QSAN Official Document

XF5226D-12C Performance

Lab Report

June 2025

ANNOUNCEMENT

Copyright

QSAN believes the information in this publication is accurate as of its publication date. The information is subject to change without notice.

Trademarks

- QSAN, the QSAN logo, and QSAN.com are trademarks or registered trademarks of QSAN Technology, Inc.
- Microsoft, Windows, Windows Server, and Hyper-V are trademarks or registered trademarks of Microsoft Corporation in the United States and/or other countries.
- Linux is a trademark of Linus Torvalds in the United States and/or other countries.
- UNIX is a registered trademark of The Open Group in the United States and other countries.
- Mac and OS X are trademarks of Apple Inc., registered in the U.S. and other countries.
- Java and all Java-based trademarks and logos are trademarks or registered trademarks of Oracle and/or its affiliates.
- VMware, ESXi, and vSphere are registered trademarks or trademarks of VMware, Inc. in the United States and/or other countries.
- Citrix and Xen are registered trademarks or trademarks of Citrix Systems, Inc. in the United States and/or other countries.
- Other trademarks and trade names used in this document to refer to either the entities claiming the marks and names or their products are the property of their respective owners.

TABLE OF CONTENTS

FIGURES

TABLES

NOTICES

The information contained in this document has been reviewed for accuracy. But it could include typographical errors or technical inaccuracies. Changes are made to the document periodically. These changes will be incorporated in new editions of the publication. QSAN may make improvements or changes in the products. All features, functionality, and product specifications are subject to change without prior notice or obligation. All statements, information, and recommendations in this document do not constitute a warranty of any kind, express or implied.

Any performance data contained herein was determined in a controlled environment. Therefore, the results obtained in other operating environments may vary significantly. Some measurements may have been made on development-level systems and there is no guarantee that these measurements will be the same on generally available systems. Furthermore, some measurements may have been estimated through extrapolation. Actual results may vary. Users of this document should verify the applicable data for their specific environment.

This information contains examples of data and reports used in daily business operations. To illustrate them as completely as possible, the examples include the names of individuals, companies, brands, and products. All these names are fictitious and any similarity to the names and addresses used by an actual business enterprise is entirely coincidental.

PREFACE

Technical Support

Do you have any questions or need help trouble-shooting a problem? Please contact QSAN Support, we will reply to you as soon as possible.

- Via the Web: https://www.qsan.com/technical_support
- Via Telephone: +886-2-77206355
- (Service hours: 09:30 - 18:00, Monday - Friday, UTC+8)
- Via Skype Chat, Teams / Skype ID: qsan.support
- (Service hours: 09:30 - 02:00, Monday - Friday, UTC+8, Summer time: 09:30 - 01:00)
- Via Email: support@qsan.com

Information, Tip, and Caution

This document uses the following symbols to draw attention to important safety and operational information.

INFORMATION

INFORMATION provides useful knowledge, definition, or terminology for reference.

TIP

TIP provides helpful suggestions for performing tasks more effectively.

CAUTION

CAUTION indicates that failure to take a specified action could result in damage to the system.

1. OVERVIEW

1.1. Introduction to XF5226D-12C

QSAN XF5 series is the premier enterprise-level all-NVMe flash storage solution with unparalleled speed. With µs-level latency, it excels in meeting the responsiveness needs of the most challenging enterprise applications. The XF5 is ideal for modern applications including AI model training, real-time database, HPC (High-Performance Computing), and high-speed backup alike.

1.2. XF5226D-12C Specifications

The following table lists the hardware specifications of XF5226D-12C for reference.

Table 1-1 XF5226D-12C Hardware Specifications

MODEL NAME	XF5226D-12C
Processor	Intel® Xeon® 12-core x 2
Memory	32 GB (up to 2,048 GB)
Drive Bays	2.5” Slot x 26
Max. Drive Bays w/ Expansion Unit	546
Onboard Connectivity	25 GbE (SFP28) LAN Port x 8 2.5 GbE (RJ45) LAN Port x 2 (Management Port)
Capacity Expansion	12 Gb/s SAS Wide Port x 4
PCIe Expansion	(Gen 4x8 Slot) x 4

Versatile Host Connectivity	32 Gb / 16 Gb Fibre Channel 25 GbE / 10 GbE LAN Port
Max. Host Connectivity	24 (8 + 16)

Equipping with 4 host card slots for expansion connections, the new generation XF5226D-12C is designed with 4 full Gen 4x8 slots. Besides, the XF5226D-12C gets onboard 25 GbE (SFP28) LAN Port x 8 ports with higher bandwidth.

1.3. Introduction to SD4 Series

QSAN SD4 NVMe SSD delivers all the advantages of flash drive technology with PCIe Gen 4 (2x2) interface, supports the industry's new U.3 interface and is fully backward compatible with U.2 slots. SD4 series offers a wide range of capacities up to 30.72 TB. Based on the latest 3D NAND technology, its performance can reach up to 7,000 MB/s for sequential read and 6,800 MB/s for sequential write. Moreover, the power consumption of SD4 SSD is much lower than traditional hard drives, making it the best embedded solution for new platforms.

1.4. SD4 Series Specifications

The following table lists the hardware specifications of QSAN SD4 NVMe SSD for reference.

Table 1-2 SD4 Hardware Specifications

MODEL NAME	SD43T840-00	SD47T640-00	SD415T40-00	SD432T40-00
Capacity	3,840 GB	7,680 GB	15,360 GB	30,720 GB
Endurance	1 DPWD			
Encryption	Non-SED			
TBW (Total Bytes Written)	7,008 TB	14,016 TB	28,032 TB	56,064 TB

Interface	Dual-port PCIe Gen 4 (2x2), NVMe 1.4			
Form Factor	U.3 (backward compatible with U.2), 2.5-inch, 15 mm			
NAME Flash Type	3D eTLC			
Sequential Read	7,000 MB/s	7,000 MB/s	7,000 MB/s	7,000 MB/s
Sequential Write	6,700 MB/s	6,800 MB/s	6,800 MB/s	6,000 MB/s
4K Random Read	1,600K IOPS	1,600K IOPS	1,600K IOPS	1,600K IOPS
4K Random Write	170K IOPS	180K IOPS	180K IOPS	180K IOPS
4K Random Read Latency	100 µs	100 µs	100 µs	90 µs
4K Random Write Latency	15 µs	15 µs	15 µs	15 µs

In addition, QSAN SD4 NVMe SSD series also has SED version. For more information, please refer to the SD4 Series Data Sheet from QSAN website.

2. PERFORMANCE DATA

2.1. XF5226D-12C Performance

QSAN XF5226D-12C plus QSAN NVMe dual-port SSD provides a low latency performance result.

Test Equipment and Configurations

- Server
  - Model: 3 x GIGABYTE
    32 Gb FC HBA: Marvell QLogic QLE2764 and QLE2742
    OS: Windows Server 2019
- Storage
  - Model: XF5226D-12C
    Memory: 128 GB (4 x 32 GB) per controller
    Host Card: 4 x 32 Gb/s Fibre Channel
    Firmware 3.0.0
  - NVMe SSD: 26 x QSAN SD43D800, 3.84 TB, dual-port, PCIe Gen 4 (2x2)
  - Pools:
    1 x RAID 10 / 5 / 6 Pool with 13 x NVMe SSDs in Controller 1
    1 x RAID 10 / 5 / 6 Pool with 13 x NVMe SSDs in Controller 2
  - Volumes:
    16 x 100 GB in Pool 1 (Controller 1)
    24 x 100 GB in Pool 2 (Controller 2)
    Block Size: 512 Byte
    Cache Mode: Write-through in RAID 10, Write-back in RAID 5 / 6
- I/O Pattern
  - Tool: Vdbench V5.04.07
    Workers: 8 (1 Worker to 1 Volume)
    Outstanding (Queue Depth): 128
    Xfersize: 4K 64K
    I/O rates: 1 ~ 10, 10 ~ 120
    Reporting Interval: 1 sec

Warmup Period: 5 sec
Elapsed Time: 30 sec. per I/O rate

Test Scenario

Create two pools, alternating between RAID 10, RAID 5, and RAID 6. One for controller 1 and the other for controller 2. Use the tool Vdbench and run 2 rounds of I/O rate from 1% to 10% and from 10% to 120%.

Performance Results

The chart below reveals the performance report. In RAID 10 configuration, the system achieved up to 60K IOPS with extremely low latency of less than 200 µs for random reads and 95K IOPS for random writes. At low latency of 500 µs, random read speeds are 257K IOPS and random write speeds are 246K IOPS. It is also worth mentioning that a value of 9K can occur at an ultra-low latency of about 120 µs.

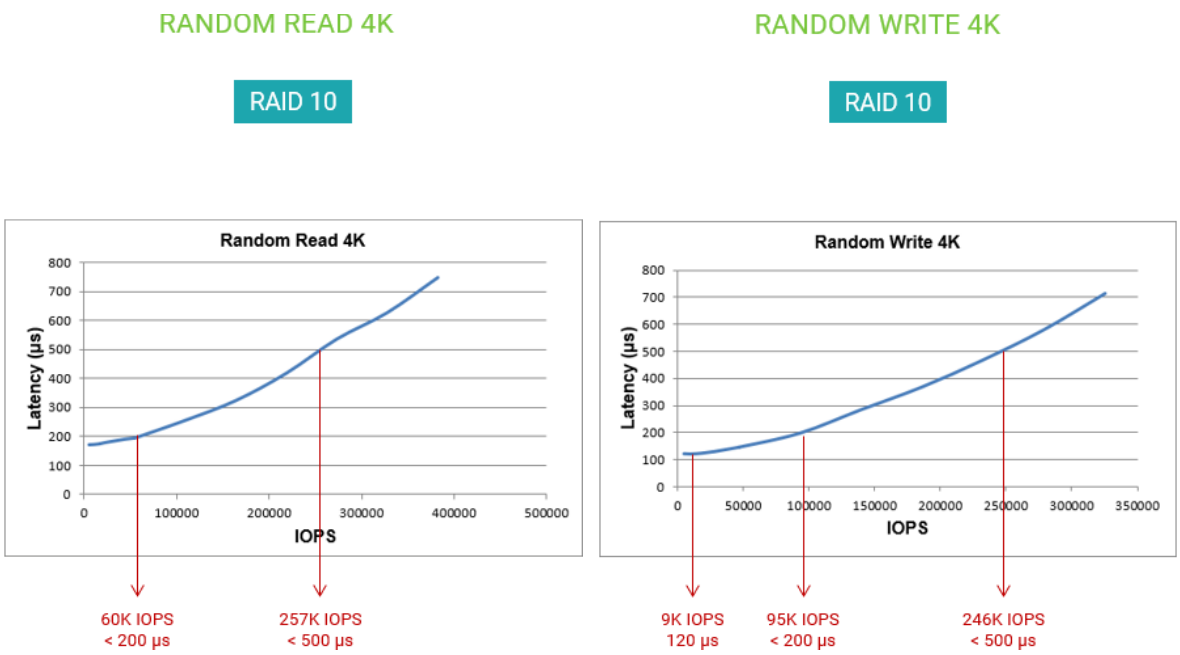

Figure 2-1 RAID 10 Test Results

The charts below reveal the performance report. Under RAID 5 and RAID 6 configuration, the system respectively brings out up to 54K and 58K IOPS under the extremely low latency of less than 200 µs on random read; and 262K and 260K IOPS at low latency of 500 µs, respectively.

Figure 2-2 Random Read Test Results

Both RAID 5 and RAID 6 also achieved sub-200 µs latency and excellent IOPS on random writes. Both configurations achieve over 90K IOPS at 500 µs latency. It is also worth mentioning that values of 8K and 6K can occur at ultra-low latency of about 115 µs.

RANDOM WRITE 4K

RAID 5

RANDOM WRITE 4K

RAID 6

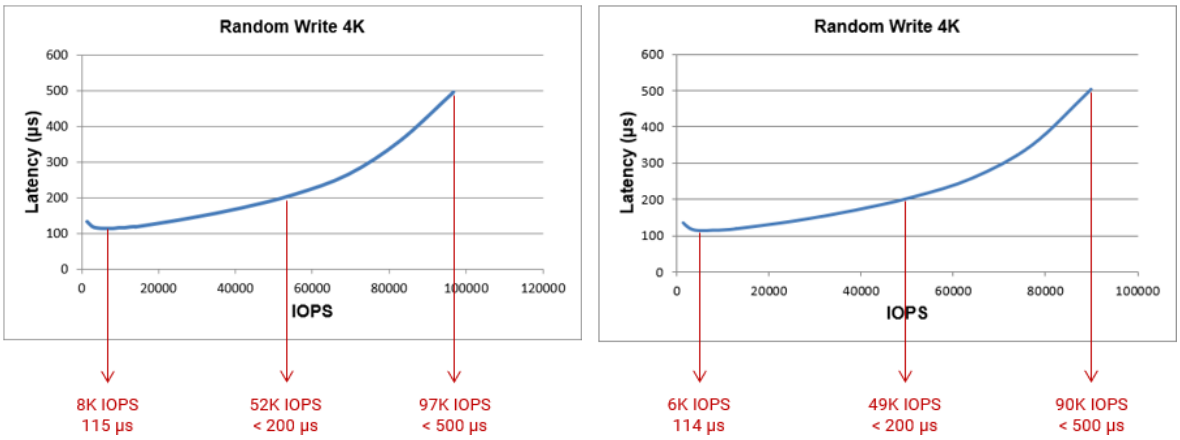

Figure 2-3 Random Write Test Results

In summary, the results show that the overall performance is not severely affected by the parity bit, whether or not the parity bit is involved. With this in mind, a combination of an all-NVMe flash memory array and NVMe SSDs can provide excellent performance without sacrificing too much space on mirrored drives.

3. CONCLUSION

The performance of compute-intensive tasks is closely tied to data throughput, with all-flash storage performance primarily influenced by the drive interface. NVMe, purpose-built for high-speed access to non-volatile memory, has emerged as the protocol of choice in environments demanding maximum efficiency—ranging from machine learning workloads to edge computing infrastructures.

Integrating NVMe SSDs within all-NVMe flash arrays delivers the next generation of high-performance storage solutions, suitable for organizations across diverse scales and sectors. The ultra-low latency of NVMe-based flash storage enables consistent, high-throughput data processing, making it ideal for handling massive datasets in real time. Beyond supporting latency-sensitive applications, NVMe storage architectures lay the groundwork for adopting future-facing technologies and scaling data infrastructure to meet evolving computational demands.

4. APPENDIX

4.1. Reference

Product Page

- XF5226 Product Model

Data Sheet

- XF5 Series Data Sheet
- SD4 NVMe SSD Data Sheet