U.2 Enterprise Grade SSD

ETD410T

Datasheet

Products

TS7T68ETD410T

TS3T84ETD410T

Product Description

U.2, PCIe Gen4x4, NVMe, 3D eTLC BiCS5, Enterprise.

Datasheet version

1.0

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Revision History

Revision No.	History	Released Date	Editor by
0.1	Draft version (WD BiCS5 eTLC)	2025/01/10	PM
0.2	Add 3840GB	2025/03/05	PM
1.0	First Version (SDK BiCS5 eTLC)	2025/10/15	PM

Transcend ETD410T Features

Part Name	Capacity
TS7T68ETD410T	7680GB
TS3T84ETD410T	3840GB

FEATURES

- PCI Express Gen4 x 4, NVMe 1.4
- Enterprise Grade
- 3D eTLC NAND Flash
- SFF-8639
- DDR4 DRAM cache
- Wear-leveling function
- Enhance Bad block management
- LDPC ECC (Error correction code) functionality
- NVM command support
- Advanced Garbage Collection
- Internal RAID Engine
- Supports S.M.A.R.T. Function
- Power Loss Protection
- End-to-End protection
- Self-encrypting drives(SED) with AES-256

PERFORMANCE[1)]

- Data Transfer Rate
  - Sequential Read 7400 MB/s
  - Sequential Write 5050 MB/s
  - Sustain Read 6400 MB/s
  - Sustain Write 4800 MB/s

RELIABILITY[1)]

- TBW
  - 7680GB 14016 TB
  - 3840GB 7008 TB

- UBER <1 sector per 10^{17} bits read
- DWPD 1
- MTBF 2,000,000 hours
- Warranty 5 years

ENVIRONMENTAL SPECIFICATIONS[1)]

- Temperature
  - Operating 0°C to 70°C
  - Non-operating -40°C to 85°C
- Humidity(Operation) 5%~95%
- Humidity(Storage) 5%~95%
- Shock 1500G, 0.5ms
- Vibration 3.13Grms, 5~800Hz

POWER REQUIREMENTS[1)]

- Supply voltage / Tolerance 12.0V±10%
- Active (max) 19 W
- Idle (max) 3 W

PHYSICAL DIMENSION

- Width 69.85.00±0.25mm
- Length(max) 100.45mm
- Height(max) 15+0/-0.5mm
- Weight Up to 195g

Note:
1) For detail information, please refer to document content.

Table of Content

1. Introduction

1.1 General Feature Information

Hardware Feature

- PCI Express Gen4 x 4, NVMe 1.4
- Controller IG5638
- 3D eTLC NAND Flash
- Temperature operation from 0°C to 70°C
- Connector follows SFF-8639 spec
- Embedded DDR4 DRAM cache
- TCG-Opal function
- Power Loss Protection

Firmware Feature

- Wear-leveling function
- Early Move function
- Read Retry function
- Enhance Bad block management function
- LDPC ECC(Error Correction Code) function
- NVM Command function
- Advanced Garbage Collection function
- Internal RAID Engine
- S.M.A.R.T. function
- AES-256
- End-to-End protection

Software Feature

- Transcend Scope Pro

1.2 Product List

Form Factor	Part Name	Capacity
2.5" U.2	TS7T68ETD410T	7680GB
	TS3T84ETD410T	3840GB

1.3 Ordering Information

T S X X X X E T D 4 1 0 T

1 2 3 4

1 – Transcend

2 – SSD Density

G: Gigabyte; T: Terabyte

3 – Enterprise Grade SSD

4 – 2.5” U.2 form factor with 3D eTLC NAND flash

PCIe Gen4x4

2. Product Specifications

2.1 Interface and Compliance

- Compatible with PCI Express specification Rev. 4.0
- Compatible with NVM Express specification Rev. 1.4
- NVM command support
- RoHS Compliance
- CE, UKCA, FCC and BSMI Compliance

2.2 Drive Capacity

[Table 1] User Capacity and Addressable Sectors

	3840GB	7680GB
User-Addressable Sectors	7,501,476,528	15,002,931,888
Byte per Sector	512 Byte	

2.3 System Performance

[Table 2] Sequential Read / Write Performance

Read / Write	3840GB	7680GB
Sequential Read (Max.)	7300 MB/s	7400 MB/s
Sequential Write (Max.)	2700 MB/s	5050 MB/s
Sustain Read	6400 MB/s	6400 MB/s
Sustain write	2500 MB/s	4800 MB/s

Note: Maximum transfer speed recorded

1) 25° C, test on Linux, FIO, iodepth=128, bs=128K.
2) The recorded performance is obtained while the SSD is not operated as an OS disk Physical Specification.
3) Test FIO test with new SSD.

[Table 3] Random Read / Write Performance

Read / Write	3840GB	7680GB
Random Read IOPS (4K Max)	1200K	1300K
Random Write IOPS (4K Max)	150K	200K

Note: Maximum transfer speed recorded

1) Random Read Performance, 25° C, test on Linux, FIO, iodepth=64, bs=4K
2) Random Write Performance, 25° C, test on Linux, FIO, iodepth=32, bs=4K
3) The recorded performance is obtained while the SSD is not operated as an OS disk Physical Specification.
4) Test FIO test with new SSD.

[Table 4] Latency

Read / Write	3840GB	7680GB
Random Read (4K)	72 us	72 us
Random Write (4K)	12 us	12 us

Note: Maximum transfer speed recorded

1) 25° C, test on Linux, FIO, iodepth=1, bs=4K
2) The recorded performance is obtained while the SSD is not operated as an OS disk Physical Specification.
3) Test FIO test with new SSD.

[Table 5] IOPS Consistency

Read / Write	3840GB	7680GB
Random Read (4K)	99%	
Random Write (4K)	99%	

Note: Maximum transfer speed recorded

1) 25° C, test on Linux, FIO, iodepth=32, bs=4K
2) The recorded performance is obtained while the SSD is not operated as an OS disk Physical Specification.
3) Test FIO test with new SSD.

[Table 6] Quality of Service (QoS)

Read / Write	3840GB	7680GB
Quality of Service (99%)		
Random Read (4K, QD1)	83 us	83 us
Random Write (4K, QD1)	13 us	13 us
Quality of Service (99.99%)		
Random Read (4K, QD1)	114 us	114 us
Random Write (4K, QD1)	17 us	17 us

Note: Maximum transfer speed recorded

1) 25° C, test on Linux, FIO, iodepth=1, bs=4K
2) The recorded performance is obtained while the SSD is not operated as an OS disk Physical Specification.
3) Test FIO test with new SSD.

2.4 Supply Voltage

[Table 7] Supply Voltage

Item	Requirements
Allowable voltage	12.0V±10%

2.5 System Power Consumption

[Table 8] Power Consumption

Read / Write	3840GB	7680GB
Active Write (Max.)[1)]	13 W	19 W
Active Read (Max.)[1)]	13 W	19 W
Idle	3 W	3 W

Note:

1) The power consumption is measured under SSD operation at maximum performance. The value is affected by system operation performance and workload.

2.6 Environment Specifications

Table 9] Environment Specification

Features	Operating[1)]	Non-Operating[2)]
Temperature	0°C to 70°C	-40°C to 85°C
Humidity (Operation)	5% to 95%	
Humidity (Storage)	5% to 95%	
Shock (Non-operation)	1500G, 0.5ms half-sine	
Vibration (Non-operation)	3.13G, 5~800Hz	

Note:

1) The operating specification is regarded as Ambient Temperature. Standard grade (0°C to +70°C) and Industrial grade (-40°C to +85°C) indicate the temperature conditions for testing devices on programmable temperature and humidity chamber room.

2) The non-operating specification is regarded as storage specification.

2.7 System Reliability

[Table 10] MTBF Specifications

Parameter	3840GB	7680GB
MTBF	2,000,000 hours	

[Table 11] UBER Specifications

Parameter	3840GB	7680GB
UBER	< 1 sector per 10^{17} bits read	

Note:

1) UBER (Uncorrectable Bit Error Rates) means the uncorrectable error per bits read.

[Table 12] TBW (Terabytes Written) Specifications

Parameter	3840GB	7680GB
TBW	7,008 TB	14,016 TB

Note:

1) TBW specification follows JESD219A Enterprise workload.

[Table 13] Drive Write Per Day (DWPD) Specifications

Parameter	3840GB	7680GB
DWPD[1)]	1	

Note:

1) DWPD is based on [Table 12] Warranty year to calculate.
DWPD = TBW/ (365 x 5years x User capacity)

[Table 14] Data Retention Specifications

Parameter	3840GB	7680GB
Data Retention	3 months	

Note:

1) Data retention was measured by assuming that SSD reaches the maximum rated endurance at 40°C under power-off state.
2) The data retention is defined in JESD218 Requirements for standard classes of SSDs.

[Table 15] Warranty

Parameter	3840GB	7680GB
Warranty	5 years limited	

[Table 16] Regulations

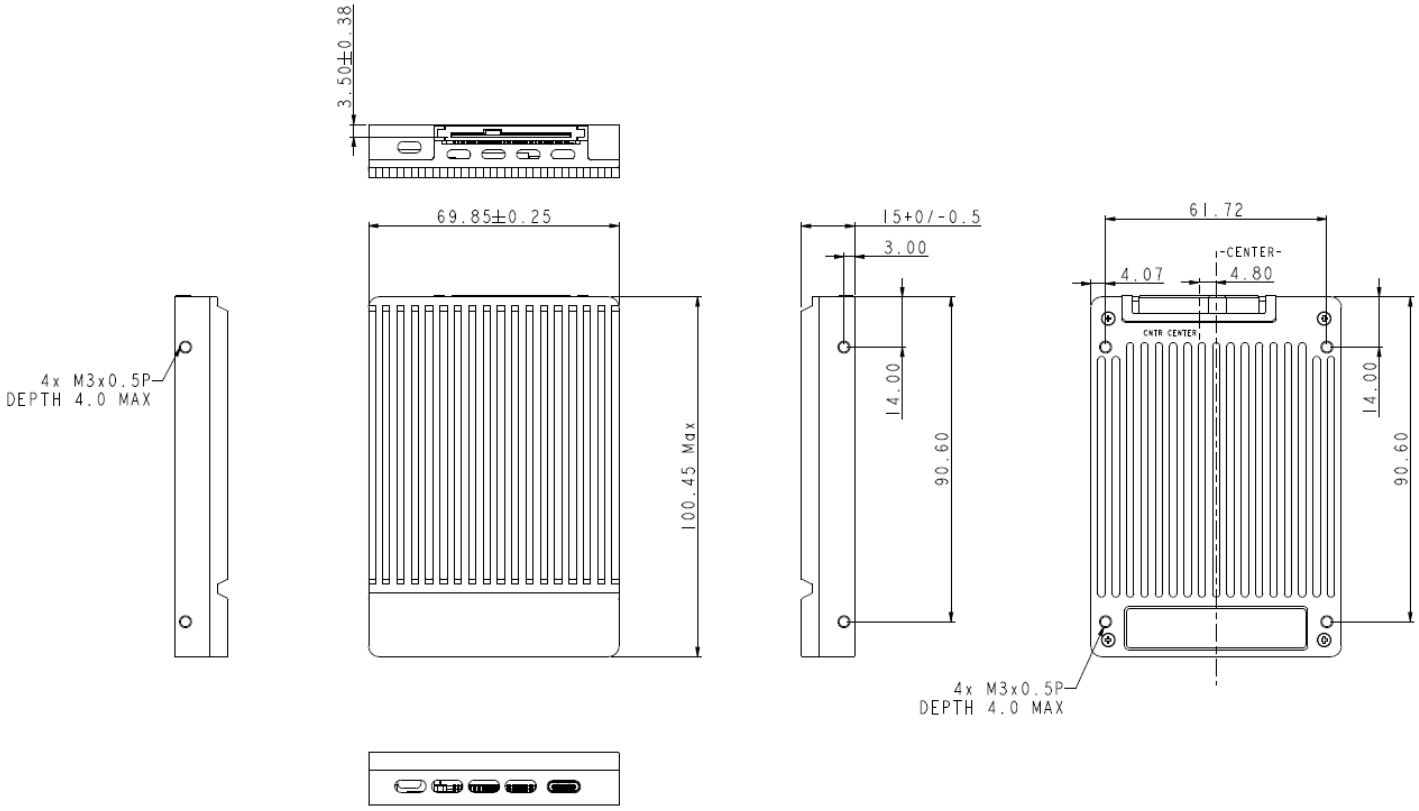
Parameter	3840GB	7680GB
Compliance	CE, UKCA, FCC and BSMI	

3. Mechanical Specification

The figure below illustrates the Transcend U.2 Solid State Drive.

[Table 17] Physical Dimensions and Weight

Model	Height (mm)	Width (mm)	Length (mm)	Weight (gram)
3840GB/7680GB	15+0/-0.5	69.85±0.25	Max 100.45	Max 195g



4. Pin Assignments

4.1 Pin Assignments

[Table 18] Pin Assignments

Pin No.	Pin Name	Pin No.	Pin Name	Pin No.	Pin Name
S1	GND	P11	ACTIVITY#	S16	GND
S2	NU	P12	GND	S17	P1RXp
S3	NU	P13	+12V	S18	P1RXn
S4	GND	P14	+12V	S19	GND
S5	NU	P15	+12V	S20	P1TXn
S6	NU	E7	REFCLKp	S21	P1TXp
S7	GND	E8	REFCLKn	S22	GND
E1	NU	E9	GND	S23	P2RXp
E2	NU	E10	P0RXp	S24	P2RXn
E3	NU	E11	P0RXn	S25	GND
E4	CLKREQ#	E12	GND	S26	P2TXn
E5	PERST#	E13	P0TXn	S27	P2TXp
E6	NU	E14	P0TXp	S28	GND
P1	NU	E15	GND	E17	P3RXp
P2	NU	E16	NU	E18	P3RXn
P3	NU	S8	GND	E19	GND
P4	IfDet#	S9	NU	E20	P3TXn
P5	GND	S10	NU	E21	P3TXp
P6	GND	S11	GND	E22	GND
P7	NU	S12	NU	E23	S_CLK
P8	NU	S13	NU	E24	S_DATA
P9	NU	S14	GND	E25	NU
P10	NU	S15	NU		

5. Function Explanations

5.1.1 Wear Leveling Function

Wear leveling ensures that every block has an even erase count. This helps to extend the life expectancy of an SSD.

There are three main processes in wear leveling:

(1) Record the block erase count and save this in the wear-leveling table.

(2) Find the static-block and save this in the wear-leveling pointer.

(3) Check the erase count when a block is pulled from the pool of spare blocks. If the block erase count is larger than WEARCNT, then swap the static-block and the over-count-block.

5.1.2 Bad Block Management Function

When the flash encounters ECC fail, program fail or erase fail, the controller will mark the block as a bad block. This will prevent the usage of bad blocks which may result in data loss in the future.

5.1.3 Enhanced S.M.A.R.T. function

Transcend SSD supports S.M.A.R.T. command (Self-Monitoring, Analysis, and Reporting Technology) that allows users to read the health information of the SSD. Transcend also define some innovated S.M.A.R.T. features which allows the user to evaluate the status of the SSD in a much more efficient way.

5.1.4 AES-256 Function

Defined by the National Institute of Standards and Technology (NIST) under the Federal Information Processing Standards Publication 197 (FIPS PUB 197), the Advanced Encryption Standard (AES) specifies a FIPS-approved cryptographic algorithm that can be used to protect electronic data.

Transcend Information's SSDs, equipped with hardware-based AES-256 encryption, offer superior data protection and performance compared to competing offerings that utilize software-based or firmware-based encryption. With hardware-based encryption, all data are encrypted before being stored in NAND Flash. After the encrypted data has been written into the flash, it becomes virtually impossible to decrypt the data without the original key. Performance is also improved as compared to software-based solutions, since hardware-based encryption does not require system resources to perform the encryption/decryption process.

5.1.5 TCG-Opal Function

Opal is a comprehensive set of guidelines. The target audience includes manufacturers of storage devices, software vendors, system integrators, and academia. These specifications cover the manufacture of storage devices, system setup, management, and use; they allow for password protection and hierarchical storage management, while preventing data from being stolen or tampered with.

They are self-encrypting devices: Data encryption is performed on the device, without need to pass through the host. The encryption key is also stored on the device (commonly AES is utilized).

(1) Features boot authentication:

When the user starts the device, the shadow MBR will conduct a pre-boot identification; where the user is cleared, the normal boot process will begin and connections to the devices are to be made.

(2) Sector specific permissions:
The device manager may create a logical block address (LBA) range and assign different permissions for each LBA range. Only users with the correct key for a particular LBA range may perform permitted actions. Where drive locations are password-protected, only users with the correct key will be authorized entry.

5.1.6 RAID engine

RAID engine technology stores data parity information in a specific area. The parity information can restore damaged data back which can enhance data reliability.

5.1.7 Transcend Scope Pro

Transcend's Scope Pro is a convenient software package that helps users monitor and manage SSD status via an intuitive interface. It offers various useful features, including drive information and S.M.A.R.T. status monitoring, diagnostic scan, secure erase, health indication, system clone, and monitoring. For more information, please refer the website link. **https://us.transcend-info.com/Embedded/Essay-20**

5.1.8 Early Move Function

Early move detects and corrects potential data errors. If error bits in a block reach upper limit, then the data should be moved to another block and the original block should be erased.

5.1.9 Read Retry Function

Read retry is designed for flash memory to adjust the read reference voltage and eliminate the read error.

5.1.10 Power Loss Protection

From Hardware opinion, Power Loss Protection extend the period of normal operation when the drive encounters power-off suddenly. From Software opinion, Power Loss Protection can protect the data in cache buffer and the data during programming to flash.

5.1.11 Other Functions

Transcend SSD embedded a lot of cutting-edge technology. Should you have any technical request, please contact the local support team or send us an e-mail.

6 Technology Term Explanations

6.1 TBW

Terabytes Written (TBW) directly measures how much you can write cumulatively into the drive over its lifetime. Essentially, it just includes the multiplication conducted above in the measurement itself.
For example, if your drive is rated for 365 TBW, that means you can write 365 TB into it before a replacement is required.
If its warranty period is 5 years, that works out to 365 TB ÷ (5 years × 365 days/year) = 200 GB of writes per day. If your drive was 200 GB in size, that's equivalent to 1 DWPD. Correspondingly, if your drive was rated for 3.65 PBW = 3,650 TBW, that works out to 2 TB of writes per day, or 10 DWPD.
As you can see, if you know the drive's size and warranty period, you can always calculate TBW from DWPD and vice-versa with simple multiplications or divisions. The two measurements are very similar.

6.2 DWPD

Drive Writes Per Day (DWPD) measures how many times you could overwrite the drive's entire size each day of its life. For example, suppose your drive is 200 GB and its warranty period is 5 years. If its DWPD is 1, that means you can write 200 GB (its size, one time) into it every single day for the next five years.
If you multiply that out, that's 200 GB per day × 365 days/year × 5 years = 365 TB of cumulative writes before you may need to replace it.
If the DWPD is 10 instead of 1, that means you can write 10 × 200 GB = 2 TB (its size, ten times) into it every day. Correspondingly, that's 3,650 TB = 3.65 PB of cumulative writes over 5 years.

7 Installation Requirements

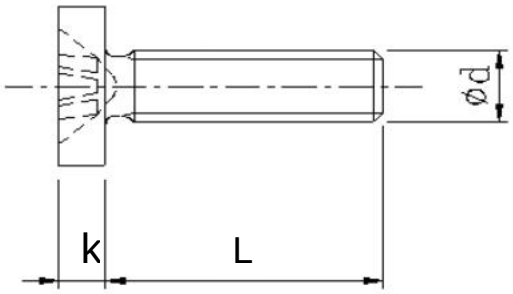
7.1 SSD Installation

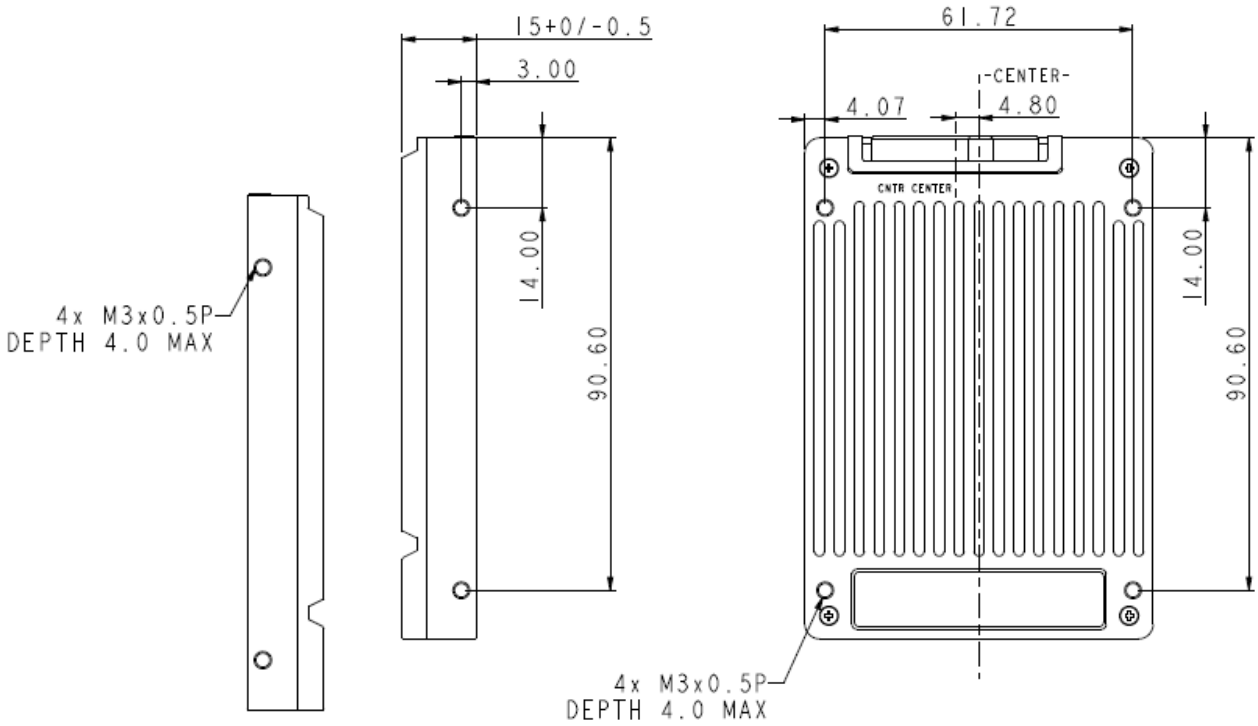
Regarding the system assembling, for U.2 cable connection, the cable should not longer than 1 meter and well-connected is necessary to avoid signal transmission error.

2.5" SSD Screw Selection Suggestion: (Reference Only)

- M3 screw pitch: 0.5 mm
- M3 screw length(L): Max 4 mm
- Screw Tightening Torques: 2.0 ~ 4.5 kgf-cm

k	1.4 - 1.6 mm
L	1.5 - 5.0 mm
Ød	2.88 - 2.98 mm





Unit: mm

8 Command Descriptions

8.1 Support Admin Command Register

The Admin command set is the commands that are submitted to the Admin Submission Queues. The detailed specifications are described in NVM Express specification document.
[Table 20] Command Table

Command Name	Code (Hex)
Delete I/O Submission Queue	00h
Create I/O Submission Queue	01h
Get Log Page	02h
Delete I/O Completion Queue	04h
Create I/O Completion Queue	05h
Identify	06h
Abort	08h
Set Features	09h
Get Features	0Ah
Asynchronous Event Request	0Ch
Namespace Management	0Dh
Firmware Commit	10h
Firmware Image Download	11h
Namespace Attachment	15h
Keep Alive	18h
I/O Command Set Specific	80h – BFh
Vendor Specific	C0h – FFh

8.2 SMART / Health Log Page

[Table 21] SMART Data information

<table>
<tr><th>BYTE</th><th>Description</th><th>Default Value</th></tr>
<tr><td>0</td><td>Critical Warning
<table>
<tr><th>Bits</th><th>Description</th></tr>
<tr><td>07:05</td><td>Reserved</td></tr>
<tr><td>04</td><td>If set to‘1’, then the volatile memory backup device has failed. This field is only valid if the controller has a volatile memory backup solution.</td></tr>
<tr><td>03</td><td>If set to‘1’, then the media has been placed in read only mode.</td></tr>
<tr><td>02</td><td>If set to‘1’, then the NVM subsystem reliability has been degraded due to significant media related errors or any internal error that degrades NVM subsystem reliability.</td></tr>
<tr><td>01</td><td>If set to‘1’, then a temperature is above an over temperature threshold or below an under temperature threshold.</td></tr>
<tr><td>00</td><td>If set to‘1’, then the available spare has fallen below the threshold.</td></tr>
</table></td><td>0</td></tr>
<tr><td>2:1</td><td>Composite Temperature</td><td>Current temperature</td></tr>
<tr><td>3</td><td>Available Spare</td><td>100</td></tr>
<tr><td>4</td><td>Available Spare Threshold</td><td>10</td></tr>
<tr><td>5</td><td>Percentage Used</td><td>0</td></tr>
<tr><td>31:6</td><td>Reserved</td><td>-</td></tr>
<tr><td>47:32</td><td>Data Units Read</td><td>0</td></tr>
<tr><td>63:48</td><td>Data Units Written</td><td>0</td></tr>
<tr><td>79:64</td><td>Host Read Commands</td><td>0</td></tr>
<tr><td>95:80</td><td>Host Write Commands</td><td>0</td></tr>
<tr><td>111:96</td><td>Controller Busy Time</td><td>0</td></tr>
<tr><td>127:112</td><td>Power Cycles</td><td>0</td></tr>
<tr><td>143:128</td><td>Power On Hours</td><td>0</td></tr>
<tr><td>159:144</td><td>Unsafe Shutdowns</td><td>0</td></tr>
<tr><td>175:160</td><td>Media and Data Integrity Errors</td><td>0</td></tr>
<tr><td>191:176</td><td>Number of Error Information Log Entries</td><td>0</td></tr>
<tr><td>195:192</td><td>Warning Composite Temperature Time</td><td>0</td></tr>
<tr><td>199:196</td><td>Critical Composite Temperature Time</td><td>0</td></tr>
</table>

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