innodisk

The Total Solution For Industrial Flash Storage

USB Drive

3SE Series

Customer: _____

Customer Part Number: _____

Innodisk Part Number: _____

Innodisk Model Name: _____

Date: _____

Innodisk Approver	Customer Approver

Table of contents

REVISION HISTORY

Revision	Description	Date
Pre.	First Release	April., 2014
1.0	Modify ECC description	May., 2014
1.1	Modify TBW based on NAND Flash specifications	Jan., 2015
1.2	Modify User Capacity/LBA of 4GB	Oct., 2016
1.3	Update RoHS/REACH/CE/FCC certification Modify golden finger	Nov., 2017
1.4	Add 24nm SLC	Jul.,2021
1.5	Update mechanical dimensions drawing	Oct., 2021
1.6	Update Performance	Mar., 2022
1.7	Add Flash Endurance	June, 2023
1.8	Revise Product View	Nov., 2023

List of Figures

List of Tables

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 3.0 interface & backward compatible with USB 2.0. The device features attractive small form factor and the connectivity over USB3.0 and the NAND flash architecture provide a faster data transmission.

1.2 Product View

Figure 1: USB Drive 3SE

1.3 Product Models

USB Drive 3SE is available in follow capacities.
USB Drive 3SE 4GB
USB Drive 3SE 8GB
USB Drive 3SE 16GB
USB Drive 3SE 32GB

1.4 Capacity

USB Drive 3SE provides unformatted from 4GB up to 32GB capacities within SLC Flash IC.

2. Theory of operation

2.1 Overview

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

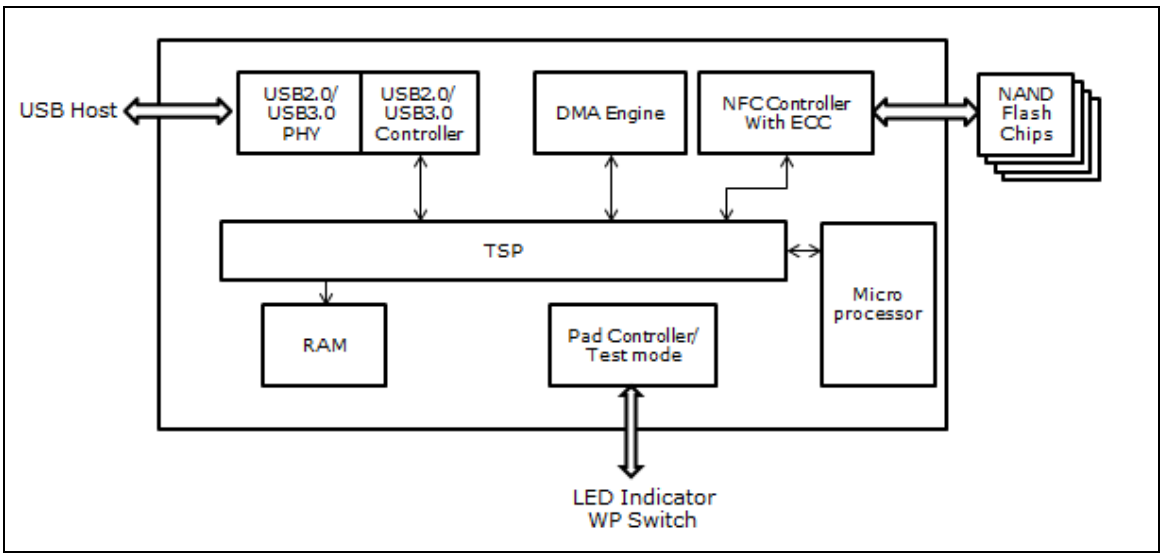

Figure 2: USB Drive 3SE Block Diagram

USB Drive 3SE integrates a USB3.0 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 60 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 3SE 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 3SE conforms to CE and FCC requirements.

3.2 RoHS Compliance

USB Drive 3SE 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

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 Drive 3SE

3.3.4 Mean Time between Failures (MTBF)

Table 2 summarizes the MTBF prediction results for various USB Drive 3SE 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 Drive 3SE	Telcordia SR-332 GB, 25°C	>3,000,000

Table 2: USB Drive 3SE MTBF

3.3.5 Terabyte Written (TBW)

Parameter	Value
Flash Endurance	60,000 P/E cycles
TBW(Sequential Write)	Unit: TB
4GB	216
8GB	432
16GB	864
32GB	1728

Table 3: USB Drive 3SE TBW

3.4 Golden finger

Au=3 μ”

3.5 Pin Assignment

USB Drive 3SE is designed within USB3.0 Interface. Particularly, its built-in power pin enables the device more compactable. Table 4 demonstrates USB Drive 3SE pin assignments.

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

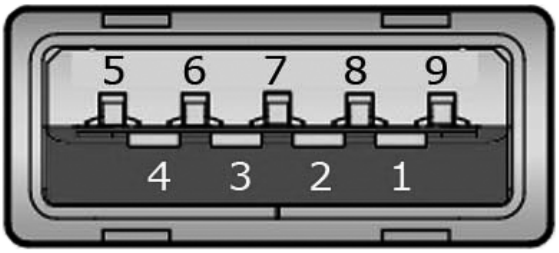

Table 4: USB Drive 3SE Pin Assignment

3.6 Mechanical Dimensions

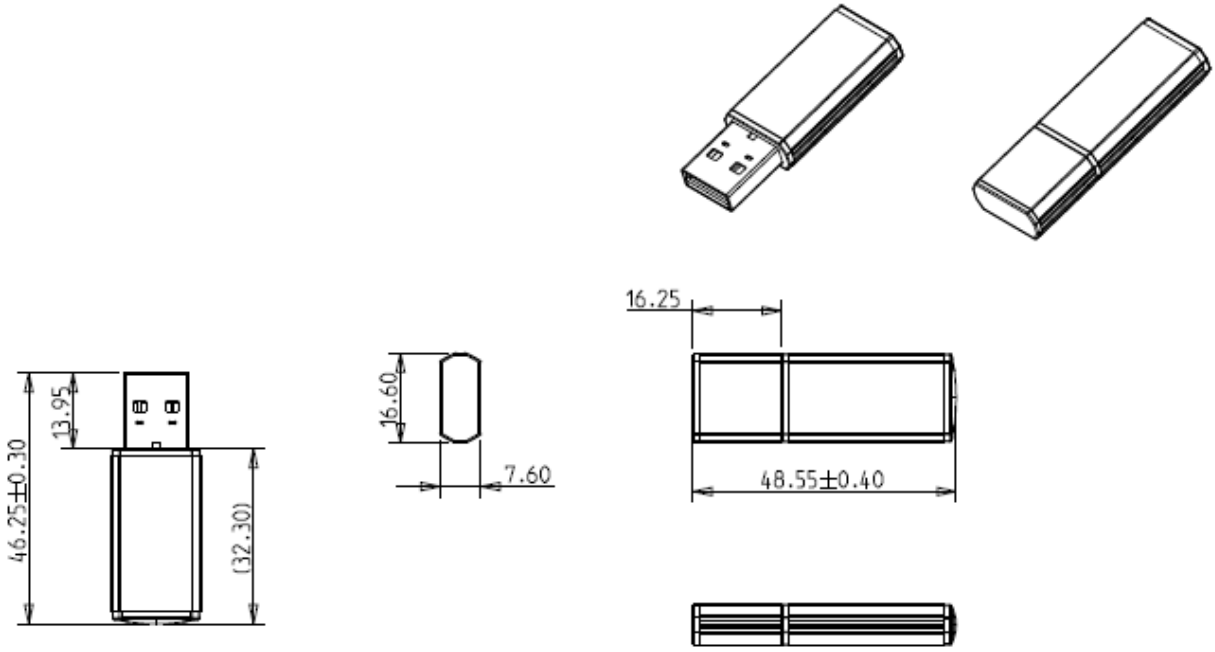

Figure 3: USB Drive 3SE mechanical dimensions

3.7 Weight

10g±2

3.8 Performance

Product name		Unit	4GB	8GB	16GB	32GB
USB Drive 3SE	Sequential Read (Max.)	MB/s	100	110	110	110
	Sequential Write (Max.)		65	80	85	85

3.9 NAND Flash Memory

USB Drive 3SE uses Single Level Cell (SLC) NAND flash memory, which is non-volatility and high reliability.

4. Electrical Specifications

4.1 Power Requirement

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

Table 5: USB Drive 3SE Power Requirement

4.2 Power Consumption

Mode	Power Consumption (mA)
Read	131 (max.)
Write	155 (max.)
Idle	67 (max.)

Table 6: Power Consumption

4.3 Device Parameters

Capacity	LBA	User capacity
4GB	7905280	3860MB
8GB	15810560	7720MB
16GB	31686656	15472MB
32GB	63373312	30944MB

Table 7: 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**	**6**	**1**	**S**	**C**	**A**	**S**	**B**	**-**	**X**	**X**
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 ~ 5th (Form Factor)	**Code 15th (Internal control)**
EUA1: USB Drive	A~Z: BGA PCB version.
	1~9: TSOP
Code 7th ~9th (Capacity)	**Code 16th (Channel)**
04G: 4GB	S: Single
08G: 8GB	
16G: 16GB	
32G: 32GB	
Code 10th ~12th (Category)	**Code 17th (Flash)**
I61: USB 3SE series	B: Toshiba SLC
Code 13th (Flash mode)	
S: Sync. Flash	
A: Async Flash	