USB EDC Horizontal 2SE2

Total Solution For Industrial Flash Storage

Customer:

Customer Part Number:

Innodisk Model Name:

Date:

Innodisk Approver	Customer Approver

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REVISION HISTORY

Revision	Description	Date
V1.0	First release	Nov., 2021
V1.1	Add power supply description Revise PN rule info.	Nov., 2021
V1.2	Update performance	Dec., 2021
V1.3	Update Mechanical Dimensions	Dec., 2021
V1.4	Update PID info.	May, 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 2SE2

1.3 Product Models

USB EDC Horizontal 2SE2 is available in follow capacities:
USB EDC Horizontal 2SE2 512MB to 32GB

1.4 Capacity

USB EDC Horizontal 2SE2 provides within SLC Flash IC and iSLC technology.

1.5 VID/PID

Default is 196D/B230.

2. Theory of operation

2.1 Overview

Figure 2 shows the operation of USB EDC Horizontal 2SE2 from the system level, including the major hardware blocks.
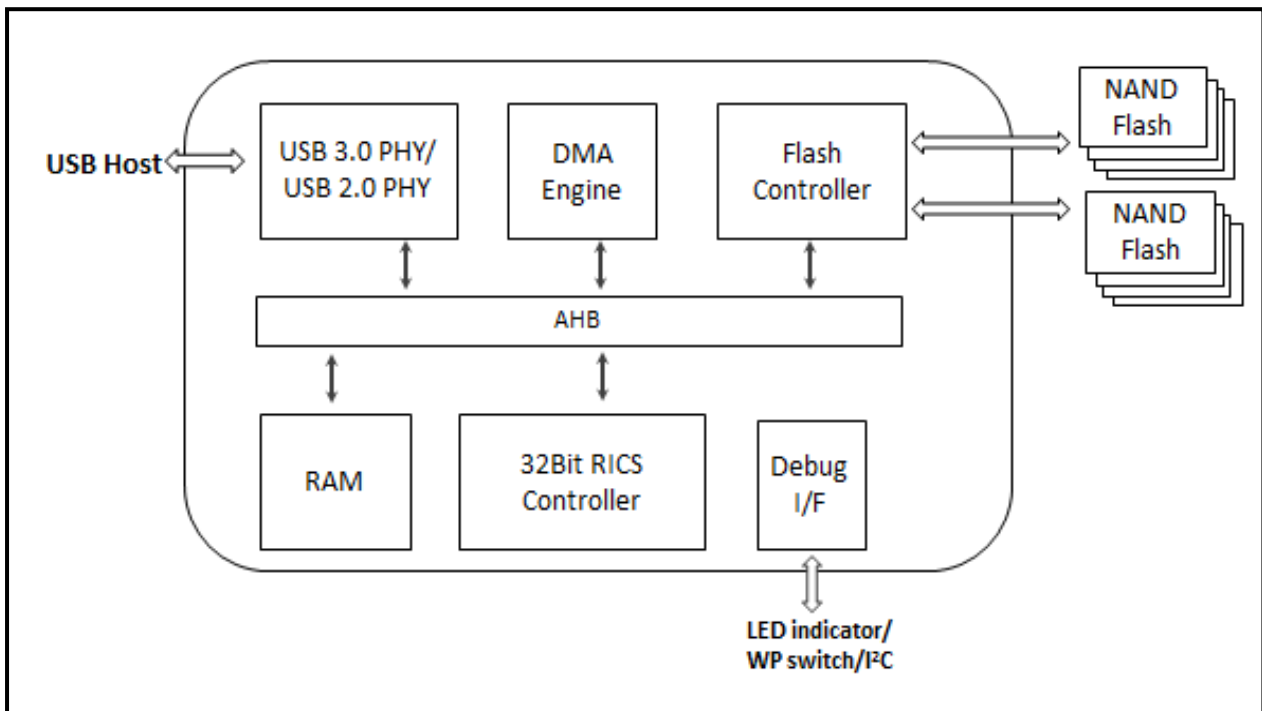
Figure 2: USB EDC Horizontal 2SE2 Block Diagram

USB EDC Horizontal 2SE2 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 2SE2 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.

3. Specifications

3.1 CE and FCC Compatibility

USB EDC Horizontal 2SE2 conforms to CE and FCC requirements.

3.2 RoHS Compliance

USB EDC Horizontal 2SE2 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

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

Table 1: Shock/Vibration Testing for USB EDC Horizontal 2SE2

3.3.4 Mean Time between Failures (MTBF)

Table 2 summarizes the MTBF prediction results for various USB EDC Horizontal 2SE2 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.

Product	Condition	MTBF (Hours)
USB EDC Horizontal 2SE2	Telcordia SR-332 GB, 25°C	>3,000,000

Table 2: USB EDC Horizontal 2SE2 MTBF

3.3.5 Terabyte Written (TBW)

Parameter	Value
Flash endurance	60,000 P/E cycles
TBW* (Total Bytes Written) Unit:TB	
Capacity	**(Sequential Write)**
512MB	27
1GB	54
2GB	108
4GB	216
8GB	432
16GB	864
32GB	1728

Table 3: USB EDC Horizontal 2SE2 TBW

3.4 Pin Assignment

USB EDC Horizontal 2SE2 is designed within USB2.0 Interface. Particularly, its built-in power pin enables the device more compactable. Table 4 demonstrates USB EDC Horizontal 2SE2 pin assignments.

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)

Table 4: USB EDC Horizontal 2SE2 Pin Assignment
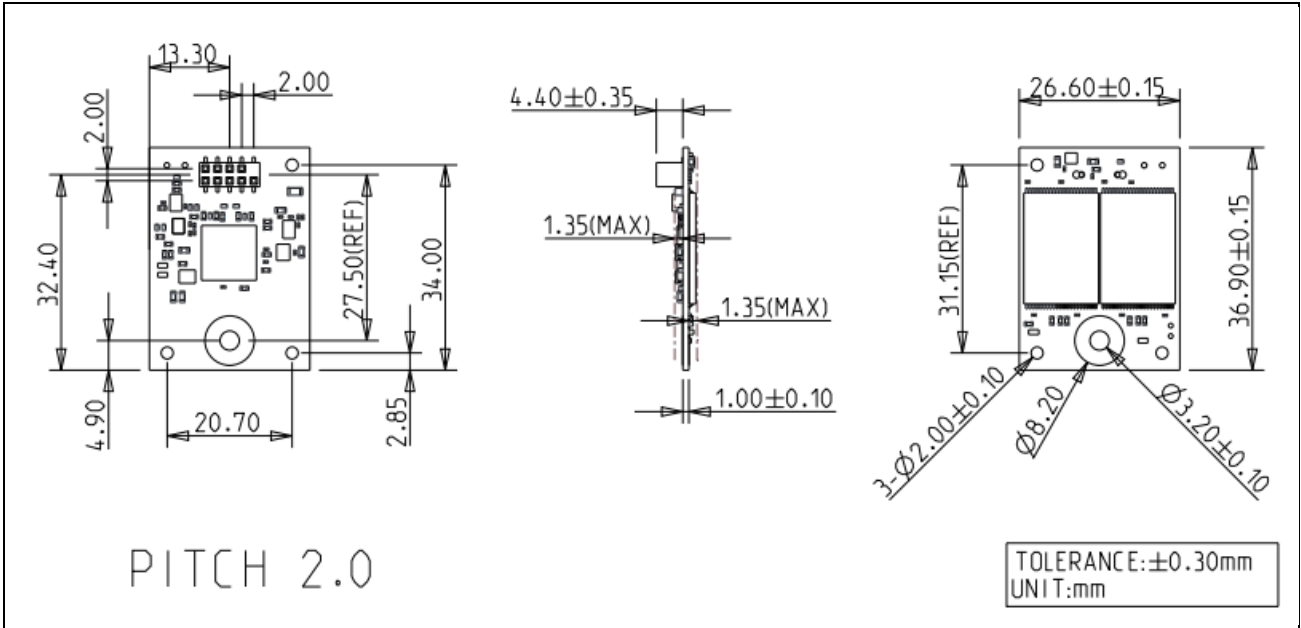
3.5 Mechanical Dimensions

Figure 3: USB EDC Horizontal 2SE2 mechanical dimensions (Pin Pitch: 2.00mm)
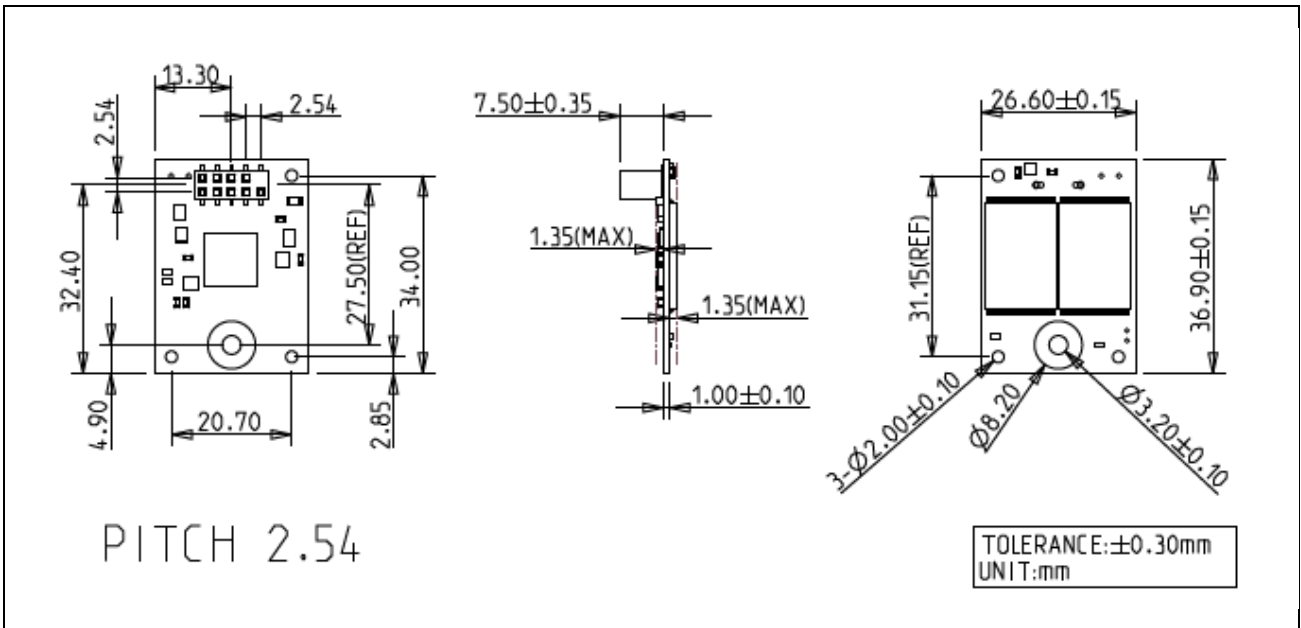
Figure 4: USB EDC Horizontal 2SE2 mechanical dimensions (Pin Pitch: 2.54mm)

3.6 Weight

5g±2

3.7 Performance

Table 5: Performance

Capacity	Unit	512MB	1GB	2GB	4GB	8GB	16GB	32GB
Sequential Read (Q32T1)	MB/s	30	30	30	30	30	30	30
Sequential Write(Q32T1)		15	15	20	25	30	30	30

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 2SE2 uses Single Level Cell (SLC) NAND flash memory, which is non-volatility, high reliability.

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4. Electrical Specifications

4.1 Operating Conditions

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

Table 5: USB EDC Operating Conditions

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

4.2 Power Consumption

Mode	Power Consumption (W)
Read	0.51
Write	0.48
Idle	0.30
Power-on peak	1.72

Table 6: Power Consumption

Target: 32GB USB EDC H 2SE2

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 5.

Table 6: Device parameters

Capacity	LBA	User Capacity(MB)
512MB	974848	476
1GB	1974672	964
2GB	3928176	1918
4GB	7835184	3826
8GB	15649200	7641
16GB	31277232	15272
32GB	62533296	30534

5. SMART Feature Set

Innodisk USB EDC H 2SE2 series support the SMART command set and defines some vendor-specific data to report SMART attributes of SSD.

Table 7: 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 2SE2 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 8: SMART Attributes

5.2 Innodisk SMART tool

Innodisk USB EDC H 2SE2 series support Innodisk USB SMART tool which can further display SSD information listing in following table.

Table 9: 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**	**-**	**3**	**2**	**G**	**D**	**Q**	**1**	**A**	**W**	**1**	**S**	**B**	**-**				
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℃~ +70℃)
	W: Industrial Grade (-40℃~ +85℃)
Code 2nd ~ 4th (Form Factor)	**Code 15th (Internal control)**
EUH: SLC, 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)**
512: 512MB	B: Kioxia SLC
01G: 1GB	
02G: 2GB	**Code 19th ~ 21st (Customize code)**
04G: 4GB	
08G: 8GB	
16G: 16GB	
32G: 32GB	
Code 10th ~12th (Category)	
DQ1: USB EDC H 2SE2 series	
Code 13th (Flash mode)	
A: Async. Flash	