### SATA Slim
#### 3SE-P Series

<table>
<thead>
<tr>
<th>Innodisk Approver</th>
<th>Customer Approver</th>
</tr>
</thead>
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<tr>
<td></td>
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</table>
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<table>
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<th>Revision</th>
<th>Description</th>
<th>Date</th>
</tr>
</thead>
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<tr>
<td>Preliminary</td>
<td>First Released</td>
<td>Nov., 2013</td>
</tr>
<tr>
<td>Rev 1.0</td>
<td>Update Performance</td>
<td>Mar., 2014</td>
</tr>
<tr>
<td>Rev 1.1</td>
<td>Modify TBW based on NAND Flash specifications</td>
<td>Jan., 2015</td>
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1. Product Overview

1.1 Introduction of Innodisk SATA Slim 3SE-P

Innodisk SATA Slim 3SE-P is designed with standard SATA interface (7+15 SATA connector), which could support most platforms with standard SATA port. Besides, with its smaller dimension, SATA Slim 3SE-P is an alternative solution of 2.5” SSD for those embedded system that may have mechanical and space concerns. SATA Slim 3SE-P operates under SATA III (6.0Gb/s) protocol with good performance. Furthermore, SATA Slim 3SE-P support TRIM for windows 7, it can improves performance when deleting files.

SATA Slim 3SE-P is also suitable in industrial field. It effectively reduces the booting time of operation system and the power consumption is less than hard disk drive (HDD). SATA Slim 3SE-P is compatible with ATA protocol, no additional drivers are required, and the SATA Slim 3SE-P can be configured as a boot device or data storage device.

1.2 Product View and Models

Innodisk SATA Slim 3SE-P is available in follow capacities within SLC flash ICs.

- SATA Slim 3SE-P 08GB
- SATA Slim 3SE-P 16GB
- SATA Slim 3SE-P 32GB
- SATA Slim 3SE-P 64GB
- SATA Slim 3SE-P 128GB

![Figure 1: Innodisk SATA Slim 3SE-P](image-url)
1.3 SATA Interface

SATA Slim 3SE-P supports SATA III interface, and backward compliant with Serial ATA Gen 1, Gen 2 and Gen 3 specification (Gen 3 supports 1.5Gbps /3.0Gbps/6.0Gbps data rate).

1.4 Capacity

Innodisk SATA Slim 3SE-P provides unformatted 8GB, 16GB, 32GB, 64GB, and 128GB capacities within SLC Flash IC.

1.5 MO-297 Form Factor

SATA Slim 3SE-P has a compact design 54.0mm (W) x 39.0mm (L) x 4.0mm (H) without metal material case, and is easy for installation.
2. Product Specifications

2.1 Capacity and Device Parameters
SATA Slim 3SE-P device parameters are shown in Table 1.

<table>
<thead>
<tr>
<th>Capacity</th>
<th>LBA</th>
<th>Cylinders</th>
<th>Heads</th>
<th>Sectors</th>
<th>User Capacity (MB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8GB</td>
<td>13695696</td>
<td>13587</td>
<td>16</td>
<td>63</td>
<td>6,687</td>
</tr>
<tr>
<td>16GB</td>
<td>29323728</td>
<td>16383</td>
<td>16</td>
<td>63</td>
<td>14,318</td>
</tr>
<tr>
<td>32GB</td>
<td>60579792</td>
<td>16383</td>
<td>16</td>
<td>63</td>
<td>29,580</td>
</tr>
<tr>
<td>64GB</td>
<td>121138416</td>
<td>16383</td>
<td>16</td>
<td>63</td>
<td>59,150</td>
</tr>
<tr>
<td>128GB</td>
<td>242255664</td>
<td>16383</td>
<td>16</td>
<td>63</td>
<td>118,289</td>
</tr>
</tbody>
</table>

2.2 Performance
Burst Transfer Rate: 6.0Gbps

<table>
<thead>
<tr>
<th>Capacity</th>
<th>8GB</th>
<th>16GB</th>
<th>32GB</th>
<th>64GB</th>
<th>128GB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sequential Read (max.)</td>
<td>410 MB/sec</td>
<td>410 MB/sec</td>
<td>480 MB/sec</td>
<td>480 MB/sec</td>
<td>480 MB/sec</td>
</tr>
<tr>
<td>Sequential Write (max.)</td>
<td>110 MB/sec</td>
<td>130 MB/sec</td>
<td>230 MB/sec</td>
<td>330 MB/sec</td>
<td>330 MB/sec</td>
</tr>
</tbody>
</table>

Note: Base on CrystalDiskMark 3.01 with file size 1000MB

2.3 Electrical Specifications

2.3.1 Power Requirement

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Rating</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input voltage</td>
<td>$V_{IN}$</td>
<td>+5 DC ± 5%</td>
<td>V</td>
</tr>
</tbody>
</table>

2.3.2 Power Consumption

<table>
<thead>
<tr>
<th>Mode</th>
<th>Power Consumption (mA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Read</td>
<td>232 (max.)</td>
</tr>
<tr>
<td>Write</td>
<td>261 (max.)</td>
</tr>
<tr>
<td>Idle</td>
<td>198 (max.)</td>
</tr>
</tbody>
</table>

* Target: 2.5: SATA SSD 3SE-P 128GB
2.4 Environmental Specifications

2.4.1 Temperature Ranges

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating</td>
<td>Standard Grade: 0°C to +70°C</td>
</tr>
<tr>
<td></td>
<td>Industrial Grade: -40°C to +85°C</td>
</tr>
<tr>
<td>Storage</td>
<td>-55°C to +95°C</td>
</tr>
</tbody>
</table>

2.4.2 Humidity

Relative Humidity: 10-95%, non-condensing

2.4.3 Shock and Vibration

<table>
<thead>
<tr>
<th>Reliability</th>
<th>Test Conditions</th>
<th>Reference Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vibration</td>
<td>7 Hz to 2K Hz, 20G, 3 axes</td>
<td>IEC 68-2-6</td>
</tr>
<tr>
<td>Mechanical Shock</td>
<td>Duration: 0.5ms, 1500 G, 3 axes</td>
<td>IEC 68-2-27</td>
</tr>
</tbody>
</table>

2.4.4 Mean Time between Failures (MTBF)

Table 7 summarizes the MTBF prediction results for various SATA Slim 3SE-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>
<thead>
<tr>
<th>Product</th>
<th>Condition</th>
<th>MTBF (Hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Innodisk SATA Slim 3SE-P</td>
<td>Telcordia SR-332 GB, 25°C</td>
<td>&gt;3,000,000</td>
</tr>
</tbody>
</table>
2.5 CE and FCC Compatibility
SATA Slim 3SE-P conforms to CE and FCC requirements.

2.6 RoHS Compliance
SATA Slim 3SE-P is fully compliant with RoHS directive.

2.7 Reliability

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Read Cycles</td>
<td>Unlimited Read Cycles</td>
</tr>
<tr>
<td>Wear-Leveling Algorithm Support</td>
<td></td>
</tr>
<tr>
<td>Bad Blocks Management Support</td>
<td></td>
</tr>
<tr>
<td>Error Correct Code Support</td>
<td></td>
</tr>
<tr>
<td>TBW (Unit: TB)</td>
<td></td>
</tr>
<tr>
<td>8GB</td>
<td>432 (Sequential Write)</td>
</tr>
<tr>
<td>16GB</td>
<td>864 (Sequential Write)</td>
</tr>
<tr>
<td>32GB</td>
<td>1728 (Sequential Write)</td>
</tr>
<tr>
<td>64GB</td>
<td>3456 (Sequential Write)</td>
</tr>
<tr>
<td>128GB</td>
<td>6912 (Sequential Write)</td>
</tr>
</tbody>
</table>

2.8 Transfer Mode
SATA Slim 3SE-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 SATA Slim 3SE-P uses a standard SATA pin-out. See Table 8 for SATA Slim 3SE-P pin assignment.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>GND</td>
<td>NA</td>
</tr>
<tr>
<td>S2</td>
<td>A+</td>
<td>Differential Signal Pair A</td>
</tr>
<tr>
<td>S3</td>
<td>A-</td>
<td></td>
</tr>
<tr>
<td>S4</td>
<td>GND</td>
<td>NA</td>
</tr>
<tr>
<td>S5</td>
<td>B-</td>
<td>Differential Signal Pair B</td>
</tr>
<tr>
<td>S6</td>
<td>B+</td>
<td></td>
</tr>
<tr>
<td>S7</td>
<td>GND</td>
<td>NA</td>
</tr>
<tr>
<td>P1</td>
<td>NC</td>
<td>NA</td>
</tr>
</tbody>
</table>

Key and Spacing separate signal and power segments
<table>
<thead>
<tr>
<th>Pin</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>P2</td>
<td>NC</td>
<td>NA</td>
</tr>
<tr>
<td>P3</td>
<td>NC</td>
<td>NA</td>
</tr>
<tr>
<td>P4</td>
<td>GND</td>
<td>NA</td>
</tr>
<tr>
<td>P5</td>
<td>GND</td>
<td>NA</td>
</tr>
<tr>
<td>P6</td>
<td>GND</td>
<td>NA</td>
</tr>
<tr>
<td>P7</td>
<td>V5</td>
<td>5V Power, Pre-Charge</td>
</tr>
<tr>
<td>P8</td>
<td>V5</td>
<td>5V Power</td>
</tr>
<tr>
<td>P9</td>
<td>V5</td>
<td>5V Power</td>
</tr>
<tr>
<td>P10</td>
<td>GND</td>
<td>NA</td>
</tr>
<tr>
<td>P11</td>
<td>DAS/DSS</td>
<td>Device Activity Signal / Disable Staggered</td>
</tr>
<tr>
<td>P12</td>
<td>GND</td>
<td>NA</td>
</tr>
<tr>
<td>P13</td>
<td>NC</td>
<td>NA</td>
</tr>
<tr>
<td>P14</td>
<td>NC</td>
<td>NA</td>
</tr>
<tr>
<td>P15</td>
<td>NC</td>
<td>NA</td>
</tr>
</tbody>
</table>

### 2.10 Mechanical Dimensions

![Mechanical Dimensions Diagram]

### 2.11 Assembly Weight

12  Rev 1.1  TPS, Jan. 2015
2.5” SATA Slim 3SE-P

An Innodisk SATA Slim 3SE-P within SLC flash ICs, 32GB’s weight is 40 grams approx. The total weight of SSD will be less than 50 grams.

2.12 Seek Time

Innodisk SATA Slim 3SE-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 SATA Slim 3SE-P uses Single Level Cell (SLC) NAND flash memory, which is non-volatility, high reliability which has 100,000 program/erase times and high speed memory storage.
3. Theory of Operation

3.1 Overview

Figure 2 shows the operation of Innodisk SATA Slim 3SE-P from the system level, including the major hardware blocks.

![Innodisk SATA Slim 3SE-P Block Diagram](image)

Innodisk 2 SATA Slim 3SE-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 SATA Slim 3SE-P is designed with ID 167, a SATA III 6.0Gbps (Gen. 3) controller, which supports external DDR3 DRAM. 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

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 SATA Slim 3SE-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 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/TRIM

Garbage collection and TRIM 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 SATA Slim 3SE-P Pin Directions

Figure 3: Signal Segment and Power Segment

4.2 Electrical Connections for SATA Slim 3SE-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 1 meter. 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. Innodisk SATA Slim 3SE-P can be configured as a boot device.
## 5. Part Number Rule

<table>
<thead>
<tr>
<th>CODE</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
<th>17</th>
<th>18</th>
<th>19</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td>D E S L M -</td>
<td>3</td>
<td>2</td>
<td>G</td>
<td>D</td>
<td>6</td>
<td>7</td>
<td>S</td>
<td>C</td>
<td>A</td>
<td>Q</td>
<td>B</td>
<td>-</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Description
- **Disk**: Synchronous flash
- **Capacity**: SATA Slim 3SE-P
- **Category**: Standard Grade (0℃ ~ +70℃)
- **Flash Mode**: Industrial Grade (-40℃ ~ +85℃)
- **Operation Temperature**: Dual Channels
- **Internal Control**: Quad Channels
- **Channel of data transfer**: Toshiba SLC

### Code Definitions
- **Code 1st (Disk)**: D
- **Code 2nd ~ 5th (Form Factor)**: GSLM
- **Code 6th (Channel of data transfer)**: 08G: 8GB, 16G: 16GB, 32G: 32GB, 64G: 64GB, A28: 128GB
- **Code 7th ~ 9th (Capacity)**: Code 10th ~ 12th (Series)
- **Code 13th (Flash Mode)**: S
- **Code 14th (Operation Temperature)**: Code 15th (Internal control)
- **Code 16th (Channel of data transfer)**: Code 17th (Flash Type)
- **Code 19th ~ 20th (Customized Code)**: Code 18th: Toshiba SLC
Manufacturer Product: All Innodisk EM Flash and Dram products

Innودisk Corporation declares that all products sold to the company, are complied with European Union RoHS Directive (2011/65/EU) requirement.

Innودisk Corporation agrees that both parties shall settle any dispute arising from or in connection with this Declaration of Conformity by friendly negotiations.

<table>
<thead>
<tr>
<th>Name of hazardous substance</th>
<th>Limited of RoHS ppm (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cd</td>
<td>&lt; 100 ppm</td>
</tr>
<tr>
<td>Pb</td>
<td>&lt; 1000 ppm</td>
</tr>
<tr>
<td>Hg</td>
<td>&lt; 1000 ppm</td>
</tr>
<tr>
<td>Chromium VI (Cr+6)</td>
<td>&lt; 1000 ppm</td>
</tr>
<tr>
<td>Polybromodiphenyl ether (PBDE)</td>
<td>&lt; 1000 ppm</td>
</tr>
<tr>
<td>Polybrominated Biphenyls (PBB)</td>
<td>&lt; 1000 ppm</td>
</tr>
</tbody>
</table>

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 李鍾亮

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

Date 日期： 2014 / 07 / 29
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）特此聲明售予貴公司之產品，皆符合歐盟化學品法規(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。

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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 李鍾亮

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

Date 日期： 2014 / 07 / 28
Certificate

Issue Date: December 18, 2013
Ref. Report No.: ISL-13HE356CE

Product Name: SATA Slim 3SE / SATA Slim 3SE-P
Model(s): DE5LM-XXXD06*#%&; DE5LM-XXXD07*#%&
Responsible Party: Innodisk Corporation
Address: 9F, No. 100, Sec. 1 Xintai 5th Rd., Xizhi City, Taipei 221, Taiwan

We, International Standards Laboratory, hereby certify that:

The device bearing the trade name and model specified above has been shown to comply with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in European Council Directive- EMC Directive 2004/108/EC. The device was passed the test performed according to:

Standards:
EN 55022: 2010 and CISPR 22: 2008 (modified)
EN 61000-3-3: 2008 and IEC 61000-3-3: 2008
EN 55024: 2010 and CISPR 24: 2010
EN 61000-4-2: 2009 and IEC 61000-4-2: 2008
EN 61000-4-3: 2006+A1: 2008 +A2: 2010 and

I attest to the accuracy of data and all measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

International Standards Laboratory

Jim Chu / Director

Hsi-Chih LAB:
No. 65, Gu Dai Keng St., Hsinchuh District,
New Taipei City 22179, Taiwan
Tel: 886-2-2646-2550; Fax: 886-2-2646-4641
Certificate

Issue Date: December 18, 2013
Ref. Report No.: ISL-13HE350FB

Product Name: SATA Slim 3SE / SATA Slim 3SE-P
Model(s): DESLM-XXXXD06##### & DESLM-XXXXD57##### &
Applicant: Innodisk Corporation
Address: 9F, No. 100, Sec. 1 Xintai 5th Rd., Xizhi City, Taipei 221, Taiwan

We, International Standards Laboratory, hereby certify that:

The device bearing the trade name and model specified above has been shown to comply with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified. (refer to Test Report if any modifications were made for compliance).

Standards:

FCC CFR Title 47 Part 15 Subpart B: 2010- Section 15.107 and 15.109
ANSI C63.4-2009

Class B

I attest to the accuracy of data and all measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

International Standards Laboratory

Jim Chu / Director

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