innodisk

The Total Solution For Industrial Flash Storage

USB Drive

3IE4 Series

Customer: _____

Customer Part Number: _____

Innodisk Part Number: _____

Innodisk Model Name: _____

Date: _____

Innodisk Approver	Customer Approver

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Features:

- USB 3.2 Gen 1
- Kioxia 3D TLC NAND
- USB drive
- Standard & Wide-temperature
- iData Guard

Power Requirements:

Input Voltage:	5V±5%
Max Operating Wattage (R/W):	1.3W
Idle Wattage:	0.6W

Performance:

- Sequential Read up to 330 MB/s
- Sequential Write up to 125 MB/s

Reliability:

Capacity	TBW	DWPD
16GB	284	10.7
32GB	568	10.7
64GB	1136	10.7
128GB	2273	10.7

Data Retention	1 Year
Warranty	5 Years

1 year data retention is at NAND life end.

For warranty details, please refer to:

https://www.innodisk.com/en/support_and_service/warranty

Revision History

Revision	Description	Date
V1.0	First Release	Dec., 2024
V1.1	Update TBW information	Mar., 2025

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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 3.2 Gen 1 interface & backward compatible with USB 2.0 and 1.1. The device features attractive small form factor and the connectivity over USB3.2 and the NAND flash architecture provide a faster data transmission. In our default setting, the USB Drive will be set up as “Removable mode”.

1.2 Product View and Models

USB Drive 3IE4 is available in follow capacities within TLC Flash IC.

USB Drive 3IE4 16GB

USB Drive 3IE4 32GB

USB Drive 3IE4 64GB

USB Drive 3IE4 128GB

Figure 1: USB Drive 3IE4

2. Theory of operation

2.1 Overview

Figure 2 shows the operation of USB Drive 3IE4 from the system level, including the major hardware blocks.

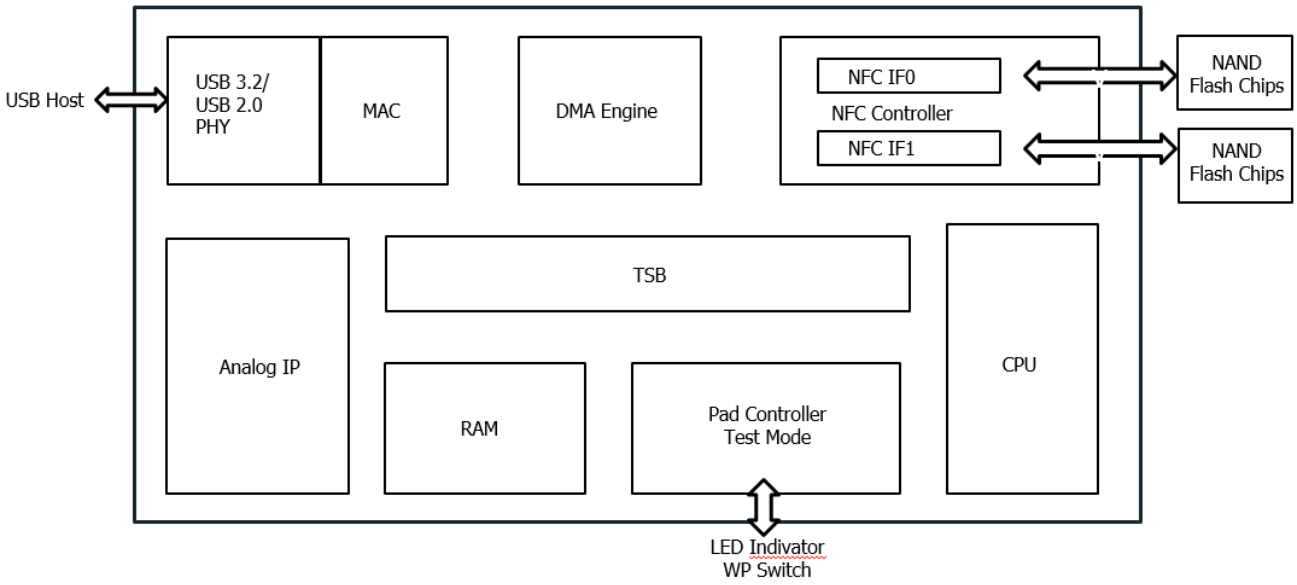


Figure 2: USB Drive 3IE4 Block Diagram

USB Drive 3IE4 integrates a USB3.2 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 Gen eration) and the Syndrome Unit (syndrome-byte computation). This unit implements an algorithm that can correct 60 bits per 1024 bytes in an ECC block. Code-byte Gen eration 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 3IE4 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 Gen erate 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 3IE4 conforms to CE and FCC requirements.

3.2 RoHS Compliance

USB Drive 3IE4 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: -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 Drive 3IE4

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 Drive 3IE4 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 Drive 3IE4 MTBF

Product	Condition	MTBF (Hours)
USB Drive 3IE4	Telcordia SR-332 GB, 25°C	>3,000,000

3.3.5 Terabyte Written (TBW)

Table 3: USB Drive 3IE4 TBW

Parameter	Value
Flash endurance	20,000 P/E cycles
TBW* (Total Bytes Written) Unit: TB	
Capacity	**Sequential workload**
16GB	284
32GB	568
64GB	1136
128GB	2273

3.4 Golden finger

Au=3 μ”

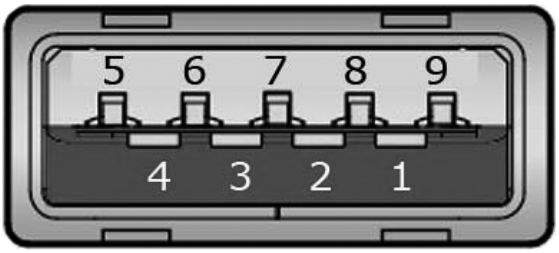
3.5 Pin Assignment

USB Drive 3IE4 is designed within USB3.2 Interface. Particularly, its built-in power pin enables the device more compactable. Table 4 demonstrates USB Drive 3IE4 pin assignments.

Table 4: USB Drive 3IE4 Pin Assignment

Pin Number	Signal Name	Description
1	VBUS	Power
2	D-	USB 2.0 differential pair
3	D+	
4	GND	Ground for power return
5	StdA_SSRX-	SuperSpeed receiver differential pair
6	StdA_SSRX+	
7	GND_DRAIN	Ground for signal return
8	StdA_SSTX-	SuperSpeed transmitter differential pair
9	StdA_SSTX+	
Shell	Shield	Connector metal shell

Note: Tx and Rx are defined from the host perspective



3.6 Mechanical Dimensions

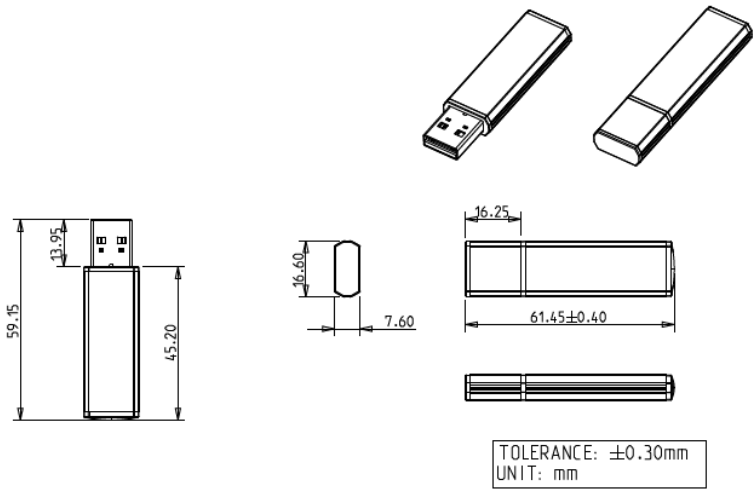


Figure 3: USB Drive 3IE4 mechanical dimensions

3.7 Weight

10g±2

3.8 Performance

Table 5: USB Drive 3IE4 performance

Capacity	Unit	16GB	32GB	64GB	128GB
Sequential Read (Q32T1)	MB/s	245	330	335	330
Sequential Write (Q32T1)		75	105	125	125
4KB Random Read (Q32T1)*	IOPS	4,200	4,050	4,050	4,000
4KB Random Write (Q32T1)*		3,550	4,350	4,450	4,350

Note: *Performance results are based on CrystalDiskMark 6.0.2 with file size 1000MB. Unit of 4KB item is IOPS.

3.9 NAND Flash Memory

USB Drive 3IE4 uses Triple Level Cell (TLC) NAND flash memory, which is non-volatility and high reliability.

4. Electrical Specifications

4.1 Power Requirement

Table 6: USB Drive 3IE4 Power Requirement

Item	Symbol	Rating	Unit
Input voltage	V_{IN}	+5 DC +- 5%	V

4.2 Power Consumption

Table 7: Typical Power Consumption

Mode	Power Consumption (W)
Read	1.3
Write	1.0
Idle	0.6

Target: 128GB USB drive 3IE4

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

Table 8: Device parameters

Capacity	LBA	User capacity (MB)
16GB	31277232	15272
32GB	62533296	30533
64GB	125045424	61057
128GB	250069680	122104

5. Part Number Rule

CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	D	**H**	**U**	**A**	**1**	**-**	**A**	**2**	**8**	**I**	**D**	**1**	**K**	**C**	**A**	**D**	**F**	**-**	**x**	**x**

Definition	
Code 1st (Disk)	**Code 14th (Operation Temperature)**
D: Disk	C: Standard Grade (0℃~ +70℃)
	W: Industrial Grade (-40℃~ +85℃)
Code 2nd ~ 5th (Form Factor)	**Code 15th (Internal control)**
HUA1: USB Drive	A PCB version
Code 7th ~9th (Capacity)	**Code 16th(Channel)**
16G: 16GB	S: Single Channel
32G: 32GB	D: Dual Channels
64G: 64GB	
A28: 128GB	
Code 10th ~12th (Category)	**Code 17th (Flash)**
ID1: USB 3IE4 series	F: Kioxia 3D TLC
Code 13th (Flash mode)	**Code 19th ~ (Customized Code)**
K: 112 layers 3D TLC	