

mSATA

3SE 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, 2013 |
| 1.0 | Official release | July, 2013 |
| 1.1 | Add 64GB | Nov, 2013 |
| 1.2 | Modify pin assignment | April, 2014 |

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1. Product Overview

1.1 Introduction of Innodisk mSATA 3SE

Innodisk mSATA 3SE is designed as the standard Mini PCIe form factor with SATA interface, and supports SATA III standard (6.0Gb/s) with excellent performance. The form factor refers to the MO-300 / MO-300B specification which established by JEDEC. Regarding of mechanical interference, Innodisk mSATA 3SE absolutely replaces the traditional hard disk and makes personal computer, in any field, smaller and easier.

Innodisk mSATA 3SE effectively reduces the booting time of operation system and the power consumption is less than hard disk drive (HDD), and complies with ATA protocol, no additional drives are required, and can be configured as a boot device or data storage device

1.2 Product View and Models

Innodisk mSATA 3SE is available in follow capacities within SLC flash ICs.

[mSATA 3SE 1GB](#)

[mSATA 3SE 2GB](#)

[mSATA 3SE 4GB](#)

[mSATA 3SE 8GB](#)

[mSATA 3SE 16GB](#)

[mSATA 3SE 32GB](#)

[mSATA 3SE 64GB](#)



Figure 1: Innodisk mSATA 3SE

964.1 SATA Interface

Innodisk mSATA 3SE 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 mSATA 3SE 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

mSATA 3SE device parameters are shown in Table 1.

Table 1: Device parameters

| Capacity | Cylinders | Heads | Sectors | LBA | User Space |
|----------|-----------|-------|---------|----------|------------|
| 1GB | 1959 | 16 | 63 | 1974672 | 964 |
| 2GB | 3897 | 16 | 63 | 3928176 | 1,918 |
| 4GB | 7773 | 16 | 63 | 7835184 | 3,826 |
| 8GB | 15525 | 16 | 63 | 15649200 | 7,641 |
| 16GB | 16383 | 16 | 63 | 31277232 | 15,272 |
| 32GB | 16383 | 16 | 63 | 62533296 | 30,533 |
| 64GB | 16383 | 16 | 63 | 12545424 | 61057 |

2.2 Performance

Burst Transfer Rate: 6.0Gbps

Table 2: Performance

| Capacity | 1GB | 2GB | 4GB | 8GB | 16GB | 32GB | 64GB |
|-------------------------|-----------|-----------|------------|------------|------------|------------|------------|
| Sequential Read (max.) | 23 MB/sec | 50 MB/sec | 250 MB/sec | 400 MB/sec | 400 MB/sec | 460 MB/sec | 460 MB/sec |
| Sequential Write (max.) | 9 MB/sec | 27 MB/sec | 50 MB/sec | 110 MB/sec | 130 MB/sec | 230 MB/sec | 230 MB/sec |

Note: the information is based on CrystalDiskMark 3.01 with file size 1000MB test patent

2.3 Electrical Specifications

2.3.1 Power Requirement

Table 3: Innodisk mSATA 3SE 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 | 310 (max.) |
| Write | 320 (max.) |
| Idle | 120 (max.) |

* Target: 32GB mSATA 3SE

2.4 Environmental Specifications

2.4.1 Temperature Ranges

Table 5: Temperature range for mSATA 3SE

| 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 mSATA 3SE

| 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 3SE 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 3SE MTBF

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

2.5 CE and FCC Compatibility

mSATA 3SE conforms to CE and FCC requirements.

2.6 RoHS Compliance

mSATA 3SE is fully compliant with RoHS directive.

2.7 Reliability

| Parameter | Value |
|-------------------------|-------------------------|
| Read Cycles | Unlimited Read Cycles |
| Flash endurance | 100,000 P/E cycles |
| Wear-Leveling Algorithm | Support |
| Bad Blocks Management | Support |
| Error Correct Code | Support |
| TBW | |
| 1GB | 90 (Sequential write) |
| 2GB | 180 (Sequential write) |
| 4GB | 360 (Sequential write) |
| 8GB | 720 (Sequential write) |
| 16GB | 1440 (Sequential write) |
| 32GB | 2880 (Sequential write) |
| 64GB | 5760 (Sequential write) |

2.8 Transfer Mode

mSATA 3SE support following transfer mode:

Serial ATA III 6.0Gbps

Serial ATA II 3.0Gbps

Serial ATA I 1.5Gbps

2.9 Pin Assignment

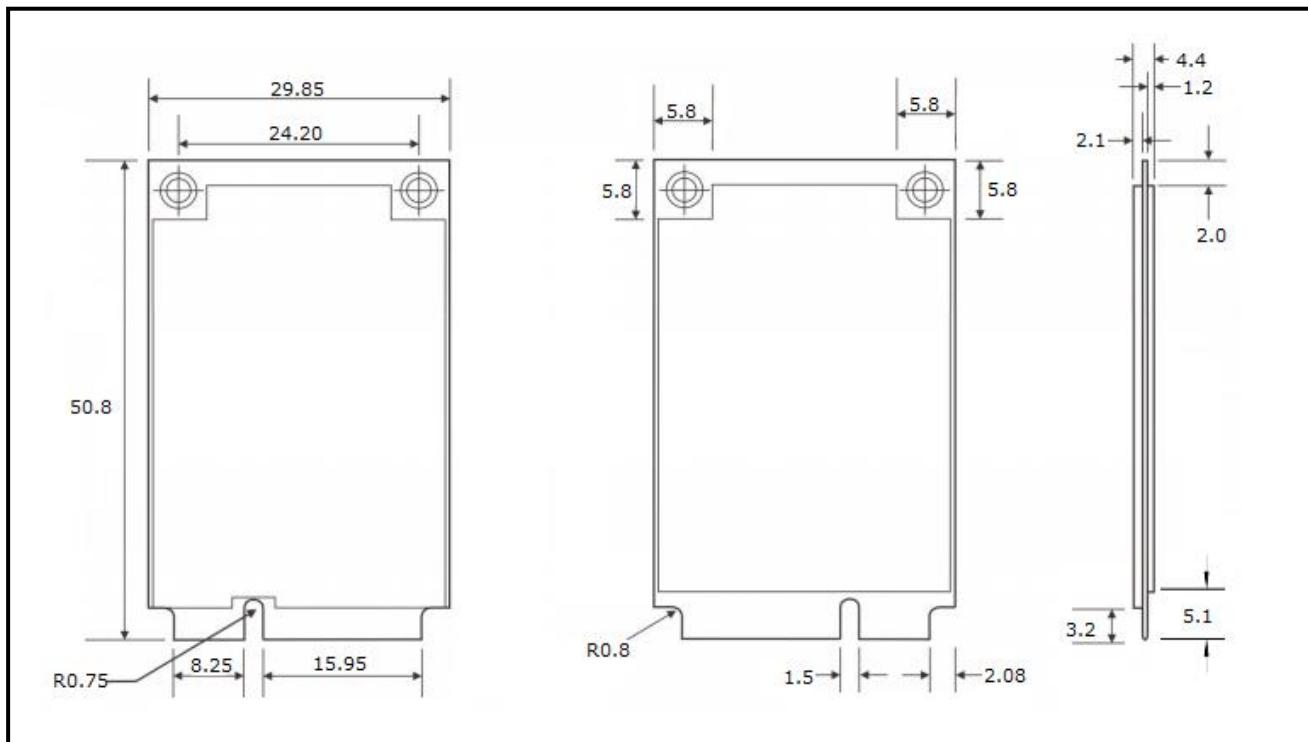
Innodisk mSATA 3SE uses a standard SATA pin-out. See Table 8 for mSATA 3SE pin assignment.

Table 8: Innodisk mSATA 3SE 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 | NC |
| +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



2.11 Assembly Weight

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

2.12 Seek Time

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

2.13 NAND Flash Memory

Innodisk mSATA 3SE uses Single Level Cell (SLC) NAND flash memory, which is non-volatile, high reliability and high speed memory storage. There are only two states 0 or 1 of one cell. Read or Write data to flash memory for SSD is controlled by microprocessor.

3. Theory of Operation

3.1 Overview

Figure 2 shows the operation of Innodisk mSATA 3SE from the system level, including the major hardware blocks.

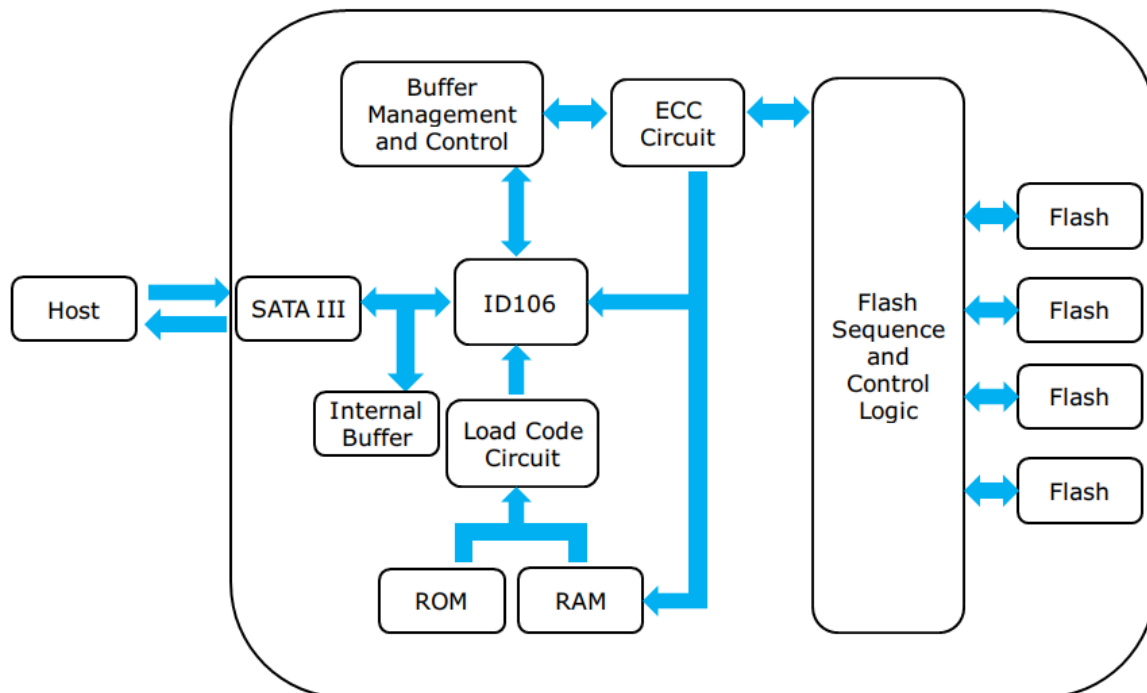


Figure 2: Innodisk mSATA 3SE Block Diagram

Innodisk mSATA 3SE 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 3SE is designed with ID106, 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 2 / 4 channels 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 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.

3.4 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 3SE 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 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.

3.7 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.

4. Installation Requirements

4.1 mSATA 3SE Pin Directions

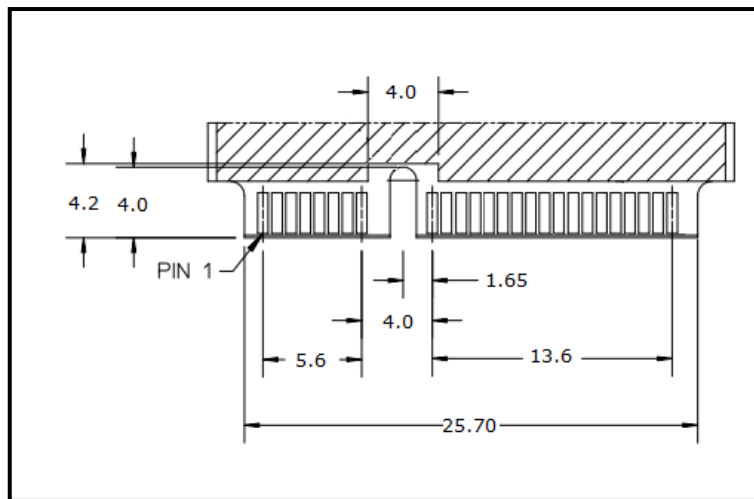


Figure 3: Signal Segment and Power Segment

4.2 Electrical Connections for mSATA 3SE

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 3SE 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 | - | 3 | 2 | G | D | 0 | 6 | S | C | X | Q | B | - | X | X | X | |
| Definition | | | | | | | | | | | | | | | | | | | | | | |
| Code 1st (Disk) | | | | | | | | | | | Code 14th (Operation Temperature) | | | | | | | | | | | |
| D : Disk | | | | | | | | | | | C: Standard Grade (0°C ~ +70°C) | | | | | | | | | | | |
| Code 2nd (Feature set) | | | | | | | | | | | W: Industrial Grade (-40°C ~ +85°C) | | | | | | | | | | | |
| E : Embedded series | | | | | | | | | | | Code 15th (Internal control) | | | | | | | | | | | |
| Code 3rd ~5th (Form factor) | | | | | | | | | | | A~Z: BGA PCB version. | | | | | | 1~9: TSOP PCB version | | | | | |
| MSR: mSATA Regular | | | | | | | | | | | Code 16th (Channel of data transfer) | | | | | | | | | | | |
| Code 7th ~9th (Capacity) | | | | | | | | | | | S: Single Channel | | | | | | | | | | | |
| 01G: 1GB | | | 02G: 2GB | | | 04G: 4GB | | | 08G: 8GB | | | D: Dual Channels | | | | | | | | | | |
| 16G: 16GB. | | | 32G: 32GB | | | 64G: 64GB | | | Q: Quad channels | | | | | | | | | | | | | |
| Code 10th ~12th (Controller) | | | | | | | | | | | Code 17th (Flash Type) | | | | | | | | | | | |
| D06: ID106 | | | | | D07: ID107 | | | | | | B: Toshiba SLC | | | | | | | | | | | |
| Code 13th (Flash mode) | | | | | | | | | | | Code 18th | | | | | | | | | | | |
| S: Synchronous NAND. | | | | | | | | | | | Code 19th~21st (Customize code) | | | | | | | | | | | |
| A: Asynchronous NAND. | | | | | | | | | | | | | | | | | | | | | | |

Appendix

CE/FCC/RoHS

Verification of Compliance

Product Name : mSATA 3SE
 Model Number : D@MSR-XXXD06* # % ※ &
 @: Feature set (G: EverGreen, H: iSLC, R:InnoRobust,
 E: Embedded)
 XXX: 4GB~64GB
 * : Flash Mode
 #: Temperature (C : Commercial Temp W : Industrial Temp)
 % : PCB Version (A, B, C... or 1, 2, 3...)
 ※ : Channel (S : Single, D:Dual, T: Three, Q : Quad, E : Eight)
 &: Flash Vender (T : Micron SLC, S : Samsung SLC,
 N : Micron MLC, B : Toshiba SLC, C: Toshiba MLC,
 F: Sandisk SLC, X: SLC)

Applicant : InnoDisk Corporation
 Address : 9F, No.100, Sec. 1, Xintai 5th Rd., Xizhi Dist., New Taipei City 221,
 Taiwan

Report Number : O22-U070-1306-275
 Issue Date : July 22, 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.



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



Central Research Technology Co.
 EMC Test Laboratory
 11, Lane 41, Fushuen St., Jungshan Chiu,
 Taipei, Taiwan, 104, R.O.C.
 Tel : 886-2-25984568
 Fax: 886-2-25984546

J. Y. Shih

(Tsun-Yu Shih/ General Manager)

Date: July 22, 2013

Verification of Compliance

Product Name : mSATA 3SE
 Model Number : D@MSR-XXXD06* # % ※ &
 @: Feature set (G: EverGreen, H: iSLC, R:InnoRobust,
 E: Embedded)
 XXX: 4GB~64GB
 * : Flash Mode
 #: Temperature (C : Commercial Temp W : Industrial Temp)
 % : PCB Version (A, B, C... or 1, 2, 3...)
 ※ : Channel (S : Single, D: Dual, T: Three, Q : Quad, E : Eight)
 & : Flash Vender (T : Micron SLC, S : Samsung SLC,
 N : Micron MLC, B : Toshiba SLC, C: Toshiba MLC,
 F: Sandisk SLC, X: SLC)

Applicant : InnoDisk Corporation
 Address : 9F, No.100, Sec. 1, Xintai 5th Rd., Xizhi Dist., New Taipei City 221,
 Taiwan

Report Number : F-U070-1306-275
 Issue Date : July 22, 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

FCC CAB Code TW1053

IC Code 4699A

VCCI Accep. No. R-1527, C-1609, T-1441, G-10,
 C-4400, T-1334, G-614



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 Fax: 886-2-25984546

(Tsun-Yu Shih/ General Manager)

Date: July 22, 2013



宜鼎國際股份有限公司

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RoHS 自我宣告書 (RoHS Declaration of Conformity)

Model Name : mSATA 3SE Series

P/N : DEMSR-XXXD0%#@#A※B

XXX=01G~32G

%=Controller (6:ID106 , 7:ID107)

@=Flash mode

#=Temperature (C : Standard Grade,W : Industrial Grade)

※=Channel(D : Dual , Q : Four)

- 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.

Table with 2 columns: Name of hazardous substance, Limited of RoHS ppm (mg/kg). Rows include Cd, Pb, Hg, Chromium VI (Cr+6), Polybromodiphenyl ether (PBDE), and Polybrominated Biphenyls (PBB).

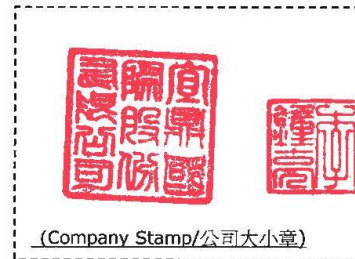
立保證書人

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 : 2013 / 07 / 22



(Company Stamp/公司大小章)