CFast 3SE

Customer:	
Customer Part Number:	
Innodisk Part Number:	
Innodisk Model Name:	
Date:	

Innodisk Approver	Customer Approver

Table of contents

REVISION HISTORY

Revision	Description	Date
Preliminary	First Released	Jun., 2013
1.0	Official Released	July, 2013
1.1	Add CFast 3SE 02GB	September, 2013
1.2	Modify PC8,PC9 pin assignment description	July, 2014
1.3	Add CFast 3SE 01GB	August, 2014
1.4	Modify TBW based on NAND Flash specifications	January, 2015
1.5	Add iDataguard feature	March, 2016
1.6	Add CFast 3SE 24nm	April, 2021
1.7	Remove EOL product	Nov., 2024

List of Tables

List of Figures

1. Product Overview

1.1 Introduction of Innodisk CFast 3SE

The Innodisk CFast 3SE operates at SATA III 6.0 Gb/s, which offers data transfer rate of read up to 470MB/sec. and of sequential write up to 250MB/s. Compliant with CFast 2.0 standard, it is designed with 7+17 pin connector and is SATA compatible. Due to the idle power saving, it reduces 35% power consumption. CFast 3SE is featured as small form factor, and suitable for most industrial application.

CFast 3SE can work under harsh environment, and complies with ATA protocol. Without additional driver, the disk can be configured as a boot device or data storage device. CFast 3SE support hardware write protect to prevent modification of valuable data on a device. Besides, through Innodisk's enhanced power cycling technology and more capacitors, CFast 3SE prevents data loss caused by sudden power failure. By using Innodsik's iSMART, users can not only monitor the operation status of SSD, but also visualize Wear-Leveling status with graphics.

1.2 Product View and Models

Innodisk CFast 3SE is available in follow capacities within SLC flash ICs.

CFast 3SE 01GB   CFast 3SE 02GB   CFast 3SE 04GB

Figure 1: Innodisk CFast 3SE

1.3 SATA Interface

Innodisk CFast 3SE supports SATA III interface, and compliant with SATA I and SATA II. SATA III interface can work with Serial Attached SCSI (SAS) host system, which is used in server computer. Innodisk CFast 3SE is compliant with Serial ATA Gen 1, Gen 2 and Gen 3 specification (Gen 3 supports 1.5Gbps /3.0Gbps/6.0Gbps data rate).

1.4 CFast 2.0 Form Factor

CFast 3SE compliant with CFast 2.0 standard, it is designed with 7+17 pin connector and is SATA compatible. CFast 2.0 leverage the same connector interface as CFast 1.1 and the SATA-3 interface for higher performance. CFast 3SE mechanical dimensions: 42.8mm x 36.4mm x 3.6mm.

2. Product Specifications

2.1 Capacity and Device Parameters

CFast 3SE device parameters are shown in Table 1.

Table 1: Device parameters

Capacity	LBA	Cylinders	Heads	Sectors	User Capacity(MB)
01GB	1974672	1959	16	63	964
02GB	3928176	3897	16	63	1918
04GB	7835184	7773	16	63	3825

2.2 Performance

Burst Transfer Rate: 6.0Gbps

Table 2: Performance

Capacity	Unit	1GB	2GB	4GB
Sequential Read (Q32T1)	MB/s	30	60	220/65*
Sequential Write (Q32T1)		10	25	60/50*
4KB Random Read(Q8T8)	IOPS	6,500	6,400	6,400
4KB Random write(Q8T8)		160	140	90

Note: Performance results are based on CrystalDiskMark 3.01 with file size 1000MB

Note: *24nm SLC, performance results are based on CrystalDiskMark v6.0.2

2.3 Electrical Specifications

2.3.1 Power Requirement

Table 3: Innodisk CFast 3SE 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 (W)	
Read	0.9 (Typical)	1.7 (Typical)*
Write	1.2 (Typical)	1.4 (Typical)*
Idle	0.4 (Typical)	1.2 (Typical)*

Note: Current results may vary depending on system components and power circuit design; *24nm SLC

2.4 Environmental Specifications

2.4.1 Temperature Ranges

Table 5: Temperature range for CFast 3SE

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 CFast 3SE

Reliability	Test Conditions	Reference Standards
Vibration	7 Hz to 2K Hz, 20G, 3 axes	IEC 60068-2-6
Mechanical Shock	Duration: 0.5ms, 1500 G, 3 axes	IEC 60068-2-27

2.4.4 Mean Time between Failures (MTBF)

Table 7 summarizes the MTBF prediction results for various CFast 3SE 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: CFast 3SE MTBF

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

2.5 CE and FCC Compatibility

CFast 3SE conforms to CE and FCC requirements.

2.6 RoHS Compliance

CFast 3SE 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(Sequential Write)	
1GB	54
2GB	108
4GB	216

2.8 Transfer Mode

CFast 3SE support following transfer mode:

Serial ATA III 6.0Gbps

Serial ATA II 3.0Gbps

Serial ATA I 1.5Gbps

2.9 Pin Assignment

Innodisk CFast 3SE uses a standard SATA pin-out. See Table 8 for CFast 3SE pin assignment.

Table 8: Innodisk CFast 3SE Pin Assignment

Name	Type	Description
S1	SGND	Ground for signal integrity
S2	A+	Differential Signal Pair A
S3	A-	
S4	SGND	Ground for signal integrity
S5	B-	Differential Signal Pair B
S6	B+	
S7	SGND	Ground for signal integrity
Key and Spacing separate signal and power segments		
P1	CDI	Card Detect In
P2	PGND	Device Ground
P3	DEVSLP	Device sleep
P4	TBD	Reserved
P5	TBD	Reserved
P6	TBD	Reserved
P7	PGND	Device Ground
P8	LED1	PHY LED (LED are lighted when P8 low active)
P9	LED2	HDDA LED (LED are lighted when P9 low active)
P10	TBD	Reserved
P11	TBD	Reserved
P12	IFDet	GND
P13	PWR	Device Power (3.3V)
P14	PWR	Device Power (3.3V)
P15	PGND	Device Ground
P16	PGND	Device Ground
P17	CDO	Card Detect Out

2.10 Mechanical Dimensions
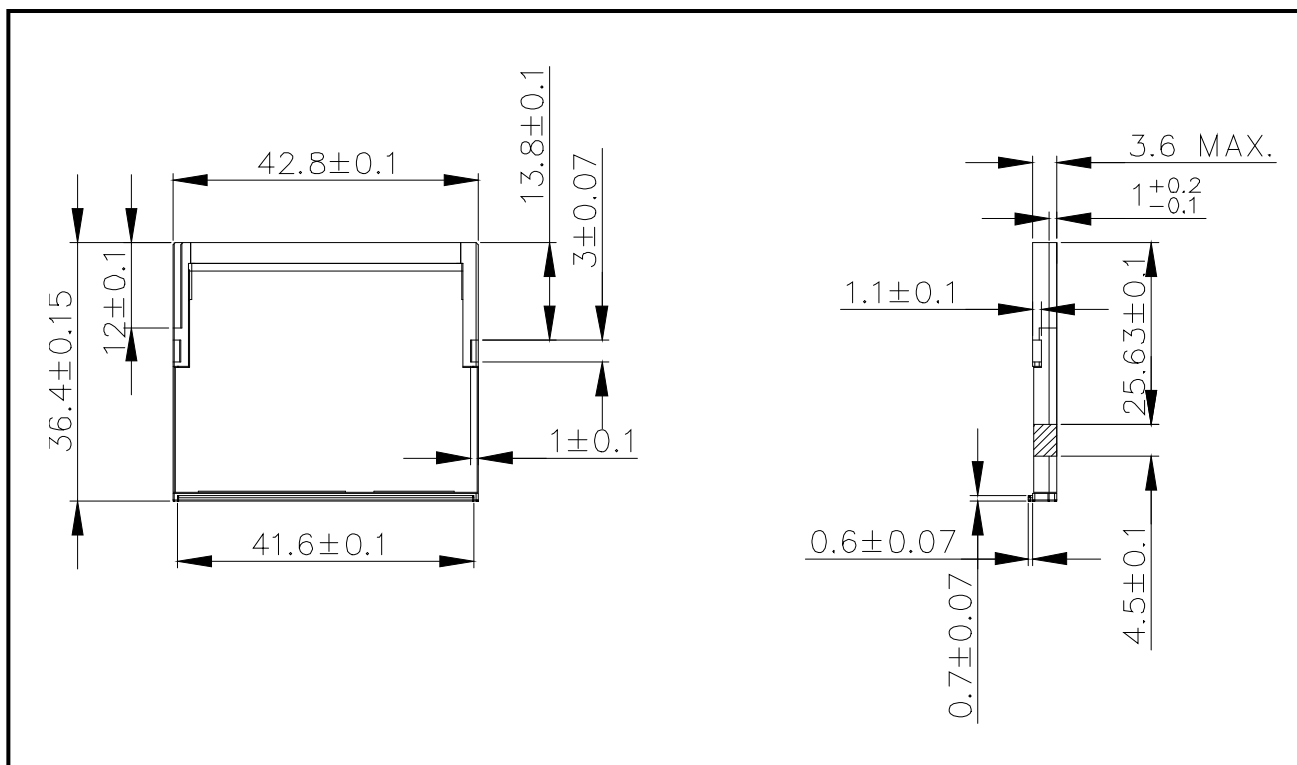
2.11 Assembly Weight

An InnodiskCFast 3SE within SLC flash ICs, 64GB's weight is 8 grams approx. The total weight of card will be less than 10 grams.

2.12 Seek Time

Innodisk CFast 3SE is not a magnetic rotating design. There is no seek or rotational latency required.

2.13 Hot Plug

The card support hot plug function and can be removed or plugged-in during operation. User has to avoid hot plugging the card 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 CFast 3SE uses single Level Cell (SLC) NAND flash memory, which is non-volatility, memory storage. There are two statuses 0 or 1 of one 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 CFast 3SE from the system level, including the major hardware blocks.
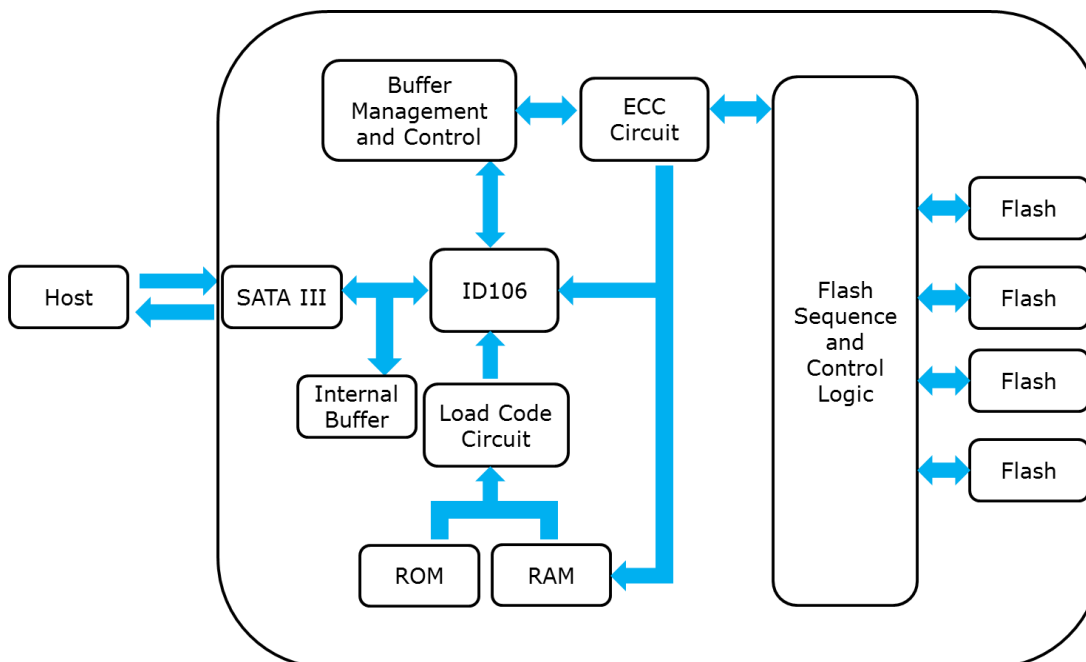

Figure 2: Innodisk CFast 3SE Block Diagram

Innodisk CFast 3SE 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 CFast 3SE is designed with ID 106, 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 4 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 CFast 3SE 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 (iDataGuard)

Innodisk iDataGuard is a critical element to ensuring data integrity, and provides a reliable power failure protection to Innodisk's SSDs. Our circuit design enables a drive to complete the Power-Down Recovery Algorithm once the trigger detects low power. Innodisk has designed the iDataGuard feature to aid in the prevention of data loss, and to protect our partner's data. Unexpected power loss may not be preventable, and data loss/corruption doesn't have to be inevitable. iDataGuard 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, please refer to below Block Diagram.
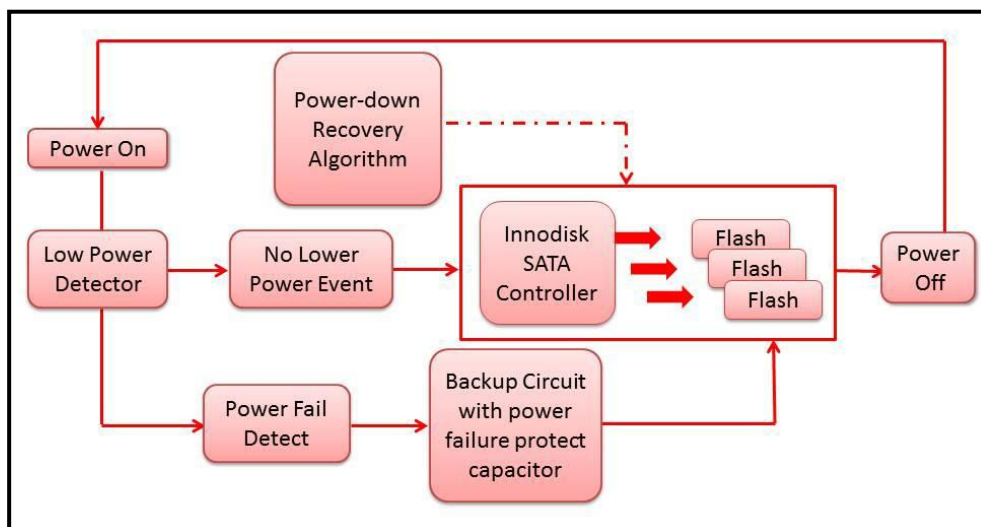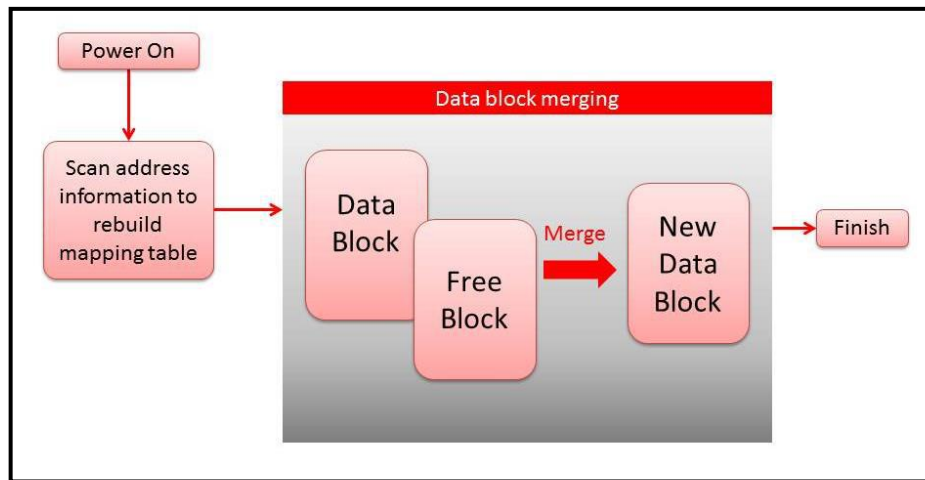

Figure 3: iDataGuard Block Diagram

Figure 4: iDataGuard Power-down Recovery Algorithm Block Diagram

3.7 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.

4. Installation Requirements
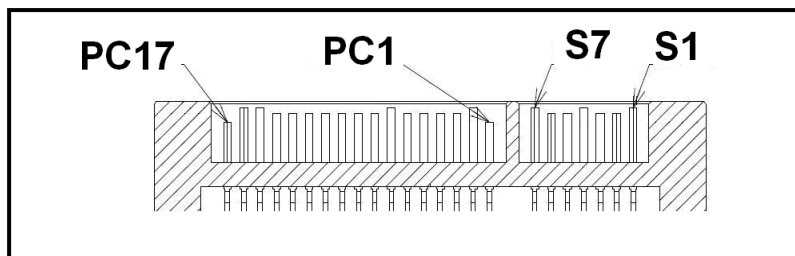
4.1 CFast 3SE Pin Directions

Figure 5: Signal Segment and Power Segment

4.2 Electrical Connections for CFast 3SE

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 1meter. The SATA interface has a separate connector for the power supply. Please refer to the pin description for further details.

4.3 Write Protection

Innodisk CFast 3SE within the write-protect function could prevent the device from modification and deletion. Write-protected data could only be read, that is, users could not write to it, edit it, append data to it, or delete it. When users would like to make sure that neither themselves nor

others could modify or destroy the file, users could switch on write-protection. Thus, Innodisk CFast 3SE could process write-protect mechanism and disable flash memory to be written-in any data. Only while the system power-off, users could switch on write-protection. Write-protection could not be switched-on, after OS booting.
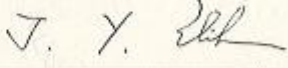
4.4 Device Drive

No additional device drives are required. Innodisk CFast 3SE 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	C	F	A	-	0	1	G	D	0	7	A	C	4	S	B	-	X	X	X

Definition	
Code 1st (Disk)	**Code 14th (Operation Temperature)**
D : Disk	C: Standard Grade (0℃~ +70℃)
	W: Industrial Grade (-40℃~ +85℃)
Code 2nd ~ 5th (Form Factor)	**Code 15th (Internal control)**
ECFA: CFast 3SE	1~9: TSOP PCB version
Code 7th ~9th (Capacity)	**Code 16th (Channel of data transfer)**
01G: 01GB	S: Single Channel
02G: 02GB	D: Dual Channels
04G: 04GB	
Code 10th ~12th (Controller)	**Code 17th (Flash Type)**
D07: ID107	B: Toshiba SLC
Code 13th (Flash Mode)	**Code 19th~21th (Customized Code)**
A: Asynchronous flash	

6. Appendix

CE/FCC/RoHS/REACH

Verification of Compliance

Product Name : CFast 3SE

Model Number : DECFA-XXXD06 ＊＃％※＆
XXX: 1GB~64GB
＊ : Flash Mode
＃: Temperature (C : Commercial Temp   W : Industrial Temp
    E: Extended Temp)
％ : PCB Version (A, B, C…. or 1, 2, 3…)
※ : Channel (S : Single, D : Dual, Q : Quad, E : Eight)
＆ : Flash Vender (S: Samsung SLC, T: Micron SLC,
    B: Toshiba SLC, C:Toshiba MLC, F: Sandisk SLC, X: SLC,
    M:Samsung MLC, N: Micron MLC)

Applicant : Innodisk Corporation

Address : 9F, No.100, Sec. 1, Xintai 5th Rd., Xizhi Dist., New Taipei City 221, Taiwan

Report Number : F-U070-1307-317

Issue Date : August 8, 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,
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: August 8, 2013

Verification of Compliance

Product Name : CFast 3SE
Model Number : DECFA-XXXD06＊＃%※&
XXX: 1GB~64GB
＊：Flash Mode
＃: Temperature (C：Commercial Temp　W：Industrial Temp
E: Extended Temp)
% : PCB Version (A, B, C···. or 1, 2, 3···)
※：Channel（S：Single, D：Dual, Q：Quad, E：Eight）
&：Flash Vender (S: Samsung SLC, T: Micron SLC,
B: Toshiba SLC, C:Toshiba MLC, F: Sandisk SLC, X: SLC,
M:Samsung MLC, N: Micron MLC)

Applicant : Innodisk Corporation
Address : 9F, No.100, Sec. 1, Xintai 5th Rd., Xizhi Dist., New Taipei City 221, Taiwan
Report Number : O22-U070-1307-317
Issue Date : August 8, 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: August 8, 2013

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
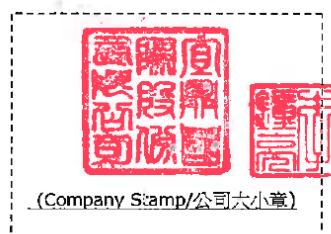connection with this Declaration of Conformity by friendly negotiations.

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)

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 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)