

M.2 (S80)

3TG6-P Series

Single-sided

Customer:

Customer

Part Number:

Innodisk

Part Number:

Innodisk

Model Name:

Date:

Innodisk Approver	Customer Approver

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REVISION HISTORY

Revision	Description	Date
1.0	Initial Release	Feb. 2020

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1. Product Overview

1.1 Introduction of Innodisk M.2 (S80) 3TG6-P Single-sided

Innodisk M.2 (S80) 3TG6-P is characterized by L³ architecture with the latest SATA III (6.0GHz) Marvell NAND controller. Innodisk's exclusive L³ architecture is L² architecture multiplied LDPC (Low Density Parity Check). L² (Long Life) architecture is a 4K mapping algorithm that reduces WAF and features a real-time wear leveling algorithm to provide high performance and prolong lifespan with exceptional reliability. Innodisk M.2 (S80) 3TG6-P is designed for industrial field, and supports several standard features, including TRIM, NCQ, and S.M.A.R.T. In addition, Innodisk's exclusive industrial-oriented firmware provides a flexible customization service, making it perfect for a variety of industrial applications.

CAUTION *TRIM must be enabled.*

TRIM enables SSD's controller to skip invalid data instead of moving. It can free up significant amount of resources, extends the lifespan of SSD by reducing erase, and write cycles on the SSD. Innodisk's handling of garbage collection along with TRIM command improves write performance on SSDs.

1.2 Product View and Models

Innodisk M.2 (S80) 3TG6-P is available in follow capacities within 3D TLC flash ICs.

[M.2 \(S80\) 3TG6-P 128GB](#)

[M.2 \(S80\) 3TG6-P 256GB](#)

[M.2 \(S80\) 3TG6-P 512GB](#)

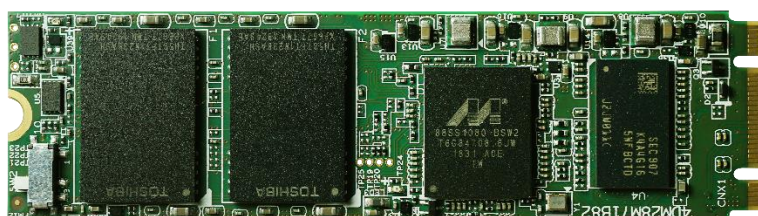


Figure 1: Innodisk M.2 (S80) 3TG6-P (type 2280)

1.3 SATA Interface

Innodisk M.2 (S80) 3TG6-P 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 M.2 (S80) 3TG6-P is compliant with Serial ATA Gen 1, Gen 2 and Gen 3 specification (Gen 3 supports 1.5Gbps /3.0Gbps/6.0Gbps data rate).

2. Product Specifications

2.1 Capacity and Device Parameters

M.2 (S80) 3TG6-P device parameters are shown in Table 1.

Table 1: Device parameters

Capacity	Cylinders	Heads	Sectors	LBA	User Capacity(MB)
128GB	16383	16	63	214906608	104935
256GB	16383	16	63	468862128	228937
512GB	16383	16	63	937703088	457863

2.2 Performance

Burst Transfer Rate: 6.0Gbps

Table 2: Performance

Capacity	128GB	256GB	512GB
Sequential* Read (max.)	500 MB/s	500 MB/s	500 MB/s
Sequential* Write (max.)	135 MB/s	290 MB/s	430 MB/s
4KB Random** Read (QD32)	41,900 IOPS	68,900 IOPS	64,000 IOPS
4KB Random** Write (QD32)	34,700 IOPS	54,000 IOPS	55,600 IOPS

Note: * Sequential performance is based on CrystalDiskMark 6.0.2 with file size 1000MB

** Random performance is based on IO meter with Queue Depth 32

2.3 Electrical Specifications

2.3.1 Power Requirement

Table 3: Innodisk M.2 (S80) 3TG6-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)
Bootup	296 (peak)
Read	674 (rms.)
Write	838 (rms.)
Idle	269 (rms.)

* Target: 512GB M.2 (S80) 3TG6-P Single-sided

2.4 Environmental Specifications

2.4.1 Temperature Ranges

Table 5: Temperature range for M.2 (S80) 3TG6-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 M.2 (S80) 3TG6-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 M.2 (S80) 3TG6-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: M.2 (S80) 3TG6-P MTBF

Product	Condition	MTBF (Hours)
Innodisk M.2 (S80) 3TG6-P	Telcordia SR-332 GB, 25°C	>3,000,000

2.5 CE and FCC Compatibility

M.2 (S80) 3TG6-P conforms to CE and FCC requirements.

2.6 RoHS Compliance

M.2 (S80) 3TG6-P is fully compliant with RoHS directive.

2.7 Reliability

Table 8: M.2 (S80) 3TG6-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
128GB	340.9	150
256GB	681.8	300
512GB	1364	600
* 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

M.2 (S80) 3TG6-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 M.2 (S80) 3TG6-P uses a standard SATA pin-out. See Table 9 for M.2 (S80) 3TG6-P pin assignment.

Table 9: Innodisk M.2 (S80) 3TG6-P Pin Assignment

Signal Name	Pin #	Pin #	Signal Name
		75	GND
3.3V	74	73	GND
3.3V	72	71	GND
3.3V	70	69	GND
NC	68	67	NC
Notch	66	65	Notch
Notch	64	63	Notch
Notch	62	61	Notch
Notch	60	59	Notch
NC	58		
NC	56	57	GND
NC	54	55	NC
NC	52	53	NC
NC	50	51	GND
NC	48	49	RX+
NC	46	47	RX-
NC	44	45	GND
NC	42	43	TX-
NC	40	41	TX+
DEVSLP	38	39	GND
NC	36	37	NC
NC	34	35	NC
NC	32	33	GND
NC	30	31	NC
NC	28	29	NC
NC	26	27	GND
NC	24	25	NC
NC	22	23	NC
NC	20	21	GND
Notch	18	19	Notch
Notch	16	17	Notch
Notch	14	15	Notch
Notch	12	13	Notch
DAS/DSS	10	11	NC

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

2.10 Mechanical Dimensions

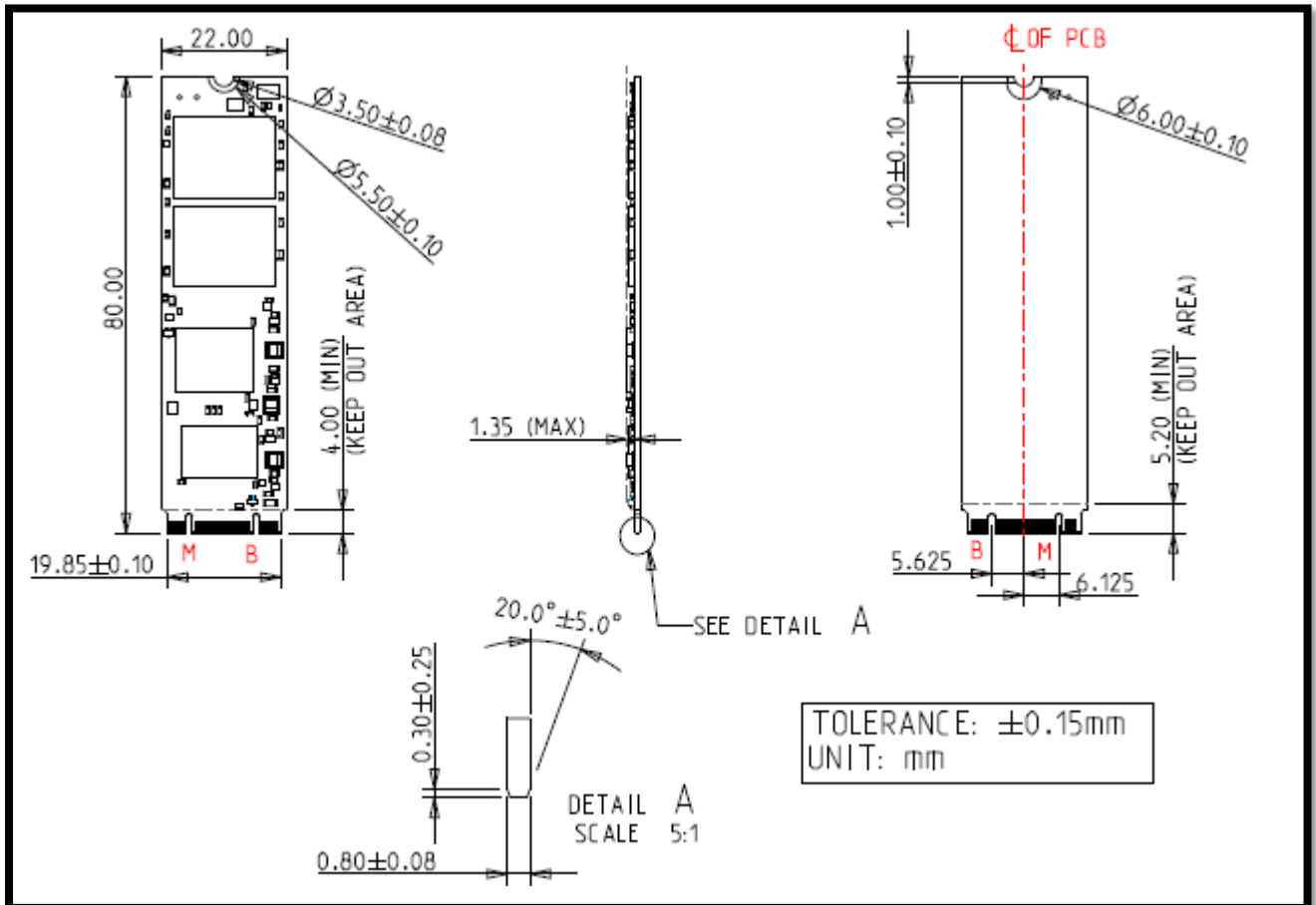


Figure 2: Innodisk M.2 (S80) 3TG6-P diagram 128GB~512GB Single-sided

2.11 Assembly Weight

An Innodisk M.2 (S80) 3TG6-P within flash ICs, 512GB's weight is 10 grams approximately.

2.12 Seek Time

Innodisk M.2 (S80) 3TG6-P is not a magnetic rotating design. There is no seek or rotational latency required.

2.13 Hot Plug

The SSD support hot plug function and can be removed or plugged-in during operation. User has to avoid hot plugging the SSD 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 M.2 (S80) 3TG6-P uses 3D Triple Level Cell (TLC) NAND flash memory, which is non-volatility, high reliability and high speed memory storage.

3. Theory of Operation

3.1 Overview

Figure 4 shows the operation of Innodisk M.2 (S80) 3TG6-P from the system level, including the major hardware blocks.

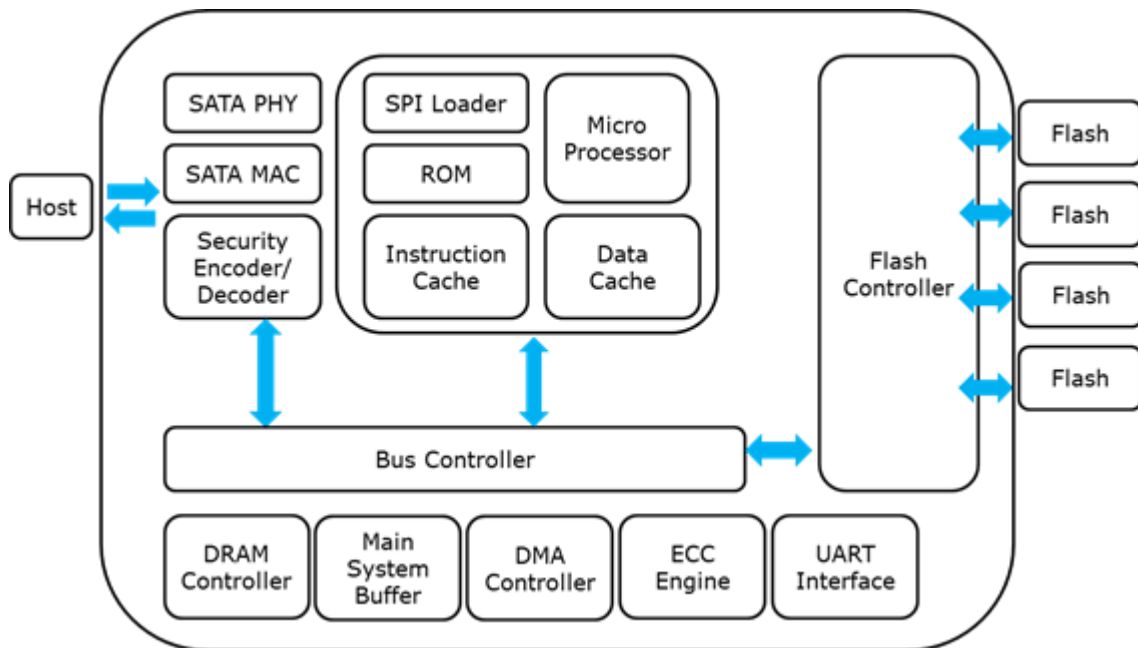


Figure 3: Innodisk M.2 (S80) 3TG6-P Block Diagram

Innodisk M.2 (S80) 3TG6-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 M.2 (S80) 3TG6-P 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 M.2 (S80) 3TG6-P 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 M.2 (S80) 3TG6-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

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 M.2 (S80) 3TG6-P series is default enable the Die RAID function for the industrial application.

4. Installation Requirements

4.1 M.2 (S80) 3TG6-P Pin Directions

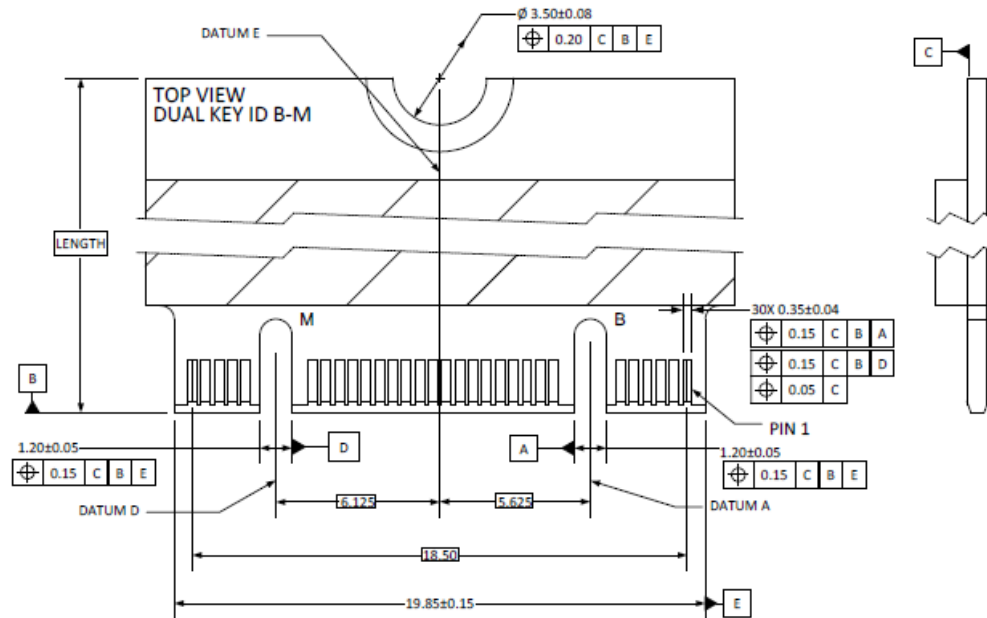


Figure 4: Signal Segment and Power Segment

4.2 Electrical Connections for M.2 (S80) 3TG6-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 1meter. 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 M.2 (S80) 3TG6-P can be configured as a boot device.

5. SMART Feature Set

Innodisk 3TG6-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 3TG6-P series SMART data attributes are listed in following table.

Table 11: SMART attribute

Attribute ID (hex)	Value	Raw Attribute Value						Rsv	Attribute Name
05	64 _{hex}	LSB			MSB	00	00	00	Later Bad
09	LSB	LSB			MSB	00	00	00	Power-On hours Count
0C	LSB	LSB			MSB	00	00	00	Drive Power Cycle Count
A3	LSB	LSB					MSB	00	Total Bad Block Count
A5	LSB	LSB			MSB	00	00	00	Max Erase count
A7	LSB	LSB			MSB	00	00	00	Avg Erase count
A9	64 _{hex}	LSB	00	00	00	00	00	00	Device Life
AA	64 _{hex}	LSB					MSB	00	Spare Block Count
AB	LSB	LSB					MSB	00	Program fail count
AC	LSB	LSB					MSB	00	Erase fail count
B8	00	LSB			MSB	00	00	00	Error Corrected Count
BB	00	LSB			MSB	00	00	00	Reported Uncorrect Count
C0	LSB	LSB			MSB	00	00	00	Unexpected Power Loss

									Count
C2	Cur.*	Cur.*	00	MIN	00	MAX	03	Cur.*	Temperature
E5	64 _{hex}	ID 0	ID 1	ID 2	ID 3	ID 4	ID 5	00	Flash ID
EB	00		MSB	LSB	MSB	LSB	MSB	LSB	Later bad block info (Read/Write/Erase)
F1	64 _{hex}	LSB					MSB	00	Total LBA written(LBA=32MB)
F2	64 _{hex}	LSB					MSB	00	Total LBA read(LBA=32MB)

Cur.* =Current

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	G	M	2	8	-	B	5	6	M	7	1	E	C	B	Q	F	S	-	X	X
Definition																					
Code 1 st (Disk)											Code 14 th (Operation Temperature)										
D : Disk											C: Standard Grade (0℃~ +70℃)										
Code 2 nd (Feature set)											W: Industrial Grade (-40℃~ +85℃)										
G : EverGreen series																					
Code 3 rd ~5 th (Form factor)											Code 15 th (Internal control)										
M28: M.2 Type 2280-D2-B-M											1~9: TSOP PCB version.										
											A~Z: BGA PCB version. A: DDR3; B: DDR4										
Code 7 th ~9 th (Capacity)											Code 16 th (Channel of data transfer)										
A28: 128GB		B56:256GB				C12:512GB					D: Dual Channels										
											Q: Quad Channels										
Code 10 th ~12 th (Controller)											Code 17 th (Flash Type)										
M71: 3TG6-P											F: Toshiba 3D TLC										
Code 13 th (Flash mode)											Code 18 th (additional features)										
E: 64 layers 3D TLC											S: for Single-sided										
G: 96 layers 3D flash											Code 19 th ~21 st (Customize code)										

7. Appendix

REACH

innodisk

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

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

We hereby confirm that the product(s) delivered to

Innodisk P/N	Description
All Innodisk EM Flash and Dram 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 191 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 & B.
- ☒ 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： 2018 / 02 / 08



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

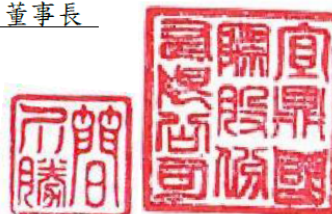
立 保 證 書 人 (Guarantor)

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： 2018 / 07 / 01



MSL**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


數位簽署者: Yi Chuan Chen
DN: cn=Yi Chuan Chen, o=Innodisk
Corporation, ou=QA Div,
email=yichuan_chen@innodisk.com, c=TW
日期: 2018.09.21 13:39:10 +08'00'

CE(EN55032)

SGS

CCSRF



VERIFICATION OF COMPLIANCE

This Verification of Compliance is hereby issued to the below named company and for below described product, based on

**Technical Standard : EMC DIRECTIVE 2014/30/EU
(EN 55032 / EN 55024)**

General Information

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

Product Description

Product Name : M.2 (S80)
Brand Name : Innodisk
Model Number : M.2 (S80) 3S@#-&
\$: Flash type: (S:SLC, L:SLC, 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)
- : marketing differentiation, (- or empty)
& : Product line: (empty, P:Plus)

Measurement Standard

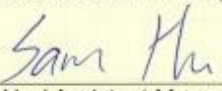
EN 55032: 2015 / AC: 2016
CISPR 32: 2015 (Ed 2.0) / C1: 2016
EN 61000-3-2: 2014
EN 61000-3-3: 2013
EN 55024: 2010 + A1: 2015
(IEC 61000-4-2: 2008; IEC 61000-4-3: 2006 + A1: 2007 + A2: 2010; IEC 61000-4-4: 2012;
IEC 61000-4-5: 2014 + A1: 2017; IEC 61000-4-6: 2013; IEC 61000-4-8: 2009; IEC 61000-4-11: 2004 + A1: 2017)

Measurement Facilities

Company Name : Compliance Certification Services Inc.
Test Laboratory : Xindian Lab.
Address of Test Lab. : No.163-1, Jhongsheng Rd., Xindian Dist., New Taipei City, 23151 Taiwan.

This device has been tested and found to be in compliance with the measurement procedures specified in the Standards & Specifications listed above and as indicated in the measurement report with the number:
T190418D07-E

The test results shown in this report are applicable only to the investigated sample identified in this report.


Sam Hu / Assistant Manager
Date: April 29, 2019

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SGS Compliance Certification Service Inc.
威智科技股份有限公司

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VERIFICATION OF COMPLIANCE

This Verification of Compliance is hereby issued to the below named company and for below described product, based on

**Technical Standard : FCC 47 CFR Part 15 Subpart B
ANSI C63.4: 2014
ISED ICES-003 (Issue 6)**

General Information

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

Product Description

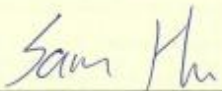
Product Name : M.2 (S80)
Brand Name : Innodisk
Model Number : M.2 (S80) 3\$@#-&
\$:Flash type: (S:SLC, I:iSLC, M:MLC, T:3D TLC, A~Z:Others)
@:Product line: (E:Embedded, G:EverGreen, R:InnoRobust, S:Server,
V:InnoREC, A~Z:Others)
#:Product Generation: (empty, 0~9)
-:marketing differentiation, (- or empty)
&:Product line: (empty, P:Plus)

Measurement Facilities

Company Name : Compliance Certification Services Inc.
Test Laboratory : Xindian Lab.
Address of Test Lab. : No.163-1, Jhongsheng Rd., Xindian Dist., New Taipei City, 23151 Taiwan.

This device has been tested and found to be in compliance with the measurement procedures specified in the Standards & Specifications listed above and as indicated in the measurement report with the number: T190418D07-D

The test results shown in this report are applicable only to the investigated sample identified in this report.


Sam Hu / Assistant Manager
Date: April 29, 2019

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