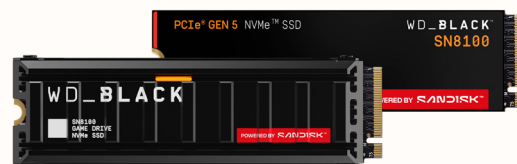


BUILDING WITH PCIe® GEN 5.0 CLIENT SSDs

Revolutionizing Storage Performance with Sandisk's Latest Innovations

Overview

The advent of PCIe® Gen 5.0 marks a significant leap in NVMe™ SSD storage interface technology, offering double the performance of its predecessor, PCIe® Gen 4.0. This solution brief explores the challenges associated with current generation PCIe® Gen 5.0 SSDs for PCs and highlights the revolutionary SANDISK® WD_BLACK™ SN8100 PCIe® Gen 5.0 NVMe™ SSDs.



Introduction

PCIe® 5.0 represents the next evolution in client NVMe™ SSD storage interfaces, delivering up to twice the interface bandwidth of PCIe® 4.0. This advancement is ideal for high-performance computing tasks that demand higher data transfer speeds, such as AI model loads, professional content creation workflows, and DirectStorage gaming. However, early SSDs with the new PCIe Gen 5.0 interface came with high power demands, and hence, thermal challenges.

Consequently, first-generation PCIe® Gen 5.0 SSDs required heatsinks or active cooling to help prevent performance throttling or component damage. Optionally, many early Gen 5.0 SSDs simply must be locked at operating at lower interface speeds, negating the benefits of PCIe® Gen 5.0.

These challenges hindered the mass adoption of Gen 5.0 SSDs in mainstream PCs and laptops, and only a revolutionary step in SSD design, encompassing controller, NAND, and firmware improvements, would enable the consumer to reap the full performance benefits of PCIe® Gen 5.0.

The PCIe® Gen 5.0 Evolution

PCIe® Gen 5.0 is the latest generation of the Peripheral Component Interconnect Express® (PCIe®), offering theoretical speeds of up to 32 GT/s (Giga Transfers per second), double that of PCIe Gen 4.0's 16 GT/s. Combined with advancements in NAND interface speeds, a PCIe® Gen 5.0 NVMe™ SSD theoretically can achieve data transfer speeds 16GBps over the four PCIe® lanes of the popular M.2 form-factor.

First Generation of PCIe® Gen 5.0 SSDs

The first generation PCIe® Gen 5.0 NVMe™ SSDs utilize similar controller process technology as PCIe® Gen 4.0 SSDs, resulting in higher power consumption and heat dissipation to maintain Gen 5.0 speeds. These SSDs require heatsinks, active cooling, or must operate at lower performance levels to avoid throttling or component damage. Many designs necessitate large heatsinks or double-sided M.2 configurations, limiting their use in laptops with single-sided M.2 slots. These thermal requirements add cost and complexity, affecting PC and motherboard compatibility. Consumers seeking the speed improvements of Gen 5.0 interface for their workflows or applications must carefully consider whether upgrading to a first generation PCIe® Gen5.0 SSD is worth the potential performance issues.

The WD_BLACK SN8100 SSD Revolution

As an industry leader in power efficiency, Sandisk's WD_BLACK SN8100 PCIe® Gen 5.0 NVMe™ SSD integrates advanced technologies to deliver high interface bandwidth. Its PCIe Gen 5.0 controller achieves up to 14,900 MB/s¹ read speeds at an efficiency of up to 2,403 MB/s / Watt* (1TB). In other words, it delivers up to twice the speed of our Gen 4.0 NVMe™ SSDs while consuming roughly the same power, thus doubling the power efficiency.²

This paradigm shift in performance is driven by three key aspects:

- Our advanced technology for the controller keeping power consumption to a minimum
- Next generation Sandisk TLC CBA (CMOS Bonded Array) NAND with higher thermal range
- The SanDisk nCache™ 4.0 SLC cache
- A single-sided M.2 design

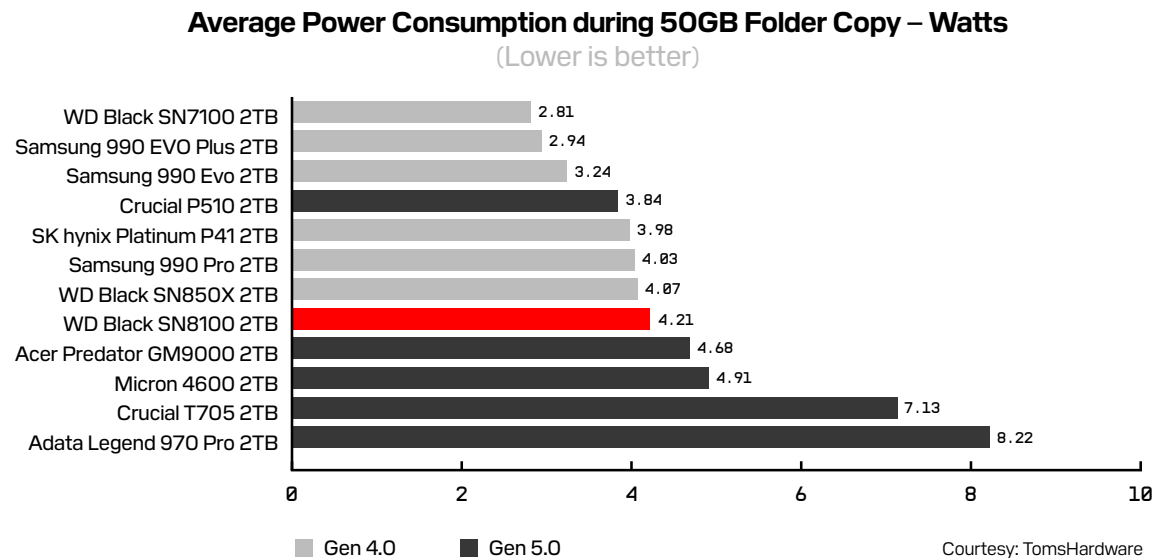
These innovations help maximize PCIe® Gen 5 interface speeds while helping minimize thermal dissipation and performance throttling as with many first generation PCIe® Gen 5.0 SSDs. With higher power efficiency and similar power consumption as with PCIe® Gen 4.0 SSDs, the WD_BLACK SN8100 PCIe® Gen 5.0 NVMe™ SSD makes it an ideal choice for desktop PCs, AI PCs, laptops, or AIOs. The WD_BLACK SN8100 NVMe™ SSD is specifically designed for prosumers or gamers seeking only the highest storage bandwidth for AI model loads, content creation workflows including 8K videos, and high-resolution gaming without performance throttling due to thermal limitations.

Putting the WD_BLACK SN8100 SSD to the Test

To test the power and thermal characteristics of the WD_BLACK SN8100 SSD, Tom's Hardware used the Quarch HD Programmable Power Module. This involved testing power consumption while the SSD is idle, and while executing a 50GB folder copy.

As shown in Chart 1, the average power consumption of the WD_BLACK SN8100 SSD during the folder copy process was considerably less than many other PCIe Gen 5.0 devices and was closer to the power figures of PCIe Gen 4.0 devices.

CHART 1:



This boils down to a much better power efficiency than many PCIe Gen 5.0 SSDs, and even several PCIe Gen 4.0 SSDs (Chart 2). The WD_BLACK SN8100 SSD also tops the charts when it comes to Idle power consumption (Chart 3), which is an important aspect to consider especially in the case of laptop upgrades.

CHART 2:

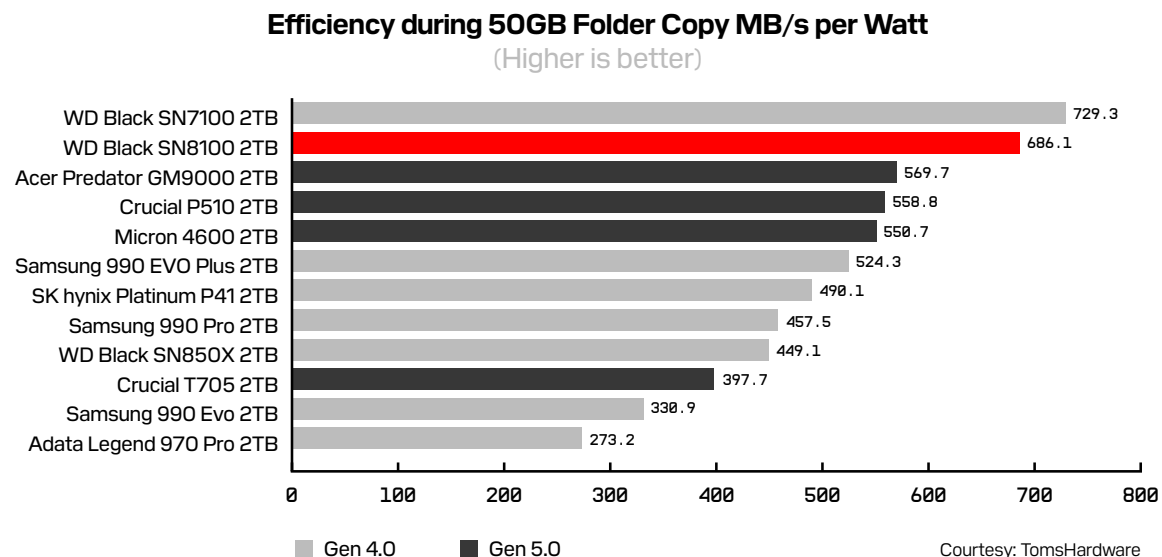
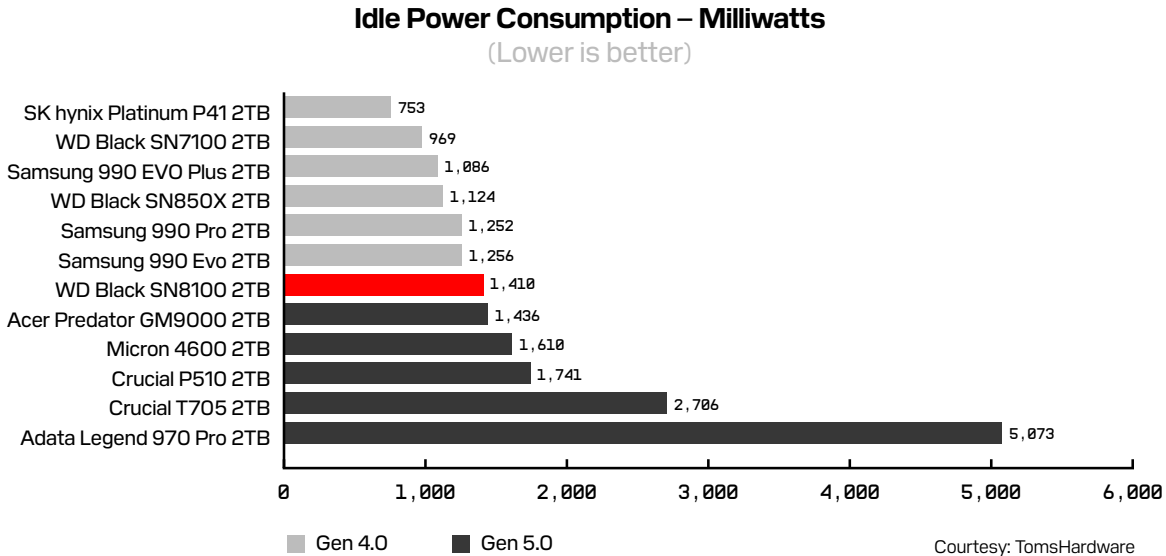


CHART 3:



The review goes on to conclude, “The WD_BLACK SN8100 is exceptionally power-efficient, following up the [WD_BLACK] SN7100 in topping the charts for each respective class of drive. There is nothing even close to this level of power efficiency and performance combined in one package.”

Conclusion

PCIe® Gen 5.0 represents a significant advancement in storage interface speeds over PCIe® Gen 4.0. However, the power consumption leading to thermal dissipation of current PCIe® Gen 5.0 NVMe™ SSDs have hindered their adoption in mainstream PCs and laptops. The WD_BLACK SN8100 PCIe® Gen 5.0 NVMe™ SSD is designed with advanced technologies, enabling its use in PC form-factors. The WD_BLACK PCIe® Gen 5.0 NVMe™ SN8100 SSD delivers an industry leader in performance and power efficiency for prosumers and gamers seeking higher storage performance for enhancing AI model loads, professional content creative workflows, or gaming.

- 1MB/s = 1 million bytes per second. IOPS = input/output operations per second. Based on internal testing; performance may vary depending upon host device, usage conditions, drive capacity, and other factors.
2. Over 100% more power efficient than the 2TB WD_BLACK SN850X NVMe™ SSD.

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