

USB EDC Horizontal 2ME3

Customer:

Customer

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 |
|-----------------|--------------------|-------------|
| V1.0 | First release | Dec., 2021 |
| V1.1 | Update PID info. | May., 2022 |
| V1.2 | Update WP info | Nov., 2022 |

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1. Product Overview

1.1 Introduction of USB EDC

The Innodisk USB EDC (Embedded Disk Card) products provide high capacity USB flash memory storage that electrically complies with USB 2.0. 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

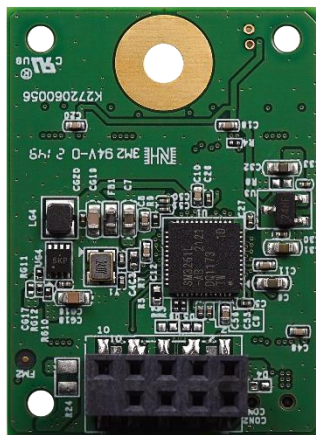


Figure 1: USB EDC Horizontal 2ME3

1.3 Product Models

USB EDC Horizontal 2ME3 is available in follow capacities:

[USB EDC Horizontal 2ME3 8GB](#)

[USB EDC Horizontal 2ME3 16GB](#)

[USB EDC Horizontal 2ME3 32GB](#)

[USB EDC Horizontal 2ME3 64GB](#)

[USB EDC Horizontal 2ME3 128GB](#)

1.4 Capacity

USB EDC Horizontal 2ME3 provides within MLC Flash IC.

1.5 VID/PID

Default is 196D/A232.

2. Theory of operation

2.1 Overview

Figure 2 shows the operation of USB EDC Horizontal 2ME3 from the system level, including the major hardware blocks.

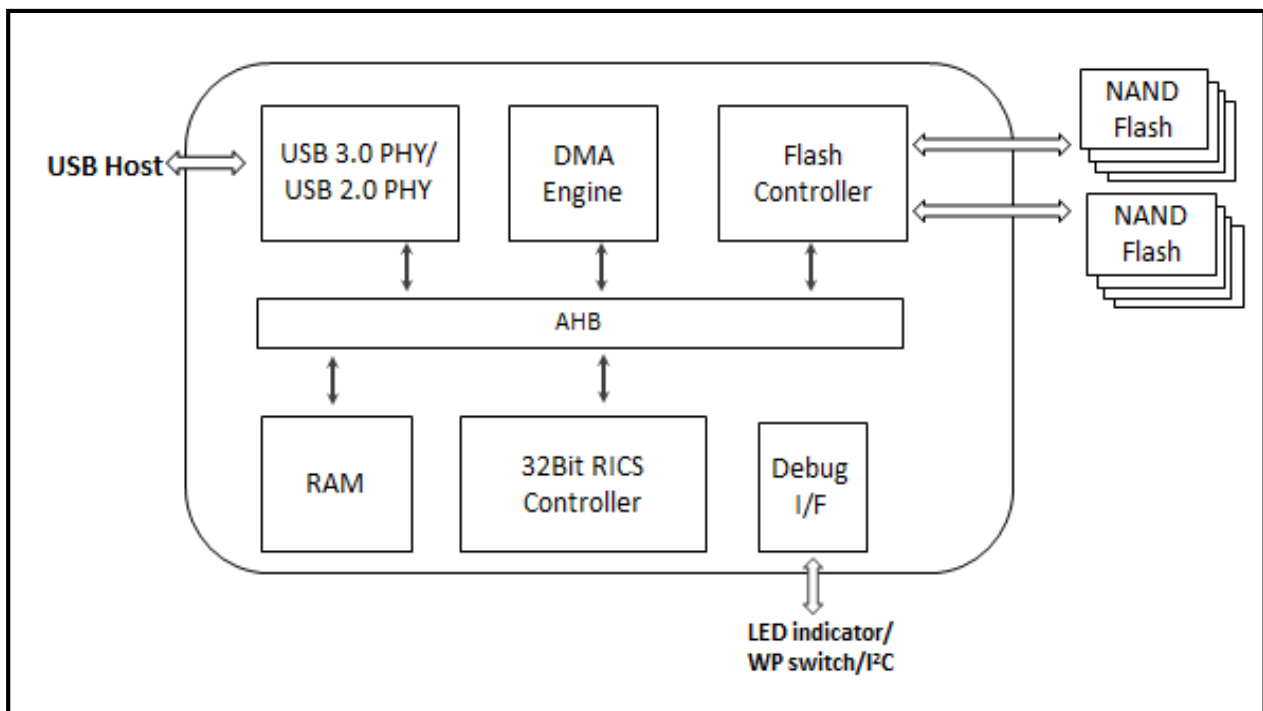


Figure 2: USB EDC Horizontal 2ME3 Block Diagram

USB EDC Horizontal 2ME3 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 96 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 EDC Horizontal 2ME3 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.

2.5 Write Protection function

USB EDC H 2ME3 provides hardware write-protect (W/P) function that could prevent the device from modification and deletion. Write-protection function is enabled through switch to the left, making write-protected data to be read only, that is, users could not write to it, edit it, append data to it, or delete it. On the contrary, user could switch to the right to disabled write protection function to write, edit or delete data.

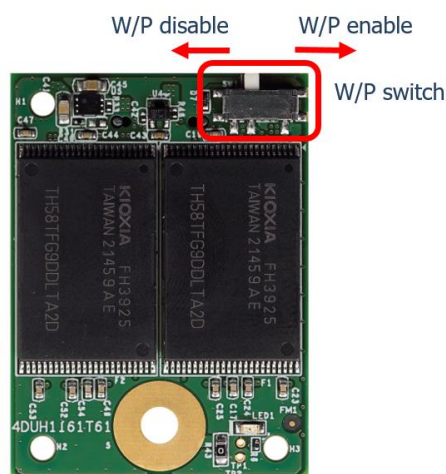


Figure 3: USB EDC H 2ME3 WP functional demonstration

3. Specifications

3.1 CE and FCC Compatibility

USB EDC Horizontal 2ME3 conforms to CE and FCC requirements.

3.2 RoHS Compliance

USB EDC Horizontal 2ME3 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 to +85°C

Storage Temperature Range:

- Standard Grade: -40°C to +85°C

3.3.2 Humidity

Relative Humidity: 10-95%, non-condensing

3.3.3 Shock and Vibration

Table 1: Shock/Vibration Testing for USB EDC Horizontal 2ME3

| Reliability | Test Conditions | Reference Standards |
|------------------|--------------------------------|---------------------|
| Vibration | 7 Hz to 2K Hz, 20G, 3 axes | IEC 68-2-6 |
| Mechanical Shock | Duration: 0.5ms, 1500G, 3 axes | IEC 68-2-27 |

3.3.4 Mean Time between Failures (MTBF)

Table 2 summarizes the MTBF prediction results for various USB EDC Horizontal 2ME3 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 2: USB EDC Horizontal 2ME3 MTBF

| Product | Condition | MTBF (Hours) |
|-------------------------|---------------------------|--------------|
| USB EDC Horizontal 2ME3 | Telcordia SR-332 GB, 25°C | >3,000,000 |

3.3.5 Terabyte Written (TBW)

Table 3: USB EDC Horizontal 2ME3 TBW

| Parameter | Value |
|---|---------------------------|
| Flash endurance | 3,000 P/E cycles |
| TBW* (Total Bytes Written) Unit:TB | |
| Capacity | (Sequential Write) |
| 8GB | 21.6 |
| 16GB | 43.2 |
| 32GB | 86.4 |
| 64GB | 172.8 |
| 128GB | 345.6 |

3.4 Pin Assignment

USB EDC Horizontal 2ME3 is designed within USB2.0 Interface. Particularly, its built-in power pin enables the device more compactable. Table 4 demonstrates USB EDC Horizontal 2ME3 pin assignments.

Table 4: USB EDC Horizontal 2ME3 Pin Assignment

| Horizontal Type | | | |
|-----------------|-------------------|-----------|-------------------|
| Pin No. | Signal | Pin No. | Signal |
| 1 | +5V DC | 2 | NC (None connect) |
| 3 | USB Data(-) | 4 | NC (None connect) |
| 5 | USB Data(+) | 6 | NC (None connect) |
| 7 | GND | 8 | NC (None connect) |
| 9 | NC (None connect) | 10 | NC (None connect) |

3.5 Mechanical Dimensions

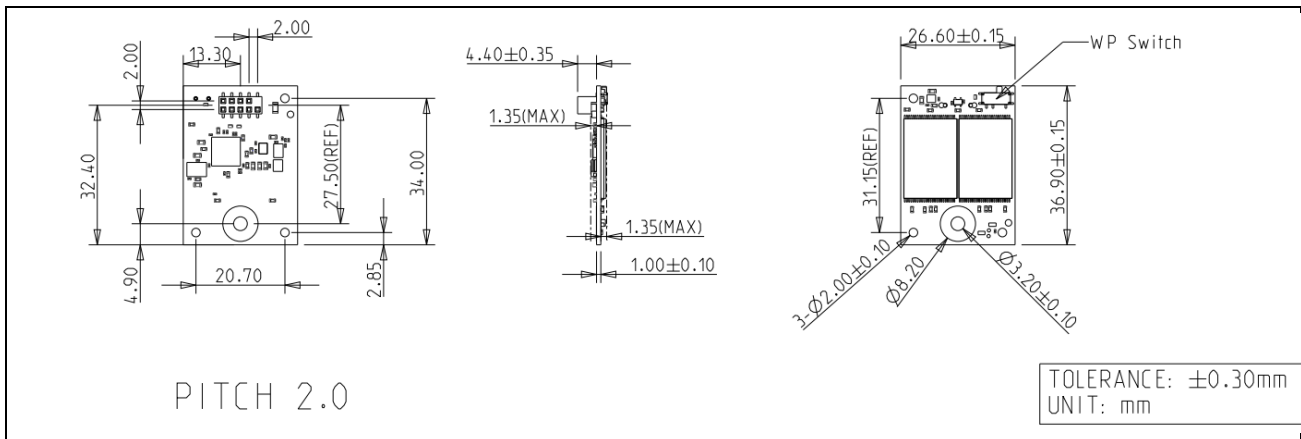


Figure 4: USB EDC Horizontal 2ME3 mechanical dimensions (Pin Pitch: 2.00mm)

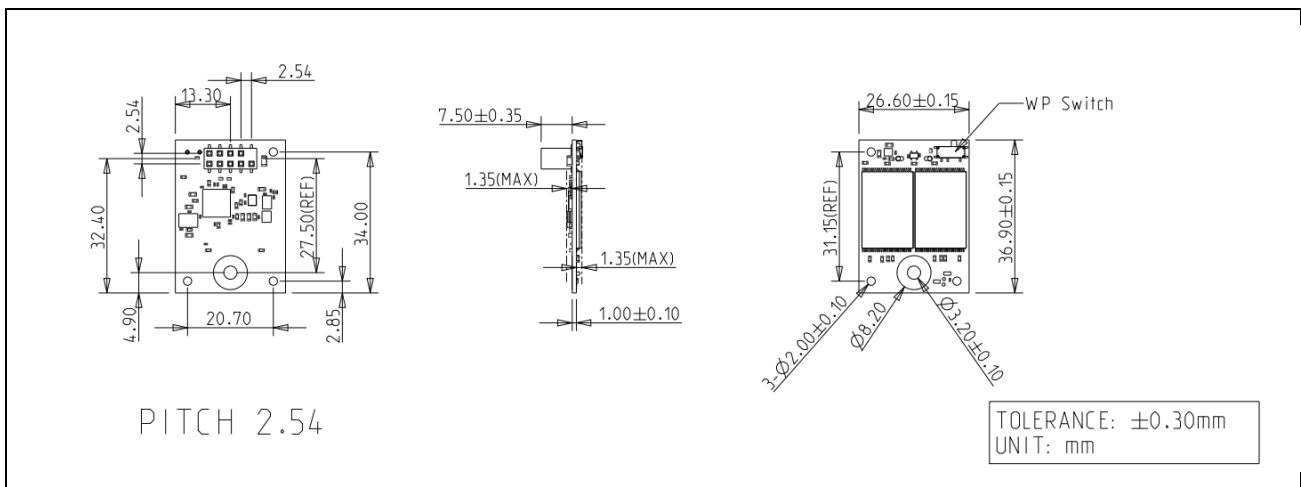


Figure 5: USB EDC Horizontal 2ME3 mechanical dimensions (Pin Pitch: 2.54mm)

3.6 Weight

5g±2

3.7 Performance

Table 5: Performance

| Capacity | Unit | 8GB | 16GB | 32GB | 64GB | 128GB |
|-------------------------|------|-----|------|------|------|-------|
| Sequential Read (Q32T1) | MB/s | 35 | 35 | 35 | 35 | 35 |
| Sequential Write(Q32T1) | | 20 | 20 | 30 | 30 | 35 |

Note: * Performance results are measured in Room Temperature with Out-of-Box devices and may vary depending on overall system setup.

Note: ** Performance results are based on CrystalDiskMark 6.0.2 with typical tolerances for range from 1% to 10%.

3.8 NAND Flash Memory

USB EDC Horizontal 2ME3 uses Multi-Level Cell (MLC) NAND flash memory, which is non-volatility, high reliability.

4. Electrical Specifications

4.1 Operating Conditions

Table 6: USB EDC Operating Conditions

| Item | Symbol | Rating | Unit |
|--------------------|--------|-----------|------|
| USB supply voltage | USBVin | +5 DC+-5% | V |

Note. For 3.3V power supply please contact sales for customization

4.2 Power Consumption

Table 7: Power Consumption

| Mode | Power Consumption (W) |
|-------|-----------------------|
| Read | 0.31 |
| Write | 0.66 |
| Idle | 0.49 |

Target: 128GB USB EDC H 2ME3

Note: Current results may vary depending on system components and power circuit design. Please refer to the test report for other capacities.

4.3 Device Parameters

USB EDC device parameters listed in Table 8.

Table 8: Device parameters

| Capacity | LBA | User Capacity(MB) |
|----------|-----------|-------------------|
| 8GB | 15649200 | 7,641 |
| 16GB | 31277232 | 15,272 |
| 32GB | 62533296 | 30,534 |
| 64GB | 125045424 | 61,057 |
| 128GB | 250069680 | 122,104 |

5. SMART Feature Set

Innodisk USB EDC H 2ME3 series support the SMART command set and defines some vendor-specific data to report SMART attributes of SSD.

Table 9: SMART command

| Value | Command |
|-------|--------------------------|
| D0h | Read Data |
| D1h | Read Attribute Threshold |
| D8h | Enable SMART Operations |
| D9h | Disable SMART Operations |
| DAh | Return Status |

5.1 SMART Attributes

Innodisk USB EDC H 2ME3 series SMART data attributes are listed in following table.

| Attribute ID (hex) | Value | Raw Attribute Value | | | | | | Rsv | Attribute Name |
|--------------------|-------|---------------------|--|--|-----|-----|-----|-----|----------------------------------|
| 0C | x | LSB | | | | MSB | | | Number of power on |
| C2 | x | LSB | | | | | | | Current temperature |
| D5 | x | | | | LSB | | MSB | | Number of current spare block |
| E5 | x | LSB | | | | | MSB | | Est. total number of block erase |
| F1 | x | LSB | | | | | MSB | | Total number LBAs written |
| F2 | x | LSB | | | | | MSB | | Total number LBA read |

Table 10: SMART Attributes

5.2 Innodisk SMART tool

Innodisk USB EDC H 2ME3 series support Innodisk USB SMART tool which can further display SSD information listing in following table.

Table 11: SSD information through Innodisk SMART tool

| | |
|-------------------------|---|
| Uncorrectable ECC Error | Uncorrectable error count |
| Average Erase Count | The average erases count of all blocks. |
| Early Bad Block Count | Number of initial invalid block |
| Later Bad Block Count | Bad blocks occurred during operation. |
| Health | (PE cycle – Average Erase Count)/PE Cycle |

6. Part Number Rule

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
|---|----------|-------------|----------|----------|----------|---|----------|----------|----------|----------|--|------------|-----------------|-------------|----------|----------|-----------------|----|----|----|----|----|
| | D | E | U | H | 1 | - | 1 | 6 | G | I | 6 | 1 | B | W | 1 | S | C | - | | | | |
| Description | Disk | Form Factor | | | | - | Capacity | | Category | | | Flash mode | Operation Temp. | PCB Version | Channel | Flash | Customized Code | | | | | |
| Definition | | | | | | | | | | | | | | | | | | | | | | |
| Code 1st (Disk) | | | | | | | | | | | Code 14th (Operation Temperature) | | | | | | | | | | | |
| D: Disk | | | | | | | | | | | C: Standard Grade (0°C~ +70°C) | | | | | | | | | | | |
| | | | | | | | | | | | W: Industrial Grade (-40°C~ +85°C) | | | | | | | | | | | |
| Code 2nd ~ 4th (Form Factor) | | | | | | | | | | | Code 15th (Internal control) | | | | | | | | | | | |
| EUH: USB EDC Horizontal | | | | | | | | | | | 1~9: TSOP PCB version | | | | | | | | | | | |
| Code 5th (Pin pitch) | | | | | | | | | | | Code 16th (Channel) | | | | | | | | | | | |
| 1: 2.54mm | | | | | | | | | | | S: Single channel | | | | | | | | | | | |
| 2: 2.00mm | | | | | | | | | | | | | | | | | | | | | | |
| Code 7th ~9th (Capacity) | | | | | | | | | | | Code 17th (Flash) | | | | | | | | | | | |
| 08G: 8GB | | | | | | | | | | | C: Kioxia MLC | | | | | | | | | | | |
| 16G: 16GB | | | | | | | | | | | | | | | | | | | | | | |
| 32G: 32GB | | | | | | | | | | | Code 19th ~ 21st (Customize code) | | | | | | | | | | | |
| 64G: 64GB | | | | | | | | | | | | | | | | | | | | | | |
| A28: 128GB | | | | | | | | | | | | | | | | | | | | | | |
| Code 10th ~12th (Category) | | | | | | | | | | | | | | | | | | | | | | |
| I61: USB EDC H 2ME3 series | | | | | | | | | | | | | | | | | | | | | | |
| Code 13th (Flash mode) | | | | | | | | | | | | | | | | | | | | | | |
| B: Kioxia 15nm MLC | | | | | | | | | | | | | | | | | | | | | | |