

SATA Slim

3ME4 Series

Customer: _____
Customer
Part
Number: _____
Innodisk
Part
Number: _____
Innodisk
Model Name: _____
Date: _____

Innodisk Approver	Customer Approver

Total Solution For
Industrial Flash Storage

Table of Contents

LIST OF FIGURES	6
1. PRODUCT OVERVIEW	7
1.1 INTRODUCTION OF INNODISK SATA SLIM 3ME4	7
1.2 PRODUCT VIEW AND MODELS	7
1.3 SATA INTERFACE.....	7
1.4 CAPACITY	8
1.5 MO-297 FORM FACTOR	8
2.1 CAPACITY AND DEVICE PARAMETERS.....	9
2.2 PERFORMANCE	9
2.3 ELECTRICAL SPECIFICATIONS	10
2.3.1 Power Requirement.....	10
2.3.2 Power Consumption	10
2.4 ENVIRONMENTAL SPECIFICATIONS	10
2.4.1 Temperature Ranges	10
2.4.2 Humidity.....	10
2.4.3 Shock and Vibration	10
2.4.4 Mean Time between Failures (MTBF)	10
2.5 CE AND FCC COMPATIBILITY	11
2.6 RoHS COMPLIANCE	11
2.7 RELIABILITY	11
2.8 TRANSFER MODE	11
2.9 PIN ASSIGNMENT	11
2.10 MECHANICAL DIMENSIONS.....	13
2.11 ASSEMBLY WEIGHT	13
2.12 SEEK TIME	13
2.13 HOT PLUG.....	13
2.14 NAND FLASH MEMORY.....	13
3.1 OVERVIEW.....	14
3.2 SATA III CONTROLLER	14
3.3 ERROR DETECTION AND CORRECTION.....	14
3.4 WEAR-LEVELING	15
3.5 BAD BLOCKS MANAGEMENT	15
3.6 GARBAGE COLLECTION/TRIM	15
4. INSTALLATION REQUIREMENTS.....	16
4.1 SATA SLIM 3ME4 PIN DIRECTIONS.....	16
4.2 ELECTRICAL CONNECTIONS FOR SATA SLIM 3ME4	16
4.3 DEVICE DRIVE	16

5. PART NUMBER RULE17

REVISION HISTORY

Revision	Description	Date
Rev 1.0	First Released	Aug., 2016
Rev 1.1	Update TBW	Oct., 2016
Rev 1.2	Update features	Sep., 2022

List of Tables

TABLE 1: DEVICE PARAMETERS	9
TABLE 2: PERFORMANCE	9
TABLE 3: INNODISK SATA SLIM 3ME4 POWER REQUIREMENT	10
TABLE 4: POWER CONSUMPTION	10
TABLE 5: TEMPERATURE RANGE FOR SATA SLIM 3ME4	10
TABLE 6: SHOCK/VIBRATION TESTING FOR SATA SLIM 3ME4	10
TABLE 7: SATA SLIM 3ME4 MTBF	11
TABLE 8: INNODISK SATA SLIM 3ME4 PIN ASSIGNMENT	12

List of Figures

FIGURE 1: INNODISK SATA SLIM 3ME4	7
FIGURE 2: INNODISK SATA SLIM 3ME4 BLOCK DIAGRAM.....	14
FIGURE 3: SIGNAL SEGMENT AND POWER SEGMENT	16

1. Product Overview

1.1 Introduction of Innodisk SATA Slim 3ME4

Innodisk SATA Slim 3ME4 is characterized by L³ architecture with the latest SATA III (6.0GHz) Marvell NAND controller. L² architecture multiplied by LDPC (Low Density Parity Check) is Innodisk's exclusive L³ architecture. L² (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 SATA Slim 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 SATA Slim 3ME4 is available in follow capacities within MLC flash ICs.

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



Figure 1: Innodisk SATA Slim 3ME4

1.3 SATA Interface

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

1.5 MO-297 Form Factor

SATA Slim 3ME4 has a compact design 54.0mm (W) x 39.0mm (L) x 4.0mm (H) without metal material case, and is easy for installation.

2. Product Specifications

2.1 Capacity and Device Parameters

Innodisk SATA Slim 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 SATA Slim 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: SATA Slim 3ME4 256GB

2.4 Environmental Specifications

2.4.1 Temperature Ranges

Table 5: Temperature range for SATA Slim 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 SATA Slim 3ME4

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 SATA Slim 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: SATA Slim 3ME4 MTBF

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

2.5 CE and FCC Compatibility

SATA Slim 3ME4 conforms to CE and FCC requirements.

2.6 RoHS Compliance

SATA Slim 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

SATA Slim 3ME4 support following transfer mode:

Serial ATA III 6.0Gbps

Serial ATA II 3.0Gbps

Serial ATA I 1.5Gbps

2.9 Pin Assignment

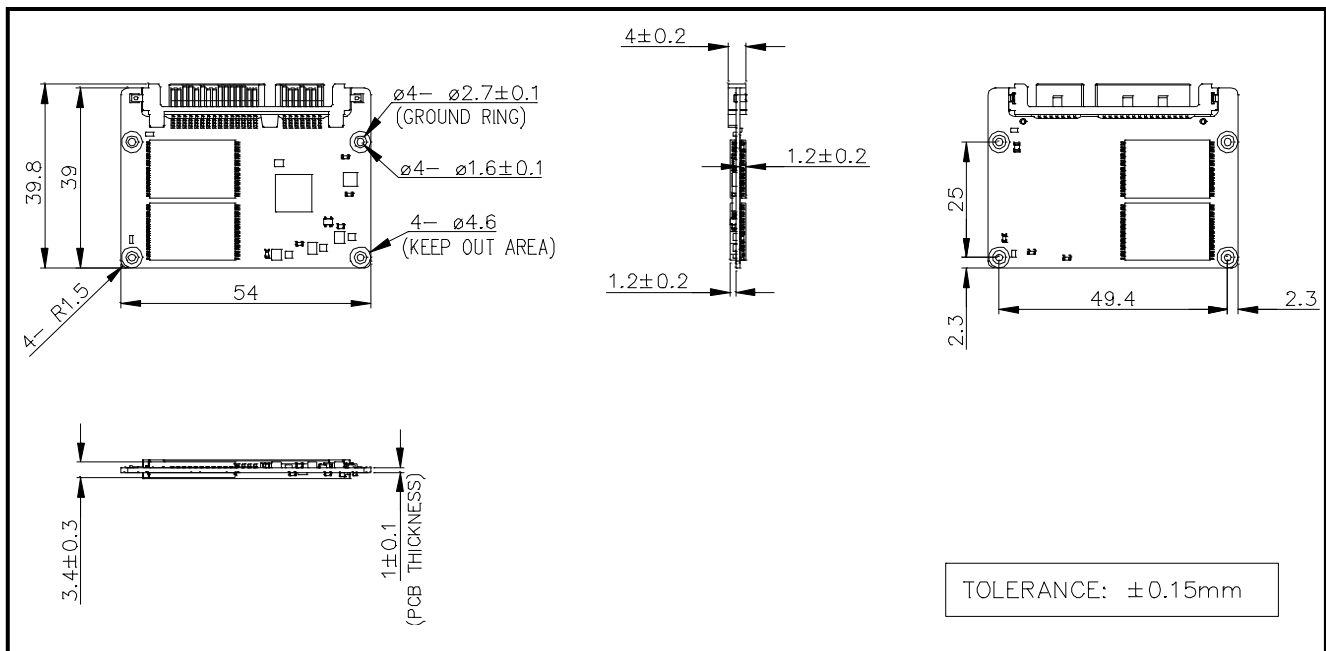
Innodisk SATA Slim 3ME4 uses a standard SATA pin-out. See Table 8 for SATA Slim 3ME4 pin

assignment.

Table 8: Innodisk SATA Slim 3ME4 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 SATA Slim 3ME4 within MLC flash ICs, 16GB's weight is 9 grams approx. The total weight of SSD will be less than 12 grams.

2.12 Seek Time

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

2.13 Hot Plug

The SSD support 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 SATA Slim 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 SATA Slim 3ME4 from the system level, including the major hardware blocks.

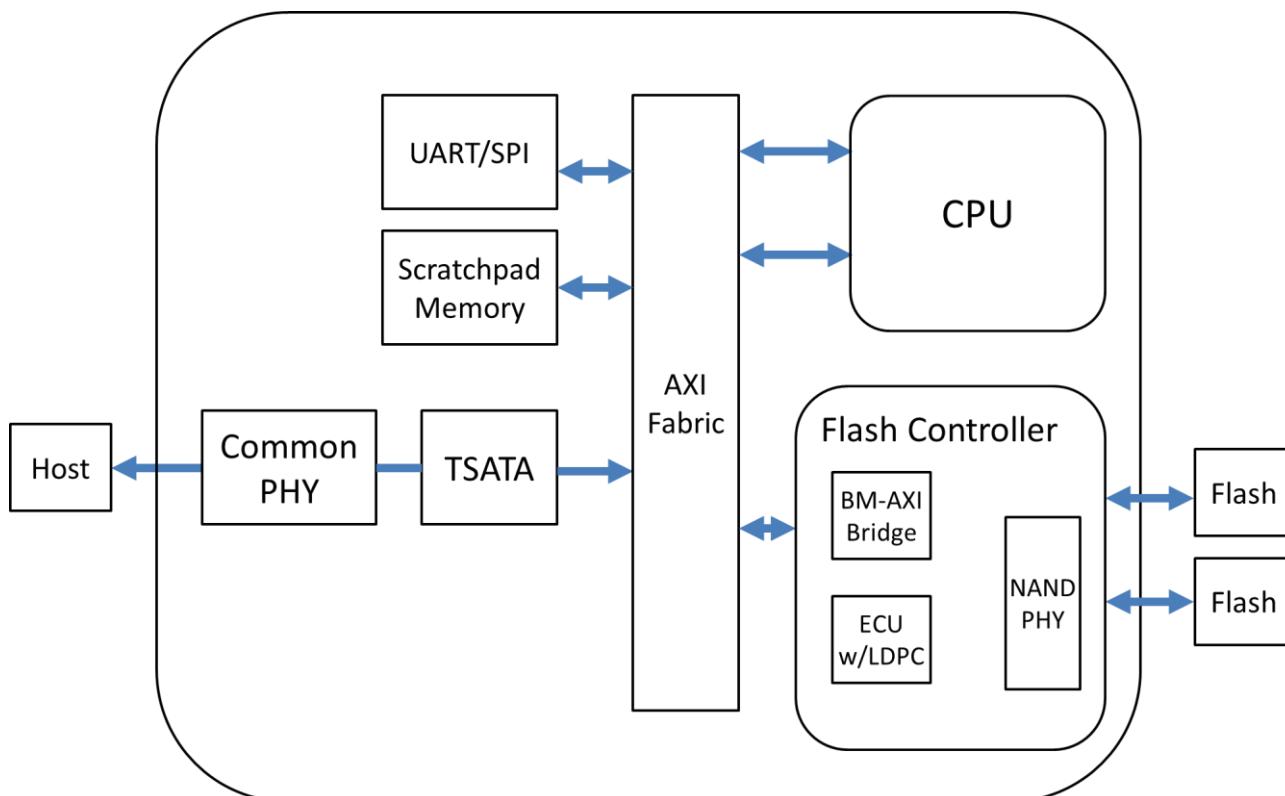


Figure 2: Innodisk SATA Slim 3ME4 Block Diagram

Innodisk SATA Slim 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 SATA Slim 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 SATA Slim 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 SATA Slim 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

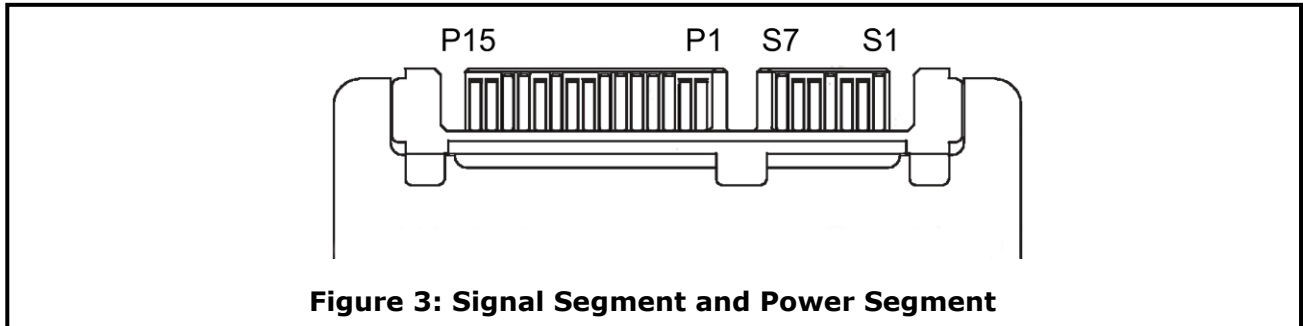
Bad Blocks are blocks that contain one or more invalid bits whose reliability are not guaranteed. The Bad Blocks may be presented while the SSD is shipped, or may develop during the life time of the SSD. When the Bad Blocks is detected, it will be flagged, and not be used anymore. The SSD implement Bad 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 SATA Slim 3ME4 Pin Directions



4.2 Electrical Connections for SATA Slim 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 SATA Slim 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	S	L	M	-	3	2	G	M	4	1	B	C	1	D	C	-	X	X
Description	Disk	SATA Slim 3ME4					Capacity			Category			Flash Mode	Operation Temp.	Internal Control	CH.	Flash	-	Customized Code	
Definition																				
Code 1 st (Disk)													Code 13 th (Flash Mode)							
D : Disk													B: Toshiba 15nm Synchronous flash							
Code 2 nd ~ 5 th (Form Factor)																				
ESLM: SATA Slim 3ME4													Code 14 th (Operation Temperature)							
Code 7 th ~9 th (Capacity)													C: Standard Grade (0℃ ~ +70℃)							
08G: 8GB													W: Industrial Grade (-40℃ ~ +85℃)							
16G: 16GB													Code 15 th (Internal control)							
32G: 32GB													1: PCB version							
64G: 64GB																				
A28: 128GB																				
B56: 256GB													Code 16 th (Channel of data transfer)							
													S: Single Channel							
													D: Dual Channels							
Code 10 th ~12 th (Series)																				
M41: 88NV1120													Code 17 th (Flash Type)							
													C: Toshiba MLC							
													Code 19 th ~20 th (Customized Code)							

Appendix

innodisk

宜鼎國際股份有限公司 Innodisk Corporation

Page 1/1

Tel: (02) 7703-3000 Fax: (02) 7703-3555 Internet: <http://www.innodisk.com/>

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



宜鼎國際股份有限公司 Innodisk Corporation

Tel: (02) 7703-3000 Fax: (02) 7703-3555 Internet: <http://www.innodisk.com/>

REACH Declaration of Conformity

Manufacturer Product: All Innodisk EM Flash and Dram products

1. 宜鼎國際股份有限公司（以下稱本公司）特此保證此售予貴公司之產品，皆符合歐盟化學品法案(Registration, Evaluation and Authorization of Chemicals: REACH)之規定

(<http://www.echa.europa.eu/de/candidate-list-table> last updated: 20/06/2016)。所提供之產品包含：(1) 產品或產品所使用到的所有原物料；(2) 包裝材料；(3) 設計、生產及重工過程中所使用到的所有原物料。

We Innodisk Corporation hereby declare that our products are in compliance with the requirements according to the REACH Regulation

(<http://www.echa.europa.eu/de/candidate-list-table> last updated: 20/06/2016).

Products include: 1) Product and raw material used by the product; 2) Packaging material; 3) Raw material used in the process of design, production and rework

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。

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

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



Certificate

Issue Date: March 11, 2015
Ref. Report No. ISL-15LE075CE

Product Name : SATA Slim
Model(s) : SATA Slim 3S*#-& (S:Flash type: (S:SLC,LiSLC,M:MLC) /
*: Product line: (E:Embedded, G: EverGreen, R: InnoRobust) /
#: controller: (empty:106/107/167/170, 2: 201/202, 3:108/109) /
&: Product feature: (P: with DRAM, empty: without DRAM))

Responsible Party : Innodisk Corporation
Address : 5F.No.237, Sec. 1, Datong Rd., Xizhi Dist., New Taipei City 221,
Taiwan (R.O.C.)

We, International Standards Laboratory, hereby certify that:

The device bearing the trade name and model specified above has been shown to comply with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in European Council Directive- EMC Directive 2004/108/EC. The device was passed the test performed according to :

CE

Standards:
EN 55022: 2010+AC2011 and CISPR 22: 2008 (modified)
EN 61000-3-2: 2006+A1:2009 +A2:2009 and IEC 61000-3-2: 2005+A1:2008 +A2:2009
EN 61000-3-3: 2013 and IEC 61000-3-3: 2013
EN 55024: 2010 and CISPR 24: 2010
EN 61000-4-2: 2009 and IEC 61000-4-2: 2008
EN 61000-4-3: 2006+A1: 2008 +A2: 2010 and
IEC 61000-4-3:2006+A1: 2007+A2: 2010
EN 61000-4-4:2012 and IEC 61000-4-4:2012

I attest to the accuracy of data and all measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

International Standards Laboratory

Jim Chu
Jim Chu / Director

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Tao Yuan City 325, Taiwan
Tel: 886-3-407-1718; Fax: 886-3-407-1738

 ELA113A

  ELA113B

Certificate

Issue Date: March 11, 2015
Ref. Report No. ISL-15LE075FB

Product Name : SATA Slim
Model(s) : SATA Slim 35*#-& (\$:Flash type: (S:SLC,I:isSLC,M:MLC) /
*: Product line: (E:Embedded, G: EverGreen, R: InnoRobust) /
#: controller: (empty:106/107/167/170, 2: 201/ 202, 3:108/109) /
&:Product feature: (P: with DRAM, empty: without DRAM))

Applicant : Innodisk Corporation
Address : 5F.No.237, Sec. 1, Datong Rd., Xizhi Dist., New Taipei City 221,
Taiwan (R.O.C.)

We, **International Standards Laboratory**, hereby certify that:

The device bearing the trade name and model specified above has been shown to comply with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified. (refer to Test Report if any modifications were made for compliance).

FC

Standards:

FCC CFR Title 47 Part 15 Subpart B: 2012- Section 15.107 and 15.109
ANSI C63.4-2009
Industry Canada Interference-Causing Equipment Standard ICES-003 Issue 5: 2012

Class B

I attest to the accuracy of data and all measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

International Standards Laboratory

Jim Chu
Jim Chu / Director

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