innodisk

Total Solution For Industrial Flash Storage

CFast

3TE7 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	Sep., 2018
Rev 1.0	Official Release; power consumption update	Jan., 2019

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1. Product Overview

1.1 Introduction of Innodisk CFast 3TE7

Innodisk CFast 3TE7 which is designed with CFast form factor by CFast 2.0, supporting SATA III standard (6.0Gb/s), achieves excellent performance up to 4CH standard by cost effective controller. Regarding of mechanical interference, Innodisk CFast 3TE7 featured as a small form factor, can be configured as a boot device or data storage and is suitable for most industrial application.

With Innodisk L^3 FW architecture, combining our signature 4K mapping algorithm L^2 FW architecture with powerful LDPC technology, 3TE7 series has outstanding high IOPS, better data integrity and extended lifespan through reducing the bad block number happening.

For real industrial application, 3TE7 series is built in thermal sensor to monitor the environment temperature. iData Guard, the power loss management mechanism developed by Innodisk, ensures data integrity while power sudden loss happened.

1.2 Product View and Models

Innodisk CFast 3TE7 is available in follow capacities within 3D TLC flash ICs.

CFast 3TE7 32GB

CFast 3TE7 64GB

CFast 3TE7 128GB

CFast 3TE7 256GB

CFast 3TE7 512GB

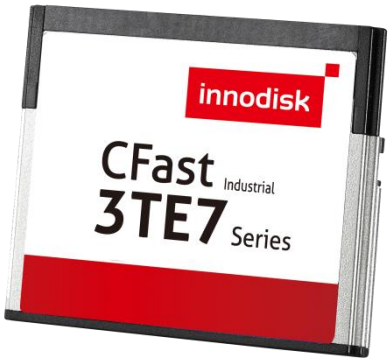


Figure 1: Innodisk CFast 3TE7

1.3 SATA Interface

Innodisk CFast 3TE7 supports SATA III(6.0Gb/s) interface, and compliant with SATA I (1.5Gb/s) and SATA II(3.0Gb/s).

1.4 CFast 2.0 Form Factor

CFast 3TE7 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 3TE7 mechanical dimensions: 42.8mm x 36.4mm x 3.6mm.

2. Product Specifications

2.1 Capacity and Device Parameters

CFast 3TE7 device parameters are shown in Table 1.

Table 1: Device parameters

Capacity	Cylinders	Heads	Sectors	LBA	User Capacity(GB)
32GB	16383	16	63	53742528	25.6
64GB	16383	16	63	117231408	55.9
128GB	16383	16	63	234441648	111.8
256GB	16383	16	63	468862128	223.6
512GB	16383	16	63	937703088	447.1

2.2 Performance

Burst Transfer Rate: 6.0Gbps

Table2: Performance

Capacity	32GB	64GB	128GB	256GB	512GB
Sequential Read (max.)	180 MB/s	360 MB/s	560 MB/s	560 MB/s	560 MB/s
Sequential Write (max.)	35 MB/s	75 MB/s	150 MB/s	300 MB/s	330 MB/s
4KB Random** Read (QD32)	12000 IOPS	23000 IOPS	44000 IOPS	77000 IOPS	83000 IOPS
4KB Random** Write (QD32)	9000 IOPS	18500 IOPS	36500 IOPS	67500 IOPS	75000 IOPS

Note: the information is based on CrystalDiskMark 5.1.2 with file size 1000MB test pattern

2.3 Electrical Specifications

2.3.1 Power Requirement

Table 3: Innodisk CFast 3TE7 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	454.3
Write	550.7
Idle	260.5

* Target: 512GB CFast 3TE7

2.4 Environmental Specifications

2.4.1 Temperature Ranges

Table 5: Temperature range for CFast 3TE7

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 3TE7

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 3TE7 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 3TE7 MTBF

Product	Condition	MTBF (Hours)
Innodisk CFast 3TE7	Telcordia SR-332 GB, 25°C	>3,000,000

2.5 CE and FCC Compatibility

CFast 3TE7 conforms to CE and FCC requirements.

2.6 RoHS Compliance

CFast 3TE7 is fully compliant with RoHS directive.

2.7 Reliability

Parameter	Value
Read Cycles	Unlimited Read Cycles
Flash endurance	3,000 P/E cycles
Wear-Leveling Algorithm	Support
Bad Blocks Management	Support
DIE RAID Recovery	Support
Error Correct Code	Support

TBW* (Total Bytes Written) Units: TB

Capacity	Sequential workload	Client workload
32GB	84.3	37.5
64GB	168.6	75
128GB	337.2	150
256GB	674.4	250
512GB	1348.8	500

* 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 3TE7 support following transfer mode:

Serial ATA III 6.0Gbps

Serial ATA II 3.0Gbps

Serial ATA I 1.5Gbps

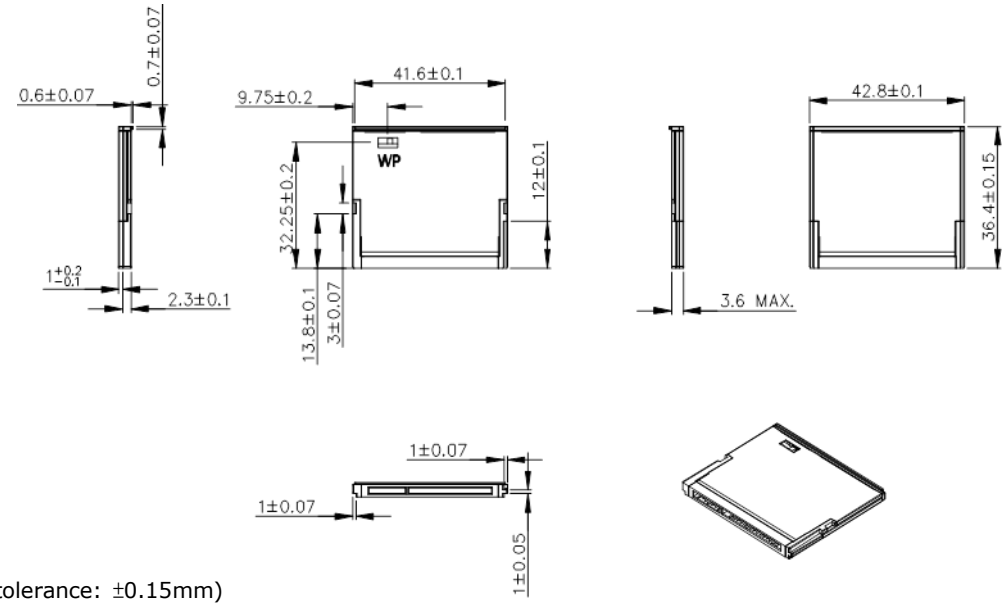
2.9 Pin Assignment

Innodisk CFast 3TE7 uses a standard SATA pin-out. See Table 8 for CFast 3TE7 pin assignment.

Table 8: Innodisk CFast 3TE7 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 3TE7 within flash ICs, 128GB's weight is 10 grams approximately.

2.12 Seek Time

Innodisk CFast 3TE7 is not a magnetic rotating design. There is no seek or rotational latency required.

2.13 NAND Flash Memory

Innodisk CFast 3TE7 uses 3D TLC NAND flash memory, with 3,000 program & erase cycles, 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 3TE7 from the system level, including the major hardware blocks.

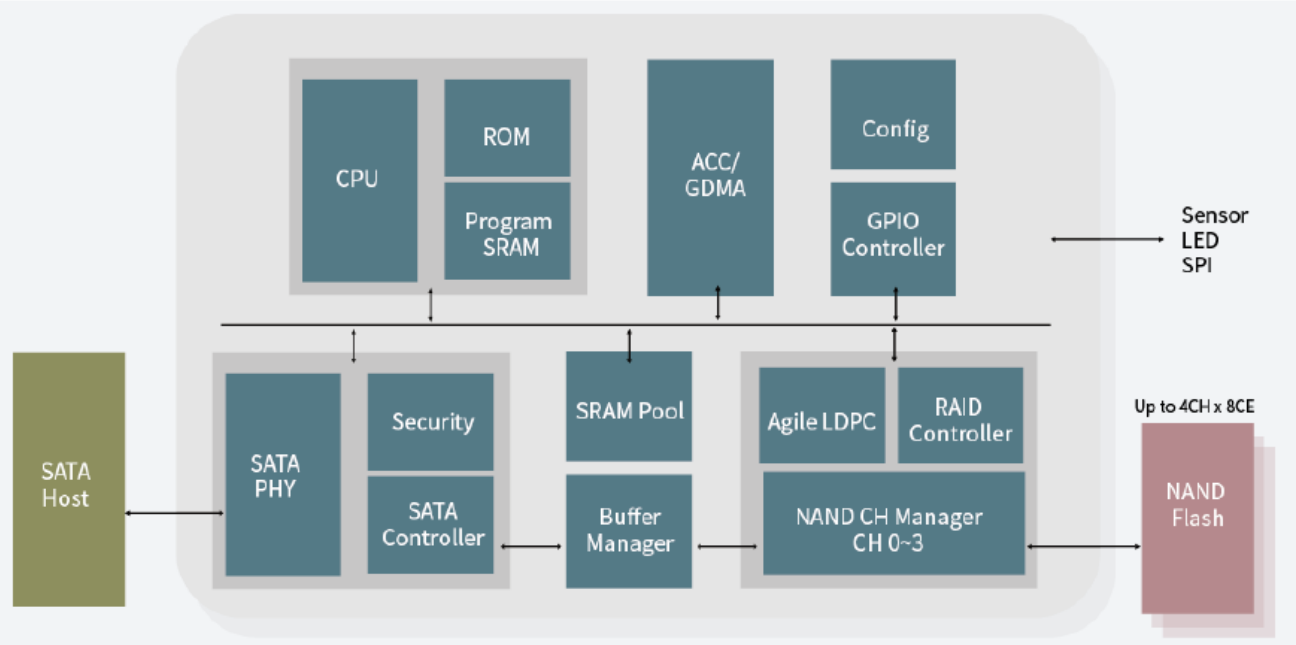


Figure 2: Innodisk CFast 3TE7 Block Diagram

Innodisk CFast 3TE7 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 3TE7 is designed with 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

Innodisk CFast 3TE7 is designed with hardware LDPC ECC engine with hard-decision and Soft-decision decoding. Low-density parity-check (LDPC) codes have excellent error correcting Performance close to the Shannon limit when decoded with the belief-propagation (BP) algorithm

using soft-decision information.

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 3TE7 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

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.

3.8 Trim

The Trim command is designed to enable the operating system to notify the SSD which pages no longer contain valid data due to erases either by the user or operating system itself. During a delete operation, the OS will mark the sectors as free for new data and send a Trim command to the SSD to mark them as not containing valid data. After that the SSD knows not to preserve the

contents of the block when writing a page, resulting in less write amplification with fewer writes to the flash, higher write speed, and increased drive life.

3.9 iPower Guard

iPower Guard technology is a set of preventive measures that protect the SSD in an unstable power supply environment. This comprehensive package comprises safeguards for startup and shutdown to maintain device performance and ensure data integrity.

4. Installation Requirements

4.1 CFast 3TE7 Pin Directions

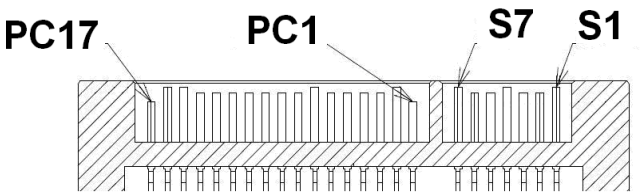


Figure 3: Signal Segment and Power Segment

4.2 Electrical Connections for CFast 3TE7

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 CFast 3TE7 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**	**-**	**C**	**1**	**2**	**D**	**K**	**1**	**E**	**C**	**1**	**Q**	**F**	**(W)**	**X**	**X**	**X**

Definition	
Code 1st (Disk)	**Code 13th (Flash Mode)**
D:Disk	E: 64 layers 3D TLC
Code 2st (Feature set)	**Code 14th (Operation Temperature)**
E:Embedded series	C: Standard Grade (0℃~ +70℃)
	W: Industrial Grade (-40℃~ +85℃)
Code 3nd ~ 5th (Form Factor)	
CFA: CFast	**Code 15th (Internal control)**
	1~9: TSOP PCB version
Code 7th ~9th (Capacity)	
32G: 32GB	**Code 16th (Channel of data transfer)**
64G: 64GB	S: Single Channel
A28: 128GB	D: Dual Channels
B56: 256GB	Q: Quad Channels
C12: 512GB	**Code 17th (Flash Type)**
	F: Toshiba 3D TLC
Code 10th ~12th (Controller)	**Code 18th (Flash Type)**
DK1: SATA 3TE7	W: H/W Write Protect function
	Code 19th~21th (Customized Code)

CE

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 (EN55022 / 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)
*:Product line: (E:Embedded, G:EverGreen, R:InnoRobust)
#:Product Generation: (empty, 0~9)
&:Product line: (empty, P:Plus)

Measurement Standard

EN 55022: 2010 / AC: 2011
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: TI610141D05-E

Sam Hu

Sam Hu / Assistant Manager
Date: October 18, 2016

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

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

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Model Number: CFast 3$*#-&
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#: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: T161014D05-D

Sam Hu

Sam Hu / Assistant Manager
Date: October 18, 2016

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 EP 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： 2018 / 07 / 01

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: 15/01/2018**)。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: 15/01/2018**). 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.

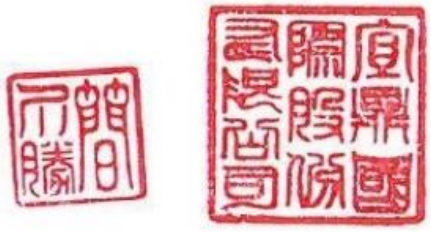
立 保 證 書 人 (Guarantor)

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： 2018 / 02 / 08



MSL Declaration of Conformity

1. Purpose: MSL (Moisture Sensitivity Levels) specification statement for all Innodisk products

2. Scope: For All Innodisk finish goods

3. Responsibilities: QA

4. Reference:

   4.1 JEDEC, S-STD-020

   4.2 JEDEC,J-STD-033

5. Description

   5.1 Innodisk Products Level: All Innodisk products meet MSL Level 1

   5.2 Floor Life Time: Refer following table

	Soak Requirements					
	Floor Life		Standard		Accelerated	
Level	Time	Cond degC/%RH	Time (hrs)	Cond degC/%RH	Time (hrs)	Cond degC/%RH
1	unlimited	<=30/85%	168+5/-0	85/85	n/a	n/a
2	1 year	<=30/60%	168+5/-0	85/60	n/a	n/a
2a	4 weeks	<=30/60%	696+5/-0	30/60	120+1/-0	60/60
3	168 hours	<=30/60%	192+5/-0	30/60	40+1/-0	60/60
4	72 hours	<=30/60%	96+2/-0	30/60	20+0.5/-0	60/60
5	48 hours	<=30/60%	72+2/-0	30/60	15+0.5/-0	60/60
5a	24 hours	<=30/60%	48+2/-0	30/60	10+0.5/-0	60/60
6	TOL	<=30/60%	TOL	30/60	n/a	60/60

Innodisk Corporation
Quality Assurance Div
Manager
Yi Chuan Chen
Date: 2018.09.21

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