MicroSD Card

3IE2 Series

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
Preliminary	First Released	May., 2018
1.0	Officially Released	July, 2018
2.0	Add 4GB/8GB/16GB information	Feb., 2019
2.1	Update Performance	May, 2019

1. Product Overview

1.1 Introduction of MicroSD 3IE2

Innodisk MicroSD 3IE2 is designed for demanding industrial applications and provides excellent performance. Moreover, Innodisk MicroSD 3IE2 supports Ultra High Speed (UHS) interface transfer mode, provides high write/read data transfer rate, high random IOPS, sudden Power-Fails protection, adaptive static wear-leveling, read/program disturb management, etc.

1.2 Product View and Models

Innodisk MicroSD 3IE2 is available in follow capacities within MLC flash ICs.

MicroSD 3IE2 4GB/8GB/16GB/32GB

1.3 SD3.0 Interface

Innodisk MicroSD 3IE2 supports SD3.0 interface, and compliant with SD 2.0 and SD 1.1.

2. Product Specifications

2.1 Capacity and Device Parameters

MicroSD 3IE2 device parameters are shown in Table 1.

Table 1: Device parameters

Capacity	LBA	User Capacity (MB)
4GB	7561216	3684
8GB	15122432	7376
16GB	30228480	14752
32GB	60456960	29508

2.2 Performance

Speed Class: Class 10 (10MB/s)

Table 2: Performance

Capacity	4GB	8GB	16GB	32GB
Sequential Read (max.)	86 MB/sec	87 MB/sec	87 MB/sec	86 MB/sec
Sequential Write (max.)	31 MB/sec	43 MB/sec	45 MB/sec	45 MB/sec
4KB Random** Read (QD32)	6.3 MB/s	6.2 MB/s	6.2 MB/s	6.1 MB/s
4KB Random** Write (QD32)	1.5 MB/s	1.5 MB/s	1.8 MB/s	1.8 MB/s

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

2.3 Electrical Specifications

2.3.1 Power Requirement

Table 3: Innodisk MicroSD 3IE2 Power Requirement

Item	Symbol	Rating	Unit
Input voltage	V_{IN}	2.7~3.6	V

2.3.2 Power Consumption

Table 4: Power Consumption

Mode	Power Consumption (mA)
Read	208
Write	165
Idle	0.44

* Target: MicroSD 3IE2 32GB

2.4 Environmental Specifications

2.4.1 Temperature Ranges

Table 5: Temperature range for MicroSD 3IE2

Temperature	Range
Operating	Standard Grade: -25°C to +85°C
Storage	-55°C to +95°C

2.4.2 Shock and Vibration

Table 6: Shock/Vibration Testing for MicroSD 3IE2

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

2.4.3 Mean Time between Failures (MTBF)

Table 7 summarizes the MTBF prediction results for various MicroSD 3IE2 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: MicroSD 3IE2 MTBF

Product	Condition	MTBF (Hours)
Innodisk MicroSD 3IE2	Telcordia SR-332 GB,	>3,000,000

25°C	

2.5 CE and FCC Compatibility

MicroSD 3IE2 conforms to CE and FCC requirements.

2.6 RoHS Compliance

MicroSD 3IE2 is fully compliant with RoHS directive.

2.7 Reliability

Parameter	Value
Read Cycles	Unlimited Read Cycles
Flash endurance	20,000 P/E cycles
Wear-Leveling Algorithm	Support
Bad Blocks Management	Support
Error Correct Code	Support
TBW* (Total Bytes Written) Unit:TB	
Capacity	**Sequential workload**
4GB	65.1
8GB	130.2
16GB	260.4
32GB	522.4
*Note: Sequential: Mainly sequential write, tested by Vdbench.	

2.8 Transfer Mode

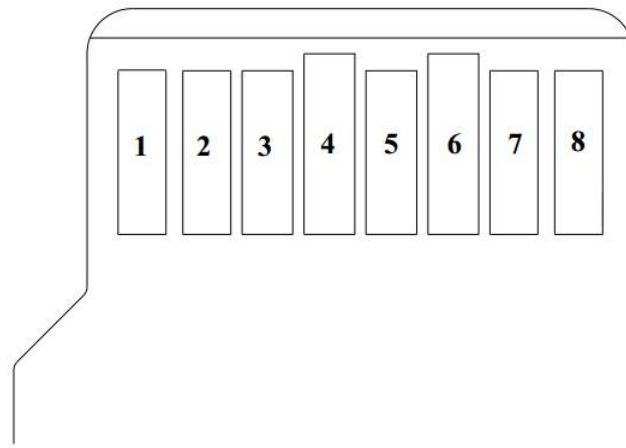MicroSD 3IE2 supports following transfer mode:

SD 3.0

SD 2.0

SD 1.1

SPI mode

2.9 Pin Assignment

MicroSD 3IE2 uses a standard SD pin-out. See Table 8 for MicroSD 3IE2 pad assignment.

Table 8: Innodisk MicroSD 3IE2 Pad Assignment

Pin #	Name	Type	description
1	DAT2[2,5]	I/O	Data Line [Bit 2]
2	CD/DAT3[2]	I/O[3]	Card Detect/Data Line[Bit 3]
3	CMD	I/O	Command/Response
4	V_{DD}	S	Supply Voltage
5	CLK	I	Clock
6	V_{SS}	S	Supply Voltage GND
7	DAT0	I/O	Data Line [Bit 0]
8	DAT1[2,4]	I/O	Data Line [Bit 1]

2.10 Mechanical Dimensions
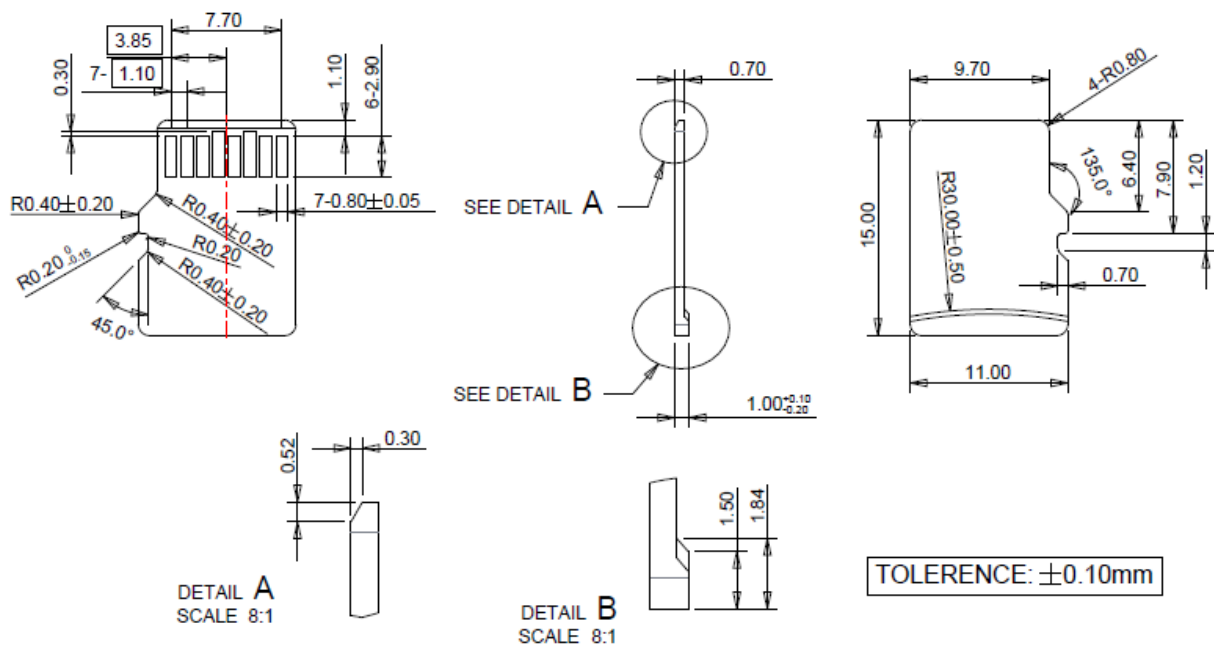
2.11 Assembly Weight

An Innodisk MicroSD 3IE2 within flash ICs weight is 0.25 grams approximately.

2.12 Seek Time

Innodisk MicroSD 3IE2 is not a magnetic rotating design. There is no seek or rotational latency required.

2.13 NAND Flash Memory

Innodisk MicroSD 3IE2 uses Multi Level Cell (MLC) NAND flash memory, which is non-volatility, high reliability and high speed memory storage. Each cell stores 2 bits or holds four states per cell. Read or Write data to flash memory for SD/MSD is control by microprocessor.

3. Theory of Operation

3.1 Overview

Figure 1 shows the operation of Innodisk MicroSD 3IE2 from the system level, including the major hardware blocks.
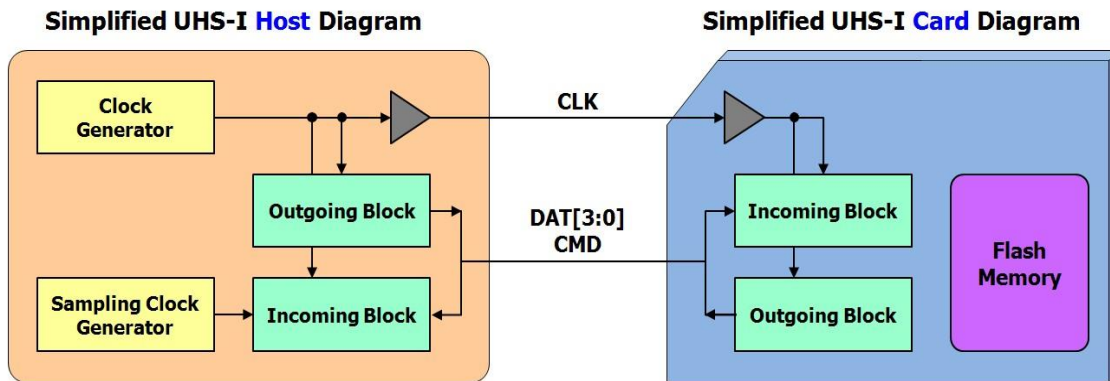

Figure 1: Innodisk MicroSD 3IE2 and Host Block Diagram

Figure 1 shows a typical UHS-I host system that supports removable cards. Host has clock generator which supplies SDCLK to the card. In case of write operation, as clock direction and data direction is the same, write data can be transferred synchronized with SDCLK regardless of transmission line delay.

In case of read operation, as clock direction and data direction is opposite, read data host received is delayed by round-trip delay, output delay and latency of host and card. So receiving data is the most critical for the host. Therefore, host needs to have sampling clock generator to receive response, CRC status and read data block.

3.2 Controller

Innodisk MicroSD 3IE2 is designed with a SD 3.0 controller.

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 43 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

Global and static wear-leveling provides more uniform block usage than dynamic and Zone-based wear-leveling. The essence had scrambled entire blocks to reach the unique probability of P/E cycle and quite longer lifetime.

Innodisk's wear-leveling scheme is accomplished by global adaptive static wear-leveling, which ensures the better endurance and optimizes the system performance of the Flash memory array.

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 SD/MSD is shipped, or may develop during the life time of the SD/MSD. When the Bad Blocks is detected, it will be flagged, and not be used anymore. The SD/MSD 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 Garbage Collection

Garbage collection is used to maintain data consistency and perform continual data cleansing on SD/MSDs. It frees up valuable controller resources while sorting good data into available blocks, and deletes bad blocks. It also significantly reduces write operations to the drive, thereby increasing the SD/MSD's speed and lifespan.

3.7 Power cycling

Innodisk's SD/MSDs provide the complete data protection mechanism during every abnormal power shutdown situation. Such as: power failure at programming data, updating system tables, erasing blocks, etc. The mechanism can maintain the data correctness and increase the reliability of the data stored in the NAND Flash memory.

4. 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	H	S	D	M	-	3	2	G	E	2	1	S	E	A	S	K	-	X	X	X
Description	Disk	MicroSD					Capacity			Controller			Flash Mode	Operation Temp.	Internal Control	CH.	Flash Type	-	Customized Code		

Definition	
Code 1ˢᵗ (Disk)	**Code 13ᵗʰ (Flash Mode)**
D : Disk	S: Sync. Flash
Code 2ⁿᵈ ~ 5ᵗʰ (Form Factor)	**Code 14ᵗʰ (Operation Temperature)**
HSDM: Micro SD	E: Extended Grade (-25℃~ +85℃)
Code 7ᵗʰ ~9ᵗʰ (Capacity)	**Code 15ᵗʰ (Internal control)**
04G: 4GB	A~Z: SBT version
08G: 8GB	**Code 16ᵗʰ (Channel of data transfer)**
16G: 16GB	S: Single Chanel
32G: 32GB	**Code 19ᵗʰ~21ᵗʰ (Customized Code)**
Code 10th ~12th (Controller)	
E21: ITE1288	

2.1

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/

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

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

$$CE$$

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 (EN55032 / EN55024)

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 : Micro SD
Brand Name : Innodisk
Model Number Micro SD #$*&
#: 1:Gen1, 2:Gen2, 3:Gen3
$: 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)

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; IEC 61000-4-6: 2013; IEC 61000-4-8: 2009; IEC 61000-4-11: 2004)

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: T171013D03-E

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

Sam Hu / Assistant Manager
Date: November 6, 2017

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)
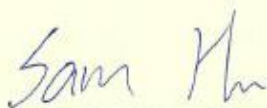
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Product Name   : Micro SD
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                     #: 1:Gen1, 2:Gen2, 3:Gen3
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                     *:Product line: (E:Embedded, G:EverGreen, R:InnoRobust, S:Server,
                     V:InnoREC, A~Z:Others)
                     &:Product Generation: (empty, 0~9)

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: T171013D03-D

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

Sam Hu / Assistant Manager
Date: November 6, 2017