USB Drive 2SE

Customer: ____________________________
Customer Part Number: ____________________________
Innodisk Part Number: ____________________________
Innodisk Part Number: ____________________________
Model Name: ____________________________
Date: ____________________________

<table>
<thead>
<tr>
<th>Innodisk Approver</th>
<th>Customer Approver</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# Table of contents

TABLE OF CONTENTS......................................................................................................................... 2  
LIST OF FIGURES ............................................................................................................................... 4  
LIST OF TABLES ................................................................................................................................. 5  

1. PRODUCT OVERVIEW .................................................................................................................... 6  
   1.1 INTRODUCTION OF USB DRIVE .............................................................................................. 6  
   1.2 PRODUCT VIEW ......................................................................................................................... 6  
   1.3 PRODUCT MODELS .................................................................................................................... 6  
   1.4 CAPACITY ................................................................................................................................. 6  
   1.5 VID/PID ..................................................................................................................................... 6  

2. THEORY OF OPERATION .................................................................................................................... 7  
   2.1 OVERVIEW ............................................................................................................................... 7  
   2.2 ERROR DETECTION AND CORRECTION ..................................................................................... 7  
   2.3 WEAR-LEVELING ....................................................................................................................... 7  
   2.4 BAD BLOCKS MANAGEMENT ...................................................................................................... 8  

3. SPECIFICATIONS .............................................................................................................................. 9  
   3.1 CE AND FCC COMPATIBILITY ................................................................................................. 9  
   3.2 RoHS COMPLIANCE .................................................................................................................. 9  
   3.3 ENVIRONMENTAL SPECIFICATIONS ...................................................................................... 9  
   3.4 GOLDEN FINGER ....................................................................................................................... 10  
   3.5 PIN ASSIGNMENT ..................................................................................................................... 10  
   3.6 MECHANICAL DIMENSIONS .................................................................................................... 11  
   3.7 WEIGHT ................................................................................................................................... 11  
   3.8 PERFORMANCE ........................................................................................................................ 11  
   3.9 NAND FLASH MEMORY ............................................................................................................ 11  

4. ELECTRICAL SPECIFICATIONS .................................................................................................... 12  
   4.1 POWER REQUIREMENT ............................................................................................................ 12  
   4.2 POWER CONSUMPTION ........................................................................................................... 12  
   4.3 DEVICE PARAMETERS ............................................................................................................. 12  

5. PART NUMBER RULE ....................................................................................................................... 13
## Revision History

<table>
<thead>
<tr>
<th>Revision</th>
<th>Description</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>First Release</td>
<td>May, 2013</td>
</tr>
<tr>
<td>1.1</td>
<td>Add TBW</td>
<td>Sep, 2013</td>
</tr>
<tr>
<td></td>
<td>Modify mechanical dimensions</td>
<td></td>
</tr>
<tr>
<td>1.2</td>
<td>Modify TBW based on NAND Flash specifications</td>
<td>Jan, 2015</td>
</tr>
<tr>
<td>1.3</td>
<td>Modify Power Requirement</td>
<td>Nov., 2016</td>
</tr>
<tr>
<td>1.4</td>
<td>Modify NAND flash P/E cycles</td>
<td>Jan., 2018</td>
</tr>
<tr>
<td></td>
<td>Update RoHS/REACH certification</td>
<td></td>
</tr>
</tbody>
</table>
List of Figures

Figure 1: USB Drive 2SE ................................................................................................................................. 6
Figure 2: USB Drive 2SE Block Diagram ...................................................................................................... 7
Figure 3: USB Drive 2SE Mechanical Dimensions ....................................................................................... 11
List of Tables

**TABLE 1: SHOCK/VIBRATION TESTING FOR USB DRIVE 2SE** ................................................................. 9
**TABLE 2: USB DRIVE 2SE MTBF** ..................................................................................................... 10
**TABLE 3: USB DRIVE 2SE TBW** ..................................................................................................... 10
**TABLE 4: USB DRIVE 2SE PIN ASSIGNMENT** ............................................................................... 10
**TABLE 5: USB DRIVE 2SE POWER REQUIREMENT** ....................................................................... 12
**TABLE 6: USB DRIVE 2SE POWER CONSUMPTION** ....................................................................... 12
**TABLE 7: USB DRIVE 2SE DEVICE PARAMETERS** .......................................................................... 12
1. **Product Overview**

1.1 **Introduction of USB Drive**

The Innodisk USB Drive products provide high capacity USB flash memory storage that electrically complies with High-speed USB 2.0 interface & backward compatible with USB 1.1. The device features attractive small form factor and the connectivity over USB2.0 and the NAND flash architecture provide a faster data transmission.

1.2 **Product View**

![USB Drive 2SE](image)

Figure 1: USB Drive 2SE

1.3 **Product Models**

USB Drive 2SE is available in follow capacities.

- USB Drive 2SE 512MB
- USB Drive 2SE 1GB
- USB Drive 2SE 2GB
- USB Drive 2SE 4GB
- USB Drive 2SE 8GB
- USB Drive 2SE 16GB

1.4 **Capacity**

USB Drive 2SE provides unformatted from 512MB up to 16GB capacities within SLC Flash IC.

1.5 **VID/PID**

Customize VID/PID(specify 4bits for each ID, Hexadecimal[0~F])

For Option, Default is 196D/0201.
2. Theory of operation

2.1 Overview

Figure 2 shows the operation of USB Drive 2SE from the system level, including the major hardware blocks.

![Figure 2: USB Drive 2SE Block Diagram](image)

USB Drive 2SE integrates a USB2.0 controller and NAND flash memories. Communication with the host occurs through the host interface. Communication with the flash device(s) occurs through the flash interface.

2.2 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 72 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.

2.3 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.

USB Drive 2SE 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.
## 2.4 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 generate 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 and 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. After the reserved block less than 40, the SSD will be locked, and cannot be written anymore.
3. Specifications

3.1 CE and FCC Compatibility
USB Drive 2SE conforms to CE and FCC requirements.

3.2 RoHS Compliance
USB Drive 2SE is fully compliant with RoHS directive.

3.3 Environmental Specifications

3.3.1 Temperature Ranges
Operating Temperature Range:
- Standard Grade: 0°C ~ +70°C
- Industrial Grade: -40°C ~ +85°C

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

3.3.2 Humidity
Relative Humidity: 10-95%, non-condensing

3.3.3 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, 1500G, 3 axes</td>
<td>IEC 68-2-27</td>
</tr>
</tbody>
</table>

Table 1: Shock/Vibration Testing for USB Drive 2SE

3.3.4 Mean Time between Failures (MTBF)

Table 2 summarizes the MTBF prediction results for various USB Drive 2SE 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>USB Drive 2SE</td>
<td>Telcordia SR-332 GB, 25°C</td>
<td>&gt;3,000,000</td>
</tr>
</tbody>
</table>

Table 2: USB Drive 2SE MTBF

### 3.3.5 Terabyte Written (TBW)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>TBW(Sequential Write) Unit:TB</td>
<td></td>
</tr>
<tr>
<td>512MB</td>
<td>27</td>
</tr>
<tr>
<td>01GB</td>
<td>54</td>
</tr>
<tr>
<td>02GB</td>
<td>108</td>
</tr>
<tr>
<td>04GB</td>
<td>216</td>
</tr>
<tr>
<td>08GB</td>
<td>432</td>
</tr>
<tr>
<td>16GB</td>
<td>864</td>
</tr>
</tbody>
</table>

Table 3: USB Drive 2SE TBW

### 3.4 Golden finger

30μ”

### 3.5 Pin Assignment

USB Drive 2SE is designed within USB2.0 Interface. Particularly, its built-in power pin enables the device more compactable. Table 3 demonstrates USB Drive 2SE pin assignments.

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>VBUS</td>
<td>+5V</td>
</tr>
<tr>
<td>2</td>
<td>D-</td>
<td>Data -</td>
</tr>
<tr>
<td>3</td>
<td>D+</td>
<td>Data +</td>
</tr>
<tr>
<td>4</td>
<td>GND</td>
<td>Ground</td>
</tr>
</tbody>
</table>

Table 4: USB Drive 2SE Pin Assignment
3.6 Mechanical Dimensions

Figure 3: USB Drive 2SE mechanical dimensions

3.7 Weight

10g±2

3.8 Performance

<table>
<thead>
<tr>
<th>Product name</th>
<th>512MB</th>
<th>1GB</th>
<th>2GB</th>
<th>4GB</th>
<th>8GB</th>
<th>16GB</th>
</tr>
</thead>
<tbody>
<tr>
<td>USB Drive 2SE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Max.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sequential Read</td>
<td>24 MB/S</td>
<td>24 MB/S</td>
<td>24 MB/S</td>
<td>26 MB/S</td>
<td>26 MB/S</td>
<td>28 MB/S</td>
</tr>
<tr>
<td>Sequential Write</td>
<td>18 MB/S</td>
<td>20 MB/S</td>
<td>20 MB/S</td>
<td>24 MB/S</td>
<td>24 MB/S</td>
<td>24 MB/S</td>
</tr>
</tbody>
</table>

3.9 NAND Flash Memory

USB Drive 2SE uses Single Level Cell (SLC) NAND flash memory, which is non-volatility, high reliability which has 60,000 program/erase times and high speed memory storage.
4. Electrical Specifications

4.1 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>$+5 \text{DC } \pm 5%$</td>
<td>V</td>
</tr>
</tbody>
</table>

Table 5: USB Drive 2SE Power Requirement

4.2 Power Consumption

<table>
<thead>
<tr>
<th>Mode</th>
<th>Power Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Read</td>
<td>170 mA (max.)</td>
</tr>
<tr>
<td>Write</td>
<td>160 mA (max.)</td>
</tr>
<tr>
<td>Idle</td>
<td>110 mA (max.)</td>
</tr>
</tbody>
</table>

The power consumption is based on 16GB Model.

Table 6: USB Drive 2SE Power Consumption

4.3 Device Parameters

USB Drive device parameters listed in Table 7.

<table>
<thead>
<tr>
<th>Capacity</th>
<th>LBA</th>
<th>User capacity (MB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>512MB</td>
<td>982016</td>
<td>479</td>
</tr>
<tr>
<td>1GB</td>
<td>2014208</td>
<td>983</td>
</tr>
<tr>
<td>2GB</td>
<td>4028416</td>
<td>1967</td>
</tr>
<tr>
<td>4GB</td>
<td>8105984</td>
<td>3958</td>
</tr>
<tr>
<td>8GB</td>
<td>16211968</td>
<td>7916</td>
</tr>
<tr>
<td>16GB</td>
<td>32481280</td>
<td>15860</td>
</tr>
</tbody>
</table>

Table 7: USB Drive 2SE Device parameters
## 5. Part Number Rule

<table>
<thead>
<tr>
<th>Description</th>
<th>Disk</th>
<th>Form Factor</th>
<th>-</th>
<th>Capacity</th>
<th>Category</th>
<th>Flash mode</th>
<th>Operation Temp.</th>
<th>CB Version</th>
<th>Channel</th>
<th>Flash</th>
<th>Customized Code</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Code 1st (Disk)</strong></td>
<td>D: Disk</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Code 2nd ~ 5th (Form Factor)</strong></td>
<td>EUA1: USB Drive</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Code 7th ~ 9th (Capacity)</strong></td>
<td>512M: 512MB</td>
<td>01G: 1GB</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>02G: 2GB</td>
<td>04G: 2GB</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>08G: 8GB</td>
<td>16G: 16GB</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Code 10th ~ 12th (Category)</strong></td>
<td>I72: USB Series</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Code 13th (Flash mode)</strong></td>
<td>A: Async Flash</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Code 14th (Operation Temperature)</strong></td>
<td>C: Standard Grade (0°C ~ +70°C)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Code 15th (PCB Version)</strong></td>
<td>1: First Version</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Code 16th (Channel)</strong></td>
<td>2: Second Version</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Code 17th (Flash)</strong></td>
<td>S: Single</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Definition**

- D: Disk
- C: Standard Grade (0°C ~ +70°C)
- W: Industrial Grade (-40°C ~ +85°C)
- EUA1: USB Drive
- Code 15th (PCB Version):
  - 1: First Version
  - 2: Second Version
- Code 16th (Channel):
  - S: Single
- Code 17th (Flash):
  - B: Toshiba SLC
- A: Async Flash
RoHS

Manufacturer Product: All Innodisk EM Flash and Dram products

Innomdsk Corporation declares that all products sold to the company, are complied with European Union RoHS Directive (2011/65/EU) and (EU) 2015/863 requirement.

Innomdsk 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>銅 (Pb)</td>
<td>&lt; 1000 ppm</td>
</tr>
<tr>
<td>汞 (Hg)</td>
<td>&lt; 1000 ppm</td>
</tr>
<tr>
<td>銅 (Cd)</td>
<td>&lt; 100 ppm</td>
</tr>
<tr>
<td>六價鉻（Cr 6+）</td>
<td>&lt; 1000 ppm</td>
</tr>
<tr>
<td>多溴聯苯（PBBs）</td>
<td>&lt; 1000 ppm</td>
</tr>
<tr>
<td>多溴二苯醚（PBDEs）</td>
<td>&lt; 1000 ppm</td>
</tr>
<tr>
<td>邻苯二甲酸二(2-乙基己基)酯（DEHP）</td>
<td>&lt; 1000 ppm</td>
</tr>
<tr>
<td>邻苯二甲酸丁酯苯甲酸酯（BBP）</td>
<td>&lt; 1000 ppm</td>
</tr>
<tr>
<td>邻苯二甲酸二丁酯（DBP）</td>
<td>&lt; 1000 ppm</td>
</tr>
<tr>
<td>邻苯二甲酸二异丁酯（DIBP）</td>
<td>&lt; 1000 ppm</td>
</tr>
</tbody>
</table>

Company name: Innodisk Corporation

Company Representative: Randy Chien

Company Representative Title: Chairman

Date: 2017 / 01 / 18
REACH Declaration of Conformity

Manufacturer Product: All Innodisk EM Flash and Dram products


所提供的產品包含：(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
Verification of Compliance

Product Name: USB Drive 2ME/2SE
Model Number: DEUA1-XXXI72 %*** & *
XXX: 512MB~16GB
#: Flash Mode
%: Temperature (C: Commercial Temp  W: Industrial Temp,
E: Extended Temp)
***: PCB Version (A, B, C..., or 1, 2, 3...)
&: Channel (S: Single, D: Dual)
*: Flash Vender (T: Micron SLC, S: Samsung SLC, N: Micron MLC,
B: Toshiba SLC, C: Toshiba MLC)

Applicant: InnoDisk Corporation
Address: 9F, No.100, Sec. 1, Xintai 5th Rd., Xizhi Dist., New Taipei City 221,
Taiwan
Report Number: O22-U070-1302-270
Issue Date: April 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 61000-4-4:2004+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.

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

(Tsun-Yu Shih/ General Manager)
Date: April 16, 2013
### Verification of Compliance

**Product Name**: USB Drive 2ME/2SE  
**Model Number**: DEUA1-XXXI72 # % & *  
**XXX**: 512MB~16GB  
# : Flash Mode  
% : Temperature (C: Commercial Temp, W: Industrial Temp, E: Extended Temp)  
*: PCB Version (A, B, C..., or 1, 2, 3...)  
& : Channel (S: Single, D: Dual)  
* : Flash Vendor (T: Micron SLC, S: Samsung SLC, N: Micron MLC, B: Toshiba SLC, C: Toshiba MLC)

**Applicant**: InnoDisk Corporation  
**Address**: 9F, No.100, Sec. 1, Xintai 5th Rd., Xizhi Dist., New Taipei City 221, Taiwan  
**Report Number**: F-U070-1302-270  
**Issue Date**: April 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.

---

**Central Research Technology Co.**  
EMC Test Laboratory  
11, Lane 41, Fushuen St., Jungshan Chiu, Taipei, Taiwan, 104, R.O.C.  
Tel.: 886-2-25984588  
Fax: 886-2-25984546

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