innodisk

Total Solution For
Industrial Flash Storage

SATA Slim

3ME3 Series

Customer: _____

Customer Part Number: _____

Innodisk Part Number: _____

Innodisk Model Name: _____

Date: _____

Innodisk Approver	Customer Approver

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Revision History

Revision	Description	Date
Preliminary	First Released	May, 2015
Rev 1.0	Update Performance and TBW	July, 2015
Rev 2.0	Add Toshiba 15nm	November, 2015
Rev 2.1	Add 2CH/4CH performance Add Quick erase function (optional)	April, 2016

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1. Product Overview

1.1 Introduction of Innodisk SATA Slim 3ME3

Innodisk SATA Slim 3ME3 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 3ME3 is an alternative solution of 2.5" SSD for those embedded system that may have mechanical and space concerns. SATA Slim 3ME3 operates under SATA III (6.0Gb/s) protocol with good performance.

SATA Slim 3ME3 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 3ME3 complies with ATA protocol, no additional drivers are required, and the SATA Slim 3ME3 can be configured as a boot device or data storage device.

1.2 Product View and Models

Innodisk SATA Slim 3ME3 is available in follow capacities within MLC flash ICs.

SATA Slim 3ME3 08GB
SATA Slim 3ME3 16GB
SATA Slim 3ME3 32GB
SATA Slim 3ME3 64GB
SATA Slim 3ME3 128GB
SATA Slim 3ME3 256GB (15nm)

Figure 1: Innodisk SATA Slim 3ME3

1.3 SATA Interface

Innodisk SATA Slim 3ME3 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 3ME3 provides unformatted 8GB, 16GB, 32GB, 64GB, 128GB and 256GB capacities within MLC Flash IC.

1.5 MO-297 Form Factor

SATA Slim 3ME3 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 3ME3 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 (ID109)	32GB (ID108)	64GB	128GB
Toshiba 19nm	Sequential Read (max.)	100 MB/sec	200 MB/sec	200 MB/sec	350 MB/sec	340 MB/sec	350 MB/sec
	Sequential Write (max.)	20 MB/sec	35 MB/sec	75 MB/sec	75 MB/sec	130 MB/sec	130 MB/sec
	4KB Random** Read (QD32)	4,300 IOPS	5,900 IOPS	7,900 IOPS	9,200 IOPS	10,300 IOPS	10,300 IOPS
	4KB Random** Write (QD32)	5,200 IOPS	8,000 IOPS	13,000 IOPS	13,000 IOPS	20,600 IOPS	20,600 IOPS

	Capacity	8GB	16GB		32GB		64GB	128GB	256GB
			1CH	2CH	2CH (ID109)	4CH (ID108)			
Toshiba 15nm	Sequential Read (max.)*	100 MB/sec	100 MB/sec	200 MB/sec	200 MB/sec	380 MB/sec	370 MB/sec	400 MB/sec	420 MB/sec
	Sequential Write (max.)*	20 MB/sec	20 MB/sec	45 MB/sec	40 MB/sec	90 MB/sec	80 MB/sec	140 MB/sec	140 MB/sec
	4KB Random** Read (QD32)	4,000 IOPS	4,000 IOPS	6,200 IOPS	6,100 IOPS	9,000 IOPS	8,900 IOPS	10,000 IOPS	10,000 IOPS
	4KB Random** Write (QD32)	5,300 IOPS	5,300 IOPS	9,400 IOPS	8,400 IOPS	15,800 IOPS	14,000 IOPS	23,000 IOPS	23,200 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 3ME3 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	310 (max.)
Write	280 (max.)
Idle	150 (max.)

* Target: SATA Slim 3ME3 128GB (19nm)

2.4 Environmental Specifications

2.4.1 Temperature Ranges

Table 5: Temperature range for SATA Slim 3ME3

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 3ME3

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 3ME3 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 3ME3 MTBF

Product	Condition	MTBF (Hours)
Innodisk SATA Slim 3ME3	Telcordia SR-332 GB, 25°C	>3,000,000

2.5 CE and FCC Compatibility

SATA Slim 3ME3 conforms to CE and FCC requirements.

2.6 RoHS Compliance

SATA Slim 3ME3 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	2.3
16GB	4.7
32GB	9.4
64GB	18.8
128GB	37.5
256GB	75

2.8 Transfer Mode

SATA Slim 3ME3 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 3ME3 uses a standard SATA pin-out. See Table 8 for SATA Slim 3ME3 pin assignment.

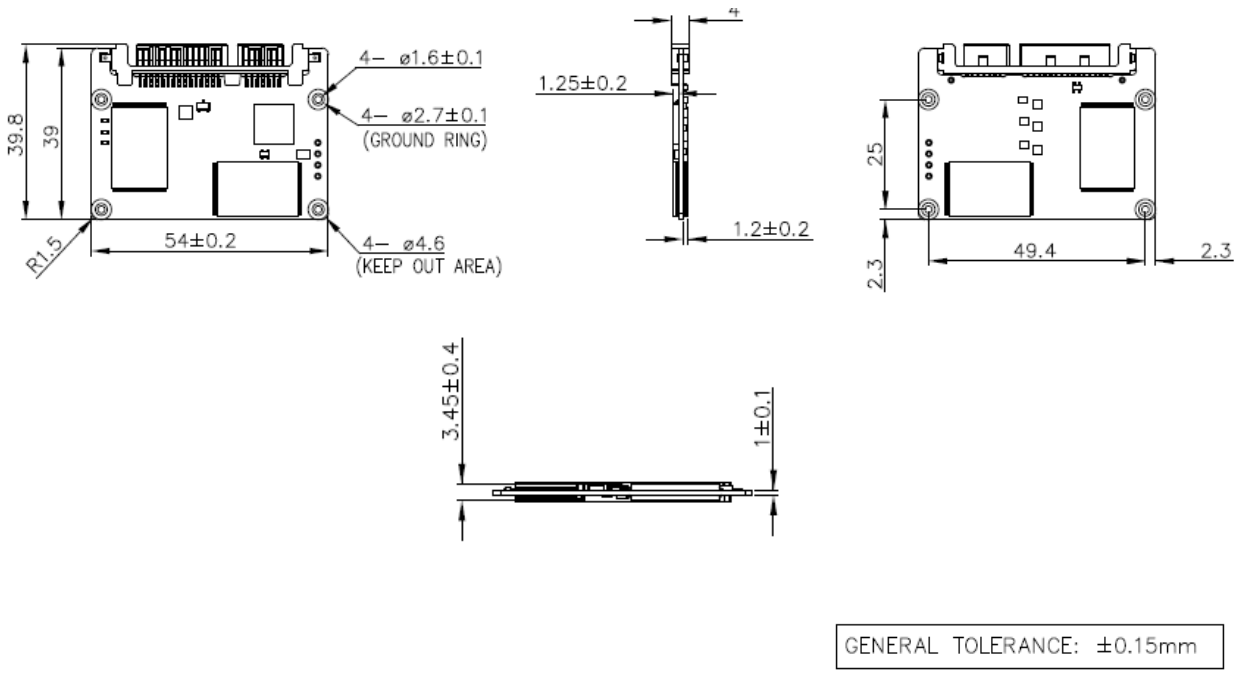
Table 8: Innodisk SATA Slim 3ME3 Pin Assignment

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

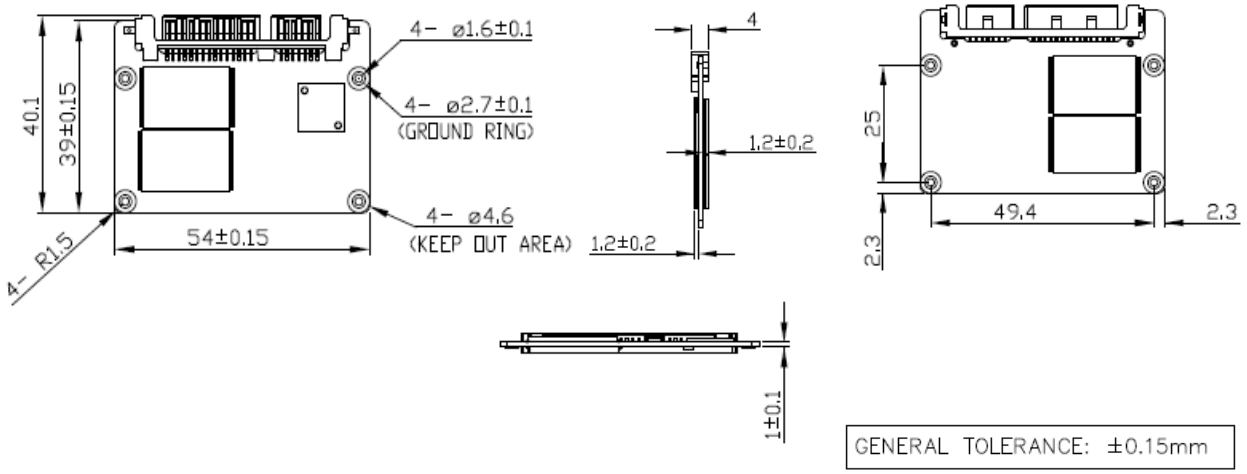
P9	V5	5V Power
P10	GND	NA
P11	DAS/DSS	Device Activity Signal / Disable Staggered
P12	GND	NA
P13	NC	NA
P14	NC	NA
P15	NC	NA

2.10 Mechanical Dimensions

* DESLM-XXXD08S(B)X1XC



* DESLM-XXXD09S(B)X1XC



2.11 Assembly Weight

An Innodisk SATA Slim 3ME3 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 3ME3 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 3ME3 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 3ME3 from the system level, including the major hardware blocks.

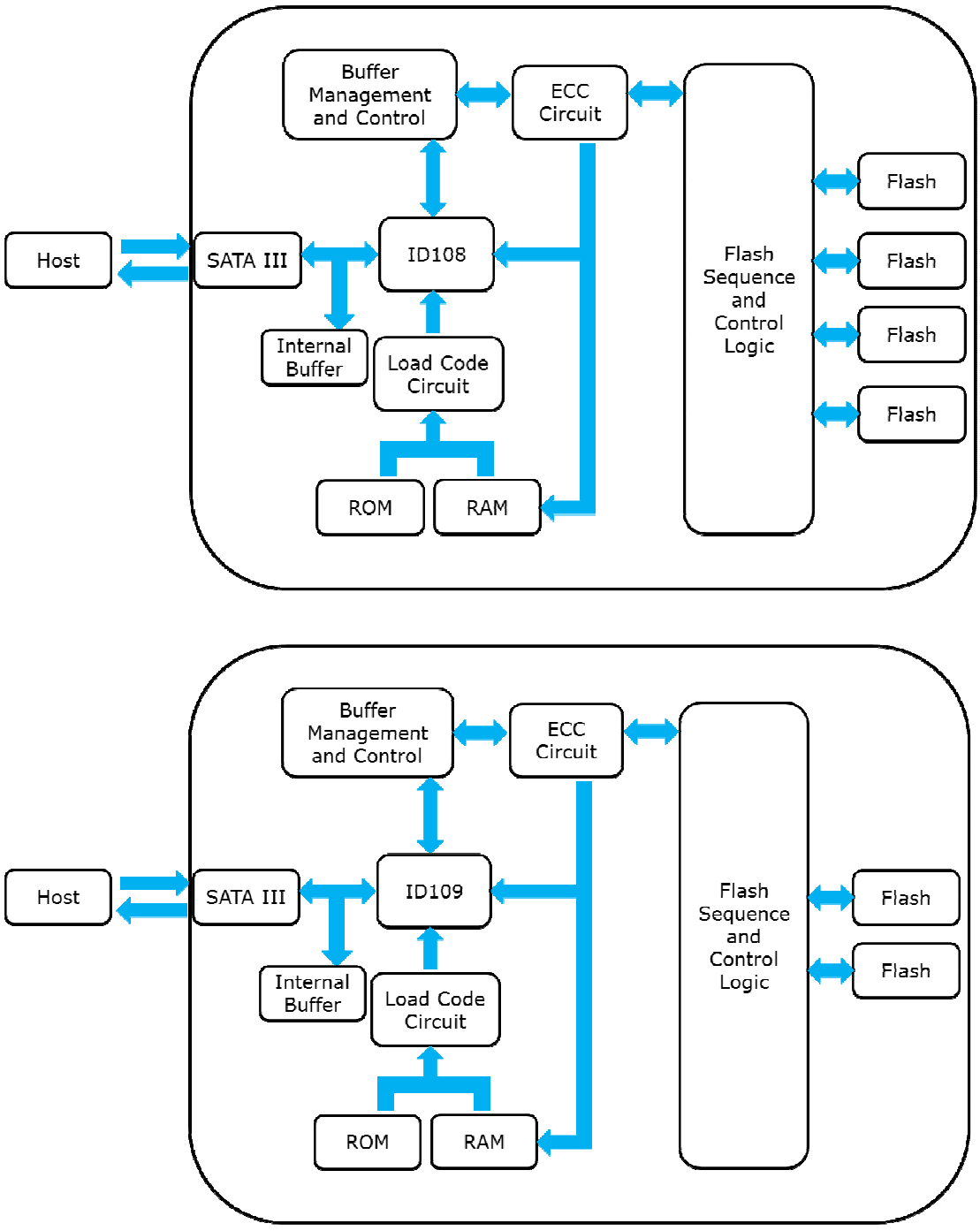


Figure 2: Innodisk SATA Slim 3ME3 Block Diagram

Innodisk SATA Slim 3ME3 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 3ME3 is designed with ID 108, ID 109, 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). ID 108 controller has 4 channels while ID 109 controller has 2 channels for flash interface.

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 3ME3 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.

3.8 QEraser Function (Optional)

QEraser function is designed for emergency data erase in few seconds by providing ATA command.

-Protocol: Non Data Command

-Inputs

Table 9: Execute Quick Erase command for inputs information

Register	7	6	5	4	3	2	1	0
Features	21h							
Sector Count	41h							
LBA Low	Na							
LBA Mid	Na							
LBA High	Na							
Device	1	1	1	0	Na			
Command	82h							

-Normal Outputs

Table 10: Quick Erase command for normal output information

Register	7	6	5	4	3	2	1	0
Error	Na							
Sector Count	Na							
LBA Low	Na							
LBA Mid	Na							
LBA High	Na							
Device	obs	Na	obs	DEV	Na	Na	Na	Na
Status	BSY	DRDY	DF	Na	DRQ	Na	Na	ERR

Device register-

DEV shall specify the selected device.

Status register

BSY will be cleared to zero indicating command completion

DRDY will be set to one.

DF (Device Fault) will be cleared to zero.

DRQ will be cleared to zero

ERR will be cleared to zero.

4. Installation Requirements

4.1 SATA Slim 3ME3 Pin Directions

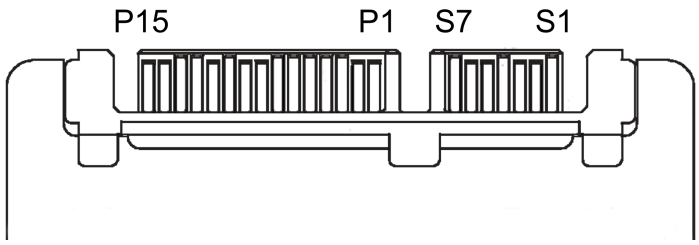


Figure 3: Signal Segment and Power Segment

4.2 Electrical Connections for SATA Slim 3ME3

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 3ME3 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**	**D**	**0**	**8**	**S**	**C**	**1**	**Q**	**C**	**-**	**X**	**X**
Description	Disk	SATA Slim 3ME3					Capacity			Category			Flash Mode	Operation Temp.	Internal Control	CH.	Flash	-	Customized Code	

Definition	
Code 1st (Disk)	**Code 13th (Flash Mode)**
D : Disk	S: Toshiba A19nm Synchronous flash
Code 2nd ~ 5th (Form Factor)	B: Toshiba 15nm Synchronous flash
ESLM: SATA Slim 3ME3	**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: Compliant with MO297
64G: 64GB	
A28: 128GB	
B56: 256GB	**Code 16th (Channel of data transfer)**
	S: Single Channel
	D: Dual Channels
Code 10th ~12th (Series)	Q: Quad Channels
D08: ID108	**Code 17th (Flash Type)**
D09: ID109	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

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

(Company Stamp/公司大小章)

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: 16/05/2014**)。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

(Company Stamp/公司大小章)

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 Standard: 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

Jim Chu / Director

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No. 120, Lane 180, Hsin Ho Rd., Lung-Tan Dist.,
Tao Yuan City 325, Taiwan
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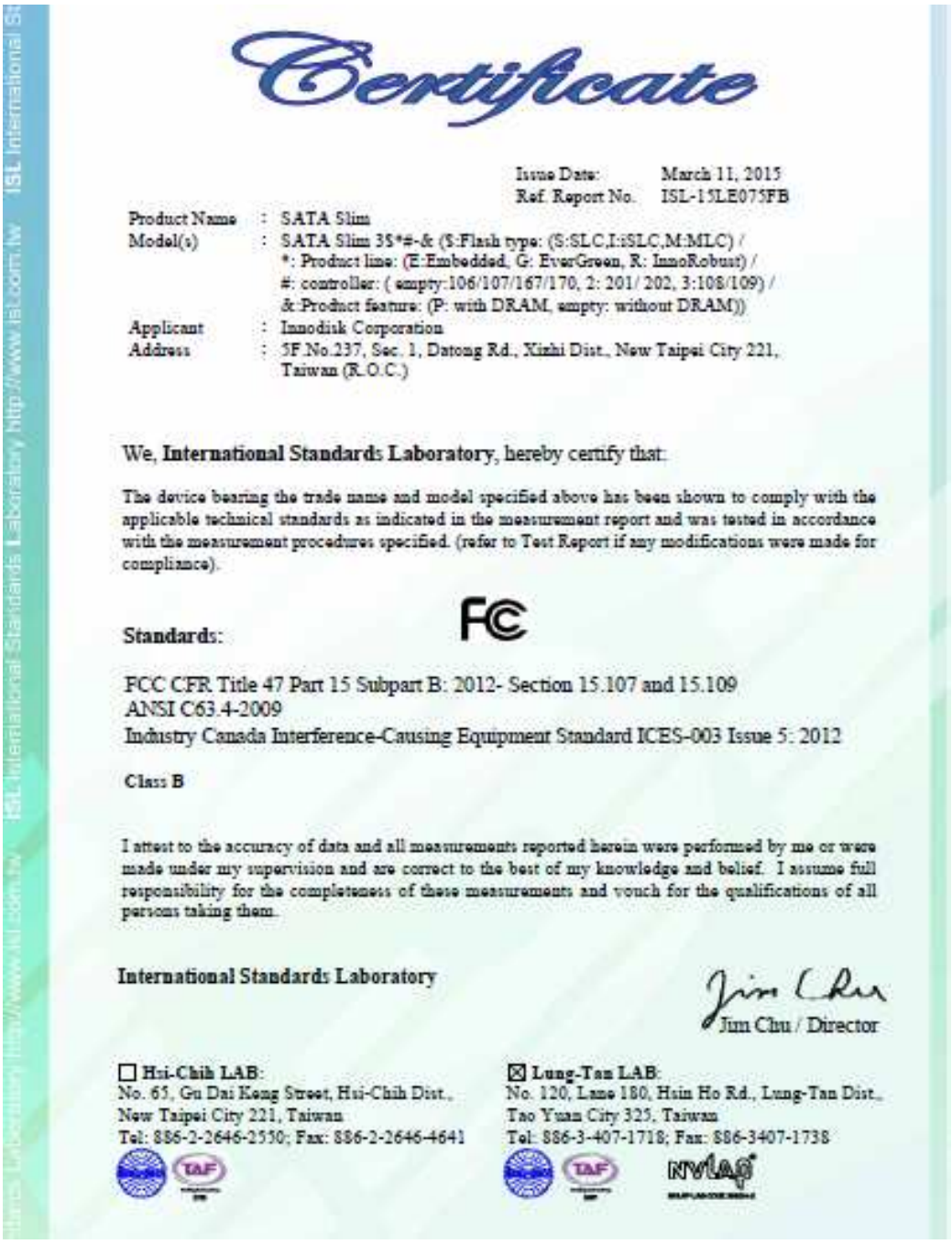

Certificate

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

Product Name	:	SATA Slim
Model(s)	:	SATA Slim 3S*#-& ($: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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