

# SATA Slim

## 3SE4 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**

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## REVISION HISTORY

Revision	Description	Date
Rev 1.0	First Released	Jul., 2017
Rev 1.1	Performance and TPW Revised	Sep., 2017
Rev 1.2	Update features	Sep., 2022

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# 1. Product Overview

## 1.1 Introduction of Innodisk SATA Slim 3SE4

Innodisk SATA Slim 3SE4 is characterized by L<sup>3</sup> architecture with the latest SATA III (6.0GHz) Marvell NAND controller. L<sup>2</sup> architecture multiplied by LDPC (Low Density Parity Check) is Innodisk's exclusive L<sup>3</sup> architecture. L<sup>2</sup> (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 3SE4 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 3SE4 is available in follow capacities within SLC flash ICs.

[SATA Slim 3SE4 08GB](#)

[SATA Slim 3SE4 32GB](#)

[SATA Slim 3SE4 16GB](#)

[SATA Slim 3SE4 64GB](#)



**Figure 1: Innodisk SATA Slim 3SE4**

## 1.3 SATA Interface

Innodisk SATA Slim 3SE4 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 3SE4 provides unformatted 8GB, 16GB, 32GB, and 64GB capacities within SLC Flash IC.

## 1.5 MO-297 Form Factor

SATA Slim 3SE4 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 3SE4 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

### 2.2 Performance

Burst Transfer Rate: 6.0Gbps

**Table 2: Performance**

Capacity	8GB	16GB	32GB	64GB
Sequential Read (max.)*	375	520	520	520
Sequential Write (max.)*	75	150	280	360
4KB Random** Read (QD32)	23,000 IOPS	24,000 IOPS	32,000 IOPS	32,000 IOPS
4KB Random** Write (QD32)	13,000 IOPS	26,000 IOPS	29,000 IOPS	29,000 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 3SE4 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	186.5 (max.)
Write	220.3 (max.)
Idle	87.2 (max.)

\* Target: SATA Slim 3SE4 64GB

## 2.4 Environmental Specifications

### 2.4.1 Temperature Ranges

**Table 5: Temperature range for SATA Slim 3SE4**

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 3SE4**

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 3SE4 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 BGA limits, during a particular measurement interval under stated conditions.

**Table 7: SATA Slim 3SE4 MTBF**

Product	Condition	MTBF (Hours)
Innodisk SATA Slim 3SE4	Telcordia SR-332 GB, 25°C	>3,000,000

## 2.5 CE and FCC Compatibility

SATA Slim 3SE4 conforms to CE and FCC requirements.

## 2.6 RoHS Compliance

SATA Slim 3SE4 is fully compliant with RoHS directive.

## 2.7 Reliability

Parameter		Value
Read Cycles		Unlimited Read Cycles
Flash endurance		60,000 P/E cycles
Wear-Leveling Algorithm		Support
Bad Blocks Management		Support
Error Correct Code		Support
<b>TBW* (Total Bytes Written) Unit:TB</b>		
Capacity	Sequential workload	Client workload
8GB	468.8	312.5
16GB	937.5	625
32GB	1,875	1,250
64GB	3,750	2,500
*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 3SE4 support following transfer mode:

Serial ATA III 6.0Gbps

Serial ATA II 3.0Gbps

Serial ATA I 1.5Gbps

## 2.9 Pin Assignment

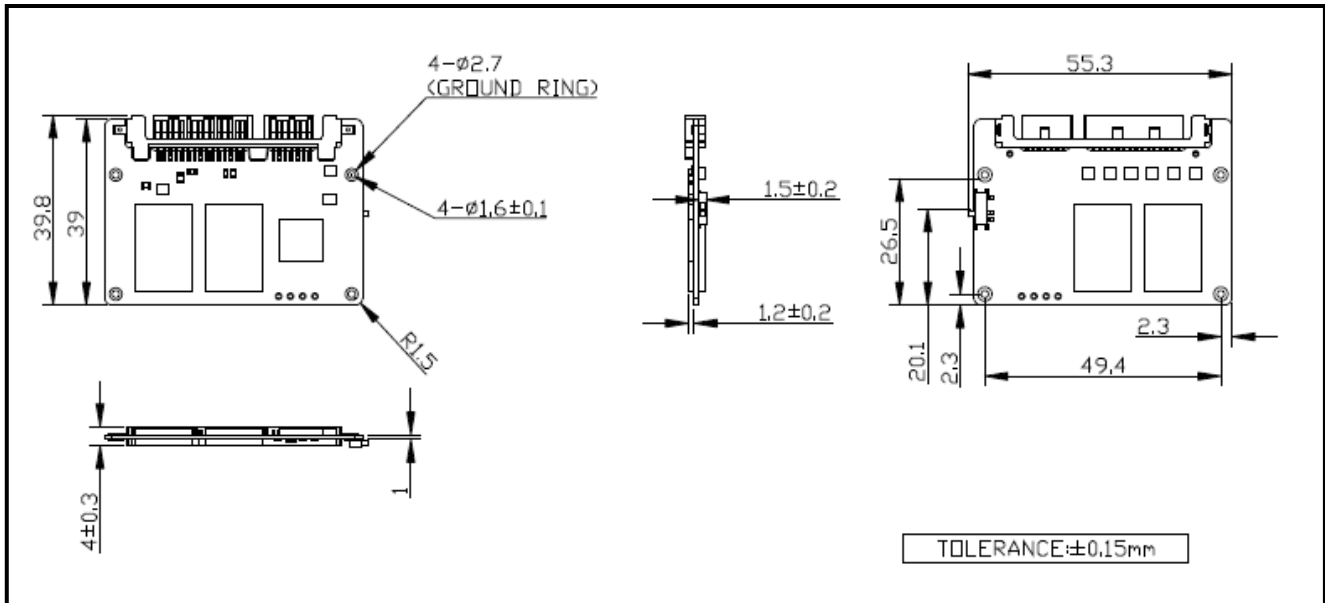
Innodisk SATA Slim 3SE4 uses a standard SATA pin-out. See Table 8 for SATA Slim 3SE4 pin assignment.

**Table 8: Innodisk SATA Slim 3SE4 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 3SE4 within SLC 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 3SE4 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.

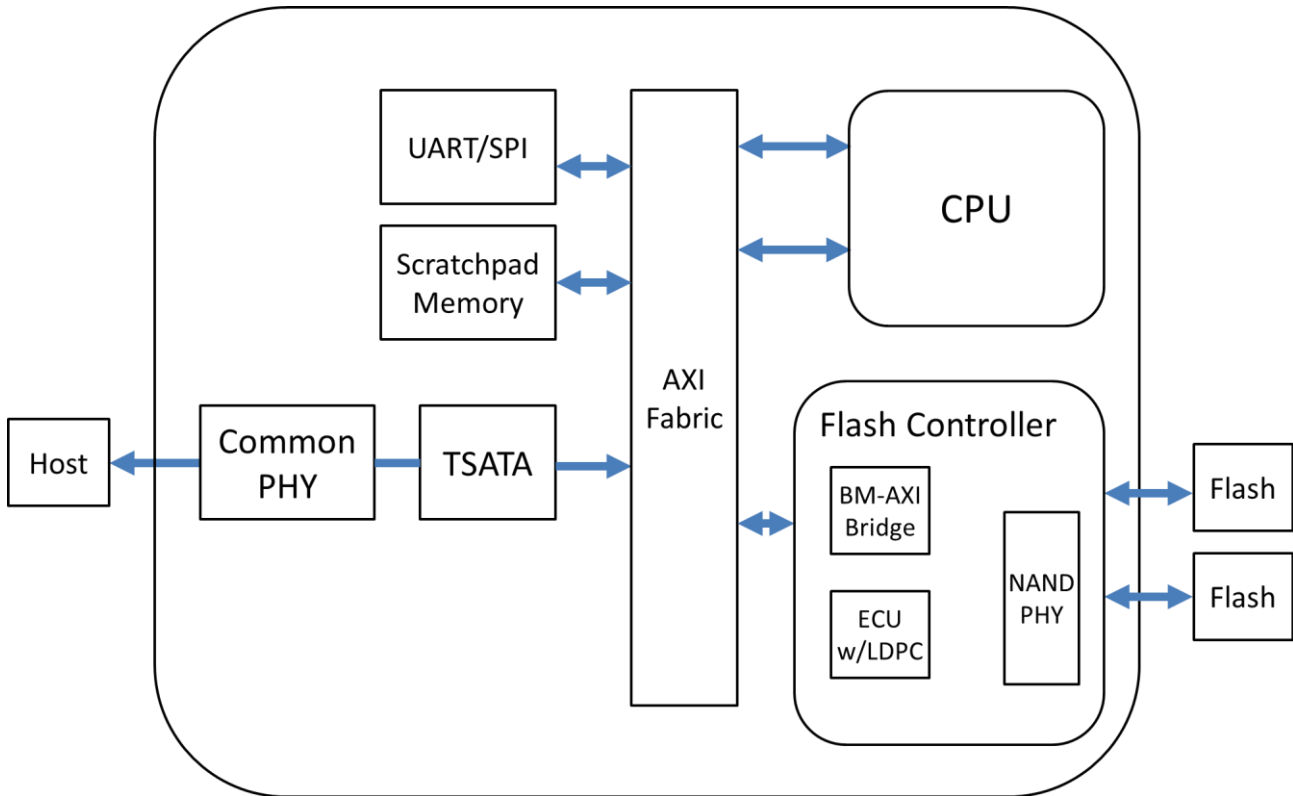
## 2.14 NAND Flash Memory

Innodisk SATA Slim 3SE4 uses Single Level Cell (SLC) NAND flash memory, which is non-volatility, high reliability which has 60,000 program/erase times and high speed memory storage.

## 3. Theory of Operation

### 3.1 Overview

Figure 2 shows the operation of Innodisk SATA Slim 3SE4 from the system level, including the major hardware blocks.



**Figure 2: Innodisk SATA Slim 3SE4 Block Diagram**

Innodisk SATA Slim 3SE4 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 3SE4 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 3SE4 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 3SE4 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

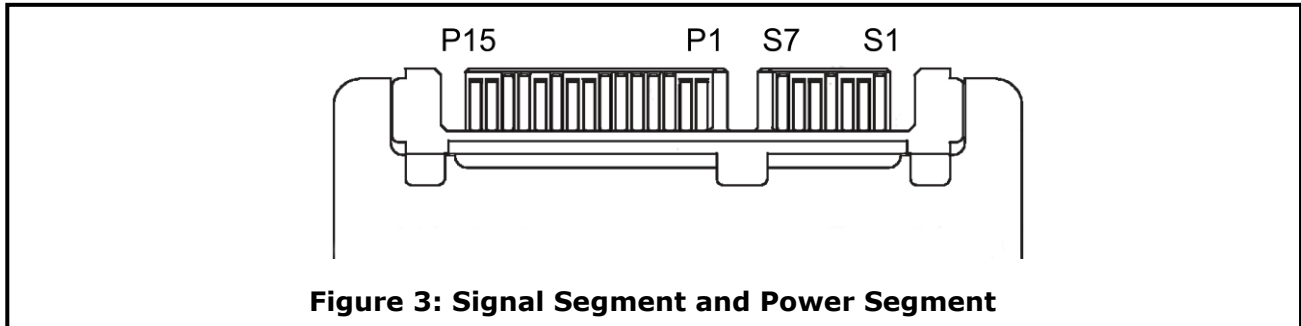
Bad Blocks are blocks that contain one or more invalid bits whose reliability are not guaranteed. The Bad Blocks may be presented while the SSD is shipped, or may develop during the life time of the SSD. When the Bad Blocks is detected, it will be flagged, and not be used anymore. The SSD implement Bad 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 3SE4 Pin Directions



**Figure 3: Signal Segment and Power Segment**

### 4.2 Electrical Connections for SATA Slim 3SE4

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 3SE4 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>E</b>	<b>S</b>	<b>L</b>	<b>M</b>	<b>-</b>	<b>3</b>	<b>2</b>	<b>G</b>	<b>M</b>	<b>4</b>	<b>1</b>	<b>S</b>	<b>C</b>	<b>A</b>	<b>D</b>	<b>B</b>	<b>-</b>	<b>X</b>	<b>X</b>
Description	Disk	SATA Slim 3SE4					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												S: Synchronous flash								
<b>Code 2<sup>nd</sup> ~ 5<sup>th</sup> (Form Factor)</b>																				
ESLM: SATA Slim 3SE4												<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												A: PCB version								
64G: 64GB																				
												<b>Code 16<sup>th</sup> (Channel of data transfer)</b>								
												D: Dual Channels								
<b>Code 10<sup>th</sup> ~12<sup>th</sup> (Series)</b>																				
M41: 88NV1120												<b>Code 17<sup>th</sup> (Flash Type)</b>								
												B: Toshiba SLC								
												<b>Code 19<sup>th</sup>~20<sup>th</sup> (Customized Code)</b>								

# Appendix

## 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 及 (EU) 2015/863 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) and (EU) 2015/863 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
鄰苯二甲酸二(2-乙基己基)酯 (DEHP)	< 1000 ppm
鄰苯二甲酸丁酯苯甲酯 (BBP)	< 1000 ppm
鄰苯二甲酸二丁酯 (DBP)	< 1000 ppm
鄰苯二甲酸二異丁酯 (DIBP)	< 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： 2017 / 01 / 18



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 ; (EC) No 1907/2006 REACH) 以及附錄 XIV 中的限用物質之規定 (<http://www.echa.europa.eu/de/candidate-list-table> last updated: 12/01/2017 , SVHC's 173 ) 。

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 (EC) No 1907/2006 REACH Regulation and restricted substances in Annex XIV (<http://www.echa.europa.eu/de/candidate-list-table> last updated: 12/01/2017 , SVHC's 173 ).

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： 2017 / 02 / 08



ISL 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 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 Standard: Laboratory

Hsi-Chih LAB:  
 No. 65, Gu Dai Keng Street, Hsi-Chih Dist.,  
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 Tel: 886-2-2646-2550; Fax: 886-2-2646-4641

 FLA1136

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 No. 120, Lane 180, Hsin Ho Rd., Lung-Tan Dist.,  
 Tao Yuan City 325, Taiwan  
 Tel: 886-3-407-1718; Fax: 886-3-407-1738

  FLA1138

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

# Certificate

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

Product Name : SATA Slim  
 Model(s) : SATA Slim 35\*#-& (S: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).



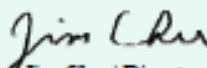
**Standards:**

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**

  
 Jim Chu / Director

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