TDS-h2489FU

24-bay U.2 NVMe PCIe Gen 4 all-flash ZFS storage supports dual Intel 3rd Gen Xeon Scalable Processors and 25GbE connectivity
Data growth leads to disruptive expansion in enterprise.

Where did that file go?

/DevOps /Engineering /Sales 2 /Sales 1 /MKT 1 /MKT 2

Uneven loading & capacity consumption

- Manually split shares between filers
- Copy files to new servers
- Redirect apps & users to new locations
How to tackle throughput- and IOPS-demanding applications with ease?

**Virtualization**
Eliminates storage bottlenecks for unstructured data and I/O intensive workloads; ideal for server virtualization and virtual desktop infrastructure (VDI).

**Data Centers**
Delivers ultra-low latency and high IOPS performance, providing response times within microseconds for data centers that host significant business-critical systems and data.

**Media & Entertainment**
Satisfies smooth 4K/8K media streaming and post-production, empowering multimedia workflows with faster data transfer, access, and backup for boosted efficiency.
Must use SSD to get the highest performance. How to choose SSDs?

<table>
<thead>
<tr>
<th>Formfactor</th>
<th>Interface</th>
<th>Major dimension</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.5 inch (hot swappable)</td>
<td>SATA</td>
<td>• Height 7~9.5 mm</td>
</tr>
<tr>
<td></td>
<td>SAS</td>
<td>• Height 15 mm</td>
</tr>
<tr>
<td></td>
<td>NVMe (U.2/U.3)</td>
<td>• Height 7 mm &lt;br&gt; • Height 15 mm</td>
</tr>
<tr>
<td>M.2</td>
<td>SATA</td>
<td>• 2230 (22 x 30 mm) &lt;br&gt;• 2280 (22 x 80 mm) &lt;br&gt;• 22110 (22 x 110 mm)</td>
</tr>
<tr>
<td>PCIe card (AIC)</td>
<td>NVMe</td>
<td>• Full height / half height &lt;br&gt;• Full length / half length</td>
</tr>
</tbody>
</table>

Each SSD model has different sequential / random read/write performance, TBW, and DWPD life expectancy. Choose wisely depends on your applications.

Source: [http://Samsung.com](http://Samsung.com)
Why the future mainstream SSD market will be PCIe NVMe SSD and not be SAS or SATA SSD?

Maximum bandwidth
64 Gb/s (8GB/s)

- PCIe Gen4 x4: 64 max Gb/s
- PCIe Gen3 x4: 32 max Gb/s
- SAS: 24 max Gb/s
- SATA: 6 max Gb/s

Low latency, Super short data path

NVMe
data → PCIe channel → CPU → applications

SAS/SATA
data → SAS/SATA channel → HBA/Controller → PCIe channel → driver → CPU → applications
800+ members in PCI-SIG community for PCIe standards since 1992 establishment

PCIe 1.0
2.5 GT/s (250 MB/s)

PCIe 2.0
5.0 GT/s (500 MB/s)

PCIe 3.0
8.0 GT/s (984.6 MB/s)

PCIe 4.0
16.0 GT/s (1,969 MB/s)

PCIe 5.0
32.0 GT/s (3,938 MB/s)

2017

2010

QNAP Systems, Inc.
7082 (IBAA Hex)

QNAP is a member of PCI-SIG (Peripheral Component Interconnect Special Interest Group) for PCIe standards. QNAP follows the specs for the optimal compatibility and performance requirements.

Source: https://pcisig.com/specifications
How to find the best data carrier of big data analysis / edge computing / AI inference?

Only PB-level shared folder is enough to store the huge data matrix.

200TB is not enough.

Deep Learning

Connect multiple JBOD to reach peta-bytes of storage capacity.
The all-flash U.2 NVMe NAS with dual Intel Xeon processors, 25GbE, and optional 100GbE

TDS-h2489FU 32 & 16 cores dual CPU 25GbE NAS

- 24 x 2.5” U.2 NVMe PCIe Gen4 SSD bays
  + 2 x M.2 2280 PCIe / SATA SSD combo slots
- Dual Xeon processors up to 32 and 16 cores:
  2 x Intel Xeon Scalable Silver 4314 16-core / 4309Y 8-core
- 32 DDR4 RDIMM memory slots, up to 1TB total
- 2 x 25GbE and 2 x 2.5GbE, with an additional PCIe Gen4 slot for 100GbE NIC, Fibre Channel, or SAS HBA

- ZFS file system for data security
- 65,536 snapshots for data protection
- Data reduction technology
  - Increase storage efficiency and maximize ROI
  - De-duplication, inline compression, data compaction
- Unified Storage: iSCSI/ FC/ NFS/ CIFS/ FTP / S3
- Container Station and Virtualization Station for virtualized applications
Dual server-grade 3rd gen Intel Xeon Silver scalable processors for the best efficiency

- 2 x Intel® Xeon® Silver 4314
  16 cores 32 threads, up to 3.4 GHz
- 2 x Intel® Xeon® Silver 4309Y
  8 cores 16 threads, up to 3.6 GHz

The latest and newest!

Ice Lake SP
CPU code name

8 CH ECC
RDIMM

10nm
Lithography

PCle 4.0
Ultra speed
TDS-h2489FU front view

- OLED status
- 24 x 2.5-inch U.2 NVMe PCIe Gen4 x4 SSD bays, Hot-swappable trays with key lock
- Bay 17~24 are U.2 NVMe PCIe Gen4 x4 SSD and SATA 6Gb/s Combo bays
- ACT LED
- Present LED
Advanced OLED display for system status

- Fan status
- Power status
- Temperature status
- NAS name
- NAS IP address
- Power module status
Ordering information and optional rail kit

**Ordering information**
- TDS-h2489FU-4309Y-64G (8 x 8GB RDIMM)
- TDS-h2489FU-4314-128G (8 x 16GB RDIMM)
- TDS-h2489FU-4314-256G (8 x 32GB RDIMM)
- TDS-h2489FU-4314-512G (16 x 32GB RDIMM), by request
- TDS-h2489FU-4314-1TB (32 x 32GB RDIMM), by request

**Optional rail kit**
- RAIL-E03
24 hot-swappable SSD trays and easy 2.5-inch SSD installation

1. Remove the tray
2. Fasten the screws
3. Insert the tray
4. Lock the tray with a key (optional step)
What if U.2 NVMe SSDs are not available in your country or if the cost is over your IT budget?

24 x U.2 NVMe SSD in the All flash NAS TDS-h2489FU

Not available for sale or long lead time?
Too expensive and over your IT budget?
Economically use M.2 NVMe SSDs with QNAP QDA-UMP4 U.2 to M.2 SSD adapter

Order P/N: QDA-UMP4

U.2 NVMe to M.2 NVMe PCIe adapter, supporting PCIe 4.0/3.0

- Use readily available and more affordable M.2 NVMe PCIe Gen4/Gen3 SSDs
- Excellent heat-conductive metal design with thermal pads so that M.2 SSDs do not overheat. Keep the optimal performance and prolong the life.

68 x 21 mm (on the top side of M.2 SSD)
68 x 15 mm (on the bottom side of SSD. Use 2 for single sided SSDs)
TDS-h2489FU rear view

4 x 2.5GbE (2.5G/1G/100M)

2 x 1200W redundant power supplies

4 x USB 3.2 Gen1 Type-A

PCIe slot 1: 1 x PCIe Gen4 x16 slot (x8 if slot 2 is occupied)

2 x PCIe Gen4 slots
- Slot 1 provides the width of PCIe Gen4 x16 when Slot 2 is not in use, and provides the width of PCIe Gen4 x8 when Slot 2 is in use.

PCIe Slot 2: 2 x 25GbE SFP28 (pre-installed 2-port 25GbE NIC)
Powerful all-flash NVMe NAS specs to meet your business digital transformation requirements

1. 24 x U.2 NVMe SSD bays (bay 17~24 also supports SATA 6Gb/s)
2. 2 x Intel® Xeon® Silver 4300 processors, up to 32 cores
3. 8 channel 32 x DDR4 RDIMM slots, up to 1TB
4. 2 x 1200W redundant PSU
5. 4 x 2.5GbE RJ45 ports
6. 4 x USB-A 3.2 Gen 1 ports
7. 2 x M.2 2280 PCIe Gen3 (x4 + x2) / SATA 6Gbps ports
8. 2 x 25GbE SFP28 ports (2-port 25GbE NIC)
9. 2 x PCIe Gen 4 slots (pre-installed 25GbE NIC)
10. System fan module
32 DDR4 ECC RDIMM RAM slots, 8-channel high-speed memory, up to 1TB RAM total

ECC

Error correction &
Optimal stability

TDS-h2489FU supports ECC Registered memory for automatic error detection and correction.

NAS tested with 1TB RAM!
Easy maintenance design for quick M.2 2280 PCIe NVMe / SATA SSD or RAM upgrade

1. Loosen the screws

2. Pull out the system module

3. Optional M.2 SSD heatsink for purchase (8 pcs P/N: HS-M2SSD-01)

4~6. Install the SSD & fasten the screws
PM9A3 Introduction

Q4, 2021 | Samsung Electronics., Ltd.

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1. Enterprise SSD market to see continuing growth due to data explosion

### Smartphone

<table>
<thead>
<tr>
<th>GB/Sys, YoY</th>
<th>Demand, B GB</th>
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<tbody>
<tr>
<td>'18</td>
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<td>'20</td>
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<tr>
<td>'21</td>
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### PC SSD

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<tr>
<td>'20</td>
<td>69</td>
</tr>
<tr>
<td>'21</td>
<td>99</td>
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</table>

### DC / Enterprise SSD

<table>
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<th>Demand, B GB</th>
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<tr>
<td>'19</td>
<td>58</td>
</tr>
<tr>
<td>'20</td>
<td>97</td>
</tr>
<tr>
<td>'21</td>
<td>130</td>
</tr>
</tbody>
</table>

Source: Samsung, Forward Insights
Industry Interface Trend: NVMe Drives eSSD Growth

1. PCIe performance benefits drive interface conversion and higher density SSD – More than 8/16TB

![Diagram showing eSSD Interface Trend and AVG Density Trend]

Source: Samsung, Forward Insights
Technical trend of DC NVMe SSDs

1. From 2020, PCIe Gen4 based DC NVMe SSDs have been introduced continuously
   1) SSD’s own performances are getting higher and various types of new form-factors are being adopted to meet host level requirements.

2. Samsung is the leading company to support best in class performances and all kinds of form-factor
Target Applications

① Multi-Thread & More functions
   (Compute, Web servers, Mainstream servers)

② Mixed workload Service with PCIe Gen.4 speed
   (Application servers, File servers)
PM9A3 Value Proposition

Samsung NVMe™ SSD PM9A3 provides the best in class PCIe Gen. 4 performances, various platform efficiencies, highly scalable design capability such as multiple form-factors and enhanced reliability with advanced V-NAND technology

Performance

- PCIe Gen.4 based performances for mainstream (Computing & Storage) servers with NVMe interface.
- Best in class QoS for various workload

Efficiency

- Improved energy efficiency, up to 80% power consumption per unit performance
- Faster emergency responsibility.

Design Capability

- Enhanced design scalability under host level constraints such as 1U server – providing multiple F/F for users’ demands
- Leading technical priority of OCP and providing new reference design based on OCP specs
1. **PM9A3 provides best-in-class PCIe Gen.4 performance for all kinds of form-factor**
   1) Random write performance is the key performance of PM9A3 → Refer to competitiveness of PM9A3.

2. **Even though high performance, PM9A3 consumes small amount of power for datacenters’ power efficiency**
   ※ Refer to appendix for power budget of SSD form-factor, PM9A3 achieves high performance with enough margin.

<table>
<thead>
<tr>
<th>Form Factor</th>
<th>U.2 (7mmT)</th>
<th>E1.S (9.5mmT)</th>
<th>M.2 (22x110mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity</td>
<td>7.68TB</td>
<td>3.84TB</td>
<td>1.92TB</td>
</tr>
<tr>
<td>Sequential</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Read</td>
<td>Write</td>
<td>Read</td>
</tr>
<tr>
<td></td>
<td>6,700</td>
<td>4,000</td>
<td>6,900</td>
</tr>
<tr>
<td></td>
<td>6,800</td>
<td>2,700</td>
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<tr>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Read</td>
<td>Write</td>
<td>Read</td>
</tr>
<tr>
<td></td>
<td>1,000</td>
<td>200</td>
<td>740</td>
</tr>
<tr>
<td></td>
<td>1,000</td>
<td>130</td>
<td>580</td>
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<tr>
<td></td>
<td>740</td>
<td>70</td>
<td>580</td>
</tr>
<tr>
<td>Power</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Active (R/W)</td>
<td>Idle</td>
<td>Active (R/W)</td>
</tr>
<tr>
<td></td>
<td>11/13.5</td>
<td>3.5</td>
<td>11/13.5</td>
</tr>
<tr>
<td></td>
<td>11/13.5</td>
<td>11/13.5</td>
<td>10/12.5</td>
</tr>
<tr>
<td></td>
<td>10/12.5</td>
<td>10/12.5</td>
<td>10/12.5</td>
</tr>
<tr>
<td></td>
<td>7.5/6.5</td>
<td>7.5/6.5</td>
<td>7.5/6.5</td>
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<tr>
<td></td>
<td>3.5</td>
<td>3.5</td>
<td>3.5</td>
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<tr>
<td></td>
<td>3.5</td>
<td>3.5</td>
<td>3.5</td>
</tr>
<tr>
<td></td>
<td>2.5</td>
<td>2.5</td>
<td>2.5</td>
</tr>
</tbody>
</table>

Form Factor: U.2 (7mmT), E1.S (9.5mmT), M.2 (22x110mm)
Performance: Best in class Latency and QoS

1. Latency

<table>
<thead>
<tr>
<th>Form Factor</th>
<th>U.2 (2.5”mm 7mmT)</th>
<th>E1.S (9.5mmT)*</th>
<th>M.2 (22x110mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity</td>
<td>7.68TB</td>
<td>3.84TB</td>
<td>1.92TB</td>
</tr>
<tr>
<td>Sequential</td>
<td>Read 20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Write 20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Random</td>
<td>Read 80</td>
<td>80</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>Write 30</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Drive Ready</td>
<td>8</td>
<td>8</td>
<td>8</td>
</tr>
</tbody>
</table>

* U.3 is under development for contracted server OEM companies first.

2. QoS (99%/99.99%)

<table>
<thead>
<tr>
<th>Form Factor</th>
<th>U.2 (2.5”mm 7mmT)</th>
<th>M.2 (22x110mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity</td>
<td>7.68TB</td>
<td>3.84TB</td>
</tr>
<tr>
<td>Read (us)</td>
<td>QD1 0.1/0.15</td>
<td>0.1/0.15</td>
</tr>
<tr>
<td></td>
<td>QD32 0.25/0.5</td>
<td>0.25/0.5</td>
</tr>
<tr>
<td>Write (us)</td>
<td>QD1 0.03/0.04</td>
<td>0.03/0.04</td>
</tr>
<tr>
<td></td>
<td>QD32 0.35/0.5</td>
<td>0.35/0.5</td>
</tr>
</tbody>
</table>
1. Regardless PCIe version, PM9A3 provides the lowest power consumption with the fastest performances.

2. Lower power consumption is the key factor of TCO for datacenters
   1) Lower power means lower heat generation and it directly affects cooling cost of systems and datacenters
   ※ Refer excel spread sheet for competitors power consumption level,

<table>
<thead>
<tr>
<th>12V supply cond.</th>
<th>U.2 (2.5”mm 7mmT)</th>
<th>M.2 (22x110mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Capacity</strong></td>
<td>7.68TB</td>
<td>3.84TB</td>
</tr>
<tr>
<td><strong>Active (Watt)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Read</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>Write</td>
<td>13.5</td>
<td>13.5</td>
</tr>
<tr>
<td>Idle (Watt)</td>
<td>3.5</td>
<td>3.5</td>
</tr>
<tr>
<td><strong>F/F Max Power</strong></td>
<td>25W</td>
<td></td>
</tr>
</tbody>
</table>

1) Power consumption was measured in the 12V power pins of the connector plug in SSD. The active and idle power is defined as the highest averaged power value, which is the maximum RMS average value over 100 ms duration.

2) The measurement condition for active power is assumed for Maximum power between sequential or random performance in PCIe Gen4.

3) The idle state is defined as the state that the host system can issue any commands into SSD at any time.
1. **PM9A3 provides up to 1.8x times better power efficiency than previous generation, PM983**

   1) Even though PM9A3 is PCIe Gen.4 based SSD, less power consumption with higher performance
Efficiency: Efficient Power management (Seq. Write)

1. PM9A3 provides up to 1.6x times better power efficiency than previous generation
Design Capability: Multiple Form Factor

# PM9A3 Overview

<table>
<thead>
<tr>
<th>Feature</th>
<th>PM9A3</th>
<th>PM983</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface</td>
<td>PCIe Gen4x4</td>
<td>PCIe Gen3</td>
</tr>
<tr>
<td>Port configuration</td>
<td>Single port</td>
<td>Single port</td>
</tr>
<tr>
<td>CTRL</td>
<td>Elpis (8ch)</td>
<td>Phoenix (8ch)</td>
</tr>
<tr>
<td>NAND</td>
<td>V6(128L) TLC</td>
<td>V4(64L) TLC</td>
</tr>
<tr>
<td>Capacity</td>
<td>15.36TB/7.68TB/3.84TB/1.92TB/960GB</td>
<td>7.68TB/3.84TB/1.92TB/960GB</td>
</tr>
<tr>
<td>Logical Block Address</td>
<td>512B(Default), 4KB</td>
<td>512B(Default), 4KB</td>
</tr>
<tr>
<td>NVMe.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NVMe Ver</td>
<td>1.4(Mandatory Only)</td>
<td>1.3c</td>
</tr>
<tr>
<td>Sanitize</td>
<td>NVMe 1.3 Compliance (Block Erase, Crypto Erase)</td>
<td>Not Support</td>
</tr>
<tr>
<td>Device Self test</td>
<td>Support</td>
<td>Not Support</td>
</tr>
<tr>
<td>SED</td>
<td>TCG/Opal</td>
<td>TCG/Opal</td>
</tr>
<tr>
<td>DWPD</td>
<td>1@5yr</td>
<td>1.3@3yr</td>
</tr>
<tr>
<td>Warranty</td>
<td>3</td>
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</tr>
</tbody>
</table>

Proprietary
Security

1. **AES 256-bit hardware-accelerated encryption with optional TCG Opal 2.0 feature to protect data at rest**
   1) SED(Self-encrypting Drive) feature with no performance degradation
   2) Advanced key management scheme guarantees no access to the encrypted data without knowing users’ credentials
   3) PUF(Physically Un-clonable Function) technology to provide an additional layer of security by encrypting sensitive information with a unique, random and unpredictable key

2. **Secure FW boot and update to prevent the firmware from illegal modification**
   1) Hardware based immutable firmware verification at every power-on
   2) Digital signature to protect firmware integrity based on RSA-3072
   3) Key Revocation feature to revoke the firmware verification key in case of compromised signing key
128KB Sequential performance (MB/s)

1. PM9A3 provides best-in-class sequential read and write performance

<table>
<thead>
<tr>
<th></th>
<th>U.2</th>
<th>3.84TB</th>
<th>1.92TB</th>
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<tbody>
<tr>
<td>Seq. Read (MB/s)</td>
<td></td>
<td>6,910</td>
<td>6,969</td>
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<tr>
<td>QD1 QD2 QD4 QD8 QD16 QD32 QD64 QD128 QD256</td>
<td>4,136</td>
<td>4,136</td>
<td>2,946</td>
</tr>
<tr>
<td>Seq. Write (MB/s)</td>
<td></td>
<td>3,495</td>
<td>2,811</td>
</tr>
<tr>
<td>QD1 QD2 QD4 QD8 QD16 QD32 QD64 QD128 QD256</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
1. PM9A3 provides robust 4KB ran performance in various types of mixed workload pattern
   1) Datacenter customers are usually focusing on 70% Read case (mixed workload 7:3), PM9A3 shows up to 20% higher IOPs.
1. PM9A3 shows stable IOPS consistency with Gen.4 performance compared to 16x based SSD

<table>
<thead>
<tr>
<th></th>
<th>PM9A3</th>
<th>A</th>
</tr>
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<tbody>
<tr>
<td>Read</td>
<td>100%</td>
<td>99%</td>
</tr>
<tr>
<td>Write</td>
<td>97%</td>
<td>90%</td>
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User-environment simulation test (script base)

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<tr>
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<th>4KB</th>
<th>Web Server</th>
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<th>4KB</th>
<th>Exchange email</th>
<th></th>
<th>64KB</th>
<th>Media streaming</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Seq. read</td>
<td>25%</td>
<td></td>
<td>Seq. Read</td>
<td>0%</td>
<td></td>
<td>Seq. Read</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Seq. Write</td>
<td>75%</td>
<td></td>
<td>Seq. Write</td>
<td>100%</td>
<td></td>
<td>Seq. Write</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ran. Read</td>
<td>95%</td>
<td></td>
<td>Ran. Read</td>
<td>67%</td>
<td></td>
<td>Ran. Read</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ran. Write</td>
<td>5%</td>
<td></td>
<td>Ran. Write</td>
<td>33%</td>
<td></td>
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※ Higher score is better

<table>
<thead>
<tr>
<th></th>
<th>4KB</th>
<th>Seq. read</th>
<th></th>
<th>64KB</th>
<th>Seq. Read</th>
<th></th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>25%</td>
<td></td>
<td></td>
<td>100%</td>
<td></td>
</tr>
<tr>
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<td>95%</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>5%</td>
<td></td>
<td></td>
<td>33%</td>
<td></td>
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</tbody>
</table>
# User-environment simulation test (script base)

※ Higher score is better

<table>
<thead>
<tr>
<th>4KB</th>
<th>File Server</th>
</tr>
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<tbody>
<tr>
<td>Seq. read</td>
<td>25%</td>
</tr>
<tr>
<td>Seq. Write</td>
<td>75%</td>
</tr>
<tr>
<td>Ran. Read</td>
<td>90%</td>
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<tr>
<td>Ran. Write</td>
<td>10%</td>
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</table>

<table>
<thead>
<tr>
<th>8KB</th>
<th>Database OLTP</th>
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<tbody>
<tr>
<td>Seq. Read</td>
<td>0%</td>
</tr>
<tr>
<td>Seq. Write</td>
<td>100%</td>
</tr>
<tr>
<td>Ran. Read</td>
<td>70%</td>
</tr>
<tr>
<td>Ran. Write</td>
<td>30%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>512KB</th>
<th>Video on demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seq. Read</td>
<td>100%</td>
</tr>
<tr>
<td>Seq. Write</td>
<td>0%</td>
</tr>
<tr>
<td>Ran. Read</td>
<td>100%</td>
</tr>
<tr>
<td>Ran. Write</td>
<td>0%</td>
</tr>
</tbody>
</table>
QNAP All Flash NAS

Fast and furious with expandability
TDS-h2489FU with powerful data reduction to extend SSD endurance

Only available when during inline data process before writing

ZFS file system with inline deduplications and compression feature

It's the best choice to pair with the all-flash and SSD storage because it reduces the data size and pattern that need to be written to the SSD directly.

Write to SSDs as sequential as much as possible.
Patented QSAL technology: preventing multiple SSD malfunctioning at the same time

For SSD RAID 5 / 6 / 50 / 60 / TP(Triple Parity).

Note: QSAL can be activated at any time and is compatible with SSD Parity RAID that has not been configured before. It is recommended to enable QSAL before the SSD lifespan reaches 50% to prevent the risk of damage to the SSD RAID due to insufficient rebuild time.
Support 25GbE/10GbE/1GbE transceivers for various network environments

- Built-in 2 x 25GbE ports for SFP28 transceivers
- Backward compatible with 10GbE and 1GbE networks with compatible SFP+/SFP transceivers
- Auto-negotiation for auto speed detection

QNAP QSW-M5216-1T 16-port 25GbE switch
Abundant high-speed network cards with plug and use support

10GbE NIC
- 2 x SFP+
- 2 x RJ45
- QXG-10G2SF-CX4
- LAN-10G2T-X710
- QXG-10G2TB
- QXG-10G1T

5GbE NIC
- 1/2/4 x RJ45
- QXG-5G1T-111C
- QXG-5G2T-111C
- QXG-5G4T-111C

40/25GbE NIC
- 2 x QSFP+ 40Gb/s
- 2 x SFP28 25Gb/s
- LAN-40G2SF-MLX
- QXG-25G2SF-CX6

100GbE NIC
- 2 x QSFP28
- QXG-100G2SF-E810

2.5GbE NIC
- 1/2/4 x RJ45
- QXG-2G1T-I225
- QXG-2G2T-I225
- QXG-2G4T-I225
PCIe Gen4 slots for 100GbE Ethernet

- Install the QNAP QXG-100G2SF-E810 network card with a 100GbE switch for 100GbE network adaptation and future proof your storage investment.
- Support port-configuration mode to connect to 4 x 25GbE port.
- Connect your 100GbE server to 4 x 25GbE or 8 x 10GbE end devices with native port-configure mode.

Mellanox 25 / 100 GbE Switch (SN2010)

- Preinstall low profile bracket
- Full-height bracket include inside package

25GbE SFP28

CAB-DAC15M-Q28
Coming soon

CAB-DAC15M-Q28B4
Coming soon
Performance of 32-core TDS-h2489FU-4314-128G with 6 x 25GbE clients

- Up to 1.1 million iSCSI random read IOPS!
- 16,165MB/s SMB seq. read and 11,022 MB/s SMB seq. write!

6 x 25GbE iSCSI, Random IOPS (4K), Compression On, Dedupe Off

- ISCSI random read: 1,127,217 IOPS
- ISCSI random write: 280,886 IOPS

6 x 25GbE SAMBA, Sequential Throughout (1MB), Compression On, Dedupe Off

- SMB sequential read: 16,165 MB/s
- SMB sequential write: 11,022 MB/s

Tested in QNAP Labs. Figures may vary by environment.

Test Environment:
NAS: TDS-h2489FU-4314-128G with QuTS hero 5.0.0
Volume type: Samsung PM9A3 960G Gen4 U.2 NVMe SSD x24 (RAID 50); Intel QXG-100G2SF-E810; QXG-25G2SF-CX4
Client PC:
6* Client PC simultaneously read and write 16GB file (= 96GB totally)
Performance of 16-core TDS-h2489FU-4309Y-64G with 6 x 25GbE clients

- Up to 745,479 iSCSI random read IOPS!
- 15,666 MB/s SMB seq. read and 9,958 MB/s SMB seq. write!

6 x 25GbE iSCSI, Random IOPS (4K), Compression On, Dedupe Off

- iSCSI random read: 745,479 IOPS
- iSCSI random write: 178,849 IOPS

6 x 25GbE SAMBA, Sequential Throughout (1MB), Compression On, Dedupe Off

- SMB sequential read: 15,666 MB/s
- SMB sequential write: 9,958 MB/s

Tested in QNAP Labs. Figures may vary by environment.

Test Environment:
- NAS: TDS-h2489FU-4309Y-64G with QuTS hero 5.0.0
- Volume type: Samsung PM9A3 960G Gen4 U.2 NVMe SSD x24 (RAID 50); Intel QXG-100G2SF-E810; QXG-25G2SF-CX4
- Client PC:
  - 6* Client PC simultaneously read and write 16GB file (= 96GB totally)
  - Intel Core™ i7-7700 4.20GHz CPU, 32GB DDR4 RAM, QXG-25G2SF-CX4, Windows® Server 2016
  - Intel Core™ i3-8100 3.60GHz CPU, 4GB DDR4 RAM, QXG-25G2SF-CX4, Windows® Server 2016
Fibre Channel SAN
32Gb & 16Gb storage solution

Designed for NAS, high-performance and efficient QNAP FC expansion cards*
* Installation on Windows/Linux hosts is not supported

Includes optical FC transceivers. Additional ones available for purchase:

- TRX-32GFC-SFP-SR
  32Gb/16Gb/8Gb
- TRX-16GFC-SFP-SR
  16Gb/8Gb/4Gb

Note: cables are not included.
Expand M.2 NVMe SSD slots with QM2

QM2 helps you to expand more M.2 NVMe SSD slots via PCIe

Keep your original storage architecture

**QM2-4P-384** (Gen 3 x8)
4 x M.2 2280 PCIe Gen 3 x4 NVMe SSD slots

**QM2-2P-384** (Gen 3 x8 )
2 x M.2 22110/2280 PCIe Gen 3 x4 NVMe SSD slots
Expand 10GbE and M.2 SSD slots with QM2

Expand both Ethernet and M.2 NVMe SSD slots with new PCIe 4.0 QM2 series

- QM2-2P410G2T (Gen 4 x8)
  - 4 x M.2 2280 PCIe Gen 4 x4 NVMe SSD slots
  - + 2 x 10GbE RJ45 ports

- QM2-2P410G1T (Gen 4 x8)
  - 2 x M.2 2280 PCIe Gen 4 x4 NVMe SSD slots
  - + 1 x 10GbE RJ45 port

PCle 4.0 high speed expansion
Reach PB storage capacity with QNAP SAS 12Gb/s 12-bay & 16-bay JBOD units

NAS supports up to 16 QNAP SAS JBOD enclosures
- 12-bay TL-R1220Sep-RP or 16-bay TL-R1620Sep-RP
- Each NAS with hundreds of HDDs, 1~3PB raw HDD capacity
- SAS JBOD can expand NAS existing storage pools

*The above data is for reference only based on IC vendor’s data sheets. Actual performance could be different due to host, expansion unit or drives.

SAS HBA (optional purchase)

<table>
<thead>
<tr>
<th>Feature</th>
<th>QXP-820S-B3408</th>
<th>QXP-1620S-B3616W</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAS IC</td>
<td>Broadcom SAS3408</td>
<td>Broadcom SAS3616W</td>
</tr>
<tr>
<td>PCIe bus</td>
<td>PCIe3 x8</td>
<td>PCIe3 x16</td>
</tr>
<tr>
<td>IOPS</td>
<td>1.2X</td>
<td>1.8X</td>
</tr>
<tr>
<td>Bandwidth</td>
<td>6,850 MBs</td>
<td>13,700 MBs</td>
</tr>
<tr>
<td>Ports</td>
<td>External 8 ports</td>
<td>External 16 ports</td>
</tr>
<tr>
<td>Connectors</td>
<td>2 x SFF8644</td>
<td>4 x SFF8644</td>
</tr>
</tbody>
</table>
Tackle the massive storage requirements of 4K/8K multimedia, big data storage, critical backups, and more.

Seagate Exos E 5U84, the 5U rackmount enclosure, can house 84 drives for storing up to 1.1 PB.

QNAP Storage & Snapshots Manager simplifies NAS and JBOD management, effectively minimizing IT operational workloads.

- QNAP NAS supports Seagate Exos E SAS JBOD units and 100+ drives to provide petabytes (PBs) of raw capacity.

Note:
1. Optional purchase of SAS HBA is required for the NAS.
2. Seagate’s JBODs can only be used as an individual storage pool or volume. Its storage pool/volume cannot be combined into the connected NAS. NAS applications cannot be installed on Seagate’s JBODs.
Scale up NAS capacity with optimized cost by using Seagate Exos E JBOD enclosures

Exos E 2U12
- Max 216 TB
- 12 x 18 TB 3.5" SAS HDD

Exos E 2U24
- Max 57.6 TB
- 24 x 2.4 TB 2.5" SAS SSD

Exos E 4U106
- Max 1.9 PB
- 106 x 18 TB 3.5" SAS HDD

Exos E 5U84
- Max 1.5 PB
- 84 x 18 TB 3.5" SAS HDD

Note:
New JBOD models and the maximum connected numbers will be tested and added throughout 2022 H1. Refer to the latest compatibility table before purchase.
Kernel 5.10 LTS

ZFS-based QuTS hero ensures performance, security, and data integrity

Fast, smooth, and easy-to-use!

Whether clicking buttons, switching between apps, expanding/collapsing windows – every action is much smoother. The search bar in the main menu also assists in quickly finding desired apps.
Big Data Storage
Security and performance are priority

- Supports TLS 1.3 to improve security and performance.
- You can also use SSH keys for authentication to secure access to your NAS, preventing password breaches or similar potential attacks.
- The new kernel improves PCIe performance, which enhances NVMe SSD performance and utilization.
Avoid silent data corruption that occurred on the running system.

Silent data corruption & self-healing with QuTS hero NAS O.S.
Read cache is not needed in AFA because it can slow down the pool performance. However, the ZIL for data protection is still needed. Therefore, the smaller capacity and high endurance Intel Optane SSDs are the perfect candidate.
License-free backup solutions to provide the most complete data backup protection

**Snapshot & Replica:**
- File level, multi-version management.
- Lightweight snapshot w/o performance impact.

**SnapSync:**
- Block level, Mirror the data copy and always kept up to date.

**HBS 3 (Hybrid Backup Sync 3):**

- RPO: hourly / daily / yearly
- RPO: real-time
- RPO: daily / scheduled
Easy to use HBS 3.0 app fulfilling backup 3-2-1 practice with deduplication
Real-time SnapSync ensures minimal RPO with real-time disaster recovery.

**Schedule SnapSync: 5min~60min**

- Normal
- By schedule
- Snapshot send

**Realtime SnapSync: RPO=0**

- Production Server
- Normal
- Disaster Recovery (RPO=0)

**Direct connected via 25GbE (Round Trip Latency < 5ms)**

Primary NAS > Real-time Snapshot > Secondary NAS

Primary NAS > Snapshot send > Secondary NAS
SnapSync + Instant Clone
Economical & efficient CDM (Copy Data Management) solution

Production Server
Main Storage
DR Storage & Analysis Server
VMware Hypervisor Host

Ethernet switch

LUN SnapSync LUN Instant Clone LUN

Production Server
Main Storage
DR Storage & Analysis Server
CDM LUN

Analysis Server

SnapSync + Instant Clone
Economical & efficient CDM (Copy Data Management) solution
QNAP QuFTP: set up a secure FTP server for file sharing and exchange

QuFTP Service consolidates all FTP related activities into a single App. With its user-friendly interface and detailed permissions settings, QuFTP Service leverages FTP’s efficiency with high security and easy management.

- Folder-level permissions
- QoS (Quality of Service) settings
- Instant event notifications
- Access time restrictions
- Limit access to only the FTP root folder
- Watermark for images & videos
- Detailed logs
- Remotely connect to other NAS
QVPN Service with WireGuard: easier VPN tunnels for remote workers

- WireGuard is an open-source VPN protocol that uses User Datagram Protocol (UDP) for network communication. The protocol uses several cryptography tools to implement secure VPN tunneling.
- The built-in WireGuard® provides faster and stable VPN connections. With a user-friendly interface, non-IT professional remote workers can easily set up VPN tunnels to access office-based QNAP devices with simplified connection methods.
QNAP’s QuWAN SD-WAN solution features Auto Mesh VPN, IPsec encryption, cloud-centric management and QVPN Service for multi-site network. Compatible with a wide range of QNAP products and Hypervisor Platforms such as VMware ESXi, QuWAN enables SMBs to efficiently build a dependable network at a cost-effective price, and to facilitate digital transformation, multi-site expansion and remote working.
Hyper Data Protector is a license-free VMware® and Hyper-V backup appliance

With only one QNAP NAS required and with no license fees to pay, you can backup unlimited VMware® and Hyper-V environments. Hyper Data Protector provides you with a cost-effective and reliable disaster recovery plan, ensuring 24/7 operation of your services.

Easy VM backup with multi-version retention
QuObjects is perfect for object storage development & testing, and backing up cold data from the cloud.

Object example:

https://alvin1.s3.ap-east-1.amazonaws.com/test1/292557.jpg
HybridMount provides two modes for file-based cloud storage gateway

<table>
<thead>
<tr>
<th></th>
<th>Network Drive Mount</th>
<th>File Cloud Gateway</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Setup Method</strong></td>
<td>Mount cloud drives</td>
<td>Select “File Cloud Gateway” mode and create a dedicated cache space</td>
</tr>
<tr>
<td><strong>Connections</strong></td>
<td>No limit</td>
<td>2 free and perpetual connections. Purchase license for more connections</td>
</tr>
<tr>
<td><strong>Access Performance</strong></td>
<td>Depends on network speed</td>
<td>High performance thanks to caching</td>
</tr>
<tr>
<td><strong>Access in File Station</strong></td>
<td>Supported</td>
<td>Supported</td>
</tr>
<tr>
<td><strong>Access through SMB / NFS / AFP</strong></td>
<td>Not supported</td>
<td>Supported</td>
</tr>
<tr>
<td><strong>Sync with the cloud</strong></td>
<td>Sync only when browsing</td>
<td>Sync constantly for quick access</td>
</tr>
<tr>
<td><strong>Integration with QTS Apps</strong></td>
<td>Not supported</td>
<td>Supported</td>
</tr>
</tbody>
</table>

- Online collaboration
- File data analysis

- NAS cache
- Slower
- Internet
- Faster
- LAN
Back up business data to the cloud. Flexible, economical, and safe with VJBOD Cloud

Connect your QNAP NAS with cloud object storage and back up business data to the cloud with reduced bandwidth usage, backup time, and optimized storage usage.
With Boxafe, you do not need to worry about data loss. You can backup files, emails, calendars and contacts from Google™ Workspace and Microsoft 365® into the QNAP NAS.

**Google™ Workspace**

- **Gmail**
  Backup all your emails and attachments in Gmail
- **Google Drive**
  Backup all your file versions in Google Drive and supports My Drive and Shared Drive
- **Contacts**
  Backup all your contacts in Google Contacts
- **Calendar**
  Backup all your events and attachments in Google Calendar

**Microsoft 365®**

- **Outlook**
  Backup all your emails and attachments in Outlook
- **Contacts (People)**
  Backup all your contacts in Outlook People
- **Calendar**
  Backup all your events and attachments in Outlook Calendar
- **SharePoint & OneDrive**
  Backup your SharePoint and OneDrive files including OneNote

Boxafe

Google™ Workspace and Microsoft 365® total backup solution
All-in-one solution for hosting virtual machines and containers

Virtualization Station
Virtualization Station allows you to create virtual machines (VM) on Turbo NAS, supporting Windows, Linux®, UNIX®, Android, and QuTScloud operating systems.

Container Station
Experience LXD and Docker® lightweight virtualization technologies, download apps from the Docker Hub Registry®, import/export containers, and create abundant microservices.

Container Station Diagram:
- Host OS
- Filesystem
- Application
- Hardware
A virtual NAS solution suited for Enterprises and Workgroup

QuTScloud is a virtual appliance based on QNAP’s QTS Operating system, can be quickly launched on QNAP Virtualization Station.

Organizations can increase their budget flexibility by using existing virtual environments, saving hardware space and additional maintenance efforts, and by leveraging the application advantages of the app-ware QuTScloud operating system.
SR-IOV (Single-Root Input/Output Virtualization) let the services on your virtual machine enjoy the physical network speed.

- If you need real-time service needs, such as ticket booking service, cash flow service, audio-visual service, you can directly enjoy the speed of the hardware network card, reducing network delay.
- Reduce the usage of the host’s CPU.
- Increase network efficiency by at least 20%
Build a comprehensive surveillance system with a QNAP NAS, QVR Elite, and IP cameras.

QNAP QVR Elite is a subscription-based smart surveillance solution, allowing you to easily build a surveillance system with lower TCO (subscriptions starting from only US $1.99 per month) and higher scalability. It also integrates multiple QNAP AI-based video analytics solutions to build smart facial recognition for retail and door access systems with QNAP NAS.

- Real-time Monitoring
- Expandable Capacity
- Value-added AI Applications

- Windows / macOS / iOS / Android QVR Pro client
Support Coral Edge M.2 PCIe and USB TPU for AI enhanced image recognition

- Official certification by Google to support Coral M.2 & USB TPU devices
- Up to 4 TPU devices per NAS

https://coral.ai/products/
QVR Face Insight
Smart Facial Recognition Solution

A facial recognition solution for small offices and residential communities that enables instant and accurate facial recognition with live AI-powered video analytics that is even capable of recognizing masked people.

- Real-Time Facial Recognition and Analytics
- Mask detection and facial recognition in one solution
- Build A Smart Facial Recognition System with One NAS
- Identity Authentication Made Easy with Profile Database
- Enhance your face recognition speed with an Edge TPU
- Empowered surveillance feeds with QVR Pro integration
The TDS-h2489FU also supports QTS - QNAP’s standard NAS operating system – that provides greater everyday performance, efficient memory utilization, and the advantage of Qtier auto-tiering. You can also migrate drives from your current QTS-based NAS to the TDS-h2489FU.

Note:
- QTS and QuTS hero use different file systems. You must remove all the drives from the TDS-h2489FU before switching from QuTS hero to QTS.
The TDS-h2489FU is backed by a 5-year warranty at no extra cost. This premier warranty demonstrates QNAP’s dedication to your essential business needs for continuous operations and non-interrupted services.
TDS-h2489FU
All flash U.2 NVMe PCIe Gen4
with dual Intel Xeon CPUs & 25GbE