<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 ............................................................................................................................... 8
   2.1 OVERVIEW ................................................................................................................................................ 8
   2.2 ERROR DETECTION AND CORRECTION ................................................................................................. 8
   2.3 WEAR-LEVELING .................................................................................................................................... 8
   2.4 BAD BLOCKS MANAGEMENT .................................................................................................................. 9

## 3. SPECIFICATIONS .............................................................................................................................................. 10
   3.1 CE AND FCC COMPATIBILITY .............................................................................................................. 10
   3.2 ROHS COMPLIANCE .............................................................................................................................. 10
   3.3 ENVIRONMENTAL SPECIFICATIONS ................................................................................................... 10
   3.4 GOLDEN FINGER .................................................................................................................................... 11
   3.5 PIN ASSIGNMENT ................................................................................................................................... 11
   3.6 MECHANICAL DIMENSIONS .................................................................................................................. 12
   3.7 WEIGHT .................................................................................................................................................. 12
   3.8 PERFORMANCE ...................................................................................................................................... 12
   3.9 NAND FLASH MEMORY ....................................................................................................................... 12

## 4. ELECTRICAL SPECIFICATIONS ..................................................................................................................... 13
   4.1 ABSOLUTE MAXIMUM RATINGS .......................................................................................................... 13
   4.2 OPERATING CONDITIONS ...................................................................................................................... 13
   4.3 POWER CONSUMPTION ......................................................................................................................... 13
   4.4 DEVICE PARAMETERS ............................................................................................................................ 14

## 5. PART NUMBER RULE ...................................................................................................................................... 15
## 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>
</tbody>
</table>
List of Figures

Figure 1: USB Drive 2SE ...................................................................................................................... 6
Figure 2: USB Drive 2SE Block Diagram ........................................................................................... 8
Figure 3: USB Drive 2SE Mechanical Dimensions ............................................................................ 12
List of Tables

TABLE 1: SHOCK/VIBRATION TESTING FOR USB DRIVE 2SE

TABLE 2: USB DRIVE 2SE MTBF

TABLE 3: USB DRIVE 2ME TBW

TABLE 4: USB DRIVE 2SE PIN ASSIGNMENT

TABLE 5: USB EDC ABSOLUTE MAXIMUM RATINGS

TABLE 6: USB EDC OPERATING CONDITIONS

TABLE 7: POWER CONSUMPTION

TABLE 8: DEVICE PARAMETERS
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 4 bits 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.

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>Flash Endurance</td>
<td>&gt;100,000 P/E cycles</td>
</tr>
<tr>
<td>TBW(Sequential Write)</td>
<td></td>
</tr>
<tr>
<td>512MB</td>
<td>35</td>
</tr>
<tr>
<td>01GB</td>
<td>65</td>
</tr>
<tr>
<td>02GB</td>
<td>135</td>
</tr>
<tr>
<td>04GB</td>
<td>275</td>
</tr>
<tr>
<td>08GB</td>
<td>550</td>
</tr>
<tr>
<td>16GB</td>
<td>1100</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](image)

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.) 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 100,000 program/erase times and high speed memory storage.
4. Electrical Specifications

4.1 Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Rating</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage Temperature</td>
<td>TStorage</td>
<td>-55 ~ 95°C</td>
<td>°C</td>
</tr>
<tr>
<td>Ambient Operating Temperature</td>
<td>Ta</td>
<td>0 ~ 70°C</td>
<td>°C</td>
</tr>
<tr>
<td>3.3V supply voltage</td>
<td>VCC33</td>
<td>-0.3 ~ 3.6V</td>
<td>V</td>
</tr>
<tr>
<td>1.8V supply voltage</td>
<td>VCC18</td>
<td>-0.3 ~ 2V</td>
<td>V</td>
</tr>
<tr>
<td>3.3V buffer input voltage</td>
<td>Vin33</td>
<td>-0.3 ~ 3.6V</td>
<td>V</td>
</tr>
<tr>
<td>3.3V/5V buffer input voltage</td>
<td>Vin335</td>
<td>-0.3 ~ 5V</td>
<td>V</td>
</tr>
<tr>
<td>1.8V buffer input voltage</td>
<td>Vin18</td>
<td>-0.3 ~ 2V</td>
<td>V</td>
</tr>
</tbody>
</table>

Table 5: USB Drive 2SE Absolute Maximum Ratings

4.2 Operating Conditions

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Rating</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>USB 5V supply voltage</td>
<td>USBVin</td>
<td>3.2 ~ 5.5V</td>
<td>V</td>
</tr>
<tr>
<td>3.3V supply voltage</td>
<td>VDD33</td>
<td>3.0 ~ 3.6V</td>
<td>V</td>
</tr>
<tr>
<td>1.8V supply voltage</td>
<td>VDD18</td>
<td>1.6 ~ 2V</td>
<td>V</td>
</tr>
</tbody>
</table>

Table 6: USB Drive 2SE Operating Conditions

4.3 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 7: Power Consumption
4.4 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 8: Device parameters
## 5. Part Number Rule

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|
| D | E | U | A | 1 | - | 0 | 8 | G | I | 7 | 2 | A | C | 1 | S | B |    |    |

**Definition**

**Code 1st (Disk)**
- **D**: Disk

**Code 2nd ~ 5th (Form Factor)**
- **EUA1**: USB Drive

**Code 7th ~ 9th (Capacity)**
- **512M**: 512MB
- **01G**: 1GB
- **02G**: 2GB
- **04G**: 2GB
- **08G**: 8GB
- **16G**: 16GB

**Code 10th ~ 12th (Category)**
- **I72**: USB Series

**Code 13th (Flash mode)**
- **A**: Async Flash

**Code 14th (Operation Temperature)**
- **C**: Standard Grade (0°C ~ +70°C)
- **W**: Industrial Grade (-40°C ~ +85°C)

**Code 15th (PCB Version)**
- **1**: First Version
- **2**: Second Version

**Code 16th (Channel)**
- **S**: Single

**Code 17th (Flash)**
- **B**: Toshiba SLC
RoHS 自我宣告書 (RoHS Declaration of Conformity)

一、依此規定，InnoDisk Corporation 宣告本公司所有產品，皆符合歐盟 2002/95/EC 關於 RoHS 之規範要求。

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。

<table>
<thead>
<tr>
<th>名稱</th>
<th>限制 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>Cr+6</td>
<td>&lt; 1000 ppm</td>
</tr>
<tr>
<td>PBDE</td>
<td>&lt; 1000 ppm</td>
</tr>
<tr>
<td>PBB</td>
<td>&lt; 1000 ppm</td>
</tr>
</tbody>
</table>

立證書人

公司名稱：**InnoDisk Corporation** 宜鼎國際股份有限公司

公司代表人：**Richard Lee 李鐘亮**

公司代表人職稱：**Chairman 董事長**

日期：**2011 / 10 / 20**
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 : 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-XXX72 # %& & 
  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: 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 : 886-2-25984568
Fax: 886-2-25984546

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