innodisk

Total Solution For Industrial Flash Storage

2.5" SATA SSD

3IE3 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
Rev 1.0	First Released	Jan., 2016
Rev 1.1	Add 16GB with 4 Channel	Mar., 2016
Rev 1.2	Update Part number Rule	May, 2016
Rev 1.3	Update Performance	Aug., 2016
Rev 1.4	Add TRIM introduction	Oct., 2016
Rev 1.4.2	Add different flash configuration of 128GB information	Jun., 2017
Rev 1.5	Update TBW	Mar., 2022
Rev 1.6	Update Assembly Torque Information	Mar., 2023

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1. Product Overview

1.1 Introduction of Innodisk 2.5” SATA SSD 3IE3

iSLC [3IE3 series], designed to outdo the endurance, performance and reliability of MLC-based solutions. Through the use of flash management algorithms, iSLC improves SSD endurance up to 20,000 times, increasing lifespans up to 7 times longer than MLC-based solutions. In addition, iSLC improves the performance of solid state drives, with similar write performance of SLC-based solutions, and with data quality that is on par with SLC technologies. The Innodisk iSLC series is cost efficient, boasting excellent benefits at only half the price of SLC-based solutions. Innodisk 2.5” SATA SSD 3IE3 is SATA III 6Gb/s Flash based disk with iSLC technology, which delivers excellent performance and reliability making it the ideal solution for a variety of applications, including embedded system, industrial computing, and enterprise field. 3IE3 2.5” SSD not only performs unmatched performance, but also designed with Innodisk owned technical knowhow to ensure the data integrity and highest levels of reliability.

1.2 Product View and Models

Innodisk 2.5” SATA SSD 3IE3 is available in follow capacities:

2.5” SATA SSD 3IE3 8GB 2.5” SATA SSD 3IE3 16GB

2.5” SATA SSD 3IE3 32GB 2.5” SATA SSD 3IE3 64GB

2.5” SATA SSD 3IE3 128GB 2.5” SATA SSD 3IE3 256GB

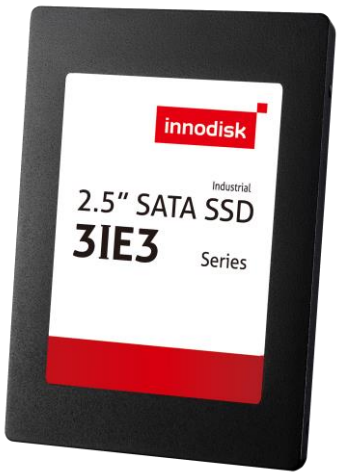


Figure 1: Innodisk 2.5” SATA SSD 3IE3

1.3 SATA Interface

Innodisk 2.5” SATA SSD 3IE3 supports SATA III interface, and compliant with SATA I and SATA II. SATA III interface can work with Serial Attached SCSI (SAS) host system, which is used in server computer. Innodisk 2.5” SATA SSD 3IE3 is 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 2.5-inch Form Factor

The Industry-standard 2.5-inch form factor design with metal material case is easy for installation because 2.5-inch is a popular form factor in industrial field. 2.5-inch is most laptop’s hard disk’s form factor. Innodisk 2.5” SATA SSD 3IE3 can easy install in laptop. Innodisk 2.5” SATA SSD 3IE3 has a compact design 69.85mm (W) x100.10mm (L) x 7mm (H).

2. Product Specifications

2.1 Capacity and Device Parameters

2.5” SATA SSD 3IE3 device parameters are shown in Table 1.

Table 1: Device parameters

Capacity	LBA	Cylinders	Heads	Sectors	User Capacity(MB)
8GB	15649200	13587	16	63	7641
16GB	31277232	16383	16	63	15272
32GB	62533296	16383	16	63	30533
64GB	125045424	16383	16	63	61057
128GB	250069680	16383	16	63	122104
256GB	500118192	16383	16	63	244198

2.2 Performance

Burst Transfer Rate: 6.0Gbps

Table 2: Performance

Capacity: Slim inside	8GB (1CH)	16GB (2CH)	16GB (4CH)	32GB (4CH)	64GB (4CH)	128GB*2 (4CH)	256GB (4CH)
Sequential Read (max.)	110 MB/s	215 MB/s	420 MB/s	420 MB/s	440 MB/s	450 MB/s	440 MB/s
Sequential Write (max.)	50 MB/s	100 MB/s	180 MB/s	180 MB/s	250 MB/s	245 MB/s	250 MB/s
4KB Random Read (QD32)	5,000	8,900	11,700	11,700	11,700	11,000	11,000
4KB Random*1 Write (QD32)	12,200	18,900	29,000	29,000	30,400	30,400	30,400

Note:

1. Performance based on CrystalDiskMark 3.03 with file size 1000MB

2. There are two flash configuration of 128GB: 4pcs 512Gb and 8pcs 256Gb, the performance is the same by different flash configuration.

2.3 Electrical Specifications

2.3.1 Power Requirement

Table 3: Innodisk 2.5” SATA SSD 3IE3 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	390 (max.)
Write	542 (max.)
Idle	104 (max.)

* Target: 2.5” SATA SSD 3IE3 256GB

2.4 Environmental Specifications

2.4.1 Temperature Ranges

Table 5: Temperature range for 2.5” SATA SSD 3IE3

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

2.4.2 Humidity

Relative Humidity: 10-95%, non-condensing

2.4.3 Shock and Vibration

Table 6: Shock/Vibration Testing for 2.5” SATA SSD 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 2.5” SATA SSD 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: 2.5” SATA SSD 3IE3 MTBF

Product	Condition	MTBF (Hours)
Innodisk 2.5” SATA SSD 3IE3	Telcordia SR-332 GB, 25°C	>3,000,000

2.5 CE and FCC Compatibility

2.5” SATA SSD 3IE3 conforms to CE and FCC requirements.

2.6 RoHS Compliance

2.5” SATA SSD 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	
Flash Endurance	20000 P/E cycles	
TBW* (Total Bytes Written)	Unit: TB	
Capacity	**Sequential workload**	**Client workload**
8GB	142	21.7
16GB	284	43.4
32GB	568	86.8
64GB	1136	173.6
128GB	2272	347.2
256GB	4544	694.4

* 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

2.5” SATA SSD 3IE3 support following transfer mode:

Serial ATA III 6.0Gbps

Serial ATA II 3.0Gbps

Serial ATA I 1.5Gbps

2.9 Pin Assignment

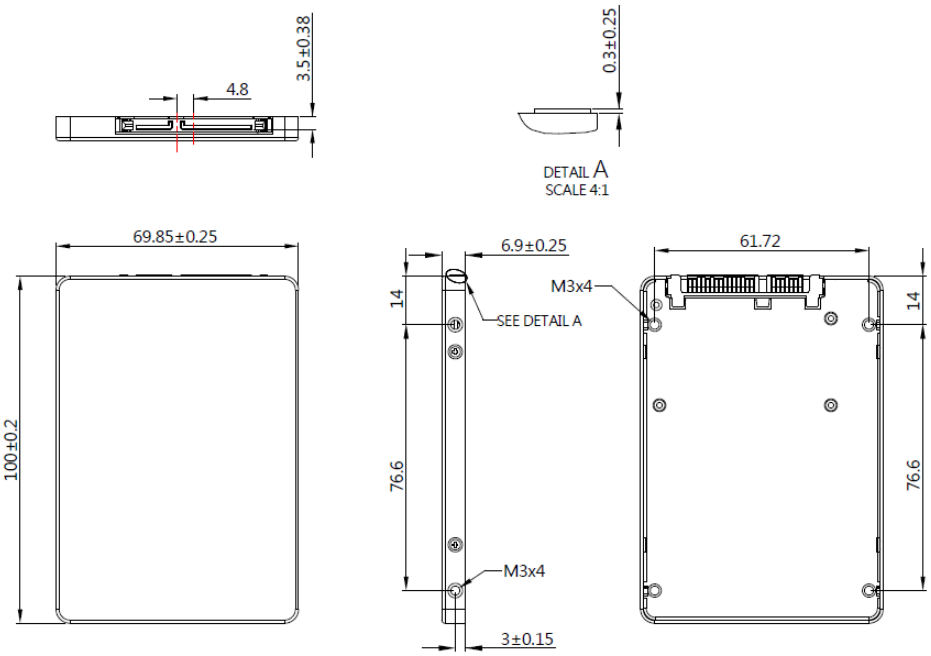
Innodisk 2.5” SATA SSD 3IE3 uses a standard SATA pin-out. See Table 8 for 2.5” SATA SSD 3IE3 pin assignment.

Table 8: Innodisk 2.5” SATA SSD 3IE3 Pin Assignment

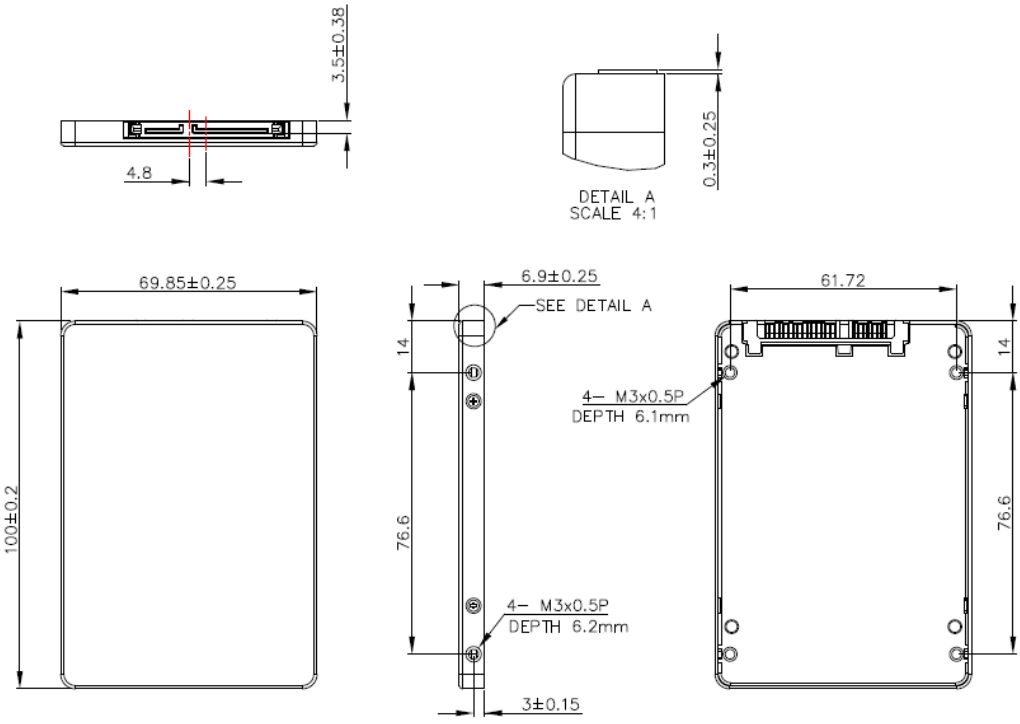
Name	Type	Description
S1	GND	NA
S2	A+	Differential Signal Pair A
S3	A-	
S4	GND	NA
S5	B-	Differential Signal Pair B
S6	B+	
S7	GND	NA
Key and Spacing separate signal and power segments		
P1	NC	NA
P2	NC	NA
P3	NC	NA
P4	GND	NA
P5	GND	NA
P6	GND	NA
P7	V5	5V Power, Pre-Charge
P8	V5	5V Power
P9	V5	5V Power
P10	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

* DHS25-XXXD09BX1XC/ DHS25-XXXD08BX3XC



* DHS25-XXXD08BX1XC



2.11 Assembly Weight

An Innodisk2.5” SATA SSD 3IE3 within iSLC flash ICs, 16GB’s weight is 100 grams approx. The total weight of SSD will be less than 105 grams.

2.12 Seek Time

Innodisk 2.5” SATA SSD 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 2.5” SATA SSD 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 2.5” SATA SSD 3IE3 from the system level, including the major hardware blocks.

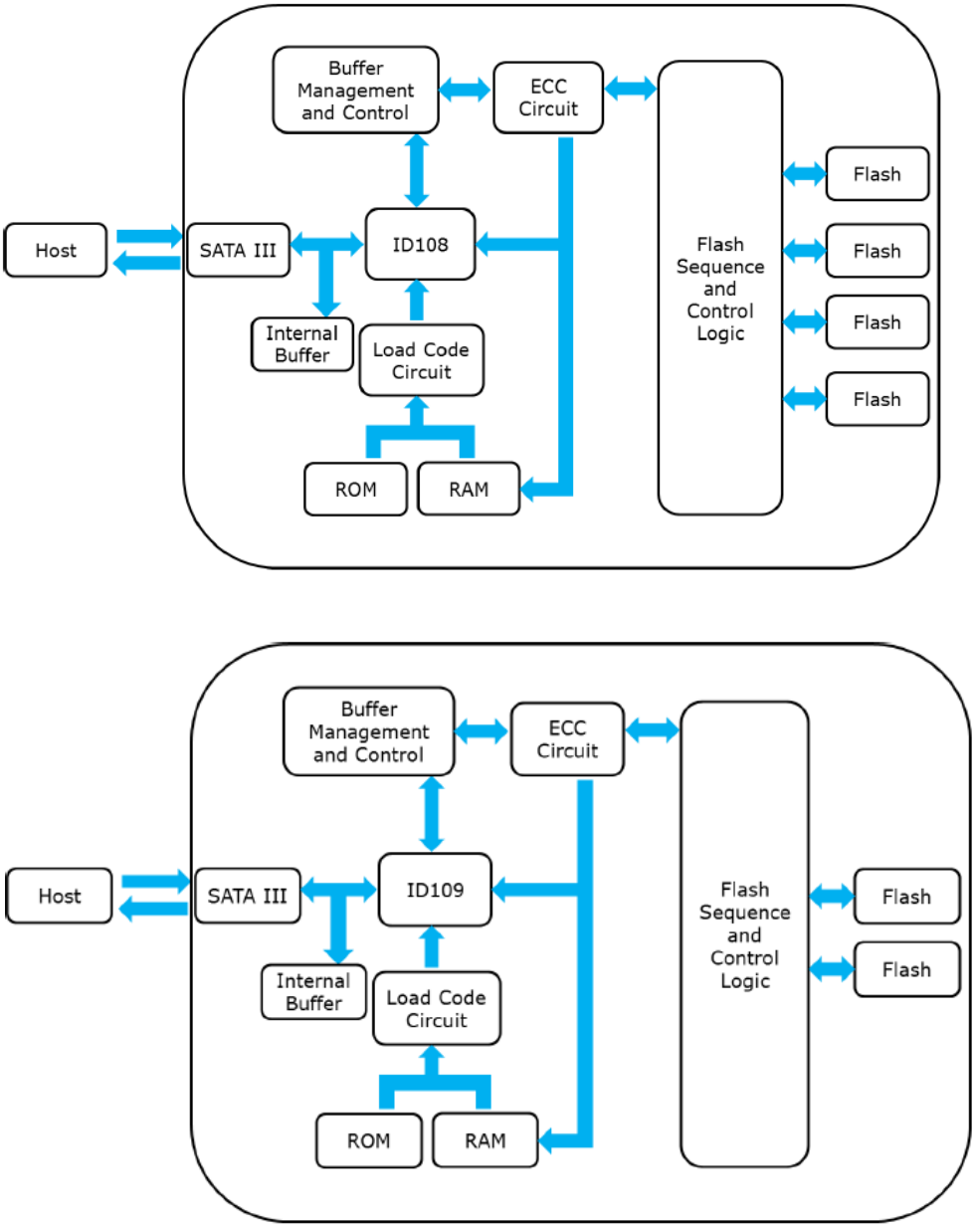


Figure 2: Innodisk 2.5” SATA SSD 3IE3 Block Diagram

Innodisk 2.5” SATA SSD 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 2.5” SATA SSD 3IE3 is designed with ID 109/ID108, a SATA III 6.0Gbps (Gen. 3) controller, which supports external DDDR3 DRAM. 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 4 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 2.5” SATA SSD 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 technology 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 TRIM

The TRIM command is designed to enable the operating system to notify the SSD which pages no longer contain valid data due to erases either by the user or operating system itself. During a delete operation, the OS will mark the sectors as free for new data and send a TRIM command to the SSD to mark them as not containing valid data. After that the SSD knows not to preserve the contents of the block when writing a page, resulting in less write amplification with fewer writes to the flash, higher write speed, and increased drive life.

4. Installation Requirements

4.1 2.5” SATA SSD 3IE3 Pin Directions

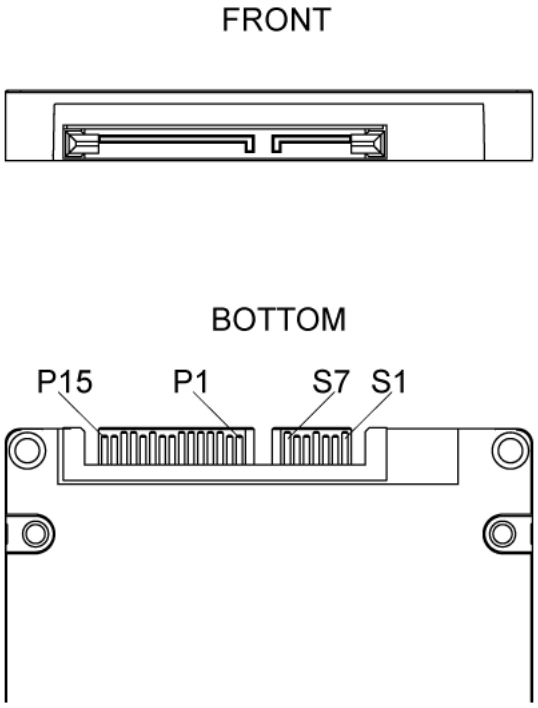


Figure 3: Signal Segment and Power Segment

4.2 Electrical Connections for 2.5” SATA SSD 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 Form Factor

Please prepare following things:

- Screw driver.
- Four M3 screws. (Torque value is 2.0 ~ 2.5 Kgf.cm)
- SATA single cable (7-pin, Maximum length l meter).
- SATA power cable (15-pin).

Please turn off your computer, and open your computer’s case. Find one of available 2.5-inch slot, and plug the SSD in. To use the screws fix the SSD. Plug in the SATA single cable, and power cable. Please boot the installation Operation System from CD-ROM, and install Operation System into SSD.

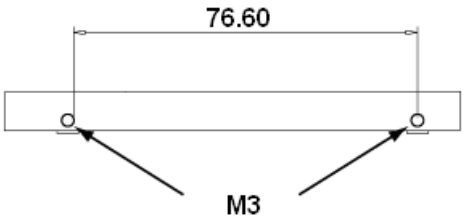


Figure 4: 2.5” SATA SSD 3IE3 Mechanical Screw Hole

4.4 Device Drive

No additional device drives are required. Innodisk 2.5” SATA SSD 3IE3 can be configured as a boot device.

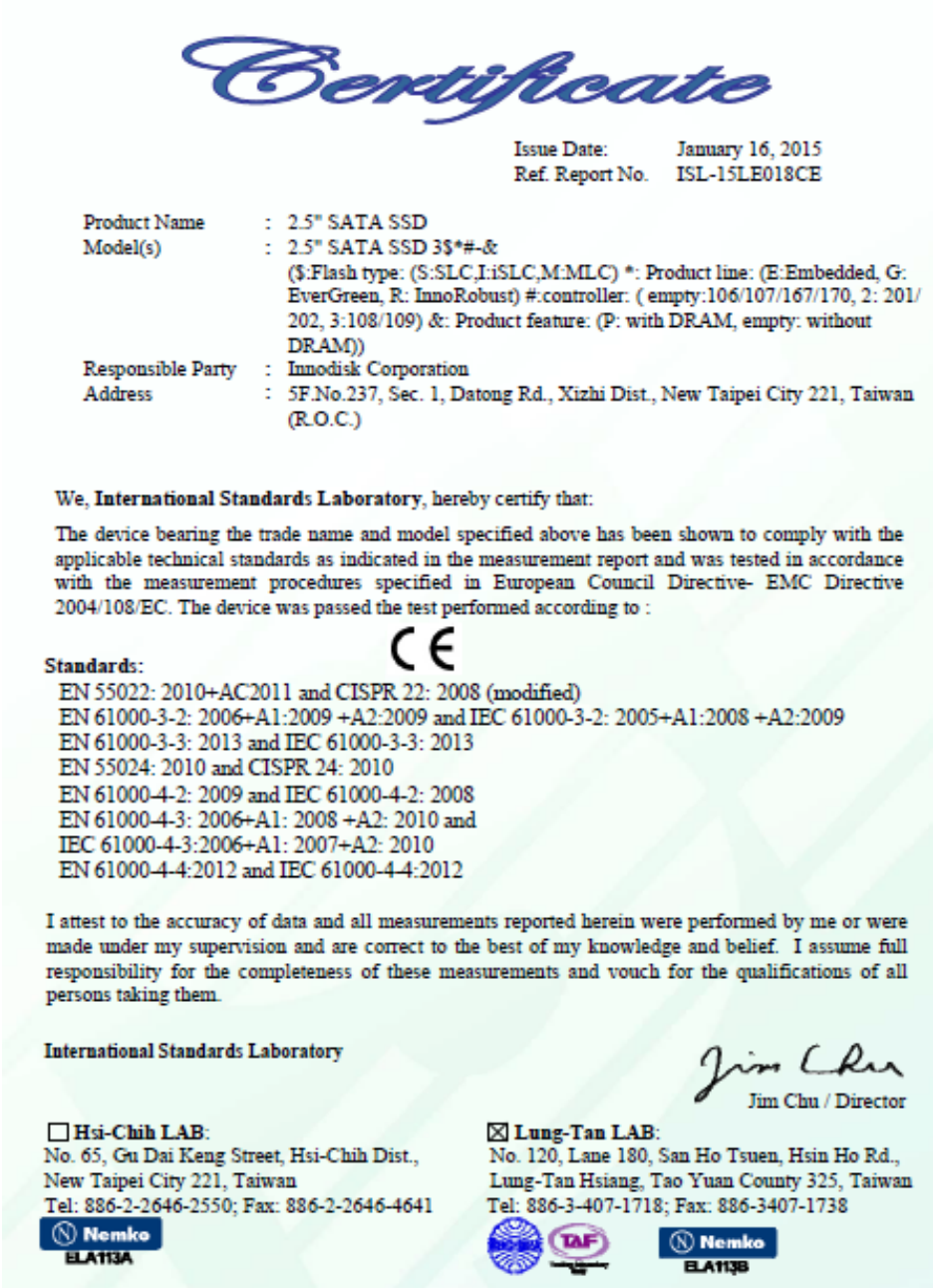
5. Part Number Rule

CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	D	**H**	**S**	**2**	**5**	**-**	**3**	**2**	**G**	**D**	**0**	**8**	**B**	**C**	**1**	**Q**	**C**	**-**	**X**	**X**
Description	Disk	2.5” SATA SSD 3IE3					Capacity			Category			Flash Mode	Operation Temp.	Internal Control	CH.	Flash	-	Customized Code	

Definition

Code 1st (Disk)	**Code 13th (Flash mode)**
D : Disk	B: Synchronous Flash for Toshiba 15nm
Code 2nd	**Code 14th (Operation Temperature)**
H: iSLC	C: Standard Grade (0℃~ +70℃)
Code 3rd ~ 5th (Form Factor)	W: Industrial Grade (-40℃~ +85℃)
S25:2.5” SSD	**Code 15th (Internal control)**
	Code 16th (Channel of data transfer)
Code 7th ~9th (Capacity)	S: Single Channel
08G: 8GB	D: Dual Channels
16G: 16GB	Q: Quad Channels
32G: 32GB	
64G: 64GB	**Code 17th (Flash Type)**
A28: 128GB	C: Toshiba MLC
B56: 256GB	**Code 19th~20th (Customized Code)**
Code 10th ~12th (Series)	
D08: 2.5” SATA SSD 3IE3 (16GB-256GB)	
D09: 2.5” SATA SSD 3IE3 (8GB-16GB)	

6. Appendix



Certificate

Issue Date: January 16, 2015
Ref. Report No. ISL-15LE018CE

Product Name	:	2.5" SATA SSD
Model(s)	:	2.5" SATA SSD 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 :

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 / Director

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TAF Nemko ELA113B

Certificate

Issue Date: January 16, 2015
Ref. Report No. ISL-15LE018FB

Product Name	:	2.5" SATA SSD
Model(s)	:	2.5" SATA SSD 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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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)