mSATA mini

3ME 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, 2013
1.0	Official release	July, 2013
1.1	Modify mechanical drawing	February, 2014
1.2	Modify pin assignment	April, 2014
1.3	Modify part number code	June, 2014
1.4	Modify part number code	October, 2014
1.5	Modify mechanical drawing	December, 2014
1.6	Remove the Flash endurance SPEC and Add 128GB	February, 2015
1.7	Update mechanical drawing	August, 2015
1.8	Modified mechanical drawing	August, 2016

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1. Product Overview

1.1 Introduction of Innodisk MSATA MINI 3ME

Innodisk mSATA mini 3ME is designed with mSATA mini form factor by MO-300/MO-300B which established by JEDEC, and support SATA III standard (6.0Gb/s) with excellent performance. Regarding of mechanical interference, Innodisk mSATA mini 3ME absolutely replaces the traditional hard disk and makes personal computer, in any field, smaller and easier.

Innodisk mSATA mini 3ME 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 mSATA mini 3ME is available in follow capacities within MLC flash ICs.

mSATA mini 3ME 04GB

mSATA mini 3ME 08GB

mSATA mini 3ME 16GB

mSATA mini 3ME 32GB

mSATA mini 3ME 64GB

mSATA mini 3ME 128GB

Figure 1: Innodisk mSATA mini 3ME

1.3 SATA Interface

Innodisk mSATA mini 3ME supports SATA III(6.0Gb/s) interface, and compliant with SATA I (1.5Gb/s) and SATA II(3.0Gb/s).

2. Product Specifications

2.1 Capacity and Device Parameters

mSATA mini 3ME device parameters are shown in Table 1.

Table 1: Device parameters

Capacity	Cylinders	Heads	Sectors	LBA	user space
4GB	7773	16	63	7835184	3,825
8GB	15525	16	63	15649200	7,641
16GB	16383	16	63	31277232	15,272
32GB	16383	16	63	62533296	30,533
64GB	16383	16	63	125045424	61,057
128GB	16383	16	63	242255664	118,289

2.2 Performance

Burst Transfer Rate: 6.0Gbps

Table 2: Performance

Capacity	04GB	08GB	16GB	32GB	64GB	128GB
Sequential Read (max.)	100 MB/sec	120 MB/sec	240 MB/sec	280 MB/sec	280 MB/sec	280 MB/sec
Sequential Write (max.)	10 MB/sec	20 MB/sec	30 MB/sec	80 MB/sec	80 MB/sec	80 MB/sec

Note: the information is based on CrystalDiskMark 3.01 with file size 1000MB test patent

2.3 Electrical Specifications

2.3.1 Power Requirement

Table 3: Innodisk mSATA mini 3ME 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	197 (max.)
Write	241 (max.)
Idle	155 (max.)

* Target: 128GB mSATA mini 3ME

2.4 Environmental Specifications

2.4.1 Temperature Ranges

Table 5: Temperature range for mSATA mini 3ME

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 mSATA mini 3ME

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 mSATA mini 3ME 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: mSATA mini 3ME MTBF

Product	Condition	MTBF (Hours)
Innodisk mSATA mini 3ME	Telcordia SR-332 GB, 25°C	>3,000,000

2.5 CE and FCC Compatibility

mSATA mini 3ME conforms to CE and FCC requirements.

2.6 RoHS Compliance

mSATA mini 3ME 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	
4GB	10.8 (Sequential write)
8GB	21.6 (Sequential write)
16GB	43.2 (Sequential write)
32GB	86.4 (Sequential write)
64GB	172.8 (Sequential write)
128GB	345.6 (Sequential write)

2.8 Transfer Mode

mSATA mini 3ME support following transfer mode:

Serial ATA III 6.0Gbps

Serial ATA II 3.0Gbps

Serial ATA I 1.5Gbps

2.9 Pin Assignment

Innodisk mSATA mini 3ME uses a standard SATA pin-out. See Table 8 for mSATA mini 3ME pin assignment.

Table 8: Innodisk mSATA mini 3ME Pin Assignment

Signal Name	Pin #	Pin #	Signal Name
GND	51	52	+3.3V
DAS	49	50	GND
NC	47	48	NC
NC	45	46	NC
NC	43	44	NC

+3.3V	41	42	NC
+3.3V	39	40	GND
GND	37	38	NC
GND	35	36	NC
RX+	33	34	GND
RX-	31	32	NC
GND	29	30	NC
GND	27	28	NC
TX-	25	26	GND
TX+	23	24	+3.3V
GND	21	22	NC
NC	19	20	NC
NC	17	18	GND
GND	15	16	NC
NC	13	14	NC
NC	11	12	NC
GND	9	10	NC
NC	7	8	NC
NC	5	6	NC
NC	3	4	GND
NC	1	2	+3.3V

2.10 Mechanical Dimensions
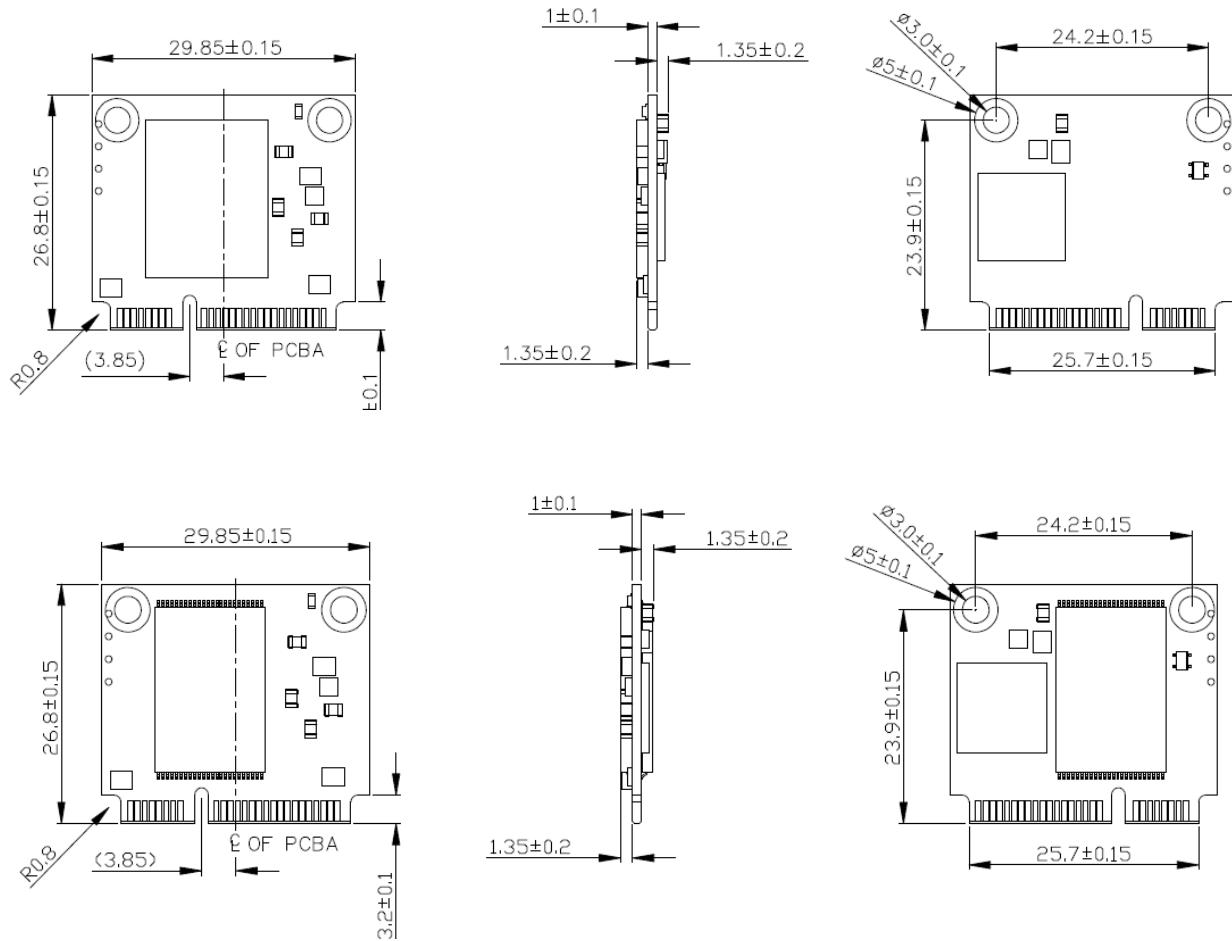
2.11 Assembly Weight

An Innodisk mSATA mini 3ME within flash ICs, 32GB's weight is 8 grams approximately.

2.12 Seek Time

Innodisk mSATA mini 3ME is not a magnetic rotating design. There is no seek or rotational latency required.

## 2.13 NAND Flash Memory

Innodisk mSATA mini 3ME uses Multi Level Cell (MLC) NAND flash memory, which is non-volatility, high reliability and high speed memory storage. Each cell stores 2 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 mSATA mini 3ME from the system level, including the major hardware blocks.
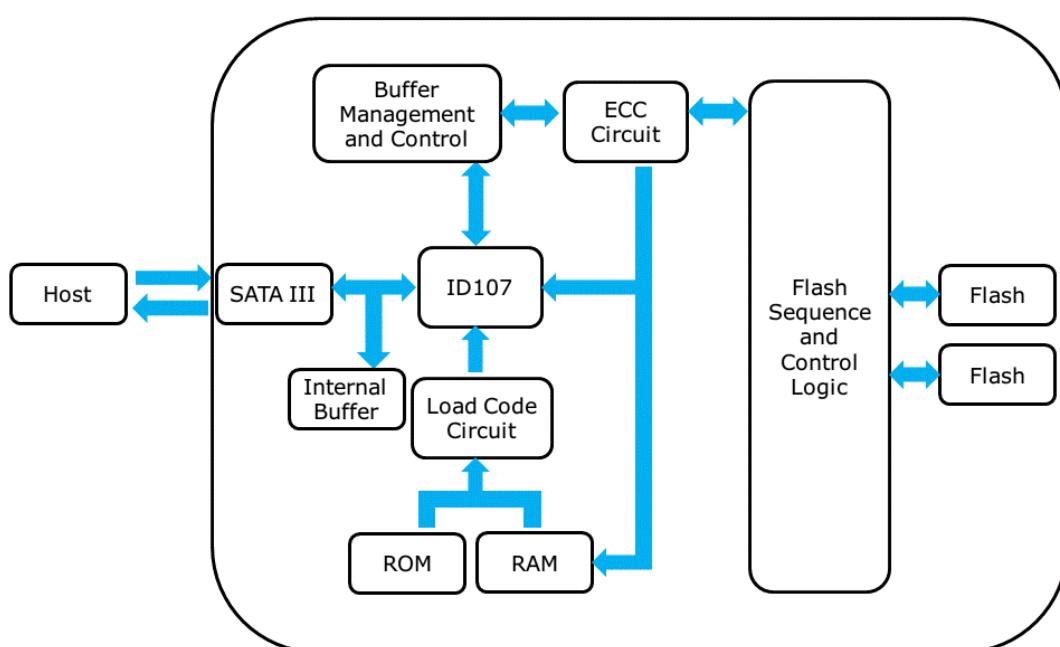
Figure 2: Innodisk mSATA mini 3ME Block Diagram

Innodisk mSATA mini 3ME 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 mSATA mini 3ME is designed with ID 107, 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 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 mSATA mini 3ME 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 mSATA mini 3ME Pin Directions
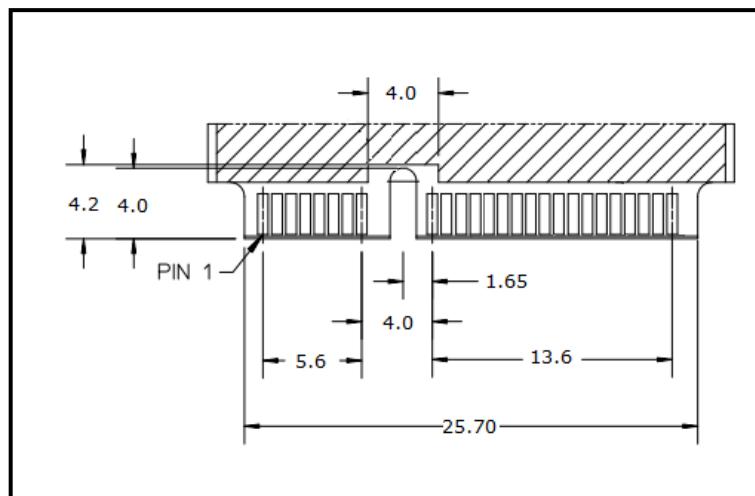
Figure 3: Signal Segment and Power Segment

4.2 Electrical Connections for mSATA mini 3ME

A Serial ATA device may be either directly connected to a host or connected to a host through an adaptor card. 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 mSATA mini 3ME 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	21
	D	E	M	S	M	-	6	4	G	D	0	7	R	C	1	D	C	-	X	X	X

Definition	
Code 1st (Disk)	**Code 13th (Flash mode)**
D : Disk	R: Toshiba A19 Synchronous Flash for 3ME/3MG-P/3MR series
Code 2nd (Feature set)	S: Synchronous flash
E : Embedded series	**Code 14th (Operation Temperature)**
Code 3rd ~5th (Form factor)	C: Standard Grade (0℃~ +70℃)
MSM: mSATA mini	W: Industrial Grade (-40℃~ +85℃)
Code 7th ~9th (Capacity)	**Code 15th (Internal control)**
04G:4GB	1~9: TSOP PCB version. A~Z: BGA PCB version.
08G:8GB	
16G:16GB	**Code 16th (Channel of data transfer)**
32G:32GB	S: Single Channel
64G:64GB	D: Dual Channels
A28:128GB	**Code 17th (Flash Type)**
Code 10th ~12th (Controller)	C: Toshiba MLC
D07: ID107	**Code 19th~21st (Customize code)**

Appendix

CE/FCC/RoHS/REACH

Verification of Compliance

Product Name	: **mSATA mini 3ME / 3SE / 3IE**
Model Number	: **D@MSM-XXXD07*＃%※&**
	@: Feature set (G: EverGreen, H: iSLC, R:InnoRobust, E: Embedded)
	XXX: 4GB~64GB
	***: Flash Mode**
	＃: Temperature (C：Commercial Temp W：Industrial Temp)
	%: PCB Version (A, B, C⋯. or 1, 2, 3⋯)
	※：Channel (S：Single, D:Dual, T: Three, Q：Quad, E：Eight)
	&: Flash Vender (T：Micron SLC, S：Samsung SLC, N：Micron MLC, B：Toshiba SLC, C: Toshiba MLC, F: Sandisk SLC, X: SLC)
Applicant	: **InnoDisk Corporation**
Address	: **9F, No.100, Sec. 1, Xintai 5th Rd., Xizhi Dist., New Taipei City 221, Taiwan**
Report Number	: **O22-U070-1306-274**
Issue Date	: **July 22, 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,
Taipei, Taiwan, 104, R.O.C.
Tel : 886-2-25984568
Fax: 886-2-25984546
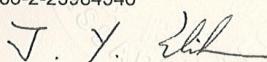
(Tsun-Yu Shih/ General Manager)
Date: July 22, 2013

Verification of Compliance

Product Name	:	**mSATA mini 3ME / 3SE / 3IE**
Model Number	:	**D@MSM-XXXD07*＃%※&**

@: Feature set (G: EverGreen, H: iSLC, R:InnoRobust, E: Embedded)
XXX: 4GB~64GB
* : Flash Mode
＃: Temperature (C：Commercial Temp W：Industrial Temp)
% : PCB Version (A, B, C···. or 1, 2, 3···)
※ : Channel (S：Single, D:Dual, T: Three, Q：Quad, E：Eight）
&：Flash Vender（T：Micron SLC, S：Samsung SLC,
N：Micron MLC, B：Toshiba SLC, C: Toshiba MLC,
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Report Number	:	**F-U070-1306-274**
Issue Date	:	**July 22, 2013**

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

IC Code 4699A

VCCI Accep. No. R-1527, C-1609, T-1441, G-10,
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(Tsun-Yu Shih/ General Manager)

Date: July 22, 2013

innodisk

宜鼎國際股份有限公司
Innodisk Corporation

Tel:(02)7703-3000 Fax:(02) 7703-1555 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）特此保證售于貴公司之所有產品，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_   李維亮

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。

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)