

2.5" PATA SSD

1MG3-P Series

Customer: _____

Customer

Part

Number: _____

Innodisk

Part

Number: _____

Innodisk

Model Name: _____

Date: _____

Innodisk Approver	Customer Approver

**Total Solution For
Industrial Flash Storage**

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REVISION HISTORY

Revision	Description	Date
Preliminary	First Released	Feb., 2016

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1. Product Overview

1.1 Introduction of Innodisk 2.5" PATA SSD 1MG3-P

Innodisk 2.5" PATA SSD 1MG3-P 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 1MG3-P is designed for industrial applications, and supports several features, including NCQ and S.M.A.R.T. Innodisk 2.5" PATA SSD 1MG3-P 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 1MG3-P is available in follow capacities:

2.5" PATA SSD 1MG3-P 8GB

2.5" PATA SSD 1MG3-P 64GB

2.5" PATA SSD 1MG3-P 16GB

2.5" PATA SSD 1MG3-P 128GB

2.5" PATA SSD 1MG3-P 32GB

2.5" PATA SSD 1MG3-P 256GB

2.5" PATA SSD 1MG3-P 512GB



Figure 1: Innodisk 2.5" PATA SSD 1MG3-P

2. Product Specifications

2.1 Capacity and Device Parameters

2.5" PATA SSD 1MG3-P device parameters are shown in Table 1.

Table 1: Device parameters

Capacity	LBA	Cylinders	Heads	Sectors	User Capacity(MB)
8GB	13695696	13587	16	63	6687
16GB	29323728	16383	16	63	14318
32GB	60579792	16383	16	63	29580
64GB	121138416	16383	16	63	59150
128GB	242255664	16383	16	63	118289
256GB	484490160	16383	16	63	236567
512GB	968959152	16383	16	63	473125

2.2 Performance

Burst Transfer Rate: Ultra DMA 5

Table 2: Performance

Capacity	8GB	16GB***	32GB****	64GB	128GB	256GB	512GB
Sequential Read* (max.) MB/sec	90	90	90	90	90	90	90
Sequential Write* (max.) MB/sec	20	20	35	80	100	100	100
4KB Random** Read (QD32)	4,300 IOPS	4,300 IOPS	4,300 IOPS	5,500 IOPS	5,500 IOPS	5,500 IOPS	5,500 IOPS
4KB Random** Write (QD32)	910 IOPS	1,400 IOPS	1,400 IOPS	11,300 IOPS	12,300 IOPS	12,300 IOPS	12,300 IOPS

Note: * Sequential performance based on CrystalDiskMark 3.03 with file size 1000MB

** Random performance based on Iometer with Queue Depth 32

***16GB: 1CH

****32GB: 2CH

2.3 Electrical Specifications

2.3.1 Power Requirement

Table 3: Innodisk 2.5" PATA SSD 1MG3-P 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	250 (max.)
Write	600 (max.)
Idle	248 (max.)

* Target: 2.5" PATA SSD 1MG3-P 512GB

2.4 Environmental Specifications

2.4.1 Temperature Ranges

Table 5: Temperature range for 2.5" PATA SSD 1MG3-P

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 1MG3-P

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 1MG3-P 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 1MG3-P MTBF

Product	Condition	MTBF (Hours)
Innodisk 2.5" PATA SSD 1MG3-P	Telcordia SR-332 GB, 25°C	>3,000,000

2.5 CE and FCC Compatibility

2.5" PATA SSD 1MG3-P conforms to CE and FCC requirements. See Appendix for documentation.

2.6 RoHS Compliance

2.5" PATA SSD 1MG3-P 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
Flash endurance	3,000 P/E cycles
TBW(Sequential Write)	
8GB	2.3
16GB	4.7
32GB	9.4
64GB	18.8
128GB	37.5
256GB	75.2
512GB	150.4
* 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

2.5" PATA SSD 1MG3-P support following transfer mode:

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

2.9 Pin Assignment

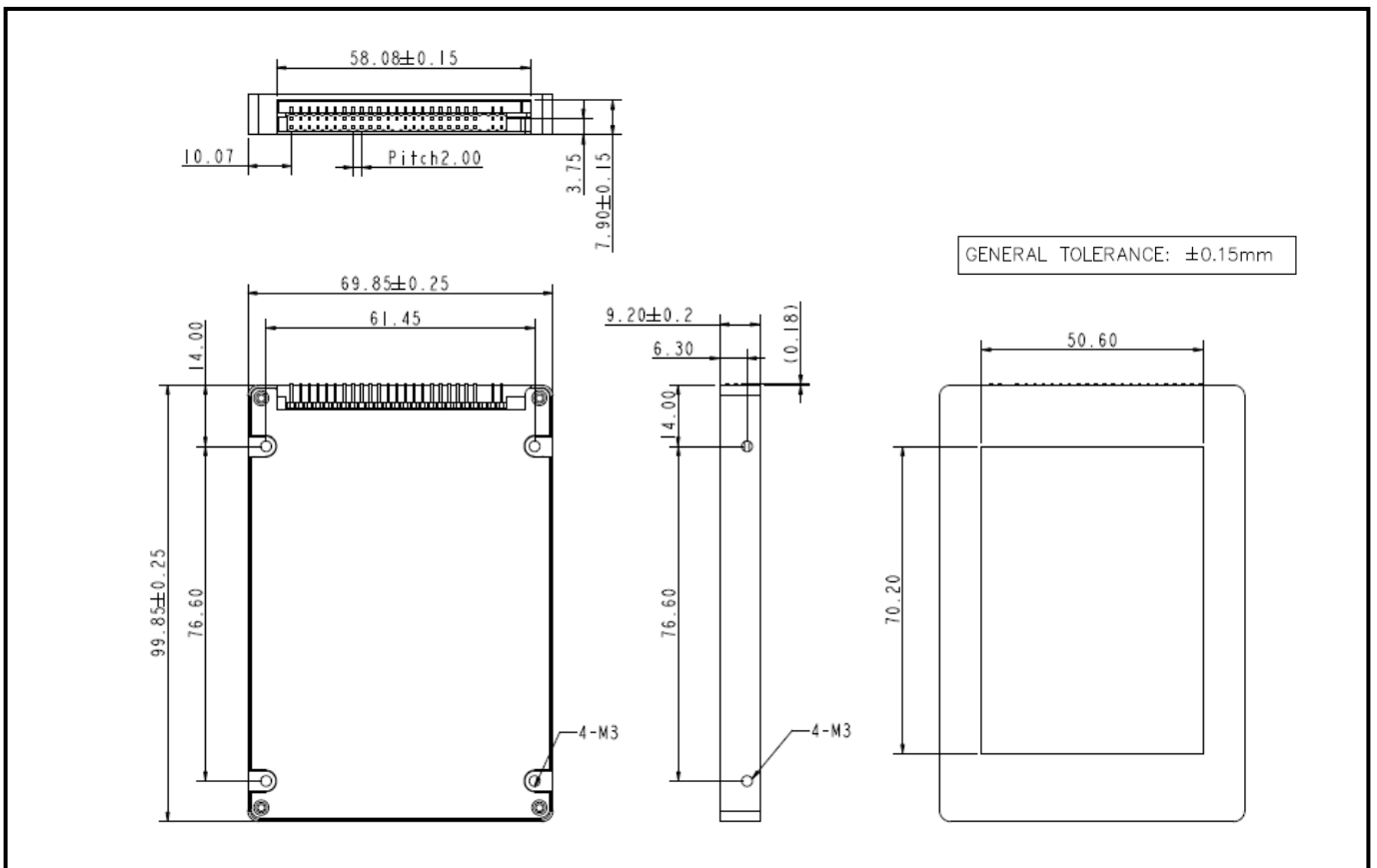
Innodisk 2.5" PATA SSD 1MG3-P uses the standard ATA pin-out. See Table 8 for 2.5" PATA SSD 1MG3-P pin assignment.

Table 8: Innodisk 2.5" PATA SSD 1MG3-P 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	Host I/O Write	24	GND	Ground
	STOP2	Stop Ultra DMA burst			
25	HIOR1	Host I/O Read	26	GND	Ground
	HDMARDY2	Ultra DMA ready			
	HSTROBE2	Ultra DMA data strobe			
27	IORDY1	I/O Ready	28	CSEL	Master/Slave Select
	DDMARDY2	Ultra DMA ready			
	DSTROBE2	Ultra DMA data strobe			
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 Innodisk 2.5" PATA SSD 1MG3-P with MLC 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 1MG3-P 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 1MG3-P uses Multi-level Cell (MLC) 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 1MG3-P from the system level, including the major hardware blocks.

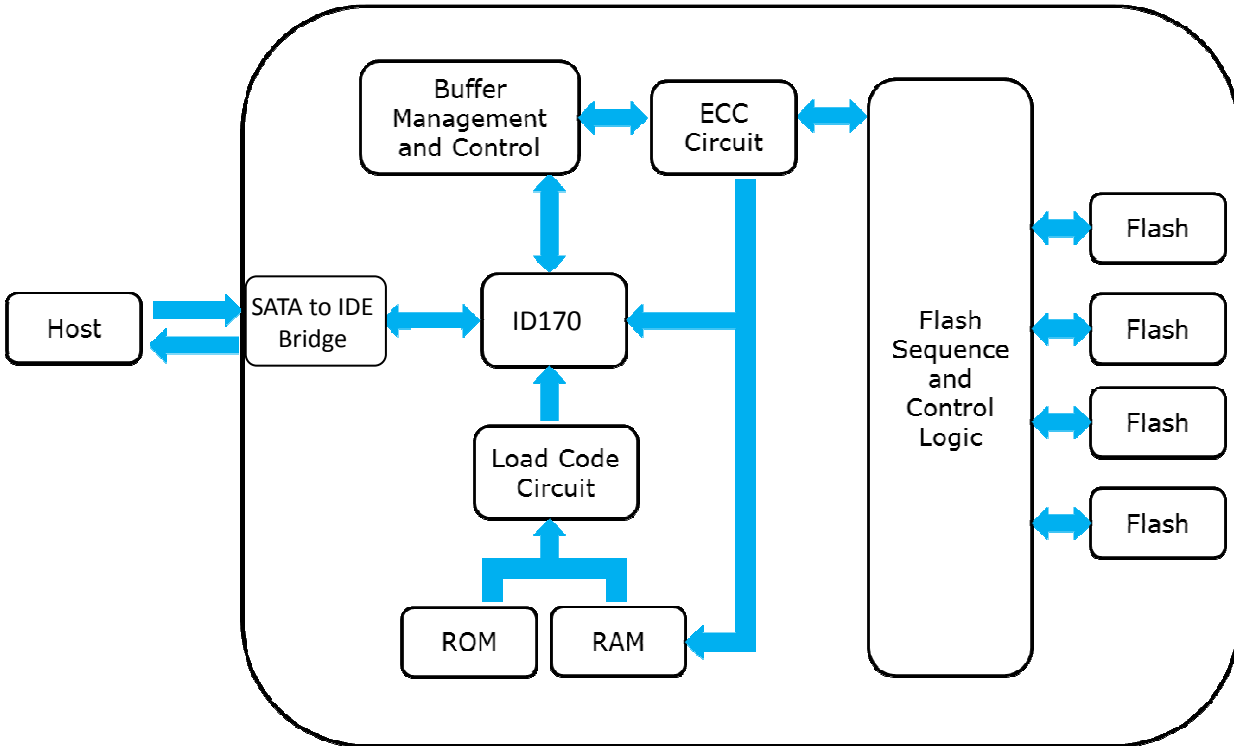


Figure 2: Innodisk FiD 2.5" PATA SSD 1MG3-P Block Diagram

Innodisk 2.5" PATA SSD 1MG3-P 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 1MG3-P is designed with ID 170, 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 1MG3-P 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 1MG3-P Pin Directions

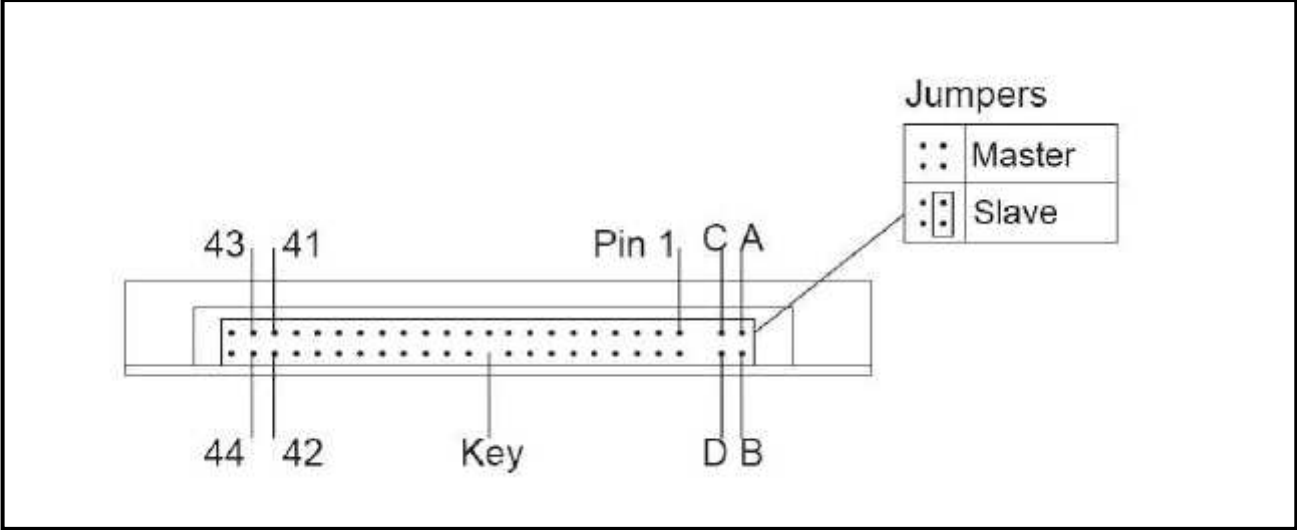


Figure 3: Signal Segment and Power Segment

4.2 Electrical Connections for 2.5" PATA SSD 1MG3-P

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 1MG3-P.

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	G	P	2	5	-	3	2	G	D	7	0	B	C	1	D	C	-	X	X
Description	Disk	2.5" PATA SSD 1MG3-P					Capacity		Category			Flash Mode	Operation Temp.	Internal Control	CH.	Flash	-	Customized Code		
Definition																				
Code 1st (Disk)											Code 13th (Firmware version)									
D : Disk											B: Toshiba 15nm Sync. Flash									
Code 2nd ~ 5th (Form Factor)											Code 14th (Operation Temperature)									
GP25: 2.5" PATA SSD											C: Standard Grade (0°C ~ +70°C)									
											W: Industrial Grade (-40°C ~ +85°C)									
Code 7th ~ 9th (Capacity)											Code 15th (Internal control)									
08G: 8GB											Code 16th (Channel of data transfer)									
16G: 16GB											S: Single Channel									
32G: 32GB											D: Dual Channels									
64G: 64GB											Q: Quad Channels									
A28: 128GB											Code 17th (Flash Type)									
B56: 256GB											B: Toshiba MLC									
C12: 512GB											Code 19th~20th (Customized Code)									
Code 10th ~ 12th (Series)																				
D70: ID170																				

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



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Innodisk Corporation

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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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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

