CFast

InnoREC™ 3MV2-P

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
Ver 1.0	First Released	Sep 2017

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1. Product Overview

1.1 Introduction of Innodisk CFast 3MV2-P

InnoREC is innodisk's proprietary flash feature set designed specifically for surveillance applications. Through the smart integration of firmware and hardware, the speed and performance required by modern surveillance solutions is fully met. Innodisk CFast 3MV2-P is SATA III 6Gb/s flash based disk, which delivers excellent performance, especially in random data transfer rate, and which offers reliability making it the ideal solution for a variety of applications, including embedded system, industrial computing, and enterprise field.

Innodisk CFast 3MV2-P supports several standard features, including REC line, TRIM, NCQ, and S.M.A.R.T. The CFast have good random Read/Write performance, no latency time and small seek time. It effectively reduces the booting time of operation system. CFast 3MV2-P not only performs unmatched performance, but also designed with Innodisk owned technical knowhow to ensure the data integrity and highest levels of reliability.

1.2 Product View and Models

Innodisk CFast 3MV2-P is available in follow capacities within MLC flash ICs.

CFast 3MV2-P 32GB

CFast 3MV2-P 64GB

CFast 3MV2-P 128GB

CFast 3MV2-P 256GB

Figure 1: Innodisk CFast 3MV2-P

1.3 SATA Interface

Innodisk CFast 3MV2-P supports supports SATA III interface, and compliant with SATA I and SATA II.

1.4 CFast 2.0 Form Factor

CFast 3MV2-P 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 3MV2-P mechanical dimensions: 42.8mm x 36.4mm x 3.6mm.

2. Product Specifications

2.1 Capacity and Device Parameters

CFast 3MV2-P device parameters are shown in Table 1.

Table 1: Device parameters

Capacity	LBA	Cylinders	Heads	Sectors	User Capacity
32GB	60579792	16383	16	63	29580
64GB	121138416	16383	16	63	59150
128GB	242255664	16383	16	63	118289
256GB	484490160	16383	16	63	236567

2.2 Performance

Burst Transfer Rate: 6.0Gbps

Table 2: Performance

Sequential Read and Write Performance

Specification (max.)	Sequential Read (SATA 6Gb/s)	Sequential Write (SATA 6Gb/s)
Unit	MB/s	MB/s
32GB (4CH)	280	45
64GB (4CH)	550	90
128GB (4CH)	560	180
256GB (4CH)	560	350

Note:

1. Sequential performance measured using out-of-box CFast 3MV2-P.

2. Performance measured using CrystalDiskMark 5.1.2 with file size 1000MB of Queue Depth 32

Steady Sequential Write Performance

Specification	Sequential Write (SATA 6Gb/s)
Unit	MB/s
32GB (4CH)	35
64GB (4CH)	85
128GB (4CH)	165
256GB (4CH)	340

Note:

1. Steady write performance measured using Vdbench 5.02.

2. SSD is separated by two areas, 30% is full of random data and 70% is full of sequential data.

3. Sequential write performance measurements are performed on writing 30% random data and then 70% sequential

data in SSD.

Random Read and Write Performance

Specification	Random Read (SATA 6Gb/s)	Random Write (SATA 6Gb/s)
Unit	IOPS	IOPS
32GB (4CH)	27000	11000
64GB (4CH)	52000	23000
128GB (4CH)	73000	46000
256GB (4CH)	76000	76000

Note:

1. Sequential performance measured using out-of-box SSD.

2. Performance measured using CrystalDiskMark 5.1.2 with file size 1000M of Queue Depth 32

2.3 Electrical Specifications

2.3.1 Power Requirement

Table 3: Innodisk CFast 3MV2-P 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	315 (max.)
Write	760 (max.)
Idle	170 (max.)
Peak Current	1080(max)

2.4 Environmental Specifications

2.4.1 Temperature Ranges

Table 5: Temperature range for CFast 3MV2-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 CFast 3MV2-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 CFast 3MV2-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: CFast 3MV2-P MTBF

Product	Condition	MTBF (Hours)
Innodisk CFast 3MV2-P	Telcordia SR-332 GB, 25°C	>3,000,000

2.5 CE and FCC Compatibility

CFast 3MV2-P conforms to CE and FCC requirements.

2.6 RoHS Compliance

CFast 3MV2-P is fully compliant with RoHS directive.

2.7 Reliability

Table 8: CFast 3MV2-P TBW

Parameter	Value
Read Cycles	Unlimited Read Cycles
Flash endurance	3,000 P/E cycles
Wear-Leveling Algorithm	Support
Bad Blocks Management	Support
Error Correct Code	Support
TBW* (Total Bytes Written) Unit: TB	

Capacity	Sequential workload	Client workload
32GB	85.	37.5
64GB	170.5	75
128GB	340.9	150
256GB	681.8	300

* Note:

1. Sequential: Mainly sequential write, tested by Vdbench.

2. Client: Follow JESD218 Test method and JESD219A Workload, tested by ULINK. (The capacity lower than 64GB client workload is not specified in JEDEC219A, the values are estimated.)

3. Based on out-of-box performance.

2.8 Transfer Mode

CFast 3MV2-P support following transfer mode:

Serial ATA III 6.0Gbps

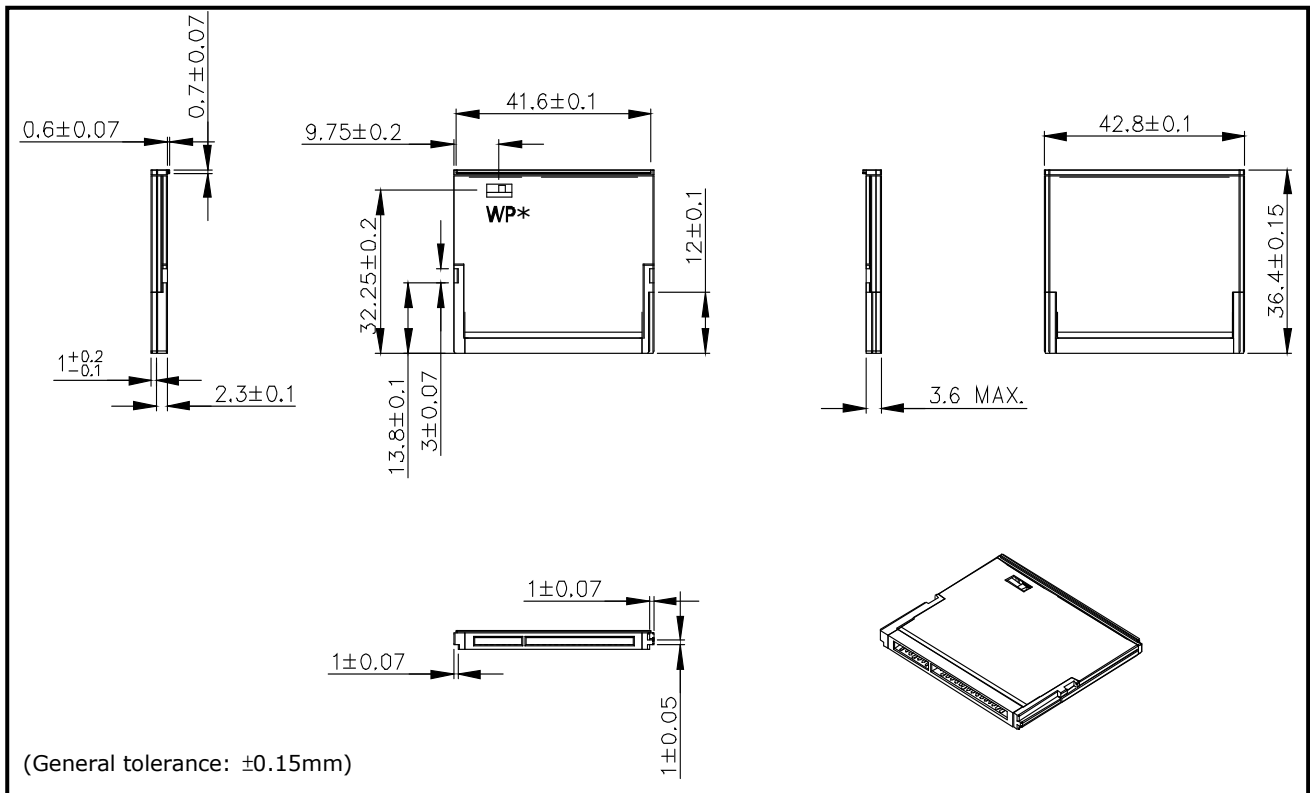Serial ATA II 3.0Gbps

Serial ATA I 1.5Gbps

2.9 Pin Assignment

Innodisk CFast 3MV2-P uses a standard SATA pin-out. See Table 9 for CFast 3MV2-P pin assignment.

Table 9: Innodisk CFast 3MV2-P 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	TBD	Reserved
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

(General tolerance: ±0.15mm)

*Write Protect is optional.

2.11 Assembly Weight

An Innodisk CFast 3MV2-P within MLC flash ICs, 256GB's weight is approximately 15 grams.

2.12 Seek Time

Innodisk CFast 3MV2-P 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 3MV2-P uses Multi Level Cell (MLC) 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 CFast 3MV2-P from the system level, including the major hardware blocks.
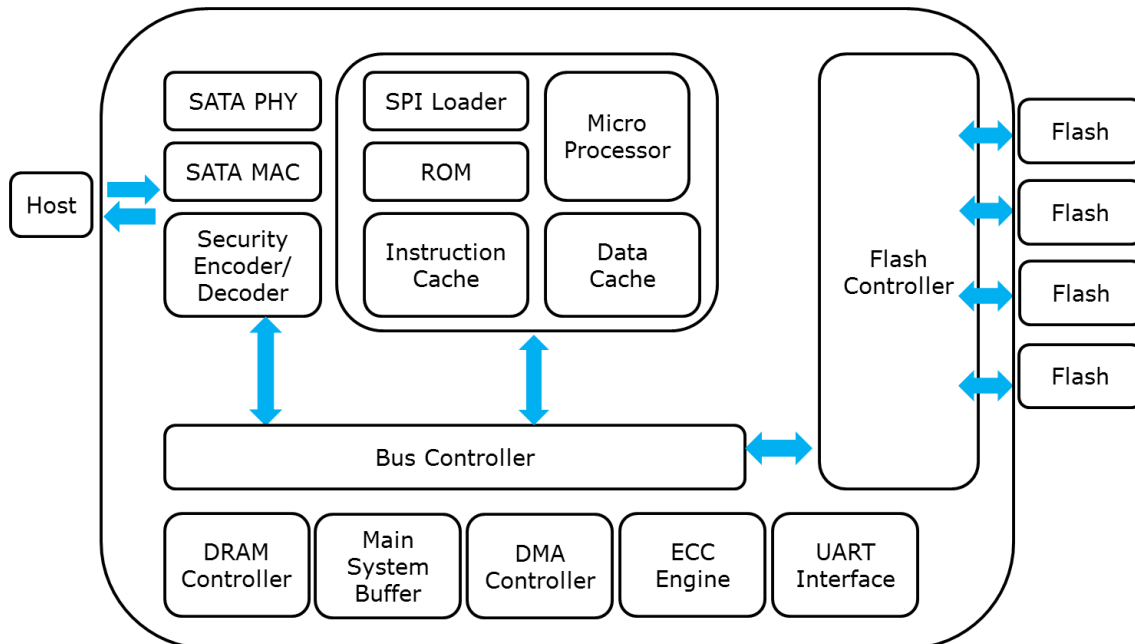

Figure 2: Innodisk CFast 3MV2-P Block Diagram

Innodisk CFast 3MV2-P 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 3MV2-P is designed with ID201, 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 66 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 3MV2-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 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 iData Guard

Innodisk's iData Guard 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 iData Guard provides effective power cycling management, preventing data stored in flash from degrading with use.

3.7 Garbage Collection/TRIM

Garbage collection and TRIM 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
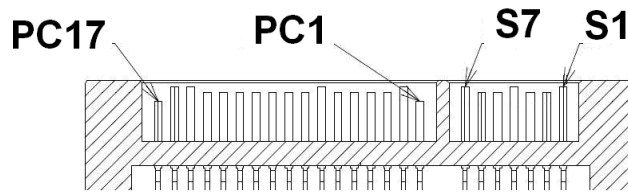
4.1 CFast 3MV2-P Pin Directions

Figure 3: Signal Segment and Power Segment

4.2 Electrical Connections for CFast 3MV2-P

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

4.3 Write Protection (Optional)

Innodisk CFast 3MV2-P 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 3MV2-P 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 3MV2-P can be configured as a boot device.

5. SMART Feature Set

Innodisk 3MV2-P series support the SMART command set and defines some vendor-specific data to report SMART attributes of SSD.

Table 10: SMART command

Value	Command	Value	Command
D0h	Read Data	D5h	Read Log
D1h	Read Attribute Threshold	D6h	Return Status
D2h	Enable/Disable Auto save	D8h	Enable SMART Operations
D3h	Save Attribute Values	D9h	Disable SMART Operations
D4h	Execute OFF-LINE Immediate	DAh	Return Status

5.1 SMART Attributes

Innodisk 3MV2-P series SMART data attributes are listed in following table.

Table 11: SMART attribute

Attribute ID (hex)	Attribute Name
1 (01h)	Raw Read Error Rate
5 (05h)	Reallocated Sector Count
9 (09h)	Power-on Hours
12 (0Ch)	Power Cycle Count
160 (A0h)	Uncorrectable sector count when read/write
161 (A1h)	Number of valid spare block
163 (A3h)	Number of initial invalid block
164 (A4h)	Total erase count
165 (A5h)	Maximum erase count
166 (A6h)	Minimum erase count
167 (A7h)	Average erase count
168 (A8h)	Max erase count of spec
169 (A9h)	Remain Life (percentage)
175 (AFh)	Program fail count in worst die
176 (B0h)	Erase fail count in worst die
177 (B1h)	Total wear level count
178 (B2h)	Runtime invalid block count
181 (B5h)	Total program fail count
182 (B6h)	Total erase fail count

Attribute ID (hex)	Attribute Name
187 (BBh)	Uncorrectable error count
192 (C0h)	Power-Off Retract Count
194 (C2h)	Controlled temperature
195 (C3h)	Hardware ECC recovered
196 (C4h)	Reallocation event count
198 (C6h)	Uncorrectable error count off-line
199 (C7h)	UltraDMA CRC error count
225 (E1h)	Total LBAs written (each write unit = 32MB)
232 (E8h)	Available reserved space
241 (F1h)	Total LBAs written (each write unit = 32MB)
242 (F2h)	Total LBAs read (each write unit = 32MB)

6. 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	V	C	F	A	-	3	2	G	D	8	1	B	C	A	D	C	X	X	X	X

Definition	
Code 1st (Disk)	**Code 13th (Flash Mode)**
D:Disk	B: Synchronous Flash Toshiba 15nm
Code 2st (Feature set)	**Code 14th (Operation Temperature)**
V: InnoREC Series	C: Standard Grade (0℃～ +70℃)
	W: Industrial Grade (-40℃～ +85℃)
Code 3nd ～ 5th (Form Factor)	
CFA: CFast	**Code 15th (Internal control)**
	A~Z: BGA PCB version
Code 7th ~9th (Capacity)	
32G: 32GB	**Code 16th (Channel of data transfer)**
64G: 64GB	D: Dual Channels
A28: 128GB	Q: Qual Channels
B56: 256GB	
	Code 17th (Flash Type)
	C: Toshiba MLC
Code 10th ～12th (Controller)	**Code 18th (Flash Type)**
D81:ID201	W: H/W Write Protect function(Optional)
	Code 19th~21th (Customized Code)

7. Appendix

CE/FCC/RoHS/REACH

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VERIFICATION OF COMPLIANCE

This Verification of Compliance is hereby issued to the below named company. The test results of this report relate only to the tested sample identified in this report.

Technical Standard: EMC DIRECTIVE 2014/30/EU (EN55032 / EN55024)
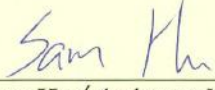
General Information
Applicant: Innodisk Corporation
               5F., No. 237, Sec. 1, Datong Rd., Xizhi Dist.,
               New Taipei City 22161, Taiwan (R.O.C)

Product Description
EUT Description: CFast
Brand Name: Innodisk
Model Number: CFast 3$*#-&
                  $:Flash type: (S:SLC, I:iSLC, M:MLC, T:3D TLC, A~Z:Others)
                  *:Product line: (E:Embedded, G:EverGreen, R:InnoRobust, S:Server, V:InnoREC, A~Z:Others)
                  #:Product Generation: (empty, 0~9)
                  &:Product line: (empty, P:Plus)

Measurement Standard
EN 55032: 2012 / AC: 2013
CISPR 32: 2012
EN 61000-3-2: 2014
EN 61000-3-3: 2013
EN 55024: 2010 + A1: 2015
    (IEC 61000-4-2: 2008; IEC 61000-4-3: 2006 + A1: 2007 + A2: 2010; IEC 61000-4-4: 2012;
    IEC 61000-4-5: 2014; IEC 61000-4-6: 2013; IEC 61000-4-8: 2009; IEC 61000-4-11: 2004)

Measurement Facilities
Xindian Lab.:   *Compliance Certification Services Inc.*
                No.163-1, Jhongsheng Rd., Xindian Dist., New Taipei City, 23151 Taiwan.
                Tel: +886-2-22170894 / Fax: +886-2-22171029

This device has been shown to be in compliance with and was tested in accordance with the measurement procedures specified in the Standards & Specifications listed above and as indicated in the measurement report number: T170504D04-E

Sam Hu / Assistant Manager
Date: May 4, 2017

CCSRF
程智科技股份有限公司
Compliance Certification Services Inc.

FC

VERIFICATION OF COMPLIANCE

This Verification of Compliance is hereby issued to the below named company. The test results of this report relate only to the tested sample identified in this report.

Technical Standard: FCC Part 15 Class B
IC ICES-003

General Information
Applicant: Innodisk Corporation
5F., No. 237, Sec. 1, Datong Rd., Xizhi Dist.,
New Taipei City 22161, Taiwan (R.O.C)

Product Description
EUT Description: CFast
Brand Name: Innodisk
Model Number: CFast 3$*#-&
$:Flash type: (S:SLC, I:iSLC, M:MLC, T:3D TLC, A~Z:Others)
*:Product line: (E:Embedded, G:EverGreen, R:InnoRobust, S:Server, V:InnoREC, A~Z:Others)
#:Product Generation: (empty, 0~9)
&:Product line: (empty, P:Plus)

Measurement Facilities
Xindian Lab.: *Compliance Certification Services Inc.*
No.163-1, Jhongsheng Rd., Xindian Dist., New Taipei City, 23151 Taiwan.
Tel: +886-2-22170894 / Fax: +886-2-22171029

This device has been shown to be in compliance with and was tested in accordance with the measurement procedures specified in the Standards & Specifications listed above and as indicated in the measurement report number: T170504D04-D

Sam Hu / Assistant Manager
Date: May 4, 2017

CCSRF
程智科技股份有限公司
Compliance Certification Services Inc.

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 及（EU）2015/863 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) and (EU) 2015/863 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）
鉛（Pb）	＜ 1000 ppm
汞（Hg）	＜ 1000 ppm
鎘（Cd）	＜ 100 ppm
六價鉻（Cr 6+）	＜ 1000 ppm
多溴聯苯（PBBs）	＜ 1000 ppm
多溴二苯醚（PBDEs）	＜ 1000 ppm
鄰苯二甲酸二(2-乙基己基)酯（DEHP）	＜ 1000 ppm
鄰苯二甲酸丁酯苯甲酯（BBP）	＜ 1000 ppm
鄰苯二甲酸二丁酯（DBP）	＜ 1000 ppm
鄰苯二甲酸二異丁酯（DIBP）	＜ 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：　Randy Chien　簡川勝

Company Representative Title 公司代表人職稱：　Chairman 董事長

Date 日期：　2017 / 01 / 18

Ver 1.0

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；(EC) No 1907/2006 REACH) 以及附錄 XIV 中的限用物質之規定（http://www.echa.europa.eu/de/candidate-list-table last updated: 12/01/2017，SVHC's 173）。

    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 (EC) No 1907/2006 REACH Regulation and restricted substances in Annex XIV （http://www.echa.europa.eu/de/candidate-list-table last updated: 12/01/2017，SVHC's 173）.

    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： Randy Chien 簡川勝

Company Representative Title 公司代表人職稱： Chairman 董事長

Date 日期： 2017 / 02 / 08