innodisk

Mini PCIeDOM
1SE Series

Customer:

Customer Part Number:

InnoDisk Part Number:

InnoDisk Model Name:

Date:

Remark:

InnoDisk Approver	Customer Approver

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Rev. 1.3   TPS, Nov., 2015

REVISION HISTORY

Revision	Description	Date
Preliminary	First Released	Mar., 2014
Rev. 1.0	Performance update Remove SPEC. of 2GB Add RoHS Declaration of Conformity	Mar., 2014
Rev. 1.1	Correct pin assignment	May, 2014
Rev. 1.2	Wording correction	July, 2014
Rev. 1.3	Add 2GB	Nov., 2015

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1. Product Overview

1.1 Introduction of InnoDisk Mini PCIeDOM 1SE

InnoDisk Mini PCIeDOM 1SE is a Flash based disk module with Mini PCI Express interface, which brings you new generation of storage solution, especially focused on embedded systems. It not only provide standard Mini PCIe interface but also delivers excellent performance.

Comparing with most Mini PCIe storage devices in the market, Mini PCIeDOM 1SE comes with standard PCI Express interface, just plug and play without any circuit modification, and no driver needed, which is the easiest way for board maker or system integrator to design in the product as a boot drive or storage device.

1.2 Product View and Models

Innodisk Mini PCIeDOM 1SE is available in follow capacities:

Mini PCIeDOM 1SE 2GB   Mini PCIeDOM 1SE 16GB
Mini PCIeDOM 1SE 4GB   Mini PCIeDOM 1SE 32GB
Mini PCIeDOM 1SE 8GB   Mini PCIeDOM 1SE 64GB

Figure 1: Innodisk Mini PCIeDOM 1SE

1.3 PCI Express Interface

Innodisk Mini PCIeDOM 1SE supports PCIe Gen.1 interface, 1 lane.

2. Product Specifications

2.1 Capacity and Device Parameters

Mini PCIeDOM 1SE device parameters are shown in Table 1.

Table 1: Device parameters

Capacity	LBA	Cylinders	Heads	Sectors	User Capacity(MB)
2GB	3928176	3897	16	63	1,918
4GB	7835184	7773	16	63	3826MB
8GB	15649200	15525	16	63	7641MB
16GB	31277232	16383	16	63	15272MB
32GB	62533296	16383	16	63	30533MB
64GB	125045424	16383	16	63	61057MB

2.2 Performance

Burst Transfer Rate: 2.5 Gbps

Table 2: Performance

Capacity	2GB	4GB	8GB	16GB	32GB	64GB
Sequential Read (max.)	60 MB/sec	75 MB/sec	80 MB/sec	85 MB/sec	85 MB/sec	85 MB/sec
Sequential Write (max.)	25 MB/sec	50 MB/sec	75 MB/sec	75 MB/sec	85 MB/sec	85 MB/sec

Note: Base on CrystalDiskMark 3.01 with file size 1000MB

2.3 Electrical Specifications

2.3.1 Power Requirement

Table 3: InnoDisk Mini PCIeDOM 1SE Power Requirement

Item	Symbol	Rating	Unit
Input voltage	V_{IN}	+3.3 DC +- 5%	V

2.3.2 Power Consumption

Table 4: Power Consumption

Mode	Power Consumption (mA)
Read	680 (max.)
Write	700 (max.)
Idle	520 (max.)

* Target: Mini PCIeDOM 1SE 64GB

2.4 Environmental Specifications

2.4.1 Temperature Ranges

Table 5: Temperature range for Mini PCIeDOM 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 Mini PCIeDOM 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 Mini PCIeDOM 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: Mini PCIeDOM 1SE MTBF

Product	Condition	MTBF (Hours)
Innodisk Mini PCIeDOM 1SE	Telcordia SR-332 GB, 25°C	>3,000,000

2.5 CE and FCC Compatibility

Mini PCIeDOM 1SE conforms to CE and FCC requirements.

2.6 RoHS Compliance

Mini PCIeDOM 1SE 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	100,000 P/E cycles
TBW(Sequential Write)	
2GB	180
4GB	360
8GB	720
16GB	1440
32GB	2880
64GB	5760

2.8 Transfer Mode

Mini PCIeDOM 1SE support following transfer mode:

PCIe Gen.1, x1 2.5Gbps

2.9 Pin Assignment

Innodisk Mini PCIeDOM 1SE uses a standard SATA pin-out. See Table 8 for Mini PCIeDOM 1SE pin assignment.

Pin #	Signal Name	Pin #	Signal Name
51	NC	52	3.3V
49	NC	50	GND
47	NC	48	NC
45	NC	46	NC
43	GND	44	NC
41	3.3V	42	NC
39	3.3V	40	GND
37	GND	38	NC
35	GND	36	NC
33	PERp0	34	GND
31	PERn0	32	NC
29	GND	30	NC
27	GND	28	NC
25	PETp0	26	GND
23	PETn0	24	3.3V
21	GND	22	PERST#
19	NC	20	NC
17	NC	18	GND
Mechanical Key			
15	GND	16	NC
13	REFCLK+	14	NC
11	REFCLK-	12	NC
9	GND	10	NC
7	GND	8	NC
5	NC	6	NC
3	NC	4	GND
1	NC	2	3.3V

Table 8: InnoDisk Mini PCIeDOM 1SE Pin Assignment

2.10 Mechanical Dimensions

* PCI Express® Mini Card Electromechanical Specification Revision 1.2
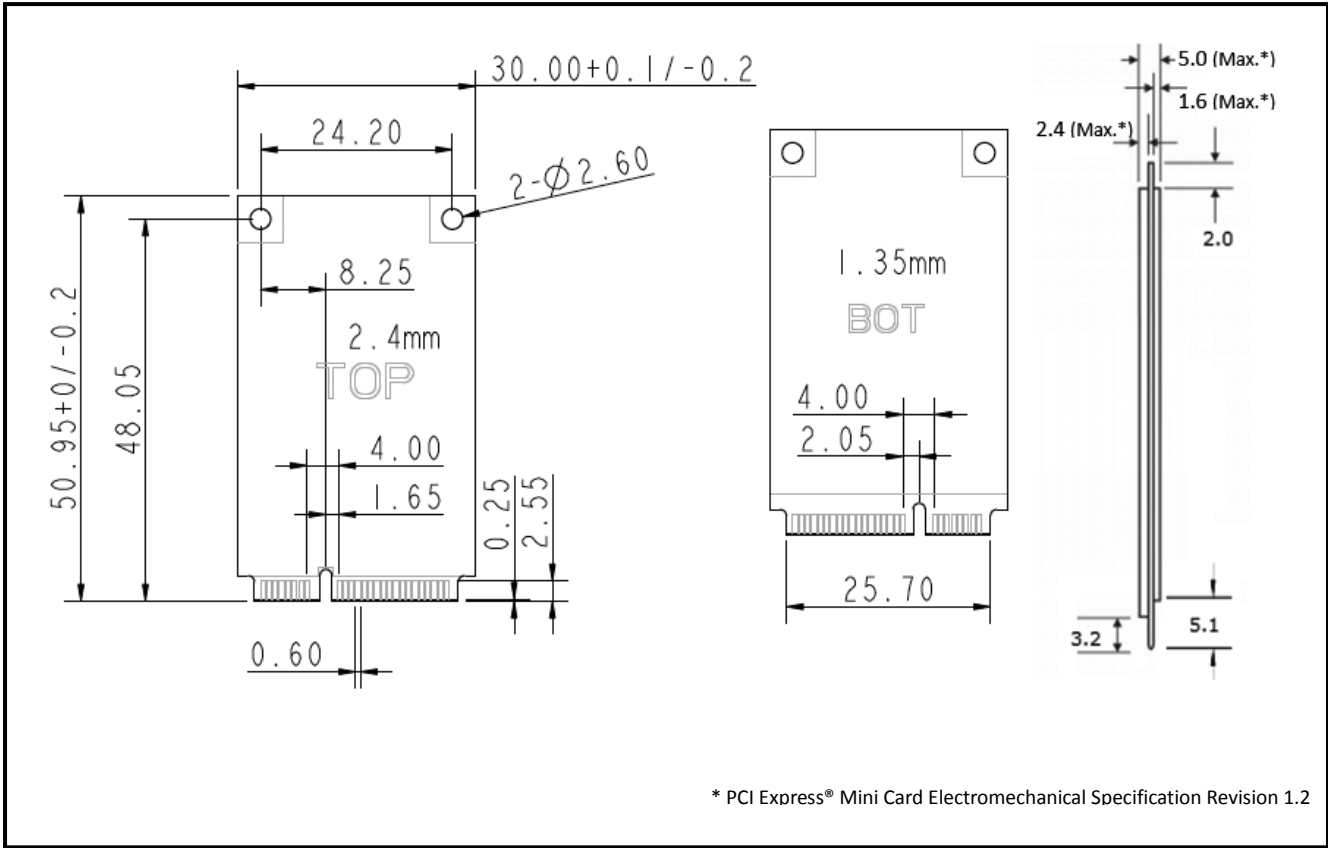
2.11 Assembly Weight

6.5g±0.5g

2.12 Seek Time

Innodisk Mini PCIeDOM 1SE is not a magnetic rotating design. There is no seek or rotational latency required.

2.13 NAND Flash Memory

Innodisk Mini PCIeDOM 1SE uses Single Level Cell (SLC) 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 Mini PCIeDOM 1SE from the system level, including the major hardware blocks.
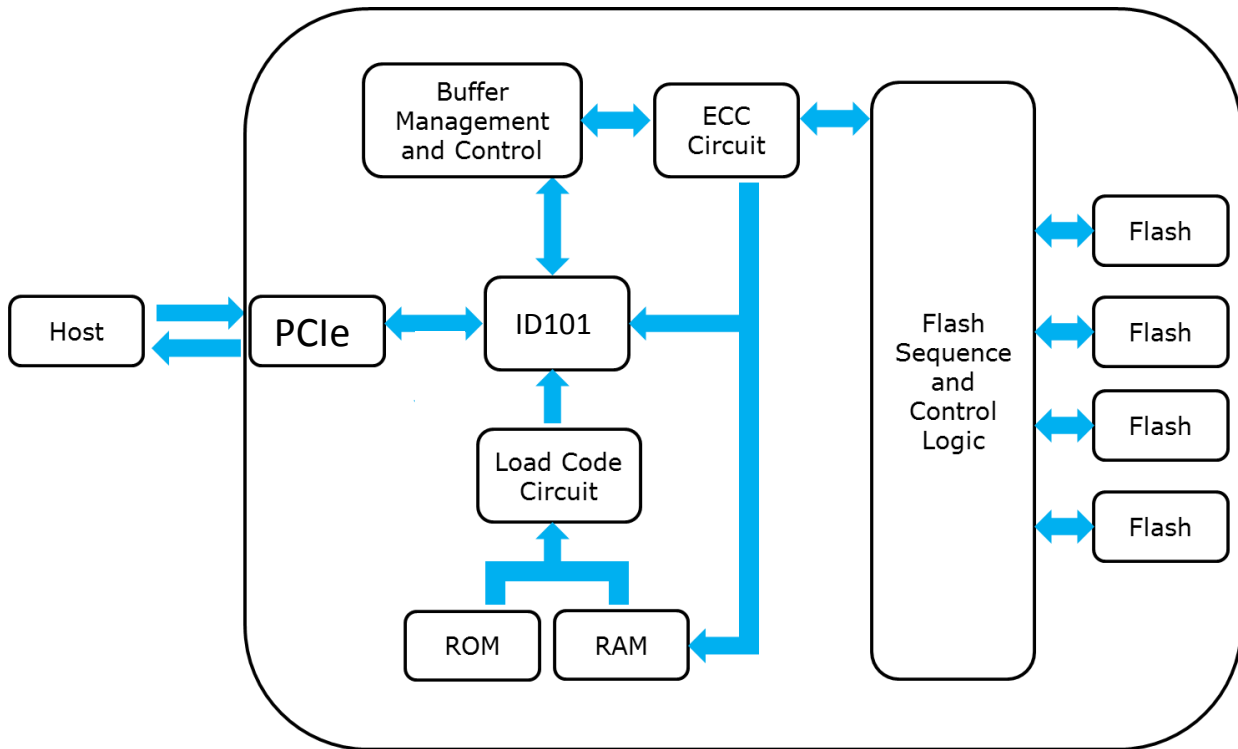

Figure 2: Innodisk Mini PCIeDOM 1SE Block Diagram

Innodisk Mini PCIeDOM 1SE integrates SATA controller, PCIe bridge controller and NAND flash memories. Communication with the host occurs through the host interface, using the standard PCIe protocol. Communication with the flash device(s) occurs through the flash interface.

3.2 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 24 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.

3.3 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 Mini PCIeDOM 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 flash media usage evenly across all pages, thereby extending flash lifetime.

3.4 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.

3.5 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.

3.6 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.

4. Installation Requirements

4.1 Mini PCIeDOM 1SE Pin Directions

Figure 3: Signal Segment and Power Segment
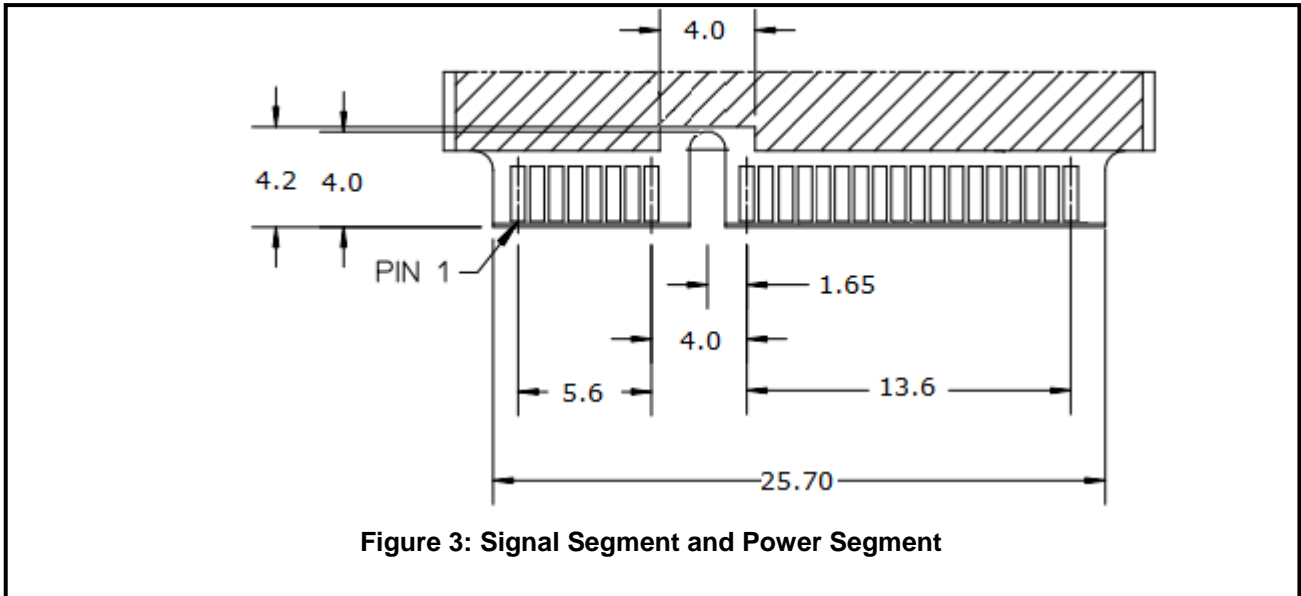
4.4 Device Driver

No additional device driver are required. Innodisk Mini PCIeDOM 1SE 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	E	D	M	-	3	2	G	J	3	0	A	C	1	Q	B	-	X	X
Description	Disk	Mini PCIeDOM 1SE					Capacity			Category			FW	Operation Temp.	Internal Control	CH.	Flash	-	Customized Code	

Definition	
Code 1st (Disk)	**Code 13th (Firmware version)**
D : Disk	A: Standard Firmware version
Code 2nd ~ 5th (Form Factor)	**Code 14th (Operation Temperature)**
EEDM: Mini PCIeDOM 1ME series	C: Standard Grade (0℃~ +70℃)
Code 7th ~9th (Capacity)	W: Industrial Grade (-40℃~ +85℃)
02G: 2GB	**Code 15th (Internal control)**
04G: 4GB	**Code 16th (Channel of data transfer)**
08G: 8GB	D: Two Channels
16G: 16GB	Q: Four Channels
32G: 32GB	**Code 17th (Flash Type)**
64G: 64GB	B: Toshiba SLC
Code 10th ~12th (Series)	**Code 19th~20th (Customized Code)**
J30: Mini PCIeDOM 1SE	

Appendix

CE/FCC Certifications, RoHS Declaration of Cconformity

Verification of Compliance

Product Name	:	Mini PCIeDOM 1ME V2
Model Number	:	DEEDM-xxxJ30*#%※&

xxx: 8G ~ 32GB
*: Firmware version
: Temperature (C : Commercial Temp., E: Extended Temp.,
    W : Industrial Temp., K: Commercial Temp. with Coating,
    T: Industrial/Extended Temp. with Coating)
%: PCB version
※ : Channel (S : Single, D:Dual, T: Three, Q : Quad, E : Eight）
& : Flash Type (S: Samsung SLC, T: Micron SLC, B: Toshiba SLC, ,
    F: Sandisk SLC, X: SLC, M:Samsung MLC, N: Micron MLC,
    C:Toshiba MLC, G:Sandisk MLC, Y: Toshiba MLC wafer base)

Applicant	:	InnoDisk Corporation
Address	:	9F, No.100, Sec. 1, Xintai 5th Rd., Xizhi Dist., New Taipei City 221, Taiwan
Report Number	:	O22-U070-1305-772
Issue Date	:	June 19, 2013
Applicable Standards	:	EN 55022:2010 Class B ITE

AS/NZS CISPR22:2009 Class B ITE
EN 55024:2010
EN 61000-4-2:2009
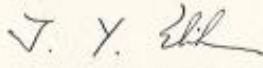EN 61000-4-3:2006+A1:2008+A2:2010
EN 61000-4-4:2004+A1:2010

Based on the EMC Directive 2004/108/EC and the specifications of the customer, one sample of the designated product has been tested in our laboratory and found to be in compliance with the EMC standards cited above.

CE

TAF 0905
FCC CAB Code TW1053
NVLAP Lab Code 200575-0
IC Code 4699A
VCCI Accep. No. R-1527, C-1609, T-1441, G-10,
    C-4400, T-1334, G-614

Central Research Technology Co.
EMC Test Laboratory
11, Lane 41, Fushuen St., Jungshan Chiu,
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Tel : 886-2-25984568
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(Tsun-Yu Shih/ General Manager)
Date: June 19, 2013

Verification of Compliance

Product Name	:	Mini PCIeDOM 1ME V2
Model Number	:	DEEDM-xxxJ30*#%※&

xxx: 8G ~ 32GB
*: Firmware version
: Temperature (C : Commercial Temp., E: Extended Temp.,
W : Industrial Temp., K: Commercial Temp. with Coating,
T: Industrial/Extended Temp. with Coating)
%: PCB version
※ : Channel (S : Single, D:Dual, T: Three, Q : Quad, E : Eight)
& : Flash Type (S: Samsung SLC, T: Micron SLC, B: Toshiba SLC, ,
F: Sandisk SLC, X: SLC, M:Samsung MLC, N: Micron MLC,
C:Toshiba MLC, G:Sandisk MLC, Y: Toshiba MLC wafer base)

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Report Number	:	F-U070-1305-772
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Applicable Standards : FCC Part 15, Subpart B Class B ITE
ANSI C63.4:2009
Industry Canada ICES-003 Issue 5
CSA-IEC CISPR22-10 Class B ITE

One sample of the designated product has been tested in our laboratory and found to be in compliance with the FCC rules cited above.

FC

NVLAP

NVLAP LAB CODE 200575-0

TAF 0905

FCC CAB Code TW1053

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VCCI Accep. No. R-1527, C-1609, T-1441, G-10,
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J. Y. Shih

(Tsun-Yu Shih/ General Manager)
Date: June 19, 2013

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RoHS 自我宣告書 (RoHS Declaration of Conformity)

Model Name : Mini PCIeDOM 1SE Series

P/N : DEEDM-xxxJ30*#%※&

XXX:01G~64G

*:A

#:C/W

%:1~9

※:S/D/Q

&:B/X

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 / 03 / 18

(Company Stamp/公司大小章)