

M.2 (S42)

3TEA Series

218 layer NAND

Customer:

Customer

Part Number:

Innodisk

Part Number:

Innodisk

Model Name:

Date:

Innodisk Approver	Customer Approver

Features:

- SATA III
- Kioxia BiCS8 3D TLC NAND
- M.2 2242-D3-B+M
- Standard temperature
- iPower Guard
- iData Guard
- SLC Cache Enable

Performance:

- Sequential Read up to 560 MB/s
- Sequential Write up to 500 MB/s

Power Requirements:

Input Voltage:	3.3V±5%
Max Operating Wattage (R/W):	1W
Idle Wattage:	0.6W

Reliability:

Capacity	TBW	DWPD
256GB	270	1
512GB	633	1.2
1TB	1065	1
2TB	3046	1.4

Data Retention	1 Year
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	First Release	Aug., 2026

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1. Product Overview

1.1 Introduction of Innodisk M.2 (S42) 3TEA

Innodisk M.2 (S42) 3TEA is a SATA III 6.0 Gb/s SSD featuring cutting-edge 218-layer industrial 3D TLC NAND flash. Integrated with an advanced controller and powerful LDPC (Low-Density Parity-Check) technology, it significantly extends drive lifespan by minimizing the occurrence of bad blocks.

The 3TEA series delivers exceptional IOPS and incorporates comprehensive NAND flash management features, including wear-leveling, garbage collection, and ATA Security. Furthermore, Innodisk backs this series with our commitment to attentive customer service and a controlled, long-term product supply to meet the rigorous demands of the industrial market.

1.2 Product View and Models

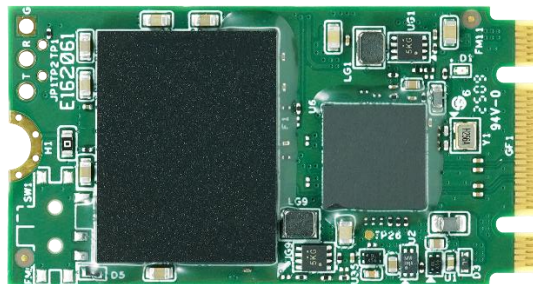
Innodisk M.2 (S42) 3TEA is available in follow capacities within 3D TLC flash ICs.

[M.2 \(S42\) 3TEA 256GB](#)

[M.2 \(S42\) 3TEA 512GB](#)

[M.2 \(S42\) 3TEA 1TB](#)

[M.2 \(S42\) 3TEA 2TB](#)



1.3 SATA Interface

Innodisk M.2 (S42) 3TEA supports SATA III interface. SATA III interface can work with Serial Attached SCSI (SAS) host system, which is used in server computer.

2. Product Specifications

2.1 Capacity and Device Parameters

M.2 (S42) 3TEA device parameters are shown in Table 1.

Table 1 : Device parameters

Capacity	LBA	User Capacity (MB)
256GB	468862128	228937
512GB	937703088	457863
1TB	1875385008	915715
2TB	3750748848	1831420

2.2 Performance

Burst Transfer Rate: 6.0Gbps

Table 2 : Performance- 218 Layers 3D TLC

Capacity	Unit	256GB	512GB	1TB	2TB
Sequential* Read (Q32T1)	MB/s	550	550	560	560
Sequential* Write (Q32T1)		480	500	500	500
Sustained Sequential Read (Avg.)***		410	390	400	400
Sustained ³ Sequential Write (Avg.)***		220	270	260	210
4KB Random** Read (Q32T1)	IOPS	52,000	86,000	93,000	92,000
4KB Random** Write (Q32T1)		65,000	64,000	65,000	60,000

Note: * Performance results are 3TEA with Kioxia BiCS8 NAND composition measured in Room Temperature with Out-of-Box devices and may vary depending on overall system setup. In addition, 3TEA series adopts a hybrid mode, which enables SLC cache followed by TLC direct write to strike a balance between burst performance and steady overall stability.

Note: ** Performance results are based on CrystalDiskMark 8.0.1 with file size 1000MB. Unit of 4KB item is IOPS.

Note: *** Performance results are based on AIDA 64 v7.3.0 with block size 1MB of Linear Read & Write Test Item.

2.3 Electrical Specifications

2.3.1 Power Requirement

Table 3 : Innodisk M.2 (S42) 3TEA Power Requirement

Item	Symbol	Rating	Unit
Input voltage	V _{IN}	+3.3 DC +- 5%	V

2.3.2 Power Consumption

Table 4 : Typical Power Consumption

Mode	Power Consumption (W)
Read	0.9
Write	1
Idle	0.6
Boot Up	2.2

Model: M.2 (S42) 3TEA ST Series

Note: Current results may vary depending on system components and power circuit design. Please refer to the test report for other capacities.

2.4 Environmental Specifications

2.4.1 Temperature Ranges

Table 5 : Temperature range for M.2 (S42) 3TEA

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 M.2 (S42) 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 M.2 (S42) 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 conditions.

Table 7 : M.2 (S42) 3TEA MTBF

Product	Condition	MTBF (Hours)
Innodisk M.2 (S42) 3TEA	Telcordia SR-332 GB, 25°C	>3,000,000

2.5 CE and FCC Compatibility

M.2 (S42) 3TEA conforms to CE and FCC requirements.

2.6 RoHS Compliance

M.2 (S42) 3TEA is fully compliant with RoHS directive.

2.7 Reliability

Table 8 : M.2 (S42) 3TEA TBW

Parameter	Value	
Flash endurance	3,000 P/E cycles	
Error Correct Code	Support	
Data Retention	Under 40°C: 1 Year at NAND Life End	
TBW* (Total Bytes Written) Units: TB		
Capacity	Sequential workload	Client workload
256GB	682	270
512GB	1364	633
1TB	2727	1065
2TB	5454	3046
* Note:		
1. Sequential: Mainly sequential write are estimated by PassMark Burnin Test v8.1 pro.		
2. Client: Follow JESD218 Test method and JESD219A Workload, tested by Innodisk. (The capacity lower than 64GB client workload is not specified in JEDEC219A, the values are estimated.)		
3. Based on out-of-box performance.		

2.8 Transfer Mode

M.2 (S42) 3TEA support following transfer mode:

SATA III 6.0Gbps

SATA II 3.0Gbps

SATA I 1.5Gbps

2.9 Pin Assignment

Innodisk M.2 (S42) 3TEA uses a standard SATA pin-out. See Table 9 for M.2 (S42) 3TEA pin assignment.

Table 9 : Innodisk M.2 (S42) 3TEA Pin Assignment

Signal Name	Pin #	Pin #	Signal Name
		75	GND
3.3V	74	73	GND
3.3V	72	71	GND
3.3V	70	69	GND
NC	68	67	NC
Notch	66	65	Notch
Notch	64	63	Notch
Notch	62	61	Notch
Notch	60	59	Notch
NC	58		
NC	56	57	GND
NC	54	55	NC
NC	52	53	NC
NC	50	51	GND
NC	48	49	RX+
NC	46	47	RX-
NC	44	45	GND
NC	42	43	TX-
NC	40	41	TX+
NC	38	39	GND
NC	36	37	NC
NC	34	35	NC
NC	32	33	GND
NC	30	31	NC
NC	28	29	NC
NC	26	27	GND
NC	24	25	NC

NC	22	23	NC
NC	20	21	GND
Notch	18	19	Notch
Notch	16	17	Notch
Notch	14	15	Notch
Notch	12	13	Notch
DAS	10	11	NC
NC	8	9	NC
NC	6	7	NC
3.3V	4	5	NC
3.3V	2	3	GND
		1	GND

LED Color	Function
Green	Power On

2.10 Mechanical Dimensions

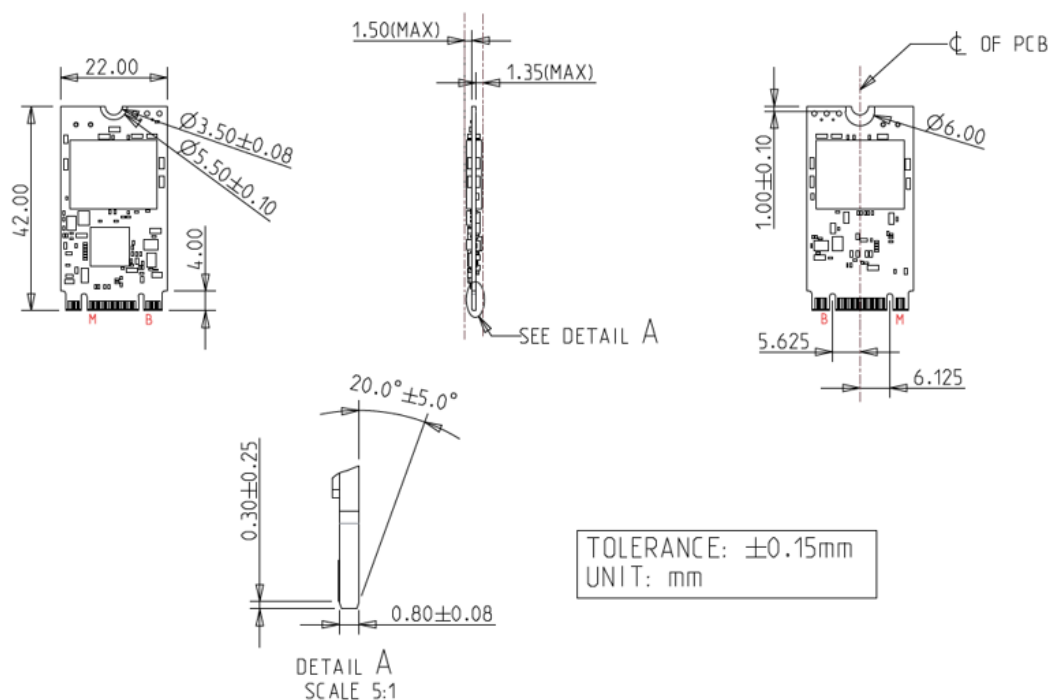


Figure 1: Innodisk M.2 (S42) 3TEA Mechanical 2D diagram

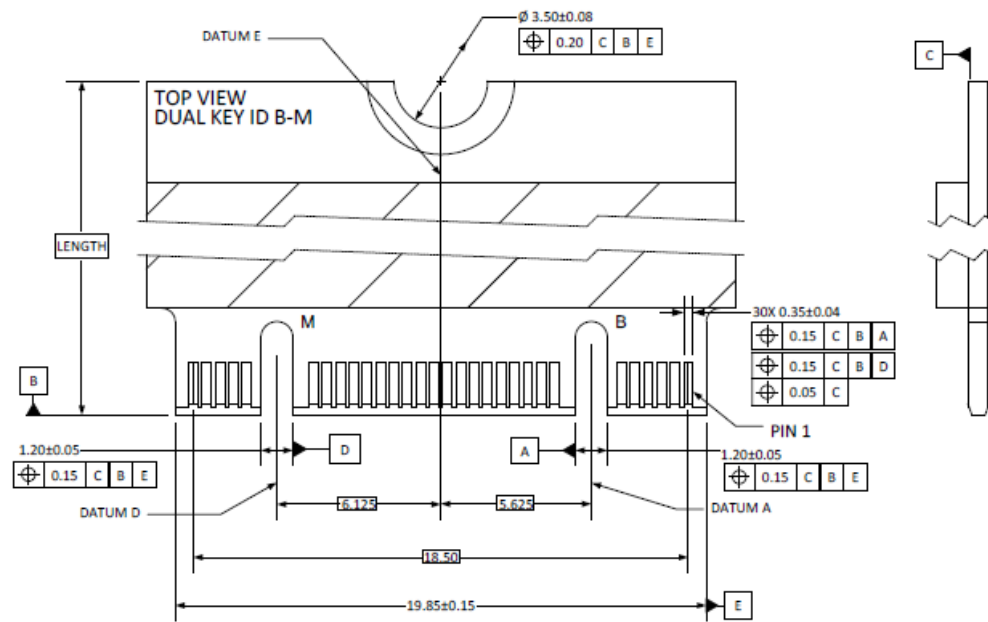


Figure 2: Signal Segment and Power Segment

2.11 Assembly Weight

An Innodisk M.2 (S42) 3TEA within flash ICs, 2TB's weight is approximately 4 grams.

3. Theory of Operation

3.1 Overview

Figure 3 shows the operation of Innodisk M.2 (S42) 3TEA from the system level, including the major hardware blocks.

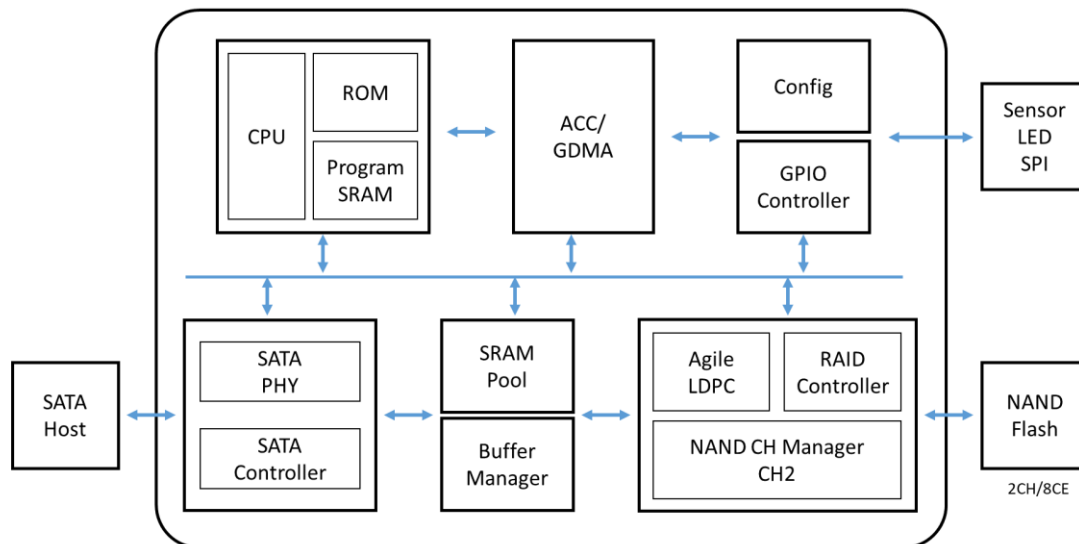


Figure 3: Innodisk M.2 (S42) 3TEA Block Diagram

Innodisk M.2 (S42) 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 Error Detection and Correction

Innodisk M.2 (S42) 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.

3.3 End to End Data Path Protection

End-to-end Data Path Protection that secures the data transmission between host system and NAND Flash. In the transmission path, no matter it's in or out, all buffer and storage implement Error Code Correction that optimizes the data integrity in the whole transmission of SSD.

3.4 Wear-Leveling

Flash memory can be erased with a limited number of cycles. This number is called the erase cycle limit or write endurance limit and is defined by the flash NAND vendor. The erase cycle limit applies

to each individual erase block in the flash device.

Wear-leveling is a controller background process that minimize the accumulation of erase and write cycle by distributes data across different memory blocks, spreading the workload evenly to ensure SSD's longevity.

3.5 Garbage Collection (GC)

The Garbage Collection mechanism is designed to maintain optimal SSD performance by reclaiming storage blocks occupied by invalid data. It is a background process that scans, consolidates, and relocates valid data to fresh blocks, allowing obsolete blocks to be erased and reused. This ensures a steady supply of free blocks for the host, enhancing both the overall response time and the drive's reliability.

3.6 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.

3.7 iData Guard

iData Guard is a comprehensive data protection mechanism that functions before and after a sudden power outage to the SSD. Low-power detection terminates data writing before an abnormal power-off, while table-remapping after power-on deletes corrupt data and maintains data integrity. iData Guard provides effective power cycling management, preventing data stored in flash from degrading with use.

3.8 iPower Guard

iPower Guard technology is a set of preventive measures that protect the SSD in an unstable power supply environment. This comprehensive package comprises safeguards for startup and shutdown to maintain device performance and ensure data integrity.

3.9 Thermal Management

M.2 (S42) 3TEA has a built-in thermal sensor that can detect the temperature of the SSD. In the meantime, the firmware will monitor the thermal sensor to prevent any failure of overheating. During extreme temperatures, firmware will adjust the data transfer behavior to maintain the SSD's reliable operation.

Thermal throttling is a protective mechanism designed to safeguard components from potential damage caused by excessive temperatures. When an SSD approaches a critical temperature threshold, the firmware regulates the SSD's temperature by adjusting the data processing speed. This mechanism is crucial for SSDs since it prevents drive damage, which could otherwise result in data loss. It is worth noting that when thermal throttling is involved, read and write operation may experience a reduction in speed.

4. SMART Feature Set

4.1 SMART Attributes

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

Table 10 : SMART attribute

Attribute ID (hex)	Value	Raw Attribute Value						Rsv	Attribute Name
05h	64h	LSB			MSB	00h	00h	00h	Later Bad
09h	LSB	LSB			MSB	00h	00h	00h	Power-On hours Count
0Ch	LSB	LSB			MSB	00h	00h	00h	Power Cycle Count
A3h	LSB	LSB					MSB	00h	Total Bad Block Count
A5h	LSB	LSB			MSB	00h	00h	00h	Max Erase Count
A7h	LSB	LSB			MSB	00h	00h	00h	Avg Erase Count
A9h	64h	LSB	00h	00h	00h	00h	00h	00h	Device Life
AAh	64h	LSB					MSB	00h	Spare Block Count
ABh	LSB	LSB					MSB	00h	Program Fail Count
ACH	LSB	LSB					MSB	00h	Erase Fail Count
B8h	00h	LSB			MSB	00h	00h	00h	Error Corrected Count
BBh	00h	LSB			MSB	00h	00h	00h	Reported Uncorrect Count
C0h	LSB	LSB			MSB	00h	00h	00h	Abnormal power cycle Count
C2h	Current	Current	00h	MIN	00h	MAX	00h	Current	Temperature
C7h	00h	LSB			MSB	00h	00h	00h	CRC Error
C8h	00h	LSB			MSB	00h	00h	00h	SATA Speed Down Count
E5h	64h	ID0	ID1	ID2	ID3	ID4	ID5	00h	Flash ID

EBh	00h		MSB	LSB	MSB	LSB	MSB	LSB	Later bad block info (Read/Write/Erase)
F1h	64h	LSB					MSB	00h	Total LBAs Written
F2h	64h	LSB					MSB	00h	Total LBAs Read

5. 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	M	2	4	-	B	5	6	D	Z	1	P	C	A	D	F	-	X	X	X
Definition																					
Code 1st (Disk)											Code 13th (Flash Mode)										
D: Disk											P: 218 layers 3D TLC										
Code 2nd (Feature set)																					
E : Embedded series																					
Code 3rd ~5th (Form factor)											Code 14th (Operation Temperature)										
M24: M.2 Type 2242-D3-B-M											C: Standard Grade (0°C~ +70°C)										
Code 7th ~9th (Capacity)											Code 15th (Internal control)										
B56: 256GB											A: BGA PCBA version										
C12: 512GB																					
01T: 1TB											Code 16th (Channel of data transfer)										
02T: 2TB											D: Dual Channels										
Code 10th ~12th (Controller)											Code 17th (Flash Type)										
DZ1: SATA 3TEA											F: Kioxia 3D TLC										
											Code 19th~21th (Customized Code)										