Industrial Micro SD Card

SD series

Total Solution For Industrial Flash Storage

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	Jan. 2012
Rev. 1.0	Add 8GB in available capacities.	Sep. 2012
Rev. 1.1	1. Update product picture 2. Add features 3. Add description of enhanced power cycling 4. Add chapter of i-S.M.A.R.T Utility	Nov. 2012
Rev. 1.2	Add device parameters Add mechanical drawing	April, 2014
Rev.1.3	Update ECC bits	March, 2016
Rev 1.4	Update performance	April, 2016

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1. Product Overview

1.1 Introduction of Innodisk Industrial Micro SD card

While micro SD card has been a popular embedded storage device for mobile market, Innodisk has been developing a more reliable micro SD card that will support ruggedized applications in the embedded fields. Therefore, Innodisk would like to introduce you the industrial-grade micro SD card built with SLC (Single Level Cell) flash, delivering the most reliable micro SD card with outstanding performance and excellent endurance.

1.2 Product View and Models

Innodisk Industrial Micro SD card is available in follow capacities.

1GB   2GB   4GB   8GB

Figure 1: Innodisk Industrial SD card

1.3 Product Features

- Interface: SD 2.0/1.1/1.0
- SLC NAND Flash
- Support SD/SPI mode
- Built-in ECC corrects up to 24 bits per 1 KB
- Resistance to Shock and Vibration
- Enhanced endurance by Global Wear-Leveling algorithm
- Enhanced Power Cycling: Pass 1,000 times copy and compare test

2. Product Specifications

2.1 Capacity and Device Parameters

Innodisk Industrial SD card device parameters are shown in Table 1.

Table 1: Device parameters

SLC		
Capacity	**LBA**	**User Capacity(MB)**
1GB	1024065536	976
2GB	2052718592	1957
4GB	4026531840	3840
8GB	8095006720	7720

2.2 Performance

Burst Transfer Rate: up to 104 MB/s in SD 3.0 SDR104

Table 2: Performance

Capacity	1GB	2GB	4GB	8GB
Sequential Read (max.)	21 MB/sec	23 MB/sec	23 MB/sec	21 MB/sec
Sequential Write (max.)	16 MB/sec	18 MB/sec	21 MB/sec	19 MB/sec

Note: Base on CrystalDiskMark 3.01 with file size 1000MB

2.3 Electrical Specifications

2.3.1 Power Requirement

Table 3: Innodisk Industrial SD card Power Requirement

Item	Symbol	Rating	Unit
Input voltage	V_{IN}	3.3V ± 5%	V

2.3.2 Power Consumption

Table 4: Power Consumption

Mode	Power Consumption (mA)
Read	30 (max.)
Write	50 (max.)
Idle	1.6 (max.)

2.4 Environmental Specifications

2.4.1 Temperature Ranges

Table 5: Temperature range for Industrial SD card

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 Industrial SD card

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 Industrial SD card 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: Industrial SD card MTBF

Product	Condition	MTBF (Hours)
Innodisk Industrial Micro SD card	Telcordia SR-332 GB, 25°C	>3,000,000

2.5 CE and FCC Compatibility

Industrial SD card conforms to CE and FCC requirements.

2.6 RoHS Compliance

Industrial SD card 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
Flash endurance	SLC: 100,000 P/E cycles
TBW(Sequential Write)	
1GB	90
2GB	180
4GB	360
8GB	720

2.8 Transfer Mode

Industrial Micro SD card support following transfer mode:

SD 3.0 / SD 2.0

2.9 Pin Assignment

Innodisk Industrial Micro SD card compliant with standard SD SPEC., please refer to Table 8 for pin assignment.
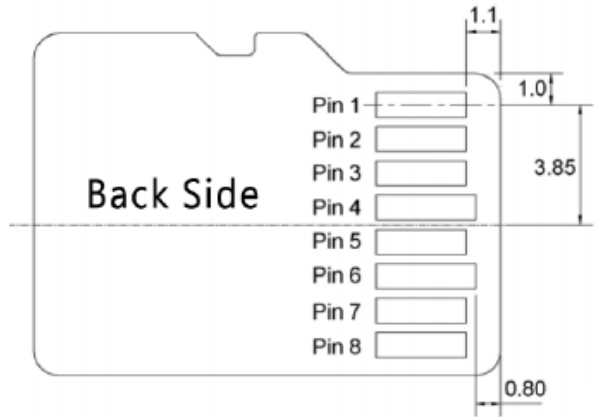
Pin #	SD Mode		SPI Mode	
	Name	Description	Name	Description
1	DAT2	Data line bit 2.	-	
2	CD,DAT3	Card Detect	CS	Chip select
3	CMD	Command/Response	DI	Data in
4	V_{DD}	Supply voltage	VDD	Supply voltage
5	CLK	Clock	CLK	Clock
6	VSS	Supply voltage ground	VSS	Supply voltage ground
7	DAT0	Data Line [Bit 0]	DO	Data Out
8	DAT1	Data Line [Bit 1]	-	

Table 8: Innodisk Industrial Micro SD card Pin Assignment

2.10 Mechanical Dimensions

Tolerance +/- 0.1 mm
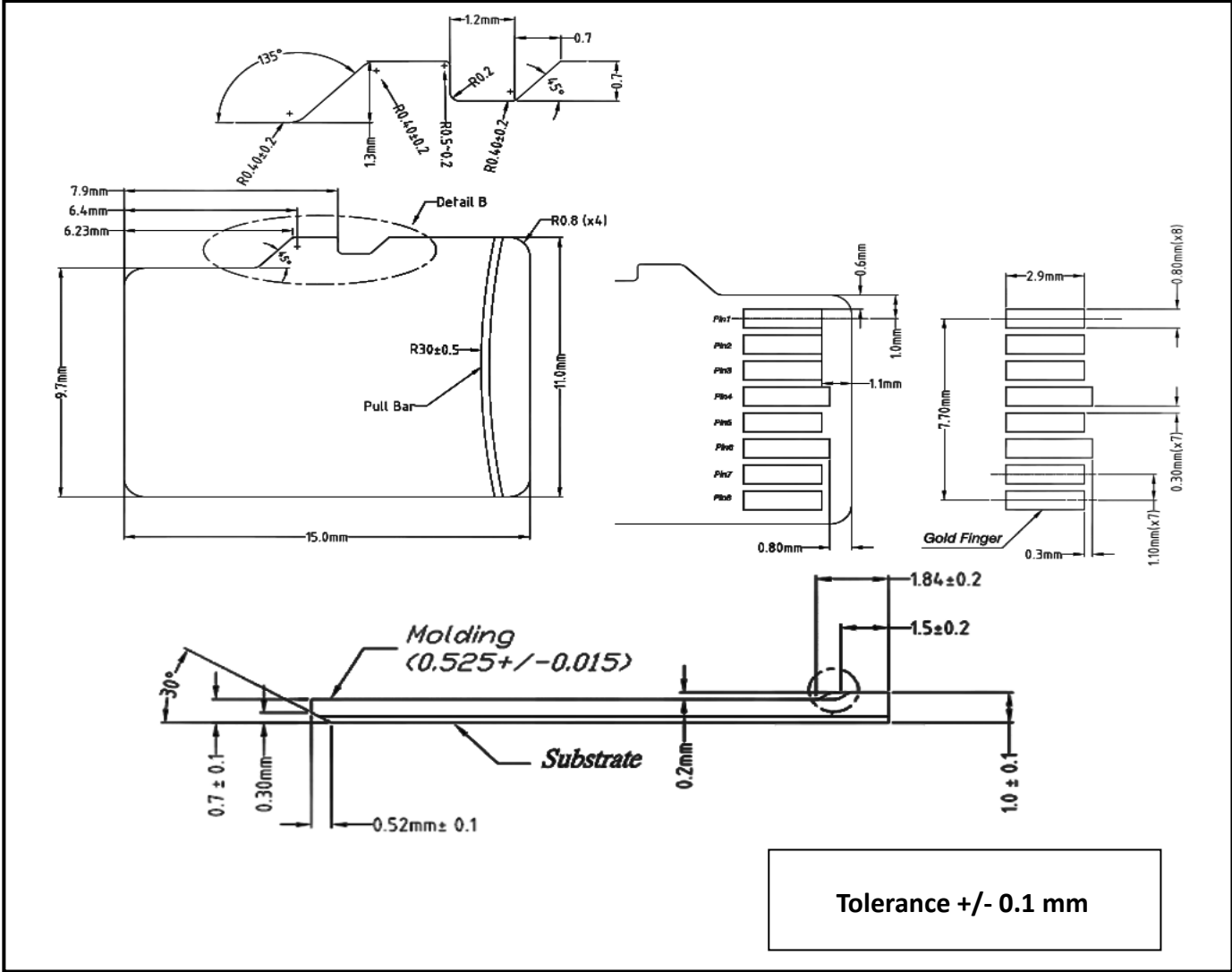
2.11 Assembly Weight

An Innodisk Industrial SD card 3.0 within MLC flash ICs, 16GB's weight is TBD grams approx.

2.12 Seek Time

Innodisk Industrial SD card is not a magnetic rotating design. There is no seek or rotational latency required.

2.13 Hot Plug

The SD card support hot plug function and can be removed or plugged-in during operation.

2.14 NAND Flash Memory

Innodisk Industrial Micro SD card uses both SLC (Single Level Cell) and 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 Industrial Micro SD card from the system level, including the major hardware blocks.
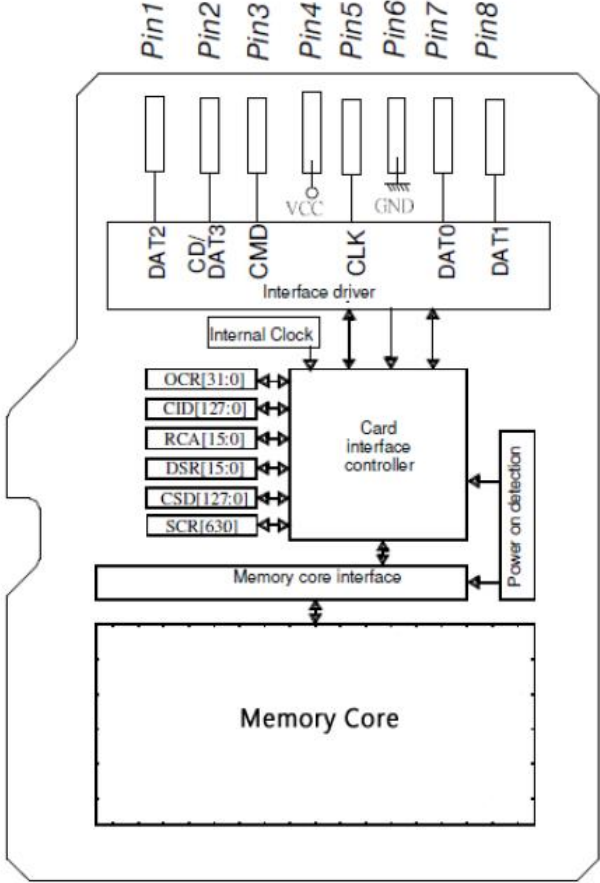

Figure 2: Innodisk Industrial Micro SD card Block Diagram

3.2 SD 2.0 Controller

Innodisk Industrial Micro SD card is designed with a SD 2.0 controller, which has single channel for flash interface.

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 up to 16 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

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 Industrial Micro SD card uses a global 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 product is shipped, or may develop during the life time of the Micro SD card. When the Bad Blocks is detected, it will be flagged, and not be used anymore. The Micro SD card 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.

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	S	2	M	-	0	8	G	I	8	1	A	C	2	S	T				
Description	Disk	Micro SD card				Capacity			Category			FW	Operation Temp.	Internal Control	CH	Flash.				

Definition	
Code 1st (Disk)	**Code 12th (Flash Mode)**
D : Disk	A: Standard F/W version
Code 2nd ~ 4th (Form Factor)	
S2M: micro SD card	
Code 6th ~8th (Capacity)	**Code 13th (Operation Temperature)**
01G: 1GB	C: Standard Grade (0℃~ +70℃)
02G: 2GB	W: Industrial Grade (-40℃~ +85℃)
04G: 4GB	**Code 14th (Internal control)**
08G: 8GB	**Code 15th (Channel of data transfer)**
	S: Single Channel
Code 9th ~11th (Series)	
I81: SD series	**Code 16th (Flash Type)**
	B: Toshiba SLC T: Micron SLC
	Code 19th~20th (Customized Code)

Appendix

CE

Verification of Compliance

Product Name	:	Industrial micro SD card
Model Number	:	DS2M-XXGI81A#1S%
		XX: capacity (01,02 ,04) ;
		#: temperature (C, W) ;
		%: flash (B, T)
Applicant	:	InnoDisk Corporation
Address	:	9F, No. 100, Sec. 1 Xintai 5th Rd., Xizhi City, Taipei 221, Taiwan
Report Number	:	O22-U070-1205-077
Issue Date	:	May 10, 2012
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

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(Tsun-Yu Shih/ General Manager)
Date: May 10, 2012

FCC

Verification of Compliance

Product Name	:	**Industrial micro SD card**
Model Number	:	**DS2M-XXGI81A#1S%**
		XX: capacity (01,02 ,04) ;
		#: temperature (C, W) ;
		%: flash (B, T)
Applicant	:	**InnoDisk Corporation**
Address	:	**9F, No. 100, Sec. 1 Xintai 5th Rd., Xizhi City, Taipei 221, Taiwan**
Report Number	:	**F-U070-1205-077**
Issue Date	:	**May 10, 2012**

Applicable Standards : **FCC Part 15, Subpart B Class B ITE**
ANSI C63.4:2009
Industry Canada ICES-003 Issue 4
CSA-IEC CISPR22: 02 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
FCC CAB Code TW1053
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