3500 SSD Series Technical Product Specification

For additional technical and warranty information, contact your Micron sales representative.

Features

- Micron® 3D TLC NAND Flash
- PCIe® Gen4 x4
- NVMe 2.0c
  - Number of namespaces supported: 1
  - Round robin arbitration: not weighted
  - Autonomous power state transitions
- TCG/Pyrite 2.02-compliant non-self-encrypting drive (non-SED)
- TCG/Opal 2.01-compliant self-encrypting drive (SED)
- Capacity (unformatted): 512GB, 1024GB, 2048GB
- Endurance: Total bytes written (TBW)
  - Up to 1200TB
- Industry-standard 512 byte sector size support
- Security
  - Digitally signed firmware
- Self-monitoring, analysis, and reporting technology (SMART)
- Device self-test
- Power loss protection for data-at-rest
- Power loss signal support
- Performance
  - Sequential 128KB READ: Up to 7000 MB/s
  - Sequential 128KB WRITE: Up to 7000 MB/s
  - Random 4KB READ: Up to 1,150,000 IOPS
  - Random 4KB WRITE: Up to 1,150,000 IOPS
- Latency
  - Read (TYP): 50 μs
  - Write (TYP): 12 μs
- Reliability
  - MTTF: 2 million device hours
  - Static and dynamic wear leveling
  - Uncorrectable bit error rate (UBER): <1 sector per 10^{15} bits read
- Operating temperature
  - Commercial (0°C to +70°C)
  - System management bus temperature monitoring (SMBus)
- Field upgradeable firmware
  - Firmware activation without reset
- Form factor
  - M.2 Type 2280
- Electrical specification
  - Power supply: 3.3V ±5%

Notes:
1. User capacity: 1GB = 1 billion bytes.
2. Typical I/O performance numbers as measured fresh-out-of-box (FOB).
3. 4KB, queue depth 1 transfers used for READ/WRITE latency values.
4. The product achieves a mean time to failure (MTTF) based on population statistics not relevant to individual units.
5. Temperature measured by SMART.

Warranty: Contact your Micron sales representative for further information regarding the product, including product warranties.
Part Numbering Information

Micron’s 3500 SSD is available in different configurations and capacities. The chart below is a comprehensive list of options for the 3500 series devices; not all options listed can be combined to define an offered product. Visit www.micron.com for a list of valid part numbers.

Figure 1: Part Number Chart

Micron Technology
Product Family
FD = Flash drive
Drive Interface
K = PCIe Gen4
Drive Form Factor
BA = M.2 (80mm x 22mm, x4 PCIe)
Drive Capacity
512 = 512GB
1T0 = 1024GB
2T0 = 2048GB
Product Family
GD = 3500
MT   FD   K   BA   512   T   GD - 1   BK   1   A   AB   YY   ES

Extended Firmware Features
A = non-SED TCG Pyrite
5 = SED TCG Opal
Sector Size
1 = 512 byte
Important Notes and Warnings

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Critical Applications. Products are not authorized for use in applications in which failure of the Micron component could result, directly or indirectly in death, personal injury, or severe property or environmental damage ("Critical Applications"). Customer must protect against death, personal injury, and severe property and environmental damage by incorporating safety design measures into customer’s applications to ensure that failure of the Micron component will not result in such harms. Should customer or distributor purchase, use, or sell any Micron component for any critical application, customer and distributor shall indemnify and hold harmless Micron and its subsidiaries, subcontractors, and affiliates and the directors, officers, and employees of each against all claims, costs, damages, and expenses and reasonable attorneys’ fees arising out of, directly or indirectly, any claim of product liability, personal injury, or death arising in any way out of such critical application, whether or not Micron or its subsidiaries, subcontractors, or affiliates were negligent in the design, manufacture, or warning of the Micron product.

Customer Responsibility. Customers are responsible for the design, manufacture, and operation of their systems, applications, and products using Micron products. ALL SEMICONDUCTOR PRODUCTS HAVE INHERENT FAILURE RATES AND LIMITED USEFUL LIVES. IT IS THE CUSTOMER’S SOLE RESPONSIBILITY TO DETERMINE WHETHER THE MICRON PRODUCT IS SUITABLE AND FIT FOR THE CUSTOMER’S SYSTEM, APPLICATION, OR PRODUCT. Customers must ensure that adequate design, manufacturing, and operating safeguards are included in customer’s applications and products to eliminate the risk that personal injury, death, or severe property or environmental damages will result from failure of any semiconductor component.

Limited Warranty. In no event shall Micron be liable for any indirect, incidental, punitive, special or consequential damages (including without limitation lost profits, lost savings, business interruption, costs related to the removal or replacement of any products or rework charges) whether or not such damages are based on tort, warranty, breach of contract or other legal theory, unless explicitly stated in a written agreement executed by Micron’s duly authorized representative.
Performance

Measured performance can vary for a number of reasons. The major factors affecting drive performance are the capacity of the drive and the interface of the host. Additionally, overall system performance can affect the measured drive performance. When comparing drives, it is recommended that all system variables are the same, and only the drive being tested varies.

Performance numbers will vary depending on the host system configuration.

For SSDs designed for the client computing market, Micron specifies performance in fresh-out-of-box (FOB) state.

For a description of these performance states and of Micron's best practices for performance measurement, refer to Micron's technical marketing brief Best Practices for SSD Performance Measurement.

Table 1: Drive Performance

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Capacity</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>512GB</td>
<td>1024GB</td>
</tr>
<tr>
<td>PCIe Gen4 sequential read (128KB transfer)</td>
<td>7000</td>
<td>7000</td>
</tr>
<tr>
<td>PCIe Gen4 sequential write (128KB transfer)</td>
<td>5100</td>
<td>6900</td>
</tr>
<tr>
<td>Gen 4 random read (4KB transfer)</td>
<td>680</td>
<td>1050</td>
</tr>
<tr>
<td>Gen 4 random write (4KB transfer)</td>
<td>700</td>
<td>1150</td>
</tr>
<tr>
<td>READ latency (TYP)</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>WRITE latency (TYP)</td>
<td>12</td>
<td>12</td>
</tr>
</tbody>
</table>

Notes: 1. Performance values measured under the following conditions:
   - Fresh-out-of-box (FOB) state, unformatted
   - Drive write cache enabled
   - NVMe power state 0
   - Sequential workloads measured using FIO with a queue depth of 32
   - Random workloads measured using FIO with a queue depth of 128

2. Performance values measured with the following system configuration:
   - ASROCK X570 Taichi Motherboard
   - AMD X570 Chipset
   - AMD Ryzen 7 3700X 8 Core Processor
   - Crucial® 8GB DIMM DDR4 DRAM

3. Latency values measured under the following conditions:
   - Random workloads using FIO with 4KB transfers and a queue depth of 1
   - TYP = median, 50th percentile

4. System variations will affect measured results.
Endurance for the SSD can be predicted based on the usage conditions applied to the device, the internal NAND component cycles, the write amplification factor, and the wear-leveling efficiency of the drive. The tables below show the drive lifetime for each SSD capacity by client computing and sequential input and based on predefined usage conditions.

Table 2: Total Bytes Written

<table>
<thead>
<tr>
<th>Capacity</th>
<th>Total Bytes Written</th>
</tr>
</thead>
<tbody>
<tr>
<td>512GB</td>
<td>300TB</td>
</tr>
<tr>
<td>1024GB</td>
<td>600TB</td>
</tr>
<tr>
<td>2048GB</td>
<td>1200TB</td>
</tr>
</tbody>
</table>

Notes: 1. Total bytes written validated with the drive 90% full.
2. SSD volatile write cache is enabled.
3. Access patterns used during reliability testing are 25% sequential and 75% random and consist of the following:
   1% are 512B; 24% are 4 KiB; 10% are 8 KiB; 10% are 16 KiB; 17% are 32 KiB; 18% are 64 KiB; 10% are 128 KiB; and 10% are 256 KiB.
4. Host workload parameters, including write cache settings, I/O alignment, transfer sizes, randomness, and percent full, that are substantially different than the described notes may result in varied endurance results.
5. GB/day can be estimated by dividing the total bytes written value by \((365 \times \text{number of years})\). For example: \(100\text{TB}/3\text{ years}/365\text{ days} = 91\text{ GB/day}\) for 3 years.
Electrical Characteristics

Table 3: NVMe Power Consumption

<table>
<thead>
<tr>
<th>Capacity</th>
<th>PS4</th>
<th>PS3</th>
<th>PS2</th>
<th>PS1</th>
<th>Active Idle</th>
<th>Active Writes PCIe Gen4</th>
<th>Active Reads PCIe Gen4</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>512GB</td>
<td>&lt;5</td>
<td>&lt;50</td>
<td>&lt;2200</td>
<td>&lt;4000</td>
<td>&lt;400</td>
<td>&lt;8250</td>
<td>&lt;8250</td>
<td>mW</td>
</tr>
<tr>
<td>1024GB</td>
<td>&lt;5</td>
<td>&lt;50</td>
<td>&lt;2200</td>
<td>&lt;4000</td>
<td>&lt;400</td>
<td>&lt;8250</td>
<td>&lt;8250</td>
<td>mW</td>
</tr>
<tr>
<td>2048GB</td>
<td>&lt;5</td>
<td>&lt;50</td>
<td>&lt;2200</td>
<td>&lt;4000</td>
<td>&lt;400</td>
<td>&lt;8250</td>
<td>&lt;8250</td>
<td>mW</td>
</tr>
</tbody>
</table>

Notes:
1. Active read power is a typical RMS active average power measurement performed using FIO with 128KB sequential read transfers.
2. Active write power is a typical RMS active average power measurement performed using FIO with 128KB sequential write transfers.
3. PS3 power measured at 25°C.

Table 4: Maximum Ratings

<table>
<thead>
<tr>
<th>Parameter/Condition</th>
<th>Symbol</th>
<th>Min</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage input</td>
<td>3.3V</td>
<td>3.135</td>
<td>3.465</td>
<td>V</td>
</tr>
<tr>
<td>Operating temperature¹</td>
<td>Tc</td>
<td>0</td>
<td>70</td>
<td>°C</td>
</tr>
<tr>
<td>Non-operating temperature</td>
<td></td>
<td>–</td>
<td>–40</td>
<td>85</td>
</tr>
<tr>
<td>Rate of temperature change</td>
<td></td>
<td>–</td>
<td>–</td>
<td>20</td>
</tr>
<tr>
<td>Relative humidity (non-condensing)</td>
<td></td>
<td>–</td>
<td>5</td>
<td>95</td>
</tr>
</tbody>
</table>

Note: 1. Temperature measured in Tcase and Tjunction by SMART.
Physical Configuration

M.2 Type 2280

Product mass: 10 grams MAX

Physical dimensions conform to the applicable form factor specifications as listed in the figure below.

Figure 2: M.2 Type 2280 Form Factor

![Figure 2: M.2 Type 2280 Form Factor](image)

Note: 1. All dimensions are in millimeters.

Table 5: M.2 Type 2280 Form Factor Dimensions

<table>
<thead>
<tr>
<th>Capacity (GB)</th>
<th>Type</th>
<th>W</th>
<th>L</th>
<th>A</th>
<th>B</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>512</td>
<td>2280-S3-M</td>
<td>22.00</td>
<td>80.00</td>
<td>1.50</td>
<td>0.80</td>
<td>mm</td>
</tr>
<tr>
<td>1024</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2048</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: 1. Dimension values per PCI Express M.2 Electromechanical Specification, Revision 1.1.
Compliance

The SSDs comply with the following:

- Micron Green Standard
- CE (Europe): EN55032, EN55024 Class B, RoHS
- UKCA (UK): EN 55032, EN 55024, Class B, RoHS
- Built with sulfur-resistant resistors
- FCC: CFR Title 47, Part 15, Class B
- UL/cUL: approval to UL/IEC 60950 and UL/IEC 62368
- BSMI (Taiwan): approval to CNS 13438 Class B, CNS15663
- RCM (Australia, New Zealand): AS/NZS CISPR32 Class B
- KC RRL (Korea): approval to KN32 Class B, KN 35 Class B
- B 급 기기   이 기기는 가정용으로 전자파적합등록을 한 기기로서 주거 (가정용 정보통신기기) 지역에서는 물론 모든 지역에서 사용할 수 있습니다.
- W.E.E.E.: Compliance with EU WEEE directive 2012/19/EC. Additional obligations may apply to customers who place these products in the markets where WEEE is enforced.
- TUV (Germany): approval to IEC/EN 60950 and IEC/EN 62368
- VCCI (Japan): 2015-04 Class B
- IC (Canada): ICES-003 Class B
  - This Class B digital apparatus complies with Canadian ICES-003.
  - Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada.
- Morocco: EN55032, EN55024 Class B
- UkrSEPRO (Ukraine): EN55032 Class B, IEC60950/EN60950, RoHS (Resolution 2017 No. 139)
FCC Rules

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.
Revision History

Rev. A – 12/2023

• Initial release