innodisk

Total Solution For Industrial Flash Storage

2.5" PATA SSD

1SE 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	Oct., 2013
Rev 1.0	Add 256GB Add CE/FCC certification	Feb., 2014
Rev 1.1	Modify TBW based on NAND Flash specifications	Jan., 2015
Rev 1.2	Add 4GB information	May, 2015

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1. Product Overview

1.1 Introduction of Innodisk 2.5” PATA SSD 1SE

Innodisk 2.5” PATA SSD 1SE products provide high capacity flash memory Solid State Drive (SSD) that electrically complies with ATA 7 standard, and supports Ultra DMA (0-5) and PIO (0-4) transfer modes. 2.5” PATA SSD 1SE is designed for industrial applications, and supports several features, including NCQ and S.M.A.R.T. Innodisk 2.5” PATA SSD 1SE are designed to have good performance with no latency. It will effectively reduce the boot up time of the operation system. The power consumption is also much lower than a traditional hard disk drive (HDD).

1.2 Product View and Models

Innodisk 2.5” PATA SSD 1SE is available in follow capacities:

2.5” PATA SSD 1SE 8GB
2.5” PATA SSD 1SE 16GB
2.5” PATA SSD 1SE 32GB
2.5” PATA SSD 1SE 64GB
2.5” PATA SSD 1SE 128GB
2.5” PATA SSD 1SE 256GB

Figure 1: Innodisk 2.5” PATA SSD 1SE

2. Product Specifications

2.1 Capacity and Device Parameters

2.5" PATA SSD 1SE device parameters are shown in Table 1.

Table 1: Device parameters

Capacity	LBA	Cylinders	Heads	Sectors	User Capacity(MB)
4GB	7835184	7773	16	63	3826
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: Ultra DMA 5

Table 2: Performance

Capacity	4GB	8GB	16GB	32GB	64GB	128GB	256GB
Sequential Read (max.)	45 MB/sec	90 MB/sec	90 MB/sec	90 MB/sec	90 MB/sec	90 MB/sec	90 MB/sec
Sequential Write (max.)	20 MB/sec	45 MB/sec	90 MB/sec	90 MB/sec	90 MB/sec	90 MB/sec	74 MB/sec

Note: Base on CrystalDiskMark 3.01 with file size 1000MB

2.3 Electrical Specifications

2.3.1 Power Requirement

Table 3: Innodisk 2.5" PATA SSD 1SE 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	290 (max.)
Write	355 (max.)
Idle	200 (max.)

* Target: 2.5" PATA SSD 1SE 128GB

2.4 Environmental Specifications

2.4.1 Temperature Ranges

Table 5: Temperature range for 2.5" PATA SSD 1SE

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 2.5" PATA SSD 1SE

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" PATA SSD 1SE 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” PATA SSD 1SE MTBF

Product	Condition	MTBF (Hours)
Innodisk 2.5” PATA SSD 1SE	Telcordia SR-332 GB, 25°C	>3,000,000

2.5 CE and FCC Compatibility

2.5” PATA SSD 1SE conforms to CE and FCC requirements. See Appendix for documentation.

2.6 RoHS Compliance

2.5” PATA SSD 1SE is fully compliant with the RoHS directive.

2.7 Reliability

Parameter	Value
Read Cycles	Unlimited Read Cycles
Wear-Leveling Algorithm	Supported
Bad Blocks Management	Supported
Error Correct Code	Supported
TBW (Unit: TB)	
4GB	216(Sequential Write)
8GB	432 (Sequential Write)
16GB	864 (Sequential Write)
32GB	1728 (Sequential Write)
64GB	3456 (Sequential Write)
128GB	6912 (Sequential Write)

2.8 Transfer Mode

2.5” PATA SSD 1SE support following transfer mode:

- PIO Mode 0~4
- Ultra DMA 0~5

2.9 Pin Assignment

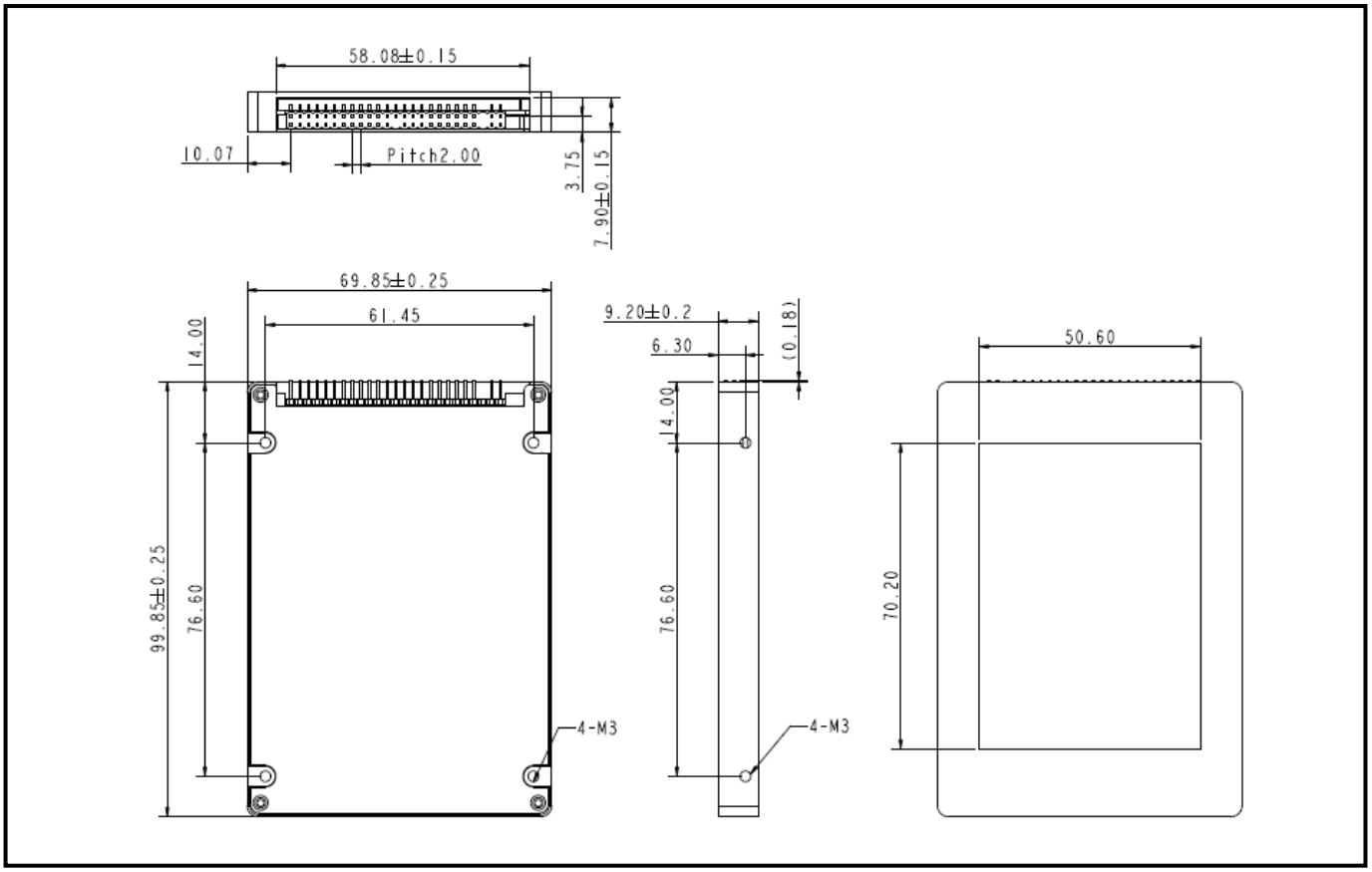
Innodisk 2.5” PATA SSD 1SE uses the standard ATA pin-out. See Table 8 for 2.5” PATA SSD 1SE pin assignment.

Table 8: Innodisk 2.5” PATA SSD 1SE Pin Assignment

Pin No.	Name	Function	Pin No.	Name	Function
1	HRESET	Host Reset	2	GND	Ground
3	HDB[7]	Host Data Bit 7	4	HDB[8]	Host Data Bit 8
5	HDB[6]	Host Data Bit 6	6	HDB[9]	Host Data Bit 9

7	HDB[5]	Host Data Bit 5	8	HDB[10]	Host Data Bit 10
9	HDB[4]	Host Data Bit 4	10	HDB[11]	Host Data Bit 11
11	HDB[3]	Host Data Bit 3	12	HDB[12]	Host Data Bit 12
13	HDB[2]	Host Data Bit 2	14	HDB[13]	Host Data Bit 13
15	HDB[1]	Host Data Bit 1	16	HDB[14]	Host Data Bit 14
17	HDB[0]	Host Data Bit 0	18	HDB[15]	Host Data Bit 15
19	GND	Ground	20	KEY	Key-pin
21	DMARQ	DMA Request	22	GND	Ground
23	HIOW1 STOP2	Host I/O Write Stop Ultra DMA burst	24	GND	Ground
25	HIOR1 HDMARDY2 HSTROBE2	Host I/O Read Ultra DMA ready Ultra DMA data strobe	26	GND	Ground
27	IORDY1 DDMARDY2 DSTROBE2	I/O Ready Ultra DMA ready Ultra DMA data strobe	28	CSEL	Master/Slave Select
29	DMACK	DMA Acknowledge	30	GND	Ground
31	INTRQ	Interrupt Request	32	IOCS16	CS I/O 16-Bit
33	HAB[1]	Host Address Bit 1	34	PDIAG	Passed Diagnostic
35	HAB[0]	Host Address Bit 0	36	HAB[2]	Host Address Bit 2
37	CS0	Chip Select 0	38	CS1	Chip Select 1
39	DASP	Drive Active	40	GND	Ground
41	VCC	Supply Voltage	42	VCC	Supply Voltage
43	GND	Ground	44	NC	Not Connected
A	N/A	Master/Slave	B	N/A	Master/Slave
C	N/A		D	N/A	

2.10 Mechanical Dimensions



2.11 Assembly Weight

The Innodisk2.5” PATA SSD 1SE with SLC flash ICs weighs approximately 100 grams for 16GB capacities. The total weight of SSD will be less than 135 grams.

2.12 Seek Time

Innodisk 2.5” PATA SSD 1SE does not have magnetic rotating motor so there is no seek or rotational latency for this drive.

2.13 NAND Flash Memory

Innodisk 2.5” PATA SSD 1SE uses Single Level Cell (SLC) NAND flash memory, which is non-volatility and high reliability.

3. Theory of Operation

3.1 Overview

Figure 2 shows the operation of Innodisk 2.5” PATA SSD 1SE from the system level, including the major hardware blocks.

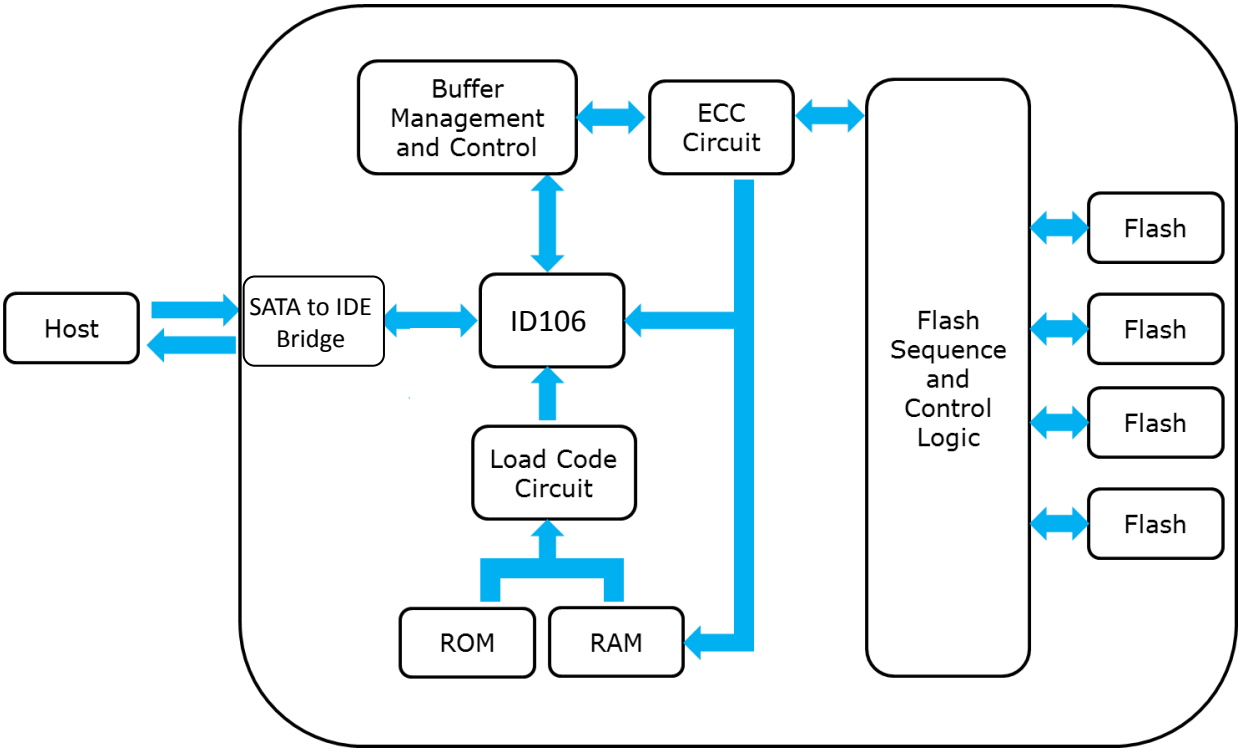


Figure 2: Innodisk FiD 2.5” PATA SSD 1SE Block Diagram

Innodisk 2.5” PATA SSD 1SE integrates a SATA to IDE Bridge, SATA III controller and NAND flash memories. Communication with the host occurs through the host interface using standard ATA protocol. Communication with the flash memory occurs through Innodisk’s SATA III controller.

3.2 NAND Flash Controller

Innodisk 2.5” PATA SSD 1SE is designed with ID 106, a SATA III 6.0Gbps (Gen. 3) controller. The controller has a four channel bandwidth for accessing the NAND flash memory.

3.3 Error Detection and Correction

Highly sophisticated Error Correcting Code algorithms are implemented into the controller. The ECC unit consists of the parity unit (parity-byte generation) and the syndrome unit (syndrome-byte computation). These units implement 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 decrease in performance.

3.4 Wear-Leveling

Flash memory can be only be erased a limited number of times. This number is called the ***erase cycle limit*** or ***write endurance limit*** and is defined by the NAND flash memory vendor. The erase cycle limit applies to each individual block in the flash device.

Innodisk 2.5" PATA SSD 1SE 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 data usage evenly across all blocks while prolonging the lifecycle of the NAND flash memory.

3.5 Bad Blocks Management

Bad Blocks are blocks that contain one or more invalid bits whose reliability are not guaranteed. Bad Blocks may be present when the SSD is shipped, and may also develop over the lifetime of the SSD. When Bad Blocks are detected, it will be flagged so that block will not be used anymore. Bad Block management, Bad Block replacement, and Error Correcting Code are implemented to avoid storing/accessing data errors. These functions are enabled automatically to transfer data from Bad Blocks to spare blocks, and also correct error bits.

3.6 Power Cycling

Innodisk's power cycling management is a complete data protection system that functions before and after a sudden loss of power to Innodisk's SSD. A Low-power detection circuit terminates data writes before an abnormal power cycle. Once power is restored, table-remapping deletes corrupted data to maintain data integrity. Innodisk's power cycling management also prevents data stored in flash from degrading overtime.

3.7 Garbage Collection

Garbage collection is used to maintain performance consistency by continuously cleaning blocks marked for deletion on SSDs. The garbage collection runs as a background process to have a minimal impact on the controller's resources while combining valid data into available blocks, and erasing blocks marked for deletion. This process also significantly reduces write operations to the

drive, thereby increasing the SSD’s lifespan.

4. Installation Requirements

4.1 2.5” PATA SSD 1SE Pin Directions

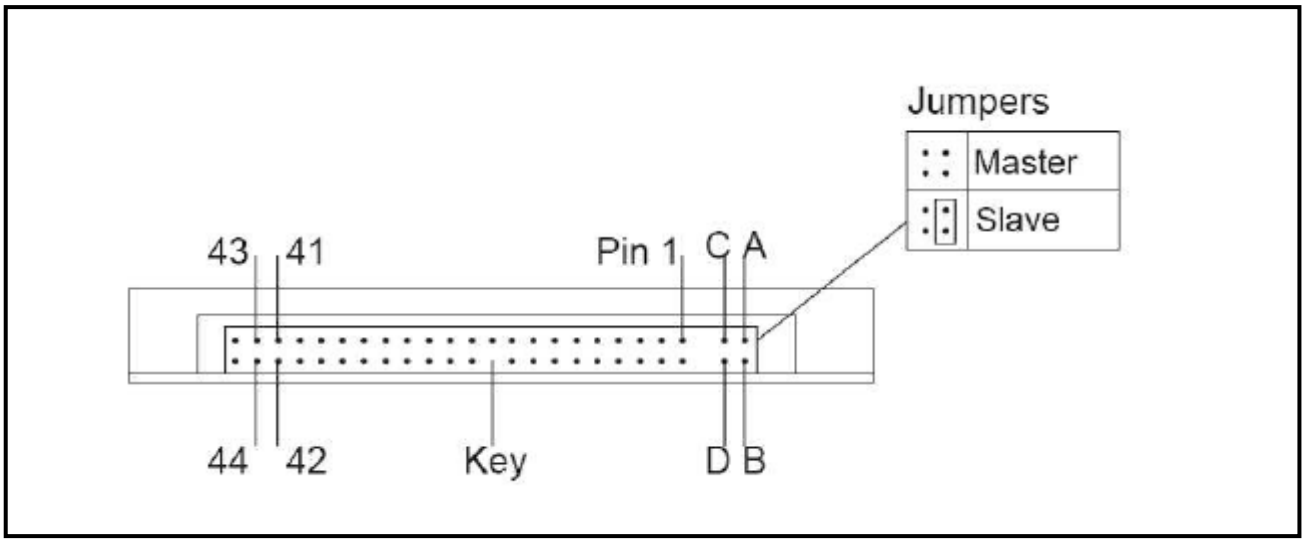


Figure 3: Signal Segment and Power Segment

4.2 Electrical Connections for 2.5” PATA SSD 1SE

2.5” PATA SSD is design with an IDE 2.00mm pin pitch interface connector and thus which can be directly connected to an IDE host or to a female 44pin connector and then to a host. For the connection through a cable, it is suggested that the cable should be no longer than 1SE.

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**	**P**	**2**	**5**	**-**	**3**	**2**	**G**	**D**	**0**	**6**	**A**	**C**	**1**	**Q**	**B**	**-**	**X**	**X**
Description	Disk	2.5" PATA SSD 1SE					Capacity			Category			Flash Mode	Operation Temp.	Internal Control	CH.	Flash	-	Customized Code	

Definition	
Code 1st (Disk)	**Code 13th (Firmware version)**
D : Disk	A: Asynchronous Flash
Code 2nd	**Code 14th (Operation Temperature)**
E: Embedded	C: Standard Grade (0℃~ +70℃)
	W: Industrial Grade (-40℃~ +85℃)
Code 3rd ~ 5th (Form Factor)	
P25:2.5" PATA SSD	**Code 15th (Internal control)**
	Code 16th (Channel of data transfer)
Code 7th ~9th (Capacity)	Q: Quad Channels
04G: 4GB	
08G: 8GB	
16G: 16GB	**Code 17th (Flash Type)**
32G: 32GB	B: Toshiba SLC
64G: 64GB	**Code 19th~20th (Customized Code)**
A28: 128GB	
B56: 256GB	
Code 10th ~12th (Series)	
D06: 2.5" PATA SSD 1SE	

6. Appendix

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宜鼎國際股份有限公司
Innodisk Corporation

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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: 16/06/2014**)。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。

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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: January 6, 2014
Ref. Report No. ISL-14HE004CE

Product Name : 2.5 PATA SSD 1SE/1ME, 2.5 PATA SSD 1SR-P
Model : DEP25-XXXD06*#%※&
Responsible Party : Innodisk Corporation
Address : 9F, No. 100, Sec. 1 Xintai 5th Rd., Xizhi City, Taipei 221, Taiwan

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 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: 2008 and IEC 61000-3-3: 2008
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: 2004 +A1:2010 and IEC 61000-4-4: 2004 +A1:2010

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

☒ **Hsi-Chih LAB**:
No. 65, Gu Dai Keng St., Hsichih District,
New Taipei City 22179, Taiwan
Tel: 886-2-2646-2550; Fax: 886-2-2646-4641

Nemko
ELA113A

Certificate

Issue Date: January 6, 2014
Ref. Report No. ISL-14HE004FB

Product Name	:	2.5 PATA SSD 1SE/1ME, 2.5 PATA SSD 1SR-P
Model	:	DEP25-XXXD06* #%※&
Applicant	:	Innodisk Corporation
Address	:	9F, No. 100, Sec. 1 Xintai 5th Rd., Xizhi City, Taipei 221, Taiwan

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: 2010- 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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