innodisk

Total Solution For Industrial Flash Storage

SATADOM-SH

3SE3 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
V 1.0	First Released	Dec. 2016
V 1.1	Revise Introduction/Performance/Power Consumption/Part Number Rule	Mar. 2017
V 1.2	Update RoHS and REACH	Aug. 2017

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1. Product Overview

1.1 Introduction of Innodisk SATADOM-SH 3SE3

Innodisk Serial ATA Disk on Module (SATADOM) supports SATA III standard (6.0Gb/s) interface with excellent performance, and SATADOM-SH 3SE3 is designed as the smallest form factor size that could enhance compatibility with various design applications.

Innodisk's patented Pin7 and Pin 8 SATA power supply technologies use the SATA connector itself as a power supply to drive the device without external power cables. It is a 100% cable-less, shock resistant, space saving and plug-and-play storage solution that optimizes airflow and makes the best use of limited board space in embedded and rackmount server systems.
Innodisk SATADOM-SH 3SE3 effectively reduces the booting time of operation system and the power consumption is less than hard disk drive (HDD), and complies with ATA protocol, no additional drives are required, and can be configured as a boot device or data storage device.

1.2 Product View and Models

Innodisk SATADOM-SH 3SE3 is available in follow capacities within SLC flash ICs.
SATADOM-SH 3SE3 4GB
SATADOM-SH 3SE3 8GB
SATADOM-SH 3SE3 16GB
SATADOM-SH 3SE3 32GB

Figure 1: Innodisk SATADOM-SH 3SE3

1.3 SATA Interface

Innodisk SATADOM-SH 3SE3 supports SATA III interface, and compliant with SATA I and SATA II.

2. Product Specifications

2.1 Capacity and Device Parameters

SATADOM-SH 3SE3 device parameters are shown in Table 1.

Table 1: Device parameters

Capacity	LBA	Cylinders	Heads	Sectors	User Capacity(MB)
4GB	7835184	7773	16	63	3,826
8GB	15649200	15525	16	63	7,641
16GB	31277232	16383	16	63	15,272
32GB	62533296	16383	16	63	30,533

2.2 Performance

Burst Transfer Rate: 6.0Gbps

Table 2: Performance

Capacity	4GB	8GB	16GB	32GB
Sequential* Read (max.)	180 MB/s	180 MB/s	220 MB/s	220 MB/s
Sequential* Write (max.)	60 MB/s	60 MB/s	110 MB/s	110 MB/s
4KB Random** Read (QD32)	9,000 IOPS	9,000 IOPS	10,200 IOPS	10,200 IOPS
4KB Random** Write (QD32)	9,600 IOPS	9,600 IOPS	16,800 IOPS	16,800 IOPS

Note: * Sequential performance is based on CrystalDiskMark 5.1.2 with file size 1000MB

** Random performance is based on IO meter with Queue Depth 32

2.3 Electrical Specifications

2.3.1 Power Requirement

Table 3: Innodisk SATADOM-SH 3SE3 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	55 (max.)
Write	65(max.)
Idle	20 (max.)
Peak Current *	880(max.)

Target: 32GB SATADOM-SH 3SE3

***To design in Pin7/8 VCC on motherboard, 5V with 1A power supply is requested.**

2.4 Environmental Specifications

2.4.1 Temperature Ranges

Table 5: Temperature range for SATADOM-SH 3SE3

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 SATADOM-SH 3SE3

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 SATADOM-SH 3SE3 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: SATADOM-SH 3SE3 MTBF

Product	Condition	MTBF (Hours)
Innodisk SATADOM-SH 3SE3	Telcordia SR-332 GB, 25°C	>3,000,000

2.5 CE and FCC Compatibility

SATADOM-SH 3SE3 conforms to CE and FCC requirements.

2.6 RoHS Compliance

SATADOM-SH 3SE3 is fully compliant with RoHS directive.

2.7 Reliability

Table 8: SATADOM-SH 3SE3 TBW

Parameter	Value
Read Cycles	Unlimited Read Cycles
Wear-Leveling Algorithm	Support
Bad Blocks Management	Support
Error Correct Code	Support
iData Guard	Support
Thermal Sensor	WT only
TBW* (Total Bytes Written)	Unit: TB
4GB	23.4
8GB	46.8
16GB	93.7
32GB	187.5
* Total bytes written is based on JEDEC 218 (Solid-State Drive Requirements and Endurance Test Method)	
** Lifespan is calculated by device written per day	

2.8 Transfer Mode

SATADOM-SH 3SE3 support following transfer mode:

Serial ATA I 1.5Gbps

Serial ATA II 3.0Gbps

Serial ATA III 6.0Gbps

2.9 Pin Assignment

Innodisk SATADOM-SH 3SE3 uses a standard SATA pin-out. See Table 9 for SATADOM-SH 3SE3 pin assignment.

Table 9: Innodisk SATADOM-SH 3SE3 Pin Assignment

Name	Type	Description
Pin 0	GND	Shielding
Pin 1	GND	Shielding
Pin 2	A+	Differential signal to A
Pin 3	A-	Differential signal to A-
Pin 4	GND	Shielding
Pin 5	B-	Differential signal to B-
Pin 6	B+	Differential signal to B
Pin 7	GND/ Vcc*	Shielding/ +5V Power*
Pin 8	VCC	+5V Power

*** SATADOM-SV 3SE3 default power supply through pin 8 or extra power cable.**

Pin 7 power supply as an optional function with separated PN end of B.

2.10 Mechanical Dimensions

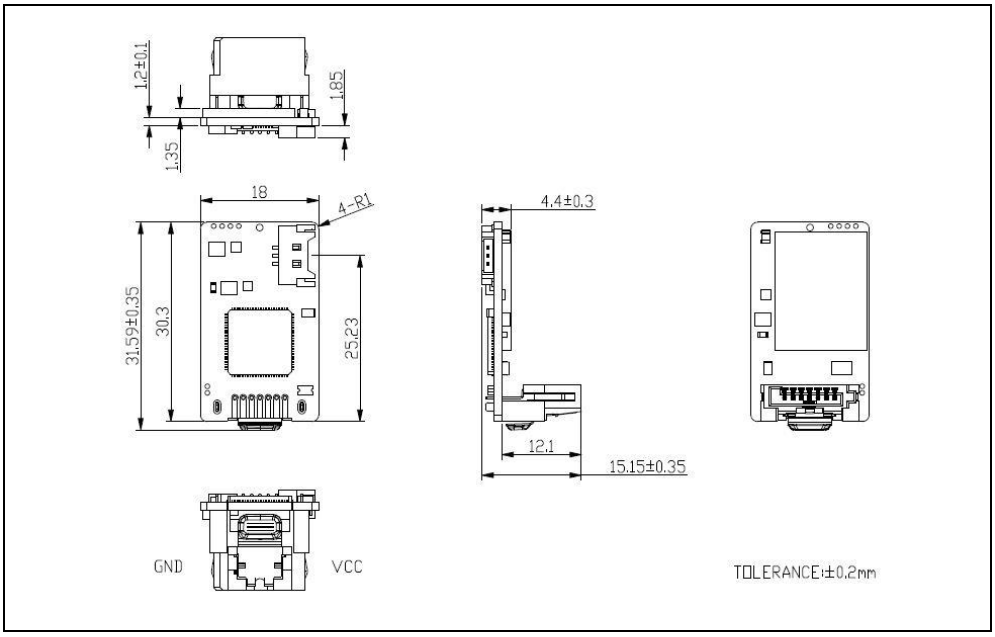

Figure 2: Innodisk SATADOM-SH 3SE3 mechanical diagram

2.11 Assembly Weight

An Innodisk SATADOM-SH 3SE3 within flash ICs, 32GB's weight is 7 grams approximately.

2.12 Seek Time

Innodisk SATADOM-SH 3SE3 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 SATADOM-SH 3SE3 uses Single Level Cell (SLC) NAND flash memory, which is non-volatility, high reliability and high speed memory storage. Each cell stores 1 bits or holds four states per cell. Read or Write data to flash memory for SSD is control by microprocessor.

3. Theory of Operation

3.1 Overview

Figure 2 shows the operation of Innodisk SATADOM-SH 3SE3 from the system level, including the major hardware blocks.

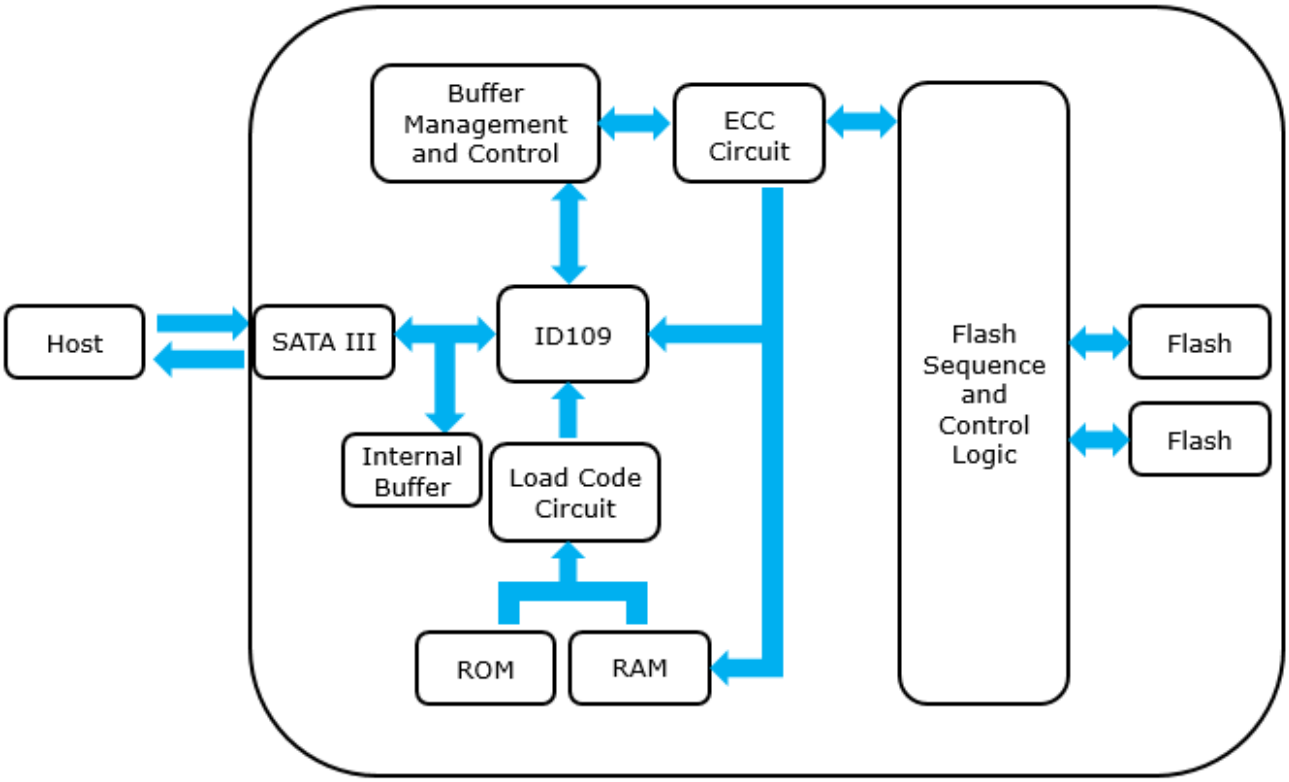

Figure 3: Innodisk SATADOM-SH 3SE3 Block Diagram

Innodisk SATADOM-SH 3SE3 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 SATADOM-SH 3SE3 is designed with ID109, 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

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 40bits per 1024bytes 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 SATADOM-SH 3SE3 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 Power Cycling

Innodisk's power cycling management 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 power cycling 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 SATADOM-SH 3SE3 Pin Directions

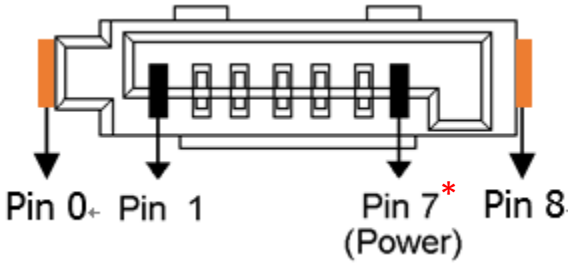

Figure 4: Signal Segment and Power Segment

*** SATADOM-SH 3SE3 default power supply through pin 8 or extra power cable.**

Pin 7 power supply as an optional function with separate PN end of B.

4.2 Electrical Connections for SATADOM-SH 3SE3

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 1 meter. 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. The Innodisk SATADOM-SH 3SE3 can be configured as a boot device.

4.4 Power supply for SATDOM

4.4.1 Power cable

A power cable is shipped with each SATADOM product, which has standard 4 pins power connector and special 3 pins power connector for SATADOM. The male and female power connector of SATADOM have foolproof design to avoid misconnection, please check it before power on. Innodisk also can customize the power connector for different host power socket design.

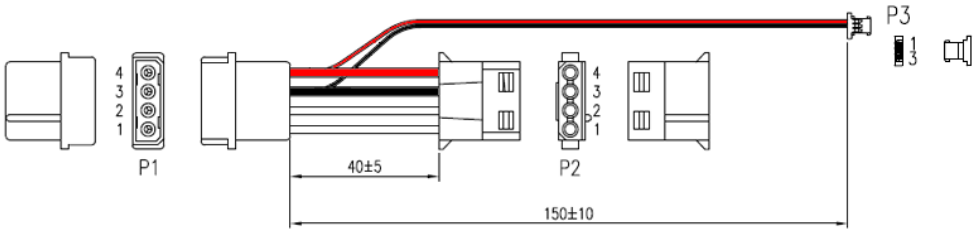

Figure 5: Standard power cable

4.4.2 Pin8 and Pin7 VCC

Innodisk's SATADOM SSDs provide an elegant, compact option for SSD storage in embedded systems, industrial PCs and server motherboards with their small form factor that connects directly to the SATA connector on the motherboard. This simplified SSD design not only frees up a precious drive bay for other storage options but eliminates messy, obtrusive SATA data cabling. Innodisk's patented Pin7 and Pin 8 SATA Power technologies take the cable-less concept to the next step by also eliminating the need for power cables for a 100% cable-less, shock resistant, space saving plug-and-play storage solution that optimizes airflow and makes the best use of limited board space in embedded and rackmount server systems.

SATADOM-SH 3SE3 series with Pin8/Pin7 VCC, it is defined Pin8/Pin7 as VCC on the SATA connector. Thus the power would come from SATA connector Pin8/Pin7 VCC. Customers DO NOT have to use the power cable for power supply. Such a cable-less design of SATADOM-SH 3SE3 series with Pin8/Pin7 VCC brings more convenience to customers' system. The followings are the points customers have to be careful of while designing in SATADOM-SH 3SE3 series with Pin8/Pin7 VCC.

When customers use SATADOM with Pin8/Pin7 VCC and the host SATA socket does not have power on Pin8/Pin7, external power must be provided to the SATADOM from the 3pin connector on the side.To have the advantages of SATADOM-SH 3SE3 series with Pin8/Pin7 VCC, and to avoid any potential damage on customer's board designed with VCC power supply. Innodisk suggests that customers MUST design their board with a fuse which should be designed before the SATA socket Pin8/Pin7 VCC. In other words, customers are suggested NOT TO layout 5V VCC to SATA socket on board directly. A circuit diagram example to explain this is shown as below.

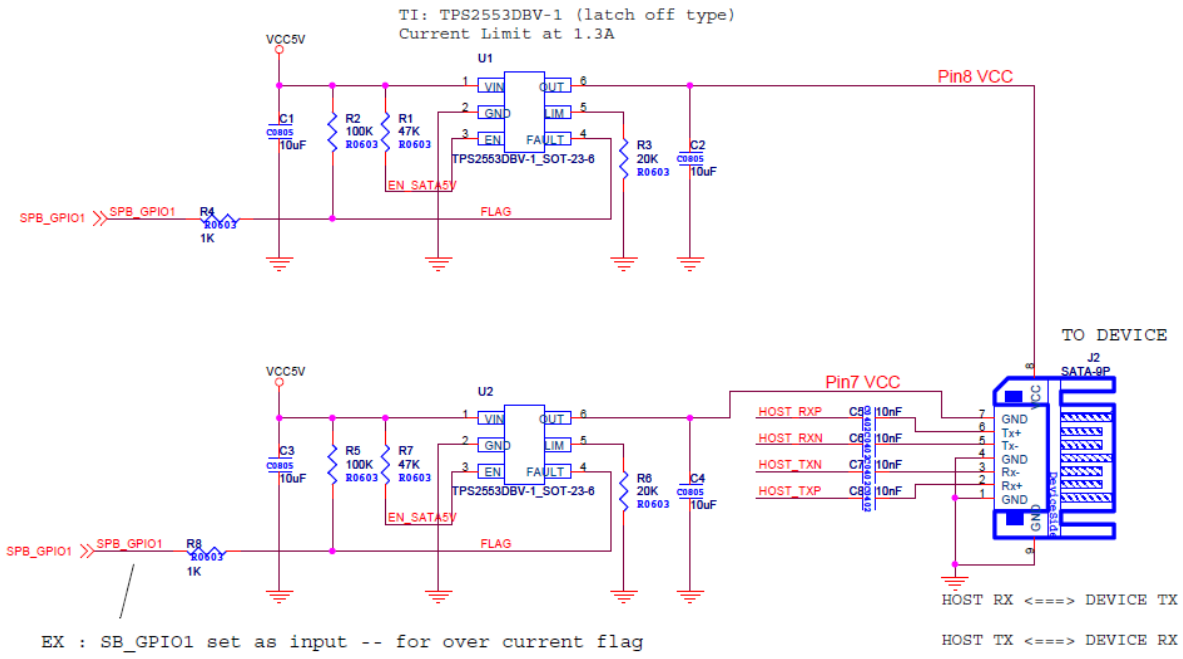

Figure 6: Pin 8 / Pin 7 host design in reference circuit

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	21
	D	**E**	**S**	**S**	**H**	**-**	**3**	**2**	**G**	**D**	**0**	**9**	**S**	**C**	**A**	**D**	**B**	**A**	**X**	**X**	**X**

Definition					
Code 1st (Disk)				**Code 14th (Operation Temperature)**	
D: Disk				C: Standard Grade (0℃~ +70℃)	
Code 2nd (Feature set)				W: Industrial Grade (-40℃~ +85℃)	
E: Embedded series				**Code 15th (Internal control)**	
Code 3rd ~5th (Form factor)				A~Z: BGA PCB version	
SSH: SATADOM-SH				**Code 16th (Channel of data transfer)**	
Code 7th ~9th (Capacity)				D: Dual Channels	
04G:4GB	08G:8GB	16G:16GB	32G:32GB		
				Code 17th (Flash Type)	
Code 10th ~12th (Controller)				B: Toshiba SLC	
D09: ID109				**Code 18th (pin7 type)**	
				A: Pin8 version / Standard version	
Code 13th (Flash mode)				B: Pin8 & Pin7 version	
S: Synchronous flash				**Code 19th~21st (Customize code)**	

6. Appendix

CE

Certificate

Issue Date: August 3, 2015
Ref. Report No. ISL-15LE336CE

Product Name : SATADOM-SH
Model(s) : SATADOM-SH 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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Tao Yuan City 325, Taiwan
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FCC

Certificate

Issue Date: August 3, 2015
Ref. Report No. ISL-15LE336FB

Product Name	:	SATADOM-SH
Model(s)	:	SATADOM-SH 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: 2014- 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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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

RoHS

innodisk

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 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