

# SATA Slim

## 3IE3 Series

**Customer:** \_\_\_\_\_  
**Customer**  
**Part**  
**Number:** \_\_\_\_\_  
**Innodisk**  
**Part**  
**Number:** \_\_\_\_\_  
**Innodisk**  
**Model Name:** \_\_\_\_\_  
**Date:** \_\_\_\_\_

<b>Innodisk Approver</b>	<b>Customer Approver</b>

**Total Solution For  
Industrial Flash Storage**

## Table of contents

<b>LIST OF FIGURES</b> .....	6
<b>1. PRODUCT OVERVIEW</b> .....	7
<b>1.1 INTRODUCTION OF INNO DISK SATA SLIM 3IE3</b> .....	7
<b>1.2 PRODUCT VIEW AND MODELS</b> .....	7
<b>1.3 SATA INTERFACE</b> .....	7
<b>1.4 CAPACITY</b> .....	8
<b>1.5 MO-297 FORM FACTOR</b> .....	8
<b>2. PRODUCT SPECIFICATIONS</b> .....	9
<b>2.1 CAPACITY AND DEVICE PARAMETERS</b> .....	9
<b>2.2 PERFORMANCE</b> .....	9
<b>2.3 ELECTRICAL SPECIFICATIONS</b> .....	9
<b>2.3.1 Power Requirement</b> .....	9
<b>2.3.2 Power Consumption</b> .....	10
<b>2.4 ENVIRONMENTAL SPECIFICATIONS</b> .....	10
<b>2.4.1 Temperature Ranges</b> .....	10
<b>2.4.2 Humidity</b> .....	10
<b>2.4.3 Shock and Vibration</b> .....	10
<b>2.4.4 Mean Time between Failures (MTBF)</b> .....	10
<b>2.5 CE AND FCC COMPATIBILITY</b> .....	11
<b>2.6 RoHS COMPLIANCE</b> .....	11
<b>2.7 RELIABILITY</b> .....	11
<b>2.8 TRANSFER MODE</b> .....	11
<b>2.9 PIN ASSIGNMENT</b> .....	11
<b>2.10 MECHANICAL DIMENSIONS</b> .....	12
<b>2.11 ASSEMBLY WEIGHT</b> .....	13
<b>2.12 SEEK TIME</b> .....	13
<b>2.13 HOT PLUG</b> .....	13
<b>2.14 NAND FLASH MEMORY</b> .....	13
<b>3.1 OVERVIEW</b> .....	14
<b>3.2 SATA III CONTROLLER</b> .....	14
<b>3.3 ERROR DETECTION AND CORRECTION</b> .....	14
<b>3.4 WEAR-LEVELING</b> .....	15
<b>3.5 BAD BLOCKS MANAGEMENT</b> .....	15
<b>3.6 POWER CYCLING</b> .....	15
<b>3.7 GARBAGE COLLECTION</b> .....	15
<b>4. INSTALLATION REQUIREMENTS</b> .....	16
<b>4.1 SATA SLIM 3IE3 PIN DIRECTIONS</b> .....	16

<b>4.2 ELECTRICAL CONNECTIONS FOR SATA SLIM 3IE3</b> .....	<b>16</b>
<b>4.3 DEVICE DRIVE</b> .....	<b>16</b>
<b>5. PART NUMBER RULE</b> .....	<b>17</b>

## REVISION HISTORY

Revision	Description	Date
Rev. 1.0	First Released	Feb., 2016
Rev 1.1	Add 2CH Performance Update Performance Update Power Consumption	June, 2016

## List of Tables

<b>TABLE 1: DEVICE PARAMETERS</b> .....	9
<b>TABLE 2: PERFORMANCE</b> .....	9
<b>TABLE 3: INNOISK SATA SLIM 3IE3 POWER REQUIREMENT</b> .....	9
<b>TABLE 4: POWER CONSUMPTION</b> .....	10
<b>TABLE 5: TEMPERATURE RANGE FOR SATA SLIM 3IE3</b> .....	10
<b>TABLE 6: SHOCK/VIBRATION TESTING FOR SATA SLIM 3IE3</b> .....	10
<b>TABLE 7: SATA SLIM 3IE3 MTBF</b> .....	11
<b>TABLE 8: INNOISK SATA SLIM 3IE3 PIN ASSIGNMENT</b> .....	11

## List of Figures

<b>FIGURE 1: INNODISK SATA SLIM 3IE3</b> .....	7
<b>FIGURE 2: INNODISK SATA SLIM 3IE3 BLOCK DIAGRAM</b> .....	14
<b>FIGURE 3: SIGNAL SEGMENT AND POWER SEGMENT</b> .....	16

# 1. Product Overview

## 1.1 Introduction of Innodisk SATA Slim 3IE3

Innodisk SATA Slim 3IE3 is designed with standard SATA interface (7+15 SATA connector), which could support most platforms with standard SATA port. Besides, with its smaller dimension, SATA Slim 3IE3 is an alternative solution of 2.5" SSD for those embedded system that may have mechanical and space concerns. SATA Slim 3IE3 operates under SATA III (6.0Gb/s) protocol with good performance.

SATA Slim 3IE3 is also suitable in industrial field. It effectively reduces the booting time of operation system and the power consumption is less than hard disk drive (HDD). SATA Slim 3IE3 complies with ATA protocol, no additional drivers are required, and the SATA Slim 3IE3 can be configured as a boot device or data storage device.

## 1.2 Product View and Models

Innodisk SATA Slim 3IE3 is available in follow capacities within iSLC flash ICs.

[SATA Slim 3IE3 08GB](#)

[SATA Slim 3IE3 64GB](#)

[SATA Slim 3IE3 16GB](#)

[SATA Slim 3IE3 128GB](#)

[SATA Slim 3IE3 32GB](#)



**Figure 1: Innodisk SATA Slim 3IE3**

## 1.3 SATA Interface

Innodisk SATA Slim 3IE3 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 3IE3 provides unformatted 8GB, 16GB, 32GB, 64GB and 128GB capacities within iSLC Flash IC.

## 1.5 MO-297 Form Factor

SATA Slim 3IE3 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 3IE3 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

### 2.2 Performance

Burst Transfer Rate: 6.0Gbps

**Table 2: Performance**

Capacity	8GB		16GB	32GB	64GB	128GB
	1CH	2CH				
Sequential Read (max.)*	110 MB/sec	200 MB/sec	200 MB/sec	400 MB/sec	440 MB/sec	440 MB/sec
Sequential Write (max.)*	50 MB/sec	100 MB/sec	100 MB/sec	180 MB/sec	260 MB/sec	220 MB/sec
4KB Random** Read (QD32)	5,400 IOPS	8,800 IOPS	8,800 IOPS	10,800 IOPS	12,200 IOPS	11,500 IOPS
4KB Random** Write (QD32)	11,800 IOPS	18,900 IOPS	18,900 IOPS	29,100 IOPS	31,500 IOPS	31,100 IOPS

Note: \* Sequential performance based on CrystalDiskMark 3.03 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 3IE3 Power Requirement**

Item	Symbol	Rating	Unit
Input voltage	V <sub>IN</sub>	+5 DC +- 5%	V

## 2.3.2 Power Consumption

**Table 4: Power Consumption**

Mode	Power Consumption (mA)
Read	352 (max.)
Write	362 (max.)
Idle	101 (max.)

\* Target: SATA Slim 3IE3 128GB

## 2.4 Environmental Specifications

### 2.4.1 Temperature Ranges

**Table 5: Temperature range for SATA Slim 3IE3**

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 3IE3**

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 3IE3 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 3IE3 MTBF**

Product	Condition	MTBF (Hours)
Innodisk SATA Slim 3IE3	Telcordia SR-332 GB, 25°C	>3,000,000

## 2.5 CE and FCC Compatibility

SATA Slim 3IE3 conforms to CE and FCC requirements.

## 2.6 RoHS Compliance

SATA Slim 3IE3 is fully compliant with RoHS directive.

## 2.7 Reliability

Parameter	Value
Read Cycles	Unlimited Read Cycles
Wear-Leveling Algorithm	Support
Bad Blocks Management	Support
Error Correct Code	Support
TBW (Unit: TB)	
8GB	15.6
16GB	31.25
32GB	62.5
64GB	125
128GB	250

## 2.8 Transfer Mode

SATA Slim 3IE3 support following transfer mode:

Serial ATA III 6.0Gbps

Serial ATA II 3.0Gbps

Serial ATA I 1.5Gbps

## 2.9 Pin Assignment

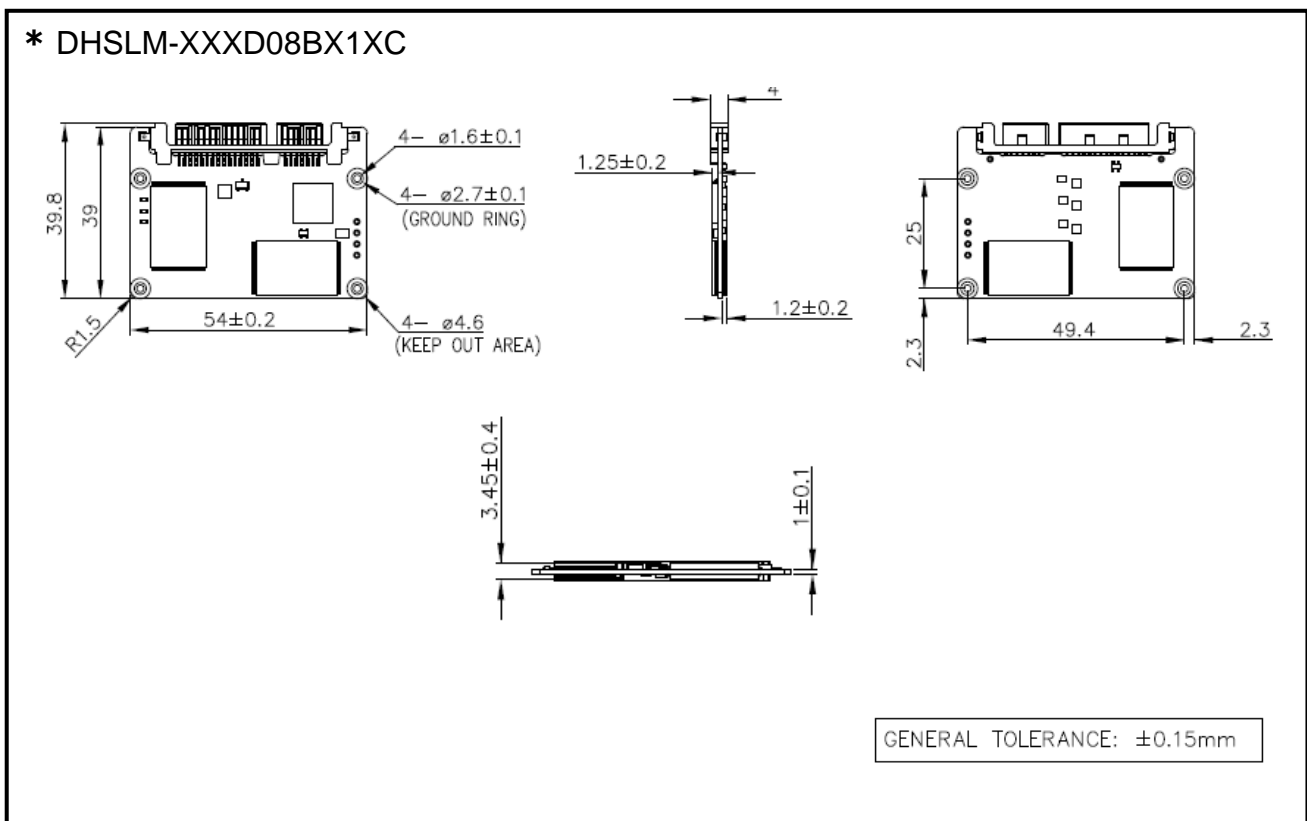
Innodisk SATA Slim 3IE3 uses a standard SATA pin-out. See Table 8 for SATA Slim 3IE3 pin assignment.

**Table 8: Innodisk SATA Slim 3IE3 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
<b>Key and Spacing separate signal and power segments</b>		
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 3IE3 within iSLC flash ICs, 8GB's weight is 9 grams approx.

## 2.12 Seek Time

Innodisk SATA Slim 3IE3 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.

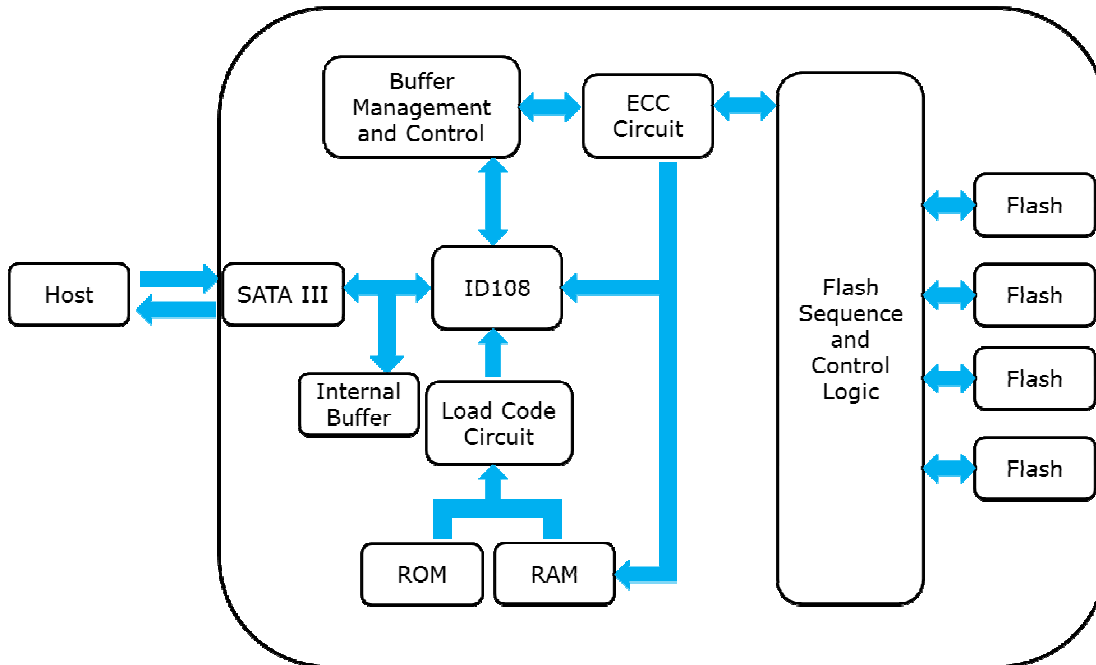
## 2.14 NAND Flash Memory

Innodisk SATA Slim 3IE3 uses Innodisk iSLC NAND flash memory, 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 SATA Slim 3IE3 from the system level, including the major hardware blocks.



**Figure 2: Innodisk SATA Slim 3IE3 Block Diagram**

Innodisk SATA Slim 3IE3 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 3IE3 is designed with ID 108, a SATA III 6.0Gbps (Gen. 3) controller with 4 channels. 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).

#### 3.3 Error Detection and Correction

Highly sophisticated Error Correction Code algorithms are implemented. The ECC unit consists of the Parity Unit (parity-byte generation) and the Syndrome Unit (syndrome-byte computation). This unit implements an algorithm that can correct 40 bits per 1024 bytes in an ECC block. Code-byte generation during write operations, as well as error detection during read operation, is implemented on the fly without any speed penalties.

### 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 3IE3 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 iDATA Guard

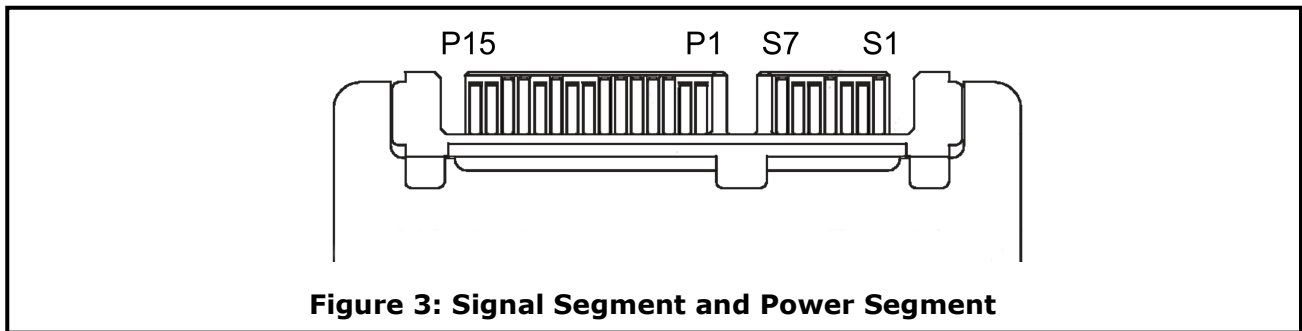
Innodisk's iData Guard is a comprehensive data protection mechanism that functions before and after a sudden power outage to SSD. Low-power detection terminates data writing before an abnormal power-off, while table-remapping after power-on deletes corrupt data and maintains data integrity. Innodisk's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

### 3.7 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.

## 4. Installation Requirements

### 4.1 SATA Slim 3IE3 Pin Directions



### 4.2 Electrical Connections for SATA Slim 3IE3

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 3IE3 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
	<b>D</b>	<b>H</b>	<b>S</b>	<b>L</b>	<b>M</b>	<b>-</b>	<b>3</b>	<b>2</b>	<b>G</b>	<b>D</b>	<b>0</b>	<b>8</b>	<b>B</b>	<b>C</b>	<b>1</b>	<b>Q</b>	<b>C</b>	<b>-</b>	<b>X</b>	<b>X</b>
Description	Disk	SATA Slim 3IE3					Capacity			Category			Flash Mode	Operation Temp.	Internal Control	CH.	Flash	-	Customized Code	
<b>Definition</b>																				
<b>Code 1<sup>st</sup> (Disk)</b>											<b>Code 13<sup>th</sup> (Flash Mode)</b>									
D : Disk											B: Toshiba 15nm Synchronous Flash									
<b>Code 2<sup>nd</sup> ~ 5<sup>th</sup> (Form Factor)</b>																				
HSLM: SATA Slim 3IE3											<b>Code 14<sup>th</sup> (Operation Temperature)</b>									
<b>Code 7<sup>th</sup> ~9<sup>th</sup> (Capacity)</b>											C: Standard Grade (0°C ~ +70°C)									
08G: 8GB											W: Industrial Grade (-40°C ~ +85°C)									
16G: 16GB											<b>Code 15<sup>th</sup> (Internal control)</b>									
32G: 32GB											1: Compliant with MO297									
64G: 64GB																				
A28: 128GB																				
											<b>Code 16<sup>th</sup> (Channel of data transfer)</b>									
											S: Single Channel									
											D: Dual Channels									
<b>Code 10<sup>th</sup> ~12<sup>th</sup> (Series)</b>											Q: Quad Channels									
D08: ID108											<b>Code 17<sup>th</sup> (Flash Type)</b>									
											C: Toshiba iSLC									
											<b>Code 19<sup>th</sup>~20<sup>th</sup> (Customized Code)</b>									

# Appendix

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## 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/

### 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）特此保證售予貴公司之所有產品，皆符合歐盟 2011/65/EU 關於 RoHS 之規範要求。

Innodisk Corporation declares that all products sold to the company, 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)
Cd	< 100 ppm
Pb	< 1000 ppm
Hg	< 1000 ppm
Chromium VI (Cr+6)	< 1000 ppm
Polybromodiphenyl ether (PBDE)	< 1000 ppm
Polybrominated Biphenyls (PBB)	< 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： Richard Lee 李鐘亮

Company Representative Title 公司代表人職稱： CEO 執行長

Date 日期： 2014 / 07 / 29



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## 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: 16/06/2014)。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: 16/06/2014).

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： Richard Lee 李鐘亮

Company Representative Title 公司代表人職稱： CEO 執行長

Date 日期： 2014 / 07 / 29



International Standards Laboratory http://www.isl.com.tw

# Certificate

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

Product Name : SATA Slim  
Model(s) : SATA Slim 3\$\*#-& ( \$:Flash type: (S:SLC,I:iSLC,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 :



**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



# Certificate

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

Product Name : SATA Slim  
 Model(s) : SATA Slim 3\$\*#-& (\$:Flash type: (S:SLC,I:iSLC,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).



## 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

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