innodisk

Total Solution For Industrial Flash Storage

Slim SSD

3ME4 Series

Customer: _____

Customer Part Number: _____

Innodisk Part Number: _____

Innodisk Model Name: _____

Date: _____

Innodisk Approver	Customer Approver

Table of Contents

REVISION HISTORY

Revision	Description	Date
Rev 1.0	First Released	Dec., 2016
Rev 1.1	Update features	Sep., 2022

List of Tables

List of Figures

1. Product Overview

1.1 Introduction of Innodisk Slim SSD 3ME4

Innodisk Slim SSD 3ME4 is characterized by L^3 architecture with the latest SATA III (6.0GHz) Marvell NAND controller. L^2 architecture multiplied by LDPC (Low Density Parity Check) is Innodisk's exclusive L^3 architecture. L^2 (Long Life) architecture is a 4K mapping algorithm that reduces WAF and features a real-time wear leveling algorithm to provide high performance and prolong lifespan with exceptional reliability. Innodisk Slim SSD 3ME4 is designed for industrial field, and supports several standard features, including TRIM, NCQ, and S.M.A.R.T. In addition, Innodisk's exclusive industrial-oriented firmware provides a flexible customization service, making it perfect for a variety of industrial applications.

1.2 Product View and Models

Innodisk Slim SSD3ME4 is available in follow capacities within MLC flash ICs.

Slim SSD 3ME4 08GB
Slim SSD 3ME4 16GB
Slim SSD 3ME4 32GB
Slim SSD 3ME4 64GB
Slim SSD 3ME4 128GB
Slim SSD 3ME4 256GB

Figure 1: Innodisk Slim SSD 3ME4

1.3 SATA Interface

Innodisk Slim SSD 3ME4 support SATA III interface, and compliant with Serial ATA Gen 1, Gen 2 and Gen 3 specification (Gen 3 supports 1.5Gbps /3.0Gbps/6.0Gbps data rate). SATA connector uses a 7-pin signal segment and a 15-pin power segment.

1.4 Capacity

Innodisk Slim SSD 3ME4 provides unformatted 8GB, 16GB, 32GB, 64GB, 128GB and 256GB capacities within MLC Flash IC.

1.5 1.8-inch Form Factor

Innodisk Slim SSD is designed with 1.8-inch housing. Innodisk Slim SSD 3ME3 has a compact design 69.85mm (W) x 50.0mm (L) x 9.0mm (H).

2. Product Specifications

2.1 Capacity and Device Parameters

Innodisk Slim SSD 3ME4 device parameters are shown in Table 1.

Table 1: Device parameters

Capacity	LBA	Cylinders	Heads	Sectors	User Capacity(MB)
8GB	15649200	15255	16	63	7,641
16GB	31277232	16383	16	63	15,272
32GB	62533296	16383	16	63	30,533
64GB	125045424	16383	16	63	61,057
128GB	250069680	16383	16	63	122,104
256GB	500118192	16383	16	63	244,198

2.2 Performance

Burst Transfer Rate: 6.0Gbps

Table 2: Performance

Capacity	8GB	16GB		32GB	64GB	128GB	256GB
		1CH	2CH				
Sequential Read (max.)	140	220	270	450	530	530	530
Sequential Write (max.)	25	25	60	50	100	190	210
4KB Random** Read (QD32)	8,700 IOPS	10,000 IOPS	15,000 IOPS	17,000 IOPS	27,000 IOPS	32,000 IOPS	32,000 IOPS
4KB Random** Write (QD32)	6,900 IOPS	6,100 IOPS	14,000 IOPS	12,000 IOPS	25,000 IOPS	31,000 IOPS	26,000 IOPS

Note: * Sequential performance based on CrystalDiskMark 5.1.2 with file size 1000MB

** Random performance based on IOmeter with Queue Depth 32

2.3 Electrical Specifications

2.3.1 Power Requirement

Table 3: Innodisk Slim SSD 3ME4 Power Requirement

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

2.3.2 Power Consumption

Table 4: Power Consumption

Mode	Power Consumption (mA)
Read	93 (max.)
Write	160 (max.)
Idle	91 (max.)

* Target: Slim SSD 3ME4 256GB

2.4 Environmental Specifications

2.4.1 Temperature Ranges

Table 5: Temperature range for Slim SSD 3ME4

Temperature	Range
Operating	Standard Grade: 0°C to +70°C
	Industrial Grade:-40°C to +85°C
Storage	-55°C to +95°C

2.4.2 Humidity

Relative Humidity: 10-95%, non-condensing

2.4.3 Shock and Vibration

Table 6: Shock/Vibration Testing for Slim SSD3ME4

Reliability	Test Conditions	Reference Standards
Vibration	7 Hz to 2K Hz, 20G, 3 axes	IEC 68-2-6
Mechanical Shock	Duration: 0.5ms, 1500 G, 3 axes	IEC 68-2-27

2.4.4 Mean Time between Failures (MTBF)

Table 7 summarizes the MTBF prediction results for various Slim SSD 3ME4 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: Slim SSD 3ME4 MTBF

Product	Condition	MTBF (Hours)
Innodisk Slim SSD 3ME4	Telcordia SR-332 GB, 25°C	>3,000,000

2.5 CE and FCC Compatibility

Slim SSD 3ME4 conforms to CE and FCC requirements.

2.6 RoHS Compliance

Slim SSD 3ME4 is fully compliant with RoHS directive.

2.7 Reliability

Parameter	Value	
Read Cycles	Unlimited Read Cycles	
Flash endurance	3,000 P/E cycles	
Wear-Leveling Algorithm	Support	
Bad Blocks Management	Support	
Error Correct Code	Support	
TBW* (Total Bytes Written) Unit:TB		
Capacity	**Sequential workload**	**Client workload**
8GB	23.4	15.6
16GB	46.8	31.2
32GB	93.6	62.4
64GB	187.2	124.8
128GB	374.4	208.3
256GB	748.8	416.6
*Note: 1. Sequential: Mainly sequential write, tested by Vdbench. 2. Client: Follow JESD218 Test method and JESD219A Workload, tested by ULINK. (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

Slim SSD3ME4 support following transfer mode:

Serial ATA III 6.0Gbps

Serial ATA II 3.0Gbps

Serial ATA I 1.5Gbps

2.9 Pin Assignment

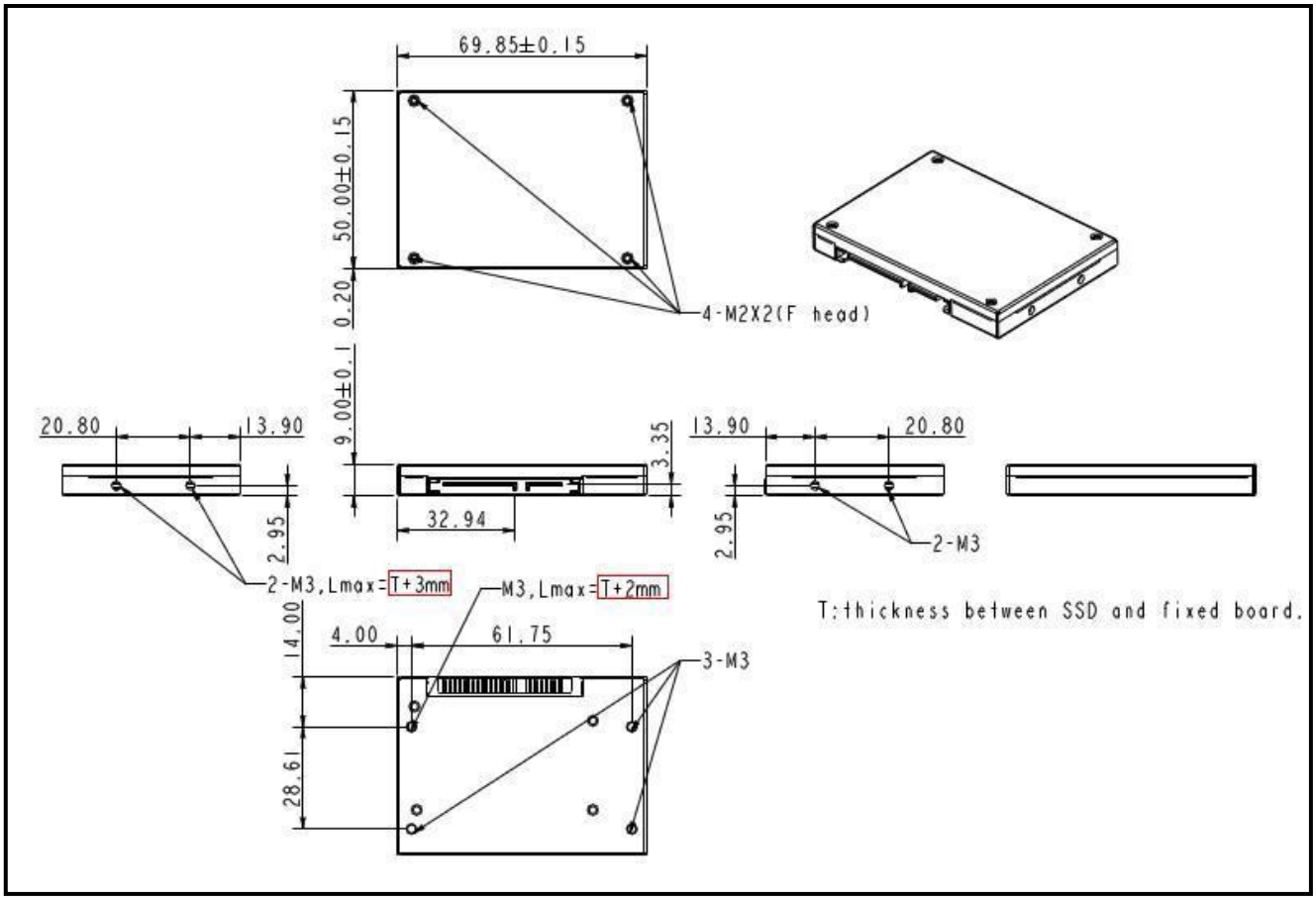
Innodisk Slim SSD 3ME4 uses a standard SATA pin-out. See Table 8 for Slim SSD 3ME4 pin

assignment.

Table 8: Innodisk Slim SSD3ME4 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



2.11 Assembly Weight

An Innodisk Slim SSD 3ME4 within MLC flash ICs, 8GB's weight is 30 grams approx. The total weight of SSD will be less than 35 grams.

2.12 Seek Time

Innodisk Slim SSD 3ME4 is not a magnetic rotating design. There is no seek or rotational latency required.

2.13 Hot Plug

The SSD supports hot plug function and can be removed or plugged-in during operation. User has to avoid hot plugging the SSD which is configured as boot device and installed operation system.

Surprise hot plug : The insertion of a SATA device into a backplane (combine signal and power) that has power present. The device powers up and initiates an OOB sequence.

Surprise hot removal: The removal of a SATA device from a powered backplane, without first being placed in a quiescent state.

2.14 NAND Flash Memory

Innodisk Slim SSD 3ME4 uses Multi Level Cell (MLC) NAND flash memory, which is non-volatility, high reliability which has 3,000 program/erase times and high speed memory storage.

3. Theory of Operation

3.1 Overview

Figure 2 shows the operation of Innodisk Slim SSD 3ME4 from the system level, including the major hardware blocks.

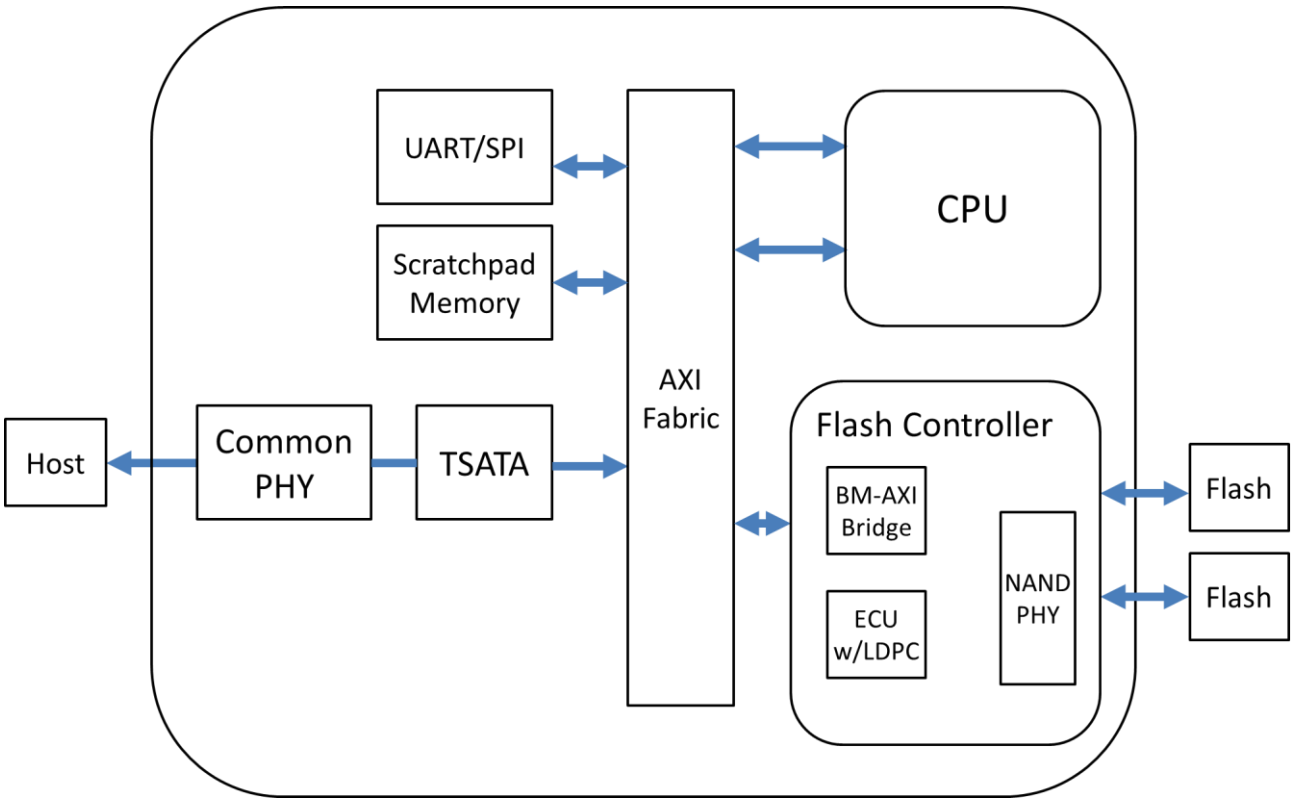


Figure 2: Innodisk Slim SSD 3ME4 Block Diagram

Innodisk Slim SSD 3ME4 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 Slim SSD 3ME4 is designed with 88NV1120, 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 2 channels for flash interface.

3.3 Error Detection and Correction

Innodisk Slim SSD 3ME4 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 Slim SSD 3ME4 uses a static wear-leveling algorithm to ensure that consecutive writes of a specific sector are not written physically to the same page/block in the flash. This spreads flash media usage evenly across all pages, thereby extending flash 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/TRIM

Garbage collection and TRIM are 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.

4. Installation Requirements

4.1 Slim SSD 3ME4 Pin Directions

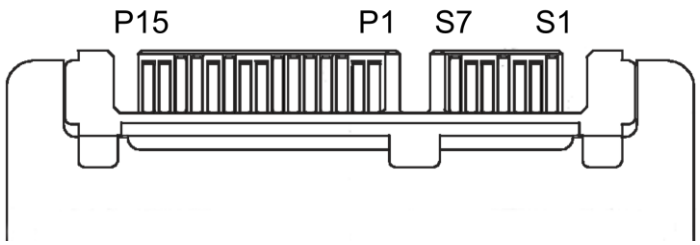


Figure 3: Signal Segment and Power Segment

4.2 Electrical Connections for Slim SSD 3ME4

A Serial ATA device may be either directly connected to a host or connected to a host through a cable. For connection via cable, the cable should be no longer than 1meter. The SATA interface has a separate connector for the power supply. Please refer to the pin description for further details.

4.3 Device Drive

No additional device drives are required. Innodisk Slim SSD 3ME4 can be configured as a boot device.

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
	D	**E**	**M**	**L**	**M**	**-**	**3**	**2**	**G**	**M**	**4**	**1**	**B**	**C**	**1**	**D**	**C**	**-**	**X**	**X**
Description	Disk	Slim SSD3ME4					Capacity			Category			Flash Mode	Operation Temp.	Internal Control	CH.	Flash	-	Customized Code	

Definition	
Code 1st (Disk)	**Code 13th (Flash Mode)**
D : Disk	B: Toshiba 15nm Synchronous flash
Code 2nd ~ 5th (Form Factor)	
EMLM: Slim SSD 3ME4	**Code 14th (Operation Temperature)**
Code 7th ~9th (Capacity)	C: Standard Grade (0℃~ +70℃)
08G: 8GB	W: Industrial Grade (-40℃~ +85℃)
16G: 16GB	**Code 15th (Internal control)**
32G: 32GB	1: PCB version
64G: 64GB	
A28: 128GB	
B56: 256GB	**Code 16th (Channel of data transfer)**
	S: Single Channel
	D: Dual Channels
Code 10th ~12th (Series)	
M41: 88NV1120	**Code 17th (Flash Type)**
	C: Toshiba MLC
	Code 19th~20th (Customized Code)

Appendix

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宜鼎國際股份有限公司
Innodisk Corporation

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RoHS 自我宣告書(RoHS Declaration of Conformity)

Manufacturer Product: All Innodisk EM Flash and Dram products

一、 宜鼎國際股份有限公司（以下稱本公司）特此保證售予新漢股份有限公司之所有產品，皆符合歐盟 2011/65/EU 關於 RoHS 之規範要求。

Innodisk Corporation declares that all products sold to Nexcom, are complied with European Union RoHS Directive (2011/65/EU) requirement.

二、 本公司同意因本保證書或與本保證書相關事宜有所爭議時，雙方宜友好協商，達成協議。

Innodisk Corporation agrees that both parties shall settle any dispute arising from or in connection with this Declaration of Conformity by friendly negotiations.

Name of hazardous substance	Limited of RoHS ppm（mg/kg）
鉛（Pb）	< 1000 ppm
汞（Hg）	< 1000 ppm
鎘（Cd）	< 100 ppm
六價鉻（Cr 6+）	< 1000 ppm
多溴聯苯（PBBs）	< 1000 ppm
多溴二苯醚（PBDEs）	< 1000 ppm

立 保 證 書 人 (Guarantor)

Company name 公司名稱： Innodisk Corporation 宜鼎國際股份有限公司

Company Representative 公司代表人： Randy Chien 簡川勝

Company Representative Title 公司代表人職稱： Chairman 董事長

Date 日期： 2016 / 08 / 04

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REACH Declaration of Conformity

Manufacturer Product: All Innodisk EM Flash and Dram products

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2.本公司同意因本保證書或與本保證書相關事宜有所爭議時，雙方宜友好協商，達成協議。

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立 保 證 書 人 (Guarantor)

Company name 公司名稱： InnoDisk Corporation 宜鼎國際股份有限公司

Company Representative 公司代表人： Randy Chien 簡川勝

Company Representative Title 公司代表人職稱： Chairman 董事長

Date 日期： 2016 / 06 / 23