innodisk

Total Solution For Industrial Flash Storage

2.5" SATA SSD

3TEA with Innodisk NAND

Customer: _____

Customer Part Number: _____

Innodisk Part Number: _____

Innodisk Model Name: _____

Date: _____

Innodisk Approver	Customer Approver

Features:

- SATA III
- Innodisk 3D TLC NAND
- 2.5” SATA SSD
- Standard temperature
- Hybrid Write

Power Requirements:

Input Voltage:	5V±5%
Max Operating Wattage:	1.5W
Idle Wattage:	0.6W

Performance:

- Sequential Read up to 550 MB/s
- Sequential Write up to 470 MB/s

Reliability:

Capacity	TBW	DWPD
128GB	129	1.52
256GB	258	1.52
512GB	516	1.52

Data Retention	10 Years
Warranty	3 Years

1 year data retention is at NAND life end.

For warranty details, please refer to:

https://www.innodisk.com/en/support_and_service/warranty

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REVISION HISTORY

Revision	Description	Date
V1.0	Official Release	Sep., 2022
V1.1	Adjust PART NUMBER RULE	Nov., 2022
V1.2	Correct DWPD Update 256GB & Add 512GB Information	Dec., 2022
V1.3	Correct Power requirement on P.2	Feb., 2023
V1.4	Update TBW & DWPD	May, 2023
V1.5	Update Warranty Policy	Jan., 2025

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1. Product Overview

1.1 Introduction of Innodisk 2.5” SATA SSD 3TEA

Innodisk 2.5” SATA SSD 3TEA is SATA III 6.0 Gb/s disk with 3D NAND Flash, incorporate advanced controllers with powerful LDPC technology that extended lifespan through reducing the bad block number happening.

In 3TEA series, Innodisk keep with outstanding high IOPS and NAND Flash management features like wear-levelling, garbage collection, ATA Security, etc. More important, we keep our attentive service & controlled product supply promise to value customer need in the market.

CAUTION TRIM must be enabled.

TRIM enables SSD’s controller to skip invalid data instead of moving. It can free up significant amount of resources, extends the lifespan of SSD by reducing erase, and write cycles on the SSD. Innodisk’s handling of garbage collection along with TRIM command improves write performance on SSDs.

1.2 Product View and Models

Innodisk 2.5” SATA SSD 3TEA is available in follow capacities within TLC flash ICs.

2.5” SATA SSD 3TEA 128GB

2.5” SATA SSD 3TEA 256GB

2.5” SATA SSD 3TEA 512GB

1.3 SATA Interface

Innodisk2.5” SATA SSD 3TEA supports SATA III interface. SATA III interface can work with Serial Attached SCSI (SAS) host system, which is used in server computer.

1.4 2.5-inch Form Factor

The Industry-standard 2.5-inch form factor design with metal material case is easy for installation, which has a compact design 69.85mm (W) x 100.00mm (L) x 7.00mm (H)

2. Product Specifications

2.1 Capacity and Device Parameters

2.5” SATA SSD 3TEA device parameters are shown in Table 1.

Table 1 : Device parameters

Capacity	LBA	Cylinders	Heads	Sectors	User Capacity (MB)
128GB	250069680	16383	16	63	122104
256GB	500118192	16383	16	63	244198
512GB	1000215216	16383	16	63	488386

2.2 Performance

Burst Transfer Rate: 6.0Gbps

Table 2 : Performance - 112 Layers 3D TLC

Capacity	Unit	128GB	256GB	512GB
Sequential[2] Read (Q32T1)	MB/s	550	535	550
Sequential[2] Write (Q32T1)		460	450	470
Sustained[3] Sequential Read (Avg.)		360	360	380
Sustained[3] Sequential Write (Avg.)		155	120	160
4KB Random[2] Read (Q32T1)	IOPS	40,000	38,000	68,000
4KB Random[2] Write (Q32T1)		75,000	73,000	75,000

Note:

1. Performance may vary based on various firmware version or test platform.
2. Performance results are based on CrystalDiskMark 6.0.2 with file size 1000MB of Queue Depth32.
3. Performance results are based on AIDA 64 v5.98 with block size 1MB of Linear Read & Write Test Item

2.3 Electrical Specifications

2.3.1 Power Requirement

Table 3 : Innodisk 2.5” SATA SSD 3TEA Power Requirement

Item	Symbol	Rating	Unit
Input voltage	V_{IN}	+5 DC +- 5%	V

2.3.2 Power Consumption

Table 4 : Typical Power Consumption

Mode	Power Consumption (W)
Read (RMS)[1]	1.5
Write (RMS)[1]	1.5
Idle	0.6
Boot Up	3.3

2.4 Environmental Specifications

2.4.1 Temperature Ranges

Table 5 : Temperature range for 2.5” SATA SSD 3TEA with Innodisk NAND

Temperature	Range
Operating	Standard Grade: 0°C to +70°C
Storage	-40°C to +85°C

2.4.2 Humidity

Relative Humidity: 10-95%, non-condensing

2.4.3 Shock and Vibration

Table 6 : Shock/Vibration Testing for 2.5” SATA SSD 3TEA

Reliability	Test Conditions	Reference Standards
Vibration	7 Hz to 2K Hz, 20G, 3 axes	IEC 60068-2-6
Mechanical Shock	Duration: 0.5ms, 1500 G, 3 axes	IEC 60068-2-27

2.4.4 Mean Time between Failures (MTBF)

Table 7 summarizes the MTBF prediction results for various 2.5” SATA SSD 3TEA configurations. The analysis was performed using a RAM Commander™ failure rate prediction.

- **Failure Rate**: The total number of failures within an item population, divided by the total number of life units expended by that population, during a particular measurement interval under stated condition.

- **Mean Time between Failures (MTBF)**: A basic measure of reliability for repairable items: The mean number of life units during which all parts of the item perform within their specified limits, during a particular measurement interval under stated condition

Table 7 : 2.5” SATA SSD 3TEA MTBF

Product	Condition	MTBF (Hours)
Innodisk 2.5” SATA SSD 3TEA	Telcordia SR-332 GB, 25°C	>3,000,000

2.5 CE and FCC Compatibility

2.5” SATA SSD 3TEA conforms to CE and FCC requirements.

2.6 RoHS Compliance

2.5” SATA SSD 3TEA is fully compliant with RoHS directive.

2.7 Reliability

Table 8 : Innodisk 2.5” SATA SSD 3TEA Reliability

Parameter	Value
Flash endurance	3,000 P/E cycles
Error Correct Code	Support
Data Retention	Under 40℃: 1 Year at NAND Life End

TBW* (Total Bytes Written) Units: TB

Capacity	Sequential workload	Client workload
128GB	341	129
256GB	682	258
512GB	1364	516

* Note:
1. Sequential: Mainly sequential write, tested by Vdbench.
2. Client: Follow JESD218 Test method and JESD219A Workload, tested by ULINK.
3. Based on out-of-box performance.

2.8 Transfer Mode

2.5” SATA SSD 3TEA support following transfer mode:

Serial ATA III 6.0Gbps

Serial ATA II 3.0Gbps

Serial ATA I 1.5Gbps

2.9 Pin Assignment

Innodisk 2.5” SATA SSD 3TEA uses a standard SATA pin-out.

See Table 9 for 2.5” SATA SSD 3TEA pin assignment.

Table 9 : Innodisk 2.5” SATA SSD 3TEA Pin Assignment

Name	Type	Description
S1	GND	NA
S2	A+	Differential Signal Pair A
S3	A-	
S4	GND	NA
S5	B-	Differential Signal Pair B
S6	B+	
S7	GND	NA
Key and Spacing separate signal and power segments		
P1	NC	NA
P2	NC	NA
P3	NC	NA
P4	GND	NA
P5	GND	NA
P6	GND	NA
P7	V5	5V Power, Pre-Charge
P8	V5	5V Power
P9	V5	5V Power
P10	GND	NA
P11	DAS/DSS	Device Activity Signal / Disable Staggered
P12	GND	NA
P13	NC	NA
P14	NC	NA
P15	NC	NA

2.10 Mechanical Dimensions

* DES25-XXXDZ1KC3XL (128GB~256GB)

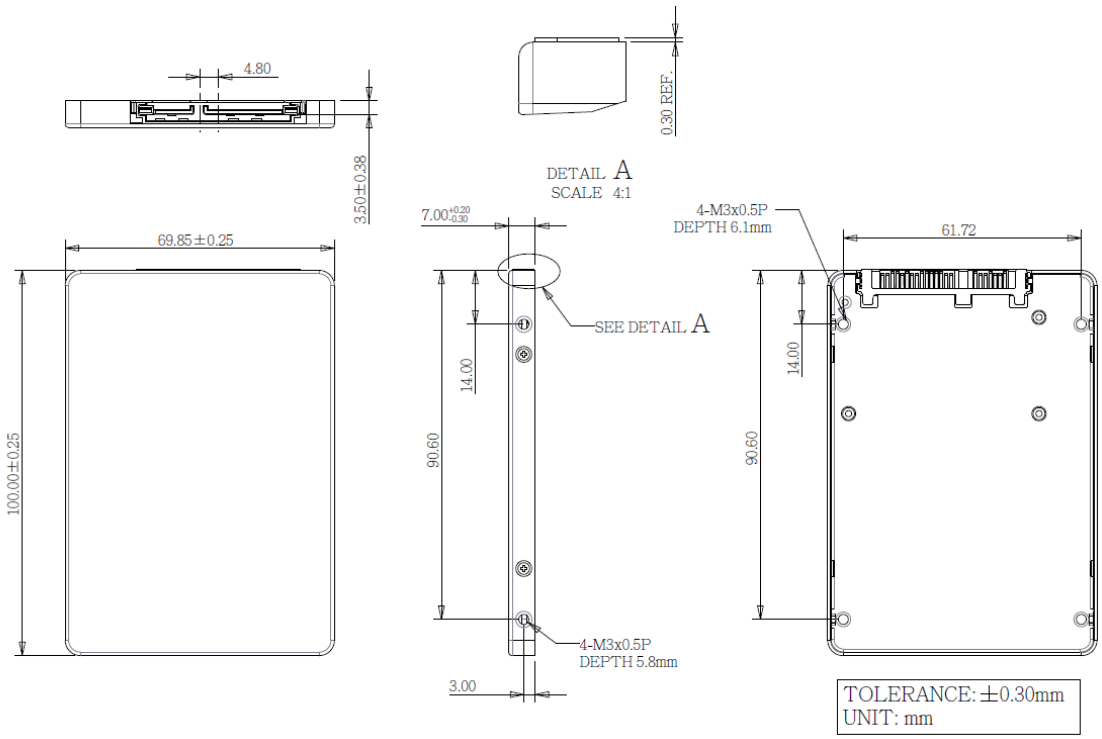

Figure 1 : Innodisk 2.5” SATA SSD Mechanical 2D diagram

2.11 Assembly Weight

An Innodisk 2.5” SATA SSD 3TEA within flash ICs, 128GB’s weight is 10 grams approximately.

2.12 Seek Time

Innodisk2.5” SATA SSD 3TEA is not a magnetic rotating design. There is no seek or rotational latency required.

2.13 NAND Flash Memory

Innodisk 2.5” SATA SSD 3TEA uses 3D TLC NAND flash memory, with 3,000 program & erase cycles, which is non-volatility, high reliability and high speed memory storage

3. Theory of Operation

3.1 Overview

Figure 2 shows the operation of Innodisk 2.5” SATA SSD 3TEA from the system level, including the major hardware blocks.

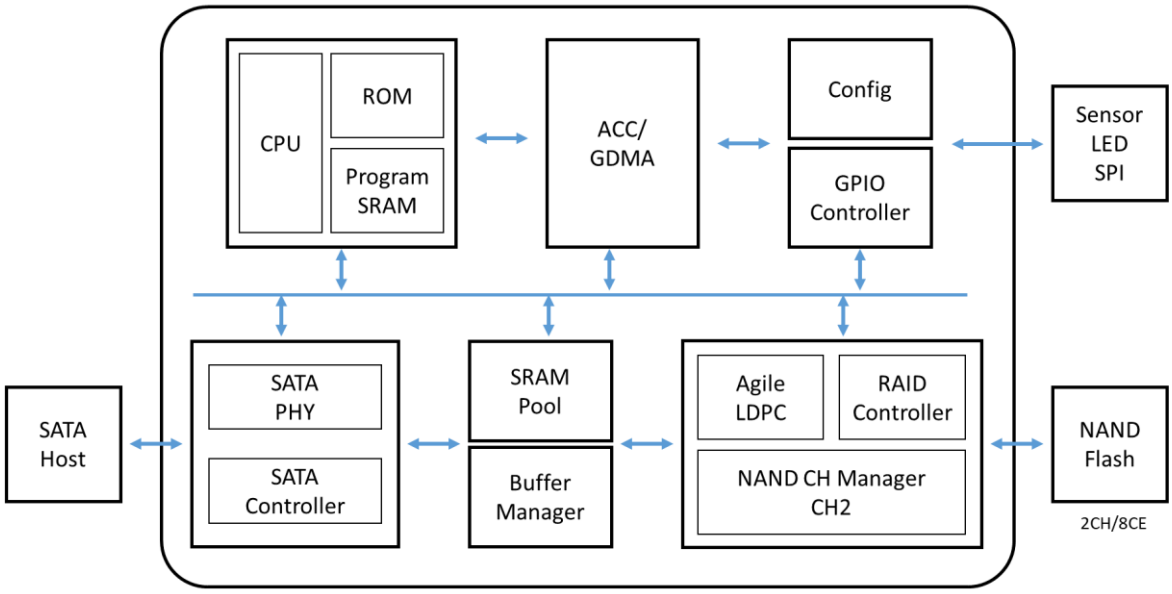

Figure 2 : Innodisk 2.5” SATA SSD 3TEA Block Diagram

Innodisk 2.5” SATA SSD 3TEA integrates a SATA III controller and NAND flash memories. Communication with the host occurs through the host interface, using the standard ATA protocol. Communication with the flash device(s) occurs through the flash interface.

3.2 SATA III Controller

Innodisk 2.5” SATA SSD 3TEA is designed with a SATA III 6.0Gbps (Gen. 3) controller. The Serial ATA physical, link and transport layers are compliant with Serial ATA Gen 1, Gen 2 and Gen 3 specification (Gen 3 supports 1.5Gbps/3.0Gbps/6.0Gbps data rate). The controller has 4 channels for flash interface.

3.3 Error Detection and Correction

Innodisk 2.5” SATA SSD 3TEA is designed with hardware LDPC ECC engine with hard-decision and Soft-decision decoding. Low-density parity-check (LDPC) codes have excellent error correcting Performance close to the Shannon limit when decoded with the belief-propagation (BP) algorithm using soft-decision information.

3.4 Wear-Leveling

Flash memory can be erased within a limited number of times. This number is called the ***erase cycle limit*** or ***write endurance limit*** and is defined by the flash array vendor. The erase cycle limit applies to each individual erase block in the flash device.

Innodisk 2.5” SATA SSD 3TEA uses a combination of two types of wear leveling- dynamic and static wear leveling- to distribute write cycling across an SSD and balance erase count of each block, thereby extending device lifetime.

3.5 Bad Blocks Management

Bad Blocks are blocks that contain one or more invalid bits whose reliability are not guaranteed. The Bad Blocks may be presented while the SSD is shipped, or may develop during the life time of the SSD. When the Bad Blocks is detected, it will be flagged, and not be used anymore. The SSD implement Bad Blocks management, Bad Blocks replacement, Error Correct Code to avoid data error occurred. The functions will be enabled automatically to transfer data from Bad Blocks to spare blocks, and correct error bit.

3.6 Garbage Collection

Garbage collection is used to maintain data consistency and perform continual data cleansing on SSDs. It runs as a background process, freeing up valuable controller resources while sorting good data into available blocks, and deleting bad blocks. It also significantly reduces write operations to the drive, thereby increasing the SSD’s speed and lifespan.

3.7 Trim

The Trim command is designed to enable the operating system to notify the SSD which pages no longer contain valid data due to erases either by the user or operating system itself. During a delete operation, the OS will mark the sectors as free for new data and send a Trim command to the SSD to mark them as not containing valid data. After that the SSD knows not to preserve the contents of the block when writing a page, resulting in less write amplification with fewer writes to the flash, higher write speed, and increased drive life.

4. Installation Requirements

4.1 2.5” SATA SSD 3TEA Pin Directions

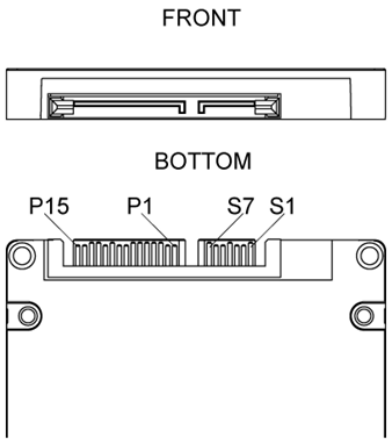

Figure 3 : Signal Segment and Power Segment

4.2 Electrical Connections for 2.5” SATA SSD 3TEA

A Serial ATA device may be either directly connected to a host or connected to a host through an adaptor card. The SATA interface has a separate connector for the power supply. Please refer to the pin description for further details.

4.3 Form Factor

Please prepare following things:

- Screw driver.
- Four M3 screws. (Torque value 2.0 kgf-cm ~ 2.5 kgf-cm)
- SATA single cable (7-pin, Maximum length l meter).
- SATA power cable (15-pin).

Please turn off your computer, and open your computer’s case. Find one of available 2.5-inch slot, and plug the SSD in. To use the screws fix the SSD. Plug in the SATA single cable, and power cable.

Please boot the installation Operation System from CD-ROM, and install Operation System into SSD.

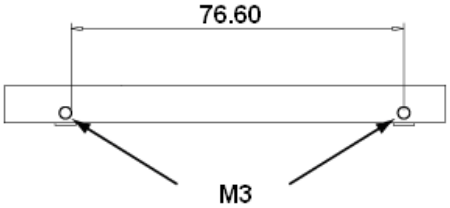

Figure 4 : 2.5” SATA SSD 3TEA Mechanical Screw Hole

4.4 Device Drive

No additional device drives are required. Innodisk 2.5” SATA SSD 3TEA can be configured as a boot device.

5. SMART Feature Set

5.1 SMART Attributes

Innodisk 3TEA series SMART data attributes are listed in following table.

Table 10 : SMART attribute

ID	Attribute Name
05h	Reallocated Sector Count
09h	Power-On Hours
0Ch	Drive Power Cycle Count
A7h	SSD Protect Mode
A8h	PHY Error Count
A9h	Bad Block Count
ABh	Program Fail Count
ACh	Erase Fail Count
ADh	Erase Count
AEh	Remap Count
AFh	Bad Cluster Table Count
B1h	Read Retry Count
B4h	Spare Block Count Left
BBh	Reported UNC Errors
C0h	Unexpected Power Loss Count
C2h	Temperature
C4h	Reallocated Event Count
C7h	UDMA CRC Error Count
CEh	Minimum Erase Count
CFh	Maximum Erase Count
D0h	Average Erase Count
D1h	Minimum Erase Count of SLC block
D2h	Maximum Erase Count of SLC block
D3h	Average Erase Count of SLC block
E7h	SSD Life Left
F1h	Write Sector Count
F2h	Read Sector Count
F5h	Bit Error Count

6. Part Number Rule

CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
	D	**E**	**S**	**2**	**5**	**-**	**A**	**2**	**8**	**D**	**Z**	**1**	**K**	**C**	**C**	**D**	**L**	**-**	**X**	**X**	**X**

Definition	
Code 1st (Disk)	**Code 13th (Flash Mode)**
D : Disk	K: 112 layers 3D TLC
Code 2nd (Feature set)	
E : Embedded series	
Code 3rd ~5th (Form factor)	**Code 14th (Operation Temperature)**
S25: 2.5” SATA SSD	C: Standard Grade (0℃~ +70℃)
Code 7th ~9th (Capacity)	**Code 15th (Internal control)**
A28: 128GB	C: Slim PCBA version
B56: 256GB	
C12: 512GB	**Code 16th (Channel of data transfer)**
	S: Single Channel
	D: Dual Channels
Code 10th ~12th (Controller)	**Code 17th (Flash Type)**
DZ1: SATA 3TEA	L: Innodisk 3D TLC
	Code 19th~21th (Customized Code)