.

The Pascari X200Z avoids this by operating in pure pSLC mode, so that it never needs to flush data from the higher performance cache into TLC blocks. This greatly improves performance and efficiency, increases the quality of service and consistency of the drive, and at the same time returns endurance to SLC levels. Using the NAND in this fashion does reduce available capacity, with each raw 4 TB of TLC NAND capacity exposing 800 GB to the OS.

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Pascari X200Z specifications

The PASCARI X200 family is Phison's current flagship line of extreme performance enterprise SSDs. Engineered to meet the rigorous demands of modern data centers, the Pascari X200Z line comes in capacities ranging from 800 GB up to 6.4 TB.

All Pascari X200Z drives come with the same core features, regardless of capacity. These include Phison's in-house designed 16-channel X2 controller with 3D TLC NAND support, running in pSLC mode for this drive. The X200Z supports a dual-port PCIe 5.0 2x2 interface using the NVMe 2.0 protocol. Pascari X200Z drives are available in the U.2 form factor. The X2 controller supports 128 namespaces, power loss protection, ISE, AES-XTS 256-bit encryption, SECDED, and NVMe-MI.

The drives also feature an industry-leading 60 DWPD endurance rating, where most enterprise SSDs are only rated for 1~5 DWPD. Modern AI and ML workloads benefit from the X200Z's extreme performance and endurance, providing faster file load times and handling the writes of multiple concurrent training tasks with ease. The Pascari X200Z sustains high read and write performance even when pressed with the most demanding 24/7 workloads.

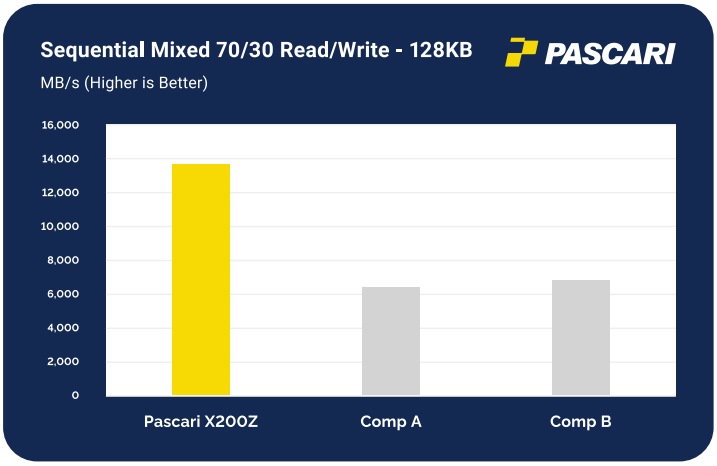
The high endurance rating makes the Pascari X200Z an excellent choice for tiered storage, where the SSDs can function as the top-level node and deliver exceptional throughput, sitting in front of QLC NAND solutions like Phison's Pascari D200V that are designed to store large amounts of data but have lower write speeds (3.2 GB/s in this case). Using the Pascari X200Z as a caching drive buffers slower storage from the most demanding write workloads, allowing the QLC drives to handle the requirements of second-level storage.

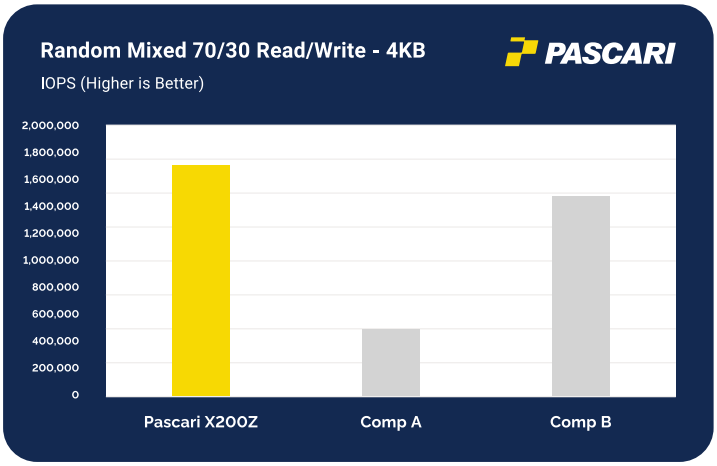
Pascari X200Z Specifications

Capacity	800 GB	1.6 TB	3.2 TB	6.4 TB
Interface	PCIe 5.0 2x2	PCIe 5.0 2x2	PCIe 5.0 2x2	PCIe 5.0 2x2
NVMe Protocol	2.0	2.0	2.0	2.0
NAND Flash	3D TLC	3D TLC	3D TLC	3D TLC
Sequential Read (MB/s)	14,800	14,800	14,800	14,800
Sequential Write (MB/s)	9,500	9,500	9,500	9,000
4K Random Read (IOPS)	3,100K	3,100K	2,800K	2,300K
4K Random Write (IOPS)	950K	950K	950K	950K
Read Latency (µs)	45	45	45	45
Write Latency (µs)	10	10	10	10
Active Power (W)	18	19	20	22
Idle Power (W)	5	5	5	5
DWPD	60	60	60	60
Endurance (TBW)	87,600	175,200	350,400	700,800
Warranty	5	5	5	5
Form Factor	U.2	U.2	U.2	U.2

Pascari X200Z Performance vs. the Competition

Compared to leading SSDs from the competition, the Pascari X200Z provides excellent performance across a wide range of scenarios. While the X200Z focuses on extreme endurance, pure write scenarios don't exist in real-world use cases, as data only holds value if it gets used. Even the most intensive workloads trend closer to a mixed read/write ratio of 30% writes and 70% reads. In such usage, the Pascari X200Z consistently delivers excellent read performance while still handling incoming writes in the most demanding real-world scenarios. Here's how the Pascari X200Z stacks up against the fastest competing drives.





The Pascari X200Z delivers top performance in demanding mixed 70/30 read/write scenarios. For sequential workloads, it's over twice as fast as the leading competitor drives. In the more demanding 4K random mixed mode testing, the Pascari X200Z is up to 35% faster than a leading competitor drive, and up to seven times faster than a slower competing drive.

In other testing, the Pascari X200Z delivered sustained read speeds of up to 15,000 GB/s and write speeds of up to 10,000 GB/s. Random 4K speeds reached up to 3,100K IOPS for reads and 950K IOPS for writes. That's up to twice the throughput that the fastest Optane drives ever offered, making the Pascari X200Z the heir apparent to the Optane throne. The increased performance comes in part from the PCIe 5.0 interface, with Phison's custom firmware combined with newer flash memory playing critical roles.

Pascari X200Z provides scalability and flexibility for modern data centers

The Pascari X200Z data center SSD delivers class-leading performance with the highest endurance available in a currently shipping SSD. Rated for 60 DWPD, it's designed for near-constant heavy write scenarios, ideal for tiered storage caching as well as AI/ML training workloads. The Pascari X200Z provides unmatched performance, reliability, and scalability, with a range of capacities to fit a variety of needs.

Phison's Pascari X200Z is a cutting-edge drive designed for the next generation of data-intensive applications that will shape the future of computing. With a high-speed controller that supports the latest PCI Express 5.0 interface, a 16-channel design, DRAM caching, and advanced features to ensure consistent performance, the Pascari X200Z is set to provide storage for the next generation of servers powering the AI and ML revolution.