innodisk

Total Solution For Industrial Flash Storage

mSATA

3TE7 series with YMTC NAND

Customer: _____

Customer Part Number: _____

Innodisk Part Number: _____

Innodisk Model Name: _____

Date: _____

Innodisk Approver	Customer Approver

Table of contents

Revision History

Revision	Description	Date
Preliminary_0.1	First Release	May., 2021

List of Tables

List of Figures

1. Product Overview

1.1 Introduction of Innodisk mSATA 3TE7

Innodisk mSATA 3TE7 is compliant with JEDEC MO-300 standard, supporting SATA III interface (6.0Gb/s). mSATA 3TE7 is capable of providing excellent performance with its 4 Channel 8 CE controller architecture with cost effectiveness in mind. In addition, through vigorous verification and with industrial-oriented Innodisk features, Innodisk mSATA 3TE7 is suitable for all fields of 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.

1.2 Product View and Models

Innodisk mSATA 3TE7 is available in follow capacities within 3D NAND flash ICs.

mSATA 3TE7 128GB mSATA 3TE7 256GB mSATA 3TE7 512GB
mSATA 3TE7 1TB

Figure 1: Innodisk mSATA 3TE7

1.3 SATA Interface

Innodisk mSATA 3TE7 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 3TE7 device parameters are shown in Table 1.

Table 1: Device parameters

Capacity	Cylinders	Heads	Sectors	LBA	User Capacity(GB)
128GB	16383	16	63	250069680	122087
256GB	16383	16	63	500118192	244181
512GB	16383	16	63	1000215216	488369
1TB	16383	16	63	2000409264	976762

2.2 Performance

Burst Transfer Rate: 6.0Gbps

Table2: Performance* 64 Layers 3D TLC

Capacity	128GB	256GB	512GB	1TB
Sequential** Read (Q32T1)	550 MB/s	550 MB/s	550 MB/s	550 MB/s
Sequential** Write (Q32T1)	460 MB/s	480 MB/s	490 MB/s	490 MB/s
Sustained Sequential Read (Avg.) ***	420 MB/s	420 MB/s	420 MB/s	400 MB/s
Sustained Sequential Write (Avg.) ***	160 MB/s	225 MB/s	260 MB/s	250 MB/s
4KB Random** Read (Q32T1)	77,000	89,000	89,000	84,000
4KB Random** Write (Q32T1)	72,000	74,000	72,000	72,000

Note: * Performance results are measured in Room Temperature with Out-of-Box devices and may vary depending on overall system setup. In addition, mSATA 3TE7 Innodisk NAND series adopt hybrid mode which enables SLC Cache up to 27% of total user capacity followed by TLC direct write to strike balance between burst performance and steady overall stability.

Note: ** Performance results are based on CrystalDiskMark 6.0.2 with file size 1000MB. Unit of 4KB items is I.O.P.S.

Note: *** Performance results are based on AIDA 64 v5.98 with block size 1MB of Linear Read & Write Test Item.

2.3 Electrical Specifications

2.3.1 Power Requirement

Table 3: Innodisk mSATA 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 64 Layers 3D TLC

Mode	Power Consumption (W)
Read (RMS)	0.6
Write (RMS)	1.4
Idle (RMS)	0.6
Power-On Peak	2.9

Note: * Current results may vary depending on system components and power circuit design.

2.4 Environmental Specifications

2.4.1 Temperature Ranges

Table 5: Temperature range for mSATA 3TE7

Temperature	Range
Operating (Ta)	Standard Grade: 0°C to +70°C Industrial Grade: -40°C to +85°C
Storage	-40°C to +85°C

2.4.2 Humidity

Relative Humidity: 10-95%, non-condensing

2.4.3 Shock and Vibration

Table 6: Shock/Vibration Testing for mSATA 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 mSATA 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: mSATA 3TE7 MTBF

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

2.5 CE and FCC Compatibility

mSATA 3TE7 conforms to CE and FCC requirements.

2.6 RoHS Compliance

mSATA 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
128GB	340	TBD
256GB	680	TBD
512GB	1360	TBD
1TB	2720	TBD

* 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

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

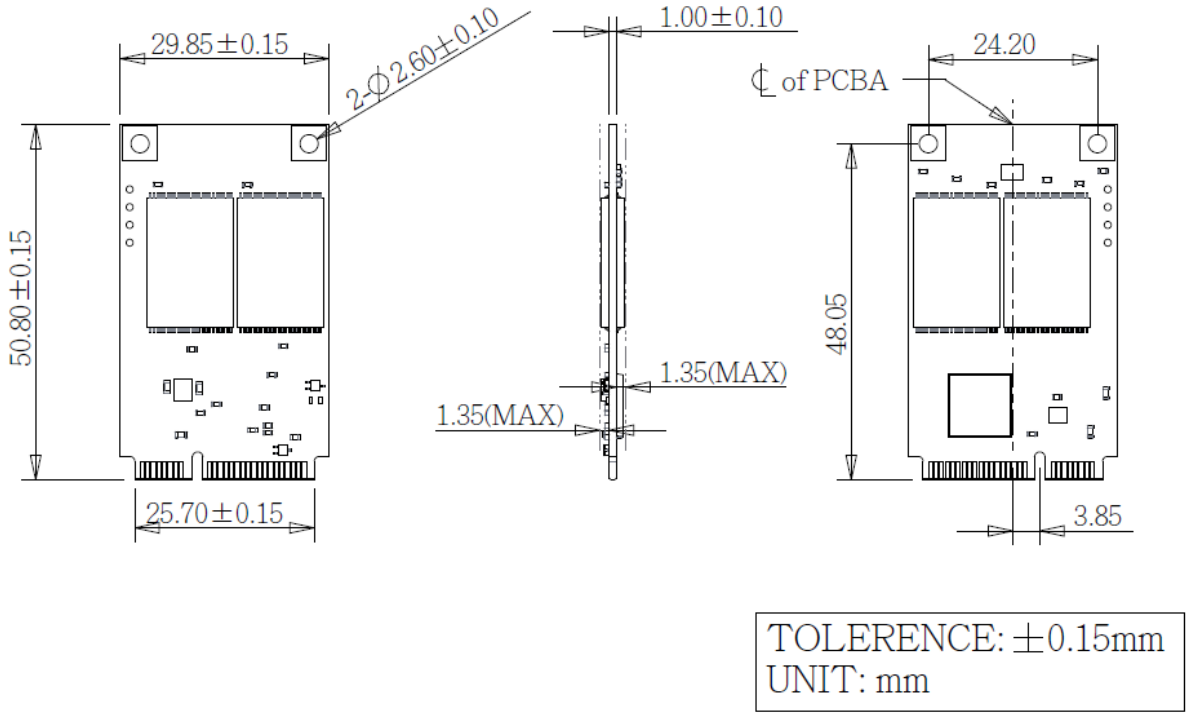
Table 8: Innodisk mSATA 3TE7 Pin Assignment

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	DEVSLP
+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

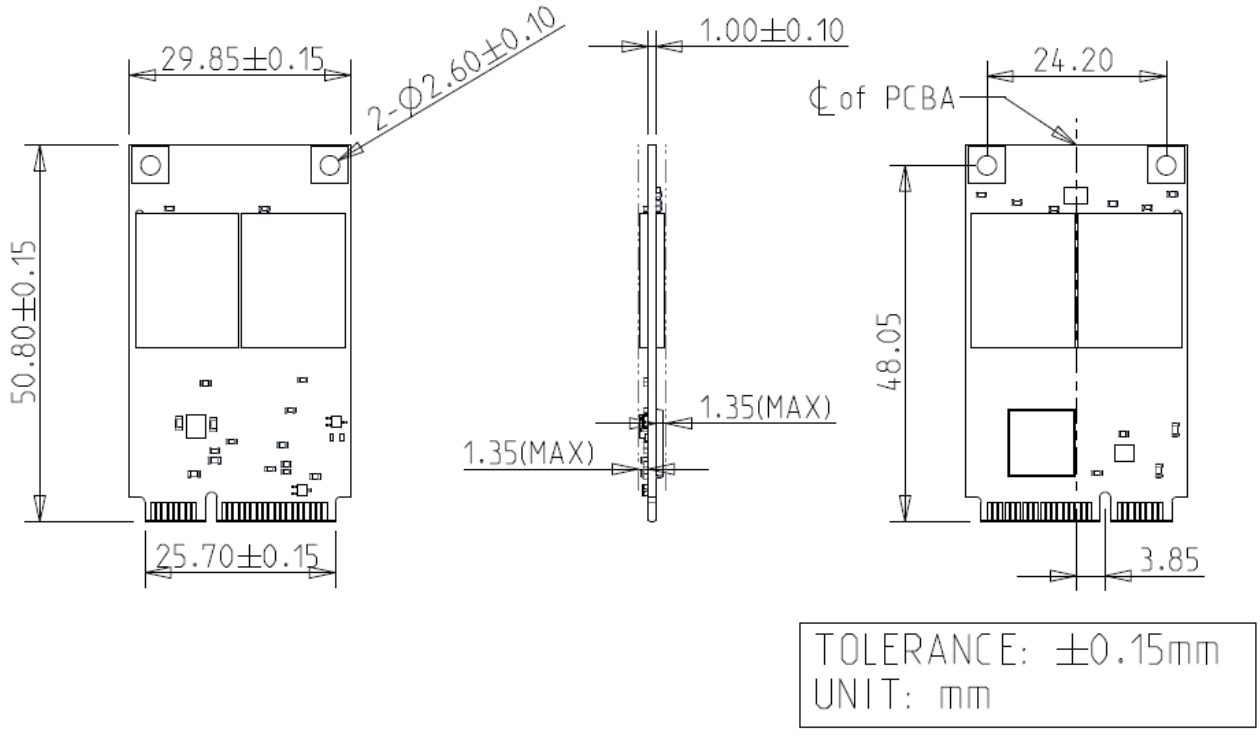
GND	9	10	NC
NC	7	8	NC
NC	5	6	NC
NC	3	4	GND
NC	1	2	+3.3V

2.10 Mechanical Dimensions

For 64GB~512GB



For 1TB~2TB



2.11 Assembly Weight

An Innodisk mSATA 3TE7 within flash ICs, 32GB's weight is 8 grams approximately.

2.12 Seek Time

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

2.13 NAND Flash Memory

Innodisk mSATA 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 mSATA 3TE7 from the system level, including the major hardware blocks.

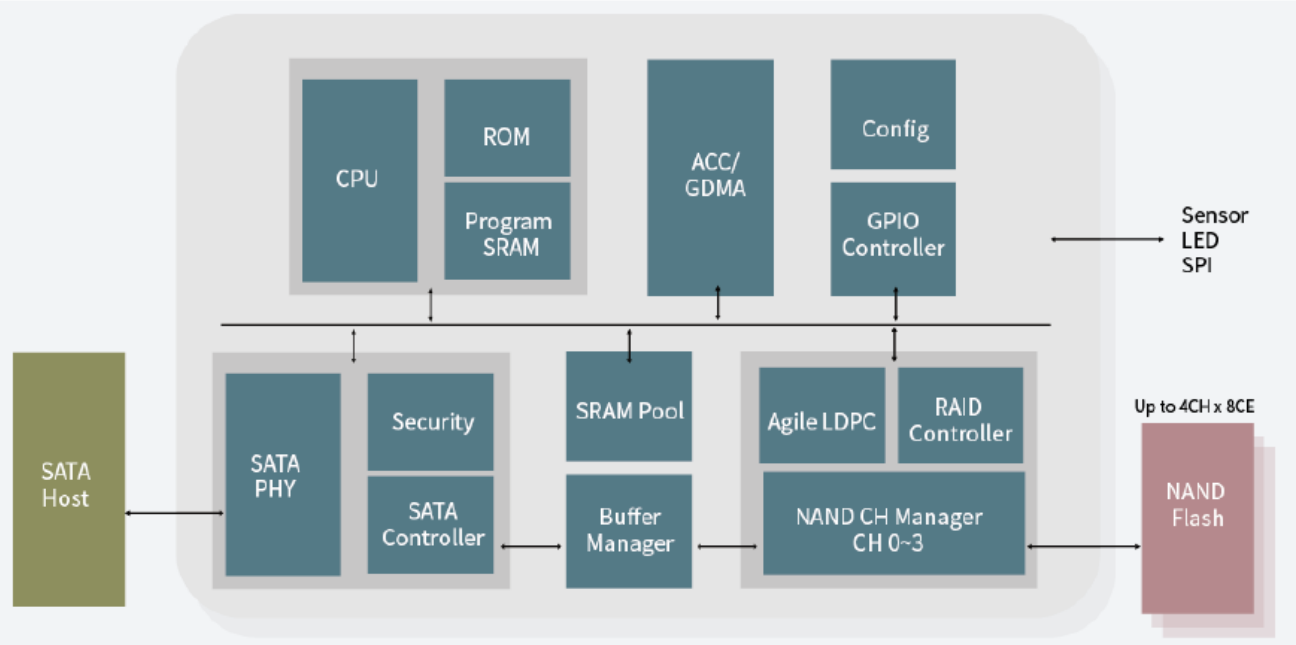


Figure 2: Innodisk mSATA 3TE7 Block Diagram

Innodisk mSATA 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 mSATA 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 mSATA 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 mSATA 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.

3.10 Die RAID

Die RAID is a controller function which leveraged user capacity to back up the data in NAND flash. Die RAID supported can ensure the user data in the NAND Flash more consistent in certain scenario. Innodisk mSATA 3TE7 series is default enable the Die RAID function for the industrial application.

3.11 SLC cache

Table 9: mSATA 3TE7 SLC cache

Capacity	128GB	256GB	512GB	1TB
SLC cache (GB)	35	60	120	240
SLC cache (%)	27%	23%	23%	23%

3TE7 series adopt hybrid mode which enables SLC Cache up to 27% of total user capacity by TLC direct write to strike balance between burst performance and steady overall stability.

4. Installation Requirements

4.1 mSATA 3TE7 Pin Directions

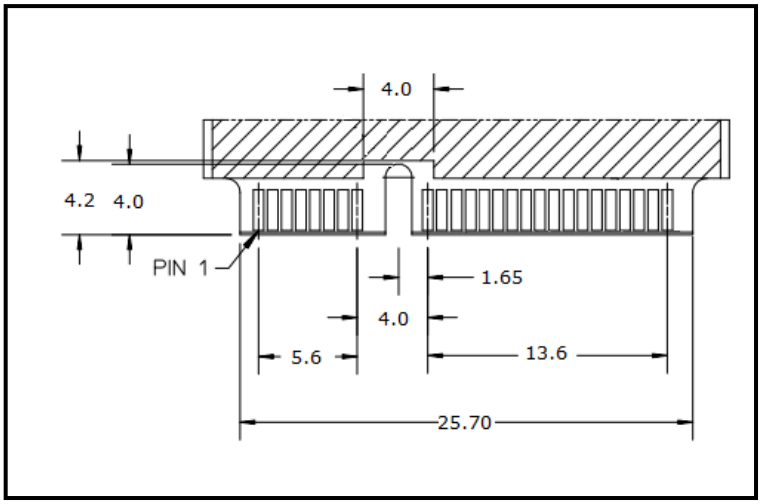


Figure 3: Signal Segment and Power Segment

4.2 Electrical Connections for mSATA 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 mSATA 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	M	S	R	-	0	1	T	D	K	1	E	C	A	Q	J	-	X	X	X

Definition	
Code 1st (Disk)	**Code 13th (Flash Mode)**
D : Disk	E: 64 layers 3D TLC
Code 2nd (Feature Set)	**Code 14th (Operation Temperature)**
E: Embedded	C: Standard Grade (0℃~ +70℃)
Code 3rd~ 5th (Form Factor)	**Code 15th (Internal control)**
MSR: mSATA Regular	A: PCB version
Code 7th ~9th (Capacity)	**Code 16th (Channel of data transfer)**
A28: 128GB	D: Dual Channels
B56: 256GB	Q: Quad Channels
C12: 512GB	**Code 17th (Flash Type)**
01T: 1TB	J: YMTC 3D TLC
Code 10th ~12th (Controller)	**Code 19th~21th (Customized Code)**
DK1: SATA 3TE7	

innodisk

宜鼎國際股份有限公司
Innodisk Corporation

Tel:(02)7703-3000 Internet: https://www.innodisk.com/

RoHS 自我宣告書(RoHS Declaration of Conformity)

Manufacturer Products: All Innodisk EM FLASH, DRAM and 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.

三、 本公司聲明我們的產品符合 RoHS 指令的附件中(7a)、(7c-I)允許豁免。
We declare, our products permitted by the following exemptions specified in the Annex of the RoHS directive.

※ (7a) Lead in high melting temperature type solders(i.e. lead-based alloys containing 85% by weight or more lead).

※ (7C-I) Electrical and electronic components containing lead in a glass or ceramic other than dielectric ceramic in capacitors, e.g. piezoelectric devices, or in a glass or ceramic matrix compound.

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： 2020 / 03 / 03

宜鼎國際股份有限公司
Innodisk Corporation
REACH Declaration

Tel:(02)7703-3000 Fax:(02) 7703-3555 Internet: https://www.innodisk.com/

Innodisk Corporation pursues its social responsibility for global environmental preservation by committing to be compliant with REACH regulation (REGULATION (EC) No 1907/2006).
We hereby confirm that the product(s) delivered to

Innodisk P/N	Description
All Innodisk EM FLASH Products	

☐ contain(s) **no** hazardous substances or constituents exceeding the defined threshold 0.1 % by weight in homogenous material if not otherwise specified, as described in the candidate list table currently including 209 substances and shown on the ECHA website (http://echa.europa.eu/de/candidate-list-table).

☑ contain(s) one or more hazardous substances or constituents exceeding 0.1 % by weight in homogenous material if not otherwise specified in candidate list table. Where the threshold value is exceeded, the substances in question are to be declared in accompanying Appendix A.

☑ Comply with REACH Annex XVII.

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： 2020 / 07/ 01

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: mSATA
Brand Name: Innodisk
Model Number: mSATA 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: T161004D13-E

Sam Hu

Sam Hu / Assistant Manager
Date: October 11, 2016

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 (EN55032)

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: mSATA
Brand Name: Innodisk
Model Number: mSATA 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 55032: 2012 / AC: 2013
CISPR 32: 2012

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: T161004D13-E

Sam Hu

Sam Hu / Assistant Manager
Date: October 11, 2016

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: mSATA
Brand Name: Innodisk
Model Number: mSATA 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 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: T161004D13-D

Sam Hu / Assistant Manager
Date: October 11, 2016

MSL Declaration of Conformity

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

2. Scope: For all Innodisk products

3. Reference:

4.1 JEDEC, J-STD-020

4.2 JEDEC, J-STD-033

4. Description

5.1 Innodisk Products MSL Level:

Flash /DRAM Module Level 1

BGA IC (nanoSSD family) Level 3

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: 2018.09.27

數位簽章者：Yi Chuan Chen
DN：cn=Yi Chuan Chen, o=Innodisk Corporation, ou=QA Div, email=yichuan_chen@innodisk.com, c=TW
日期：2018.09.27 10:41:58 +08'00'