innodisk

Total Solution For
Industrial Flash Storage

2.5" SATA SSD

3SE3 Series

Customer: _____

Customer Part Number: _____

Innodisk Part Number: _____

Innodisk Model Name: _____

Date: _____

Innodisk Approver	Customer Approver

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Revision History

Revision	Description	Date
Rev. 1.0	First Released	Mar., 2016
Rev. 1.1	Add Power Consumption	Jun., 2016
Rev. 1.2	Add TRIM note Update RoHS Report	Apr., 2019
Rev. 1.3	Update Assembly Torque Information	Mar., 2023
Rev. 1.4	Update Reliability	Aug., 2024

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1. Product Overview

1.1 Introduction of Innodisk 2.5” SATA SSD 3SE3

Innodisk 2.5” SATA SSD 3SE3 products provide high capacity flash memory Solid State Drive (SSD) that electrically complies with Serial ATA (SATA) standard. It supports SATA III standard (6.0GHz) with high performance. Innodisk 2.5” SATA SSD 3SE3 delivers sustain read speeds of up to 490MB/s and sustain write speeds of up to 430 MB/s. It designed with standard 2.5-inch form factor, which can be used in laptop. Innodisk 2.5” SATA SSD 3SE3 is designed for industrial field. The SSD have good performance, no latency time and small seek time. It effectively reduces the booting time of operation system and the power consumption is less than hard disk drive (HDD). Innodisk 2.5” SATA SSD 3SE3 can work in harsh environment. The SSD is vibration resistance, and can work in lower or higher temperature than HDD. Innodisk 2.5” SATA SSD 3SE3 complies with ATA protocol, no additional drives are required, and the SSD can be configured as a boot device or data storage device.

CAUTION TRIM must be enabled.

TRIM enables SSD’s controller to skip invalid data instead of moving. It can free up significant amount of resources, extends the lifespan of SSD by reducing erase, and write cycles on the SSD. Innodisk’s handling of garbage collection along with TRIM command improves write performance on SSDs.

1.2 Product View and Models

Innodisk 2.5” SATA SSD 3SE3 is available in follow capacities within SLC flash ICs.

2.5” SATA SSD 3SE3 08GB
2.5” SATA SSD 3SE3 16GB
2.5” SATA SSD 3SE3 32GB
2.5” SATA SSD 3SE3 64GB
2.5” SATA SSD 3SE3 128GB

Figure 1: Innodisk 2.5” SATA SSD 3SE3

1.3 SATA Interface

Innodisk 2.5” SATA SSD 3SE3 supports SATA III interface, and compliant with SATA I and SATA II. SATA III interface can work with Serial Attached SCSI (SAS) host system, which is used in server computer. Innodisk 2.5” SATA SSD 3SE3 is compliant with Serial ATA Gen 1, Gen 2 and Gen 3 specification (Gen 3 supports 1.5Gbps /3.0Gbps/6.0Gbps data rate). SATA connector uses a 7-pin signal segment and a 15-pin power segment.

1.4 2.5-inch Form Factor

The Industry-standard 2.5-inch form factor design with metal material case is easy for installation because 2.5-inch is a popular form factor in industrial field. 2.5-inch is most laptop’s hard disk’s form factor. Innodisk 2.5” SATA SSD 3SE3 can easy install in laptop. Innodisk 2.5” SATA SSD 3SE3 has a compact design 69.85mm (W) x99.85mm (L) x 9.20mm (H).

2. Product Specifications

2.1 Capacity and Device Parameters

2.5” SATA SSD 3SE3 device parameters are shown in Table 1.

Table 1: Device parameters

Capacity	LBA	Cylinders	Heads	Sectors	User Capacity(MB)
8GB	15649200	15255	16	63	7641
16GB	31277232	16383	16	63	15272
32GB	62533296	16383	16	63	30533
64GB	125045424	16383	16	63	61057
128GB	250069680	16383	16	63	122104

2.2 Performance

Burst Transfer Rate: 6.0Gbps

Table 2: Performance

Capacity	8GB	16GB	32GB	64GB	128GB
Sequential Read (max.)	330 MB/sec	330 MB/sec	360 MB/sec	370 MB/sec	360 MB/sec
Sequential Write (max.)	100 MB/sec	120 MB/sec	210 MB/sec	230 MB/sec	210 MB/sec
4K Random Read (QD32)	12,800 IOPS	12,400 IOPS	13,000 IOPS	12,200 IOPS	12,400 IOPS
4K Random Write (QD32)	8,200 IOPS	8,600 IOPS	10,800 IOPS	20,000 IOPS	20,000 IOPS

Note: Base on CrystalDiskMark 3.01 with file size 1000MB

2.3 Electrical Specifications

2.3.1 Power Requirement

Table 3: InnoDisk 2.5” SATA SSD 3SE3 Power Requirement

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

2.3.2 Power Consumption

Table 4: Power Consumption

Mode	Power Consumption (mA)
Read	152 mA
Write	148 mA
Idle	101 mA

* Target: 2.5: SATA SSD 3SE3 128GB

2.4 Environmental Specifications

2.4.1 Temperature Ranges

Table 5: Temperature range for 2.5” SATA SSD 3SE3

Temperature	Range
Operating	Standard Grade: 0°C to +70°C
	Industrial Grade:-40°C to +85°C
Storage	-55°C to +95°C

2.4.2 Humidity

Relative Humidity: 10-95%, non-condensing

2.4.3 Shock and Vibration

Table 6: Shock/Vibration Testing for 2.5” SATA SSD 3SE3

Reliability	Test Conditions	Reference Standards
Vibration	7 Hz to 2K Hz, 20G, 3 axes	IEC 60068-2-6
Mechanical Shock	Duration: 0.5ms, 1500 G, 3 axes	IEC 60068-2-27

2.4.4 Mean Time between Failures (MTBF)

Table 7 summarizes the MTBF prediction results for various 2.5” SATA SSD 3SE3 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 7: 2.5” SATA SSD 3SE3 MTBF

Product	Condition	MTBF (Hours)
Innodisk 2.5” SATA SSD 3SE3	Telcordia SR-332 GB, 25°C	>3,000,000

2.5 CE and FCC Compatibility

2.5” SATA SSD 3SE3 conforms to CE and FCC requirements.

2.6 RoHS Compliance

2.5” SATA SSD 3SE3 is fully compliant with RoHS directive.

2.7 Reliability

Parameter	Value
Read Cycles	Unlimited Read Cycles
Flash Endurance	60,000 P/E cycles
Wear-Leveling Algorithm	Support
Bad Blocks Management	Support
Error Correct Code	Support
Data Retention	Under 40℃: 1 Year at NAND Life End
TBW (Unit: TB)	
8GB	46.8
16GB	93.7
32GB	187.5
64GB	375
128GB	750
* Total bytes written is based on JEDEC 218 (Solid-State Drive Requirements and Endurance Test Method) ** Lifespan is calculated by device written per day	

2.8 Transfer Mode

2.5” SATA SSD 3SE3 support following transfer mode:

Serial ATA III 6.0Gbps

Serial ATA II 3.0Gbps

Serial ATA I 1.5Gbps

2.9 Pin Assignment

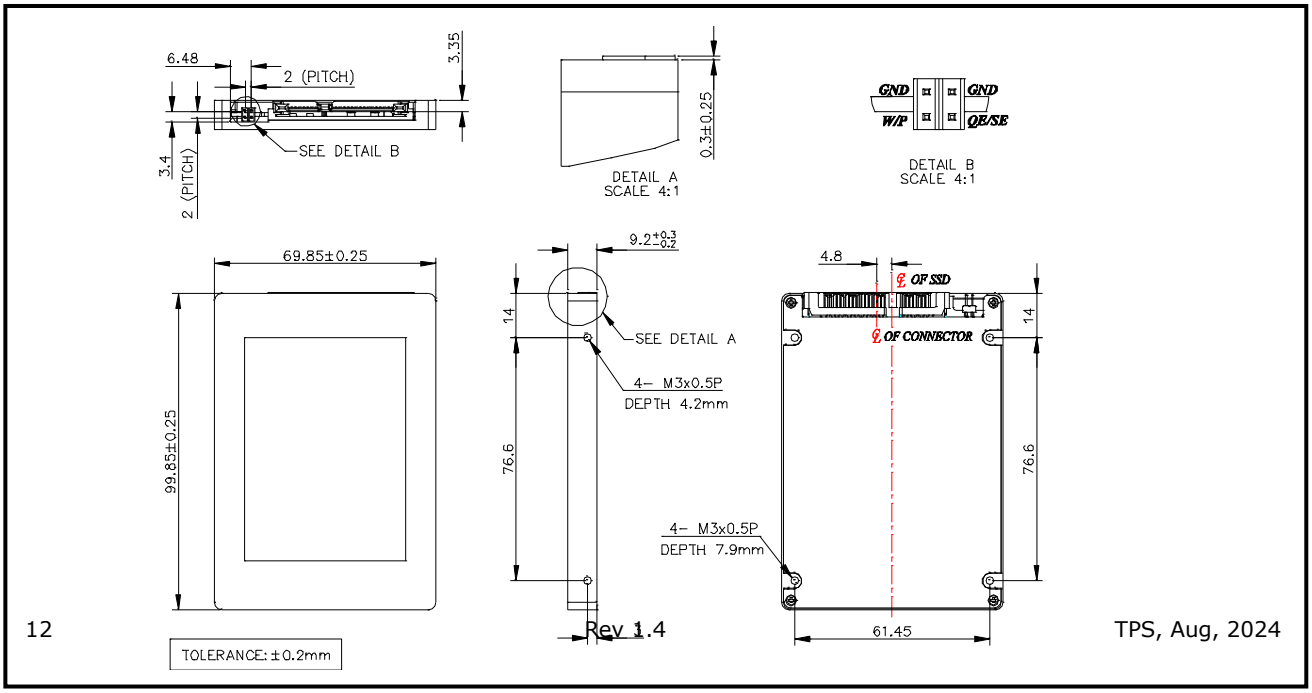
Innodisk 2.5” SATA SSD 3SE3 uses a standard SATA pin-out. See Table 8 for 2.5” SATA SSD 3SE3 pin assignment.

Table 8: Innodisk 2.5” SATA SSD 3SE3 Pin Assignment

Name	Type	Description

S1	GND	NA
S2	A+	Differential Signal Pair A
S3	A-	
S4	GND	NA
S5	B-	Differential Signal Pair B
S6	B+	
S7	GND	NA
Key and Spacing separate signal and power segments		
P1	NC	NA
P2	NC	NA
P3	NC	NA
P4	GND	NA
P5	GND	NA
P6	GND	NA
P7	V5	5V Power, Pre-Charge
P8	V5	5V Power
P9	V5	5V Power
P10	GND	NA
P11	DAS/DSS	Device Activity Signal / Disable Staggered
P12	GND	NA
P13	NC	NA
P14	NC	NA
P15	NC	NA

2.10 Mechanical Dimensions



2.11 Assembly Weight

An Innodisk2.5” SATA SSD 3SE3 within SLC flash ICs, 16GB’s weight is 100 grams approx. The total weight of SSD will be less than 135 grams.

2.12 Seek Time

Innodisk 2.5” SATA SSD 3SE3 is not a magnetic rotating design. There is no seek or rotational latency required.

2.13 Hot Plug

The SSD support hot plug function and can be removed or plugged-in during operation. User has to avoid hot plugging the SSD which is configured as boot device and installed operation system.

Surprise hot plug : The insertion of a SATA device into a backplane (combine signal and power) that has power present. The device powers up and initiates an OOB sequence.

Surprise hot removal: The removal of a SATA device from a powered backplane, without first being placed in a quiescent state.

2.14 NAND Flash Memory

Innodisk 2.5” SATA SSD 3SE3 uses Single Level Cell (SLC) NAND flash memory, which is non-volatility, high reliability and high speed memory storage. There are only two statuses 0 or 1 of one cell. Read or Write data to flash memory for SSD is control by microprocessor.

3. Theory of Operation

3.1 Overview

Figure 2 shows the operation of Innodisk 2.5” SATA SSD 3SE3 from the system level, including the major hardware blocks.

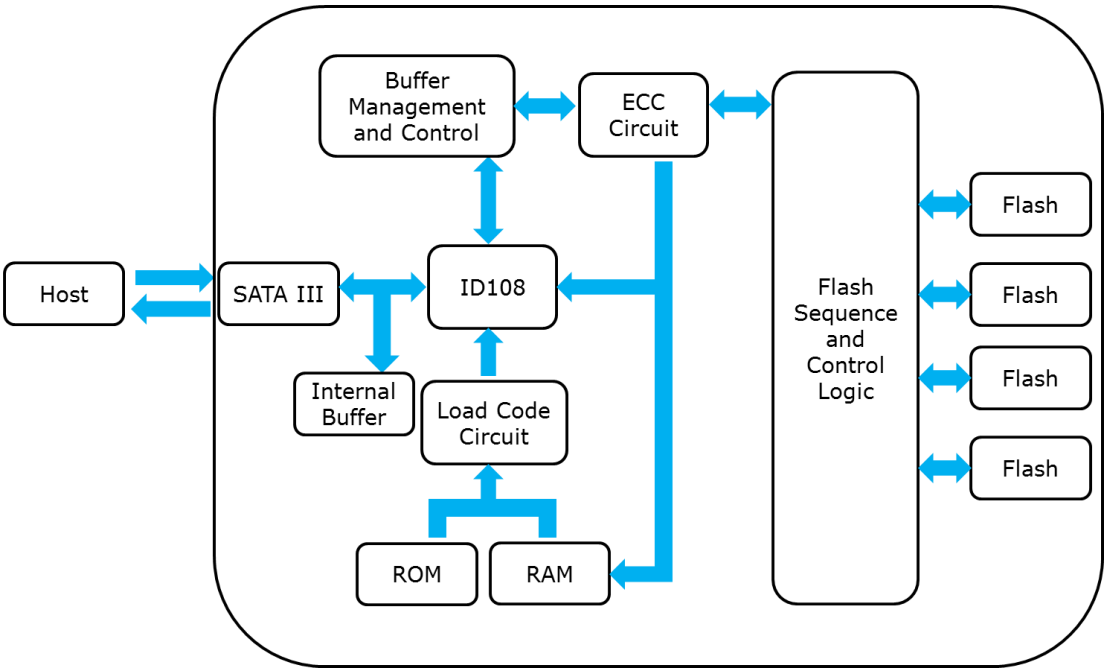


Figure 2: Innodisk FiD 2.5” SATA SSD 3SE3 Block Diagram

Innodisk 2.5” SATA SSD 3SE3 integrates a SATA III controller and NAND flash memories. Communication with the host occurs through the host interface, using the standard ATA protocol. Communication with the flash device(s) occurs through the flash interface.

3.2 SATA III Controller

Innodisk 2.5” SATA SSD 3SE3 is designed with ID 108, a SATA III 6.0Gbps (Gen. 3) controller. The Serial ATA physical, link and transport layers are compliant with Serial ATA Gen 1, Gen 2 and Gen 3 specification (Gen 3 supports 1.5Gbps/3.0Gbps/6.0Gbps data rate). The controller has 4 channels for flash interface.

3.3 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 40 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.

3.4 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.

Innodisk 2.5” SATA SSD 3SE3 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.

3.5 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 develop 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, Bad Blocks 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.

3.6 Power Cycling

Innodisk’s power cycling management is a comprehensive data protection mechanism that functions before and after a sudden power outage to SSD. Low-power detection terminates data writing before an abnormal power-off, while table-remapping after power-on deletes corrupt data and maintains data integrity. Innodisk’s power cycling provides effective power cycling management, preventing data stored in flash from degrading with use.

3.7 Garbage Collection

Garbage collection is used to maintain data consistency and perform continual data cleansing on SSDs. It runs as a background process, freeing up valuable controller resources while sorting good data into available blocks, and deleting bad blocks. It also significantly reduces write operations to the drive, thereby increasing the SSD’s speed and lifespan.

3.8 Write Protect (Optional)

When Write Protect pins (pin 3 and pin 4) are shorted, Write Protect function would be enabled, and ATA write command would be aborted, which can prevent the disk from data modification or data deletion. Write-protected data in disk is read-only, that is, users could not write to it, edit it, append data to it, or delete it.

4. Installation Requirements

4.1 2.5” SATA SSD 3SE3 Pin Directions

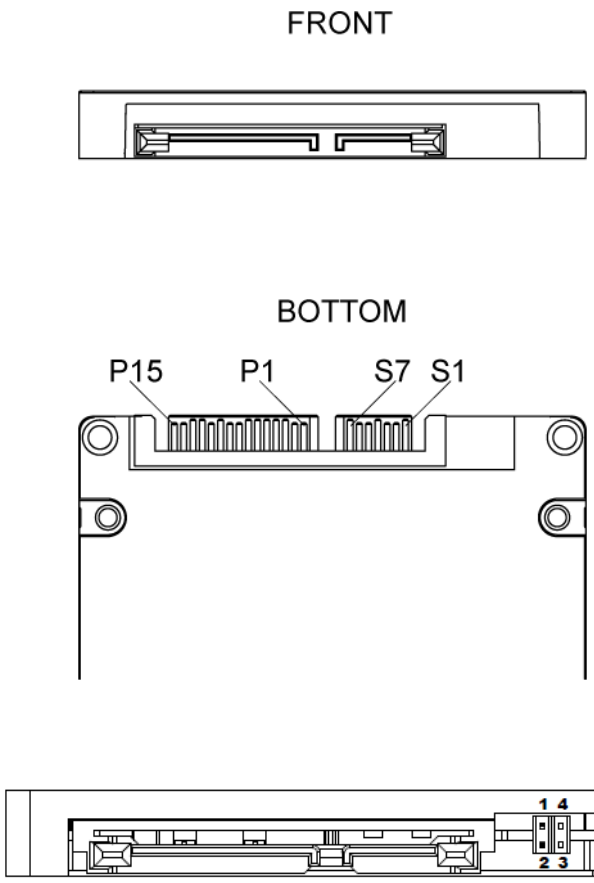


Figure 3: Signal Segment and Power Segment

4.2 Electrical Connections for 2.5” SATA SSD 3SE3

A Serial ATA device may be either directly connected to a host or connected to a host through a cable. For connection via cable, the cable should be no longer than 1 meter. The SATA interface has a separate connector for the power supply. Please refer to the pin description for further details.

4.3 Form Factor

Please prepare following things:

- Screw driver.
- Four M3 screws. (Torque value is 2.0 ~ 2.5 Kgf.cm)
- SATA single cable (7-pin, Maximum length l meter).
- SATA power cable (15-pin).

Please turn off your computer, and open your computer’s case. Find one of available 2.5-inch slot, and plug the SSD in. Use the screws to fix the SSD. Plug in the SATA single cable, and power cable.

Please boot the installation Operation System from CD-ROM, and install Operation System into SSD.

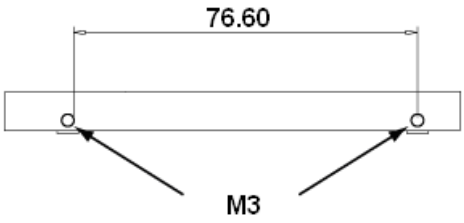


Figure 4: 2.5” SATA SSD 3SE3 Mechanical Screw Hole

4.4 Device Drive

No additional device drives are required. Innodisk 2.5” SATA SSD 3SE3 can be configured as a boot device.

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	**E**	**S**	**2**	**5**	**-**	**0**	**8**	**G**	**D**	**0**	**8**	**S**	**C**	**A**	**Q**	**B**	**-**	**X**	**X**

Definition	
Code 1st (Disk)	**Code 13th (Flash Mode)**
D : Disk	S: Synchronous flash
Code 2nd ~ 5th (Form Factor)	**Code 14th (Operation Temperature)**
ES25: 2.5” SATA SSD 3SE3	C: Standard Grade (0℃~ +70℃)
Code 7th ~9th (Capacity)	W: Industrial Grade (-40℃~ +85℃)
08G: 8GB	
16G: 16GB	**Code 15th (Internal control)**
32G: 32GB	**Code 16th (Channel of data transfer)**
64G: 64GB	Q: Quad Channels
A28: 128GB	D: Dual Channels
	Code 17th (Flash Type)
	B: Toshiba SLC
Code 10th ~12th (Series)	**Code 19th~20th (Customized Code)**
D08: ID108	