innodisk

Total Solution For Industrial Flash Storage

Mini PCIeDOM

1IE3 Series

Customer: _____

Customer Part Number: _____

Innodisk Part Number: _____

Innodisk Model Name: _____

Date: _____

Remark: _____

Innodisk Approver	Customer Approver

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REVISION HISTORY

Revision	Description	Date
Rev. 1.0	MP release	April, 2016

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1. Product Overview

1.1 Introduction of Innodisk Mini PCIeDOM 1IE3

Innodisk Mini PCIeDOM 1IE3 is a Flash based disk module with Mini PCI Express interface, which brings you new generation of storage solution, especially focused on embedded systems. It not only provide standard Mini PCIe interface but also delivers excellent performance.

Comparing with most Mini PCIe storage devices in the market, Mini PCIeDOM 1IE3 comes with standard Mini PCI Express interface, just plug and play without any circuit modification, and no driver needed, which is the easiest way for board maker or system integrator to design in the product as a boot drive or storage device.

1.2 Product View and Models

Innodisk Mini PCIeDOM 1IE3 is available in follow capacities:

Mini PCIeDOM 1IE3 8GB Mini PCIeDOM 1IE3 64GB

Mini PCIeDOM 1IE3 16GB Mini PCIeDOM 1IE3 128GB

Mini PCIeDOM 1IE3 32GB

Figure 1: Innodisk Mini PCIeDOM 1IE3

1.3 PCI Express Interface

Innodisk Mini PCIeDOM 1IE3 supports PCIe Gen.1 interface, with 1 lane.

2. Product Specifications

2.1 Capacity and Device Parameters

Mini PCIeDOM 1IE3 device parameters are shown in Table 1.

Table 1: Device parameters

Capacity	LBA	Cylinders	Heads	Sectors	User Capacity(MB)
8GB	15649200	13587	16	63	7641
16GB	31277232	16383	16	63	15272
32GB	62533296	16383	16	63	30533
64GB	125045424	16383	16	63	61057
128GB	250069680	16383	16	63	122104

2.2 Performance

Burst Transfer Rate: 2.5Gbps

Table 2: Performance

Capacity	8GB	16GB	32GB	64GB	128GB
Sequential* Read (max.)	110 MB/sec	130 MB/sec	130 MB/sec	130 MB/sec	130 MB/sec
Sequential* Write (max.)	50 MB/sec	100 MB/sec	100 MB/sec	100 MB/sec	100 MB/sec
4KB Random** Read (QD32)	4600	4600	4600	4600	4600
4KB Random** Write (QD32)	8900	8900	8900	8900	8900

Note: Base on CrystalDiskMark 3.01 with file size 1000MB

2.3 Electrical Specifications

2.3.1 Power Requirement

Table 3: Innodisk Mini PCIeDOM 1IE3 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	565 (max.)
Write	622 (max.)
Idle	542 (max.)

* Target: Mini PCIeDOM 1IE3 64GB

2.4 Environmental Specifications

2.4.1 Temperature Ranges

Table 5: Temperature range for Mini PCIeDOM 1IE3

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 Mini PCIeDOM 1IE3

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 Mini PCIeDOM 1IE3 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: Mini PCIeDOM 1IE3 MTBF

Product	Condition	MTBF (Hours)
Innodisk Mini PCIeDOM 1IE3	Telcordia SR-332 GB, 25°C	>3,000,000

2.5 CE and FCC Compatibility

Mini PCIeDOM 1IE3 conforms to CE and FCC requirements.

2.6 RoHS Compliance

Mini PCIeDOM 1IE3 is fully compliant with RoHS directive.

2.7 Reliability

Parameter	Value
Read Cycles	Unlimited Read Cycles
Wear-Leveling Algorithm	Support
Bad Blocks Management	Support
Error Correct Code	Support
TBW* (Total Bytes Written)	Unit: TB
8GB	16
16GB	32
32GB	64
64GB	128
128G**B**	256
* Total bytes written is based on JEDEC 218 (Solid-State Drive Requirements and Endurance Test Method)	
** Lifespan is calculated by device written per day	

2.8 Transfer Mode

Mini PCIeDOM 1IE3 support following transfer mode:

PCIe Gen.1, x1 2.5Gbps

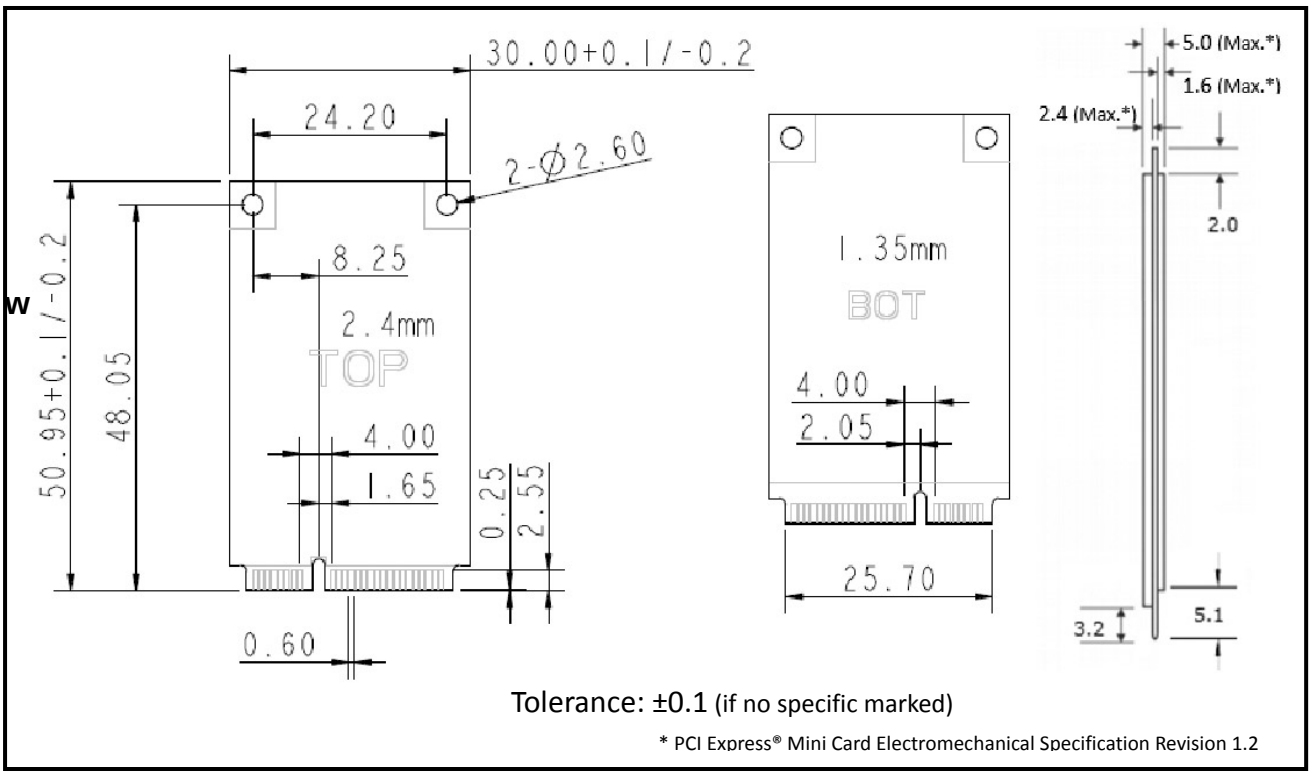
2.9 Pin Assignment

Innodisk Mini PCIeDOM 1IE3 is designed with standard Mini PCIe pin-out. See Table 8 for Mini PCIeDOM 1IE3 pin assignment.

Pin #	Signal Name	Pin #	Signal Name
51	NC	52	3.3V
49	NC	50	GND
47	NC	48	NC
45	NC	46	NC
43	GND	44	NC
41	3.3V	42	NC
39	3.3V	40	GND
37	GND	38	NC
35	GND	36	NC
33	PERp0	34	GND
31	PERn0	32	NC
29	GND	30	NC
27	GND	28	NC
25	PETp0	26	GND
23	PETn0	24	3.3V
21	GND	22	PERST#
19	NC	20	NC
17	NC	18	GND
Mechanical Key			
15	GND	16	NC
13	REFCLK+	14	NC
11	REFCLK-	12	NC
9	GND	10	NC
7	GND	8	NC
5	NC	6	NC
3	NC	4	GND
1	NC	2	3.3V

Table 8: Innodisk Mini PCIeDOM 1IE3 Pin Assignment

2.10 Mechanical Dimensions



2.11 Assembly Weight

6.5g±0.5g

2.12 Seek Time

Innodisk Mini PCIeDOM 1IE3 is not a magnetic rotating design. There is no seek or rotational latency required.

2.13 NAND Flash Memory

Innodisk Mini PCIeDOM 1IE3 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 Mini PCIeDOM 1IE3 from the system level, including the major hardware blocks.

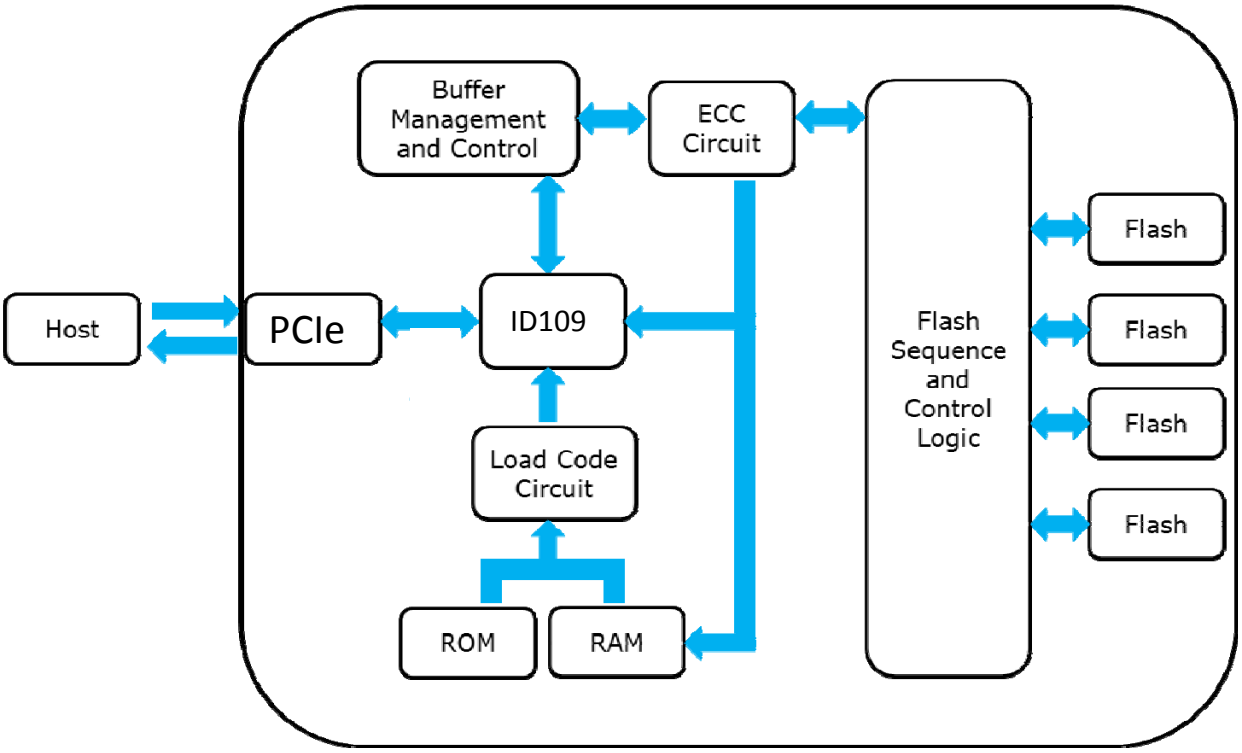


Figure 2: Innodisk Mini PCIeDOM 1IE3 Block Diagram

Innodisk Mini PCIeDOM 1IE3 integrates SATA controller, PCIe bridge controller and NAND flash memories. Communication with the host occurs through the host interface, using the standard PCIe protocol. Communication with the flash device(s) occurs through the flash interface.

3.2 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 40 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.

3.3 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 Mini PCIeDOM 1IE3 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.

3.4 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.

3.5 Power Cycling

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

3.6 Garbage Collection

Garbage collection 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 Mini PCIeDOM 1IE3 Pin Directions

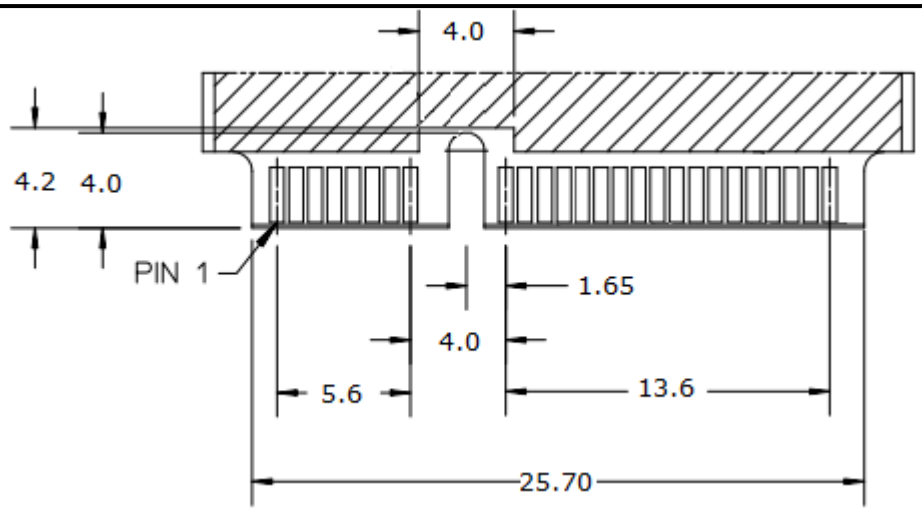


Figure 3: Signal Segment and Power Segment

4.4 Device Driver

No additional device driver are required. Innodisk Mini PCIeDOM 1IE3 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
	D	**H**	**E**	**D**	**M**	**-**	**3**	**2**	**G**	**D**	**0**	**9**	**B**	**C**	**1**	**D**	**C**	**-**	**X**	**X**
Description	Disk	Mini PCIeDOM					Capacity			Category			Flash mode	Operation Temp.	Internal Control	CH.	Flash	-	Customized Code	

Definition	
Code 1st (Disk)	**Code 13th (Flash mode)**
D : Disk	B: Toshiba 15nm Synchronous Flash
Code 2nd ~ 5th (Form Factor)	
HEDM: Mini PCIeDOM with iSLC	**Code 14th (Operation Temperature)**
Code 7th ~9th (Capacity)	C: Standard Grade (0℃~ +70℃)
08G: 8GB	W: Industrial Grade (-40℃~ +85℃)
16G: 16GB	
32G: 32GB	**Code 15th (Internal control)**
64G: 64GB	**Code 16th (Channel of data transfer)**
A28: 128GB	S: Single Channel
	D: Dual Channels
	Code 17th (Flash Type)
Code 10th ~12th (Series)	C: Toshiba MLC
D09: ID109	**Code 19th~20th (Customized Code)**

Appendix

Verification of Compliance

Product Name	:	**Mini PCIeDOM 1ME**
Model Number	:	**DEEDM-xxxD07$%1*$** **XXX : 8GB~256GB** **(xxx: capacity; %: Working Temp.; *: Channel; $: Flash type)**
Applicant	:	**InnoDisk Corporation**
Address	:	**9F, No.100, Sec. 1, Xintai 5th Rd., Xizhi Dist., New Taipei City 221, Taiwan**
Report Number	:	**O22-U070-1305-624**
Issue Date	:	**July 16, 2013**
Applicable Standards	:	**EN 55022:2010 Class B ITE** **AS/NZS CISPR22:2009 Class B ITE** **EN 55024:2010** EN 61000-4-2:2009 EN 61000-4-3:2006+A1:2008+A2:2010 EN 61000-4-4:2004+A1:2010

Based on the EMC Directive 2004/108/EC and the specifications of the customer, one sample of the designated product has been tested in our laboratory and found to be in compliance with the EMC standards cited above.

CE

TAF 0905
FCC CAB Code TW1053
NVLAP Lab Code 200575-0
IC Code 4699A
VCCI Accep. No. R-1527, C-1609, T-1441, G-10, C-4400, T-1334, G-614

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Tel : 886-2-25984568
Fax: 886-2-25984546

J. Y.

(Tsun-Yu Shih/ General Manager)
Date: July 16, 2013

Verification of Compliance

Product Name	:	**Mini PCIeDOM 1ME**
Model Number	:	**DEEDM-xxxD07$%1*$** **XXX : 8GB~256GB** **(xxx: capacity; %: Working Temp.; *: Channel; $: Flash type)**
Applicant	:	**InnoDisk Corporation**
Address	:	**9F, No.100, Sec. 1, Xintai 5th Rd., Xizhi Dist., New Taipei City 221, Taiwan**
Report Number	:	**F-U070-1305-624**
Issue Date	:	**July 16, 2013**
Applicable Standards	:	**FCC Part 15, Subpart B Class B ITE** **ANSI C63.4:2009** **Industry Canada ICES-003 Issue 5** **CSA-IEC CISPR22-10 Class B ITE**

One sample of the designated product has been tested in our laboratory and found to be in compliance with the FCC rules cited above.

NVLAP LAB CODE 200575-0

TAF 0905
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(Tsun-Yu Shih/ General Manager)
Date: July 16, 2013

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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 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) 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）
Cd	< 100 ppm
Pb	< 1000 ppm
Hg	< 1000 ppm
Chromium VI（Cr+6）	< 1000 ppm
Polybromodiphenyl ether（PBDE）	< 1000 ppm
Polybrominated Biphenyls（PBB）	< 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： Richard Lee 李鐘亮

Company Representative Title 公司代表人職稱： CEO 執行長

Date 日期： 2014 / 07 / 29


(Company Stamp/公司大小章)

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: 16/06/2014**)。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: 16/06/2014**). 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： Richard Lee 李鐘亮

Company Representative Title 公司代表人職稱： CEO 執行長

Date 日期： 2014 / 07 / 29

(Company Stamp/公司大小章)