

mSATA mini

3SE Series

Customer: _____
Customer
Part Number: _____
Innodisk
Part Number: _____
Innodisk
Model Name: _____
Date: _____

Innodisk Approver	Customer Approver

**Total Solution For
Industrial Flash Storage**

Table of contents

- LIST OF FIGURES5**
- 1. PRODUCT OVERVIEW6**
 - 1.1 INTRODUCTION OF INNODISK MSATA MINI 3SE.....6**
 - 1.2 PRODUCT VIEW AND MODELS6**
 - 1.3 SATA INTERFACE.....6**
 - 2.1 CAPACITY AND DEVICE PARAMETERS.....7**
 - 2.2 PERFORMANCE7**
 - 2.3 ELECTRICAL SPECIFICATIONS7**
 - 2.3.1 Power Requirement.....7**
 - 2.3.2 Power Consumption7**
 - 2.4 ENVIRONMENTAL SPECIFICATIONS8**
 - 2.4.1 Temperature Ranges8**
 - 2.4.2 Humidity.....8**
 - 2.4.3 Shock and Vibration8**
 - 2.4.4 Mean Time between Failures (MTBF)8**
 - 2.5 CE AND FCC COMPATIBILITY8**
 - 2.6 RoHS COMPLIANCE9**
 - 2.7 RELIABILITY9**
 - 2.8 TRANSFER MODE9**
 - 2.9 PIN ASSIGNMENT9**
 - 2.10 MECHANICAL DIMENSIONS.....11**
 - 2.11 ASSEMBLY WEIGHT11**
 - 2.12 SEEK TIME11**
 - 2.13 NAND FLASH MEMORY.....11**
- 3. THEORY OF OPERATION12**
 - 3.1 OVERVIEW.....12**
 - 3.2 SATA III CONTROLLER12**
 - 3.3 ERROR DETECTION AND CORRECTION.....13**
 - 3.4 WEAR-LEVELING13**
 - 3.5 BAD BLOCKS MANAGEMENT13**
 - 3.6 POWER CYCLING13**
 - 3.7 GARBAGE COLLECTION.....13**
- 4. INSTALLATION REQUIREMENTS14**
 - 4.1 mSATA MINI 3SE PIN DIRECTIONS.....14**
 - 4.2 ELECTRICAL CONNECTIONS FOR MSATA MINI 3SE14**
 - 4.3 DEVICE DRIVE14**
- 5. PART NUMBER RULE15**

REVISION HISTORY

Revision	Description	Date
Preliminary	First Released	Jun., 2013
1.0	Official release	Jul., 2013
1.1	Add Capacity 1GB, 2GB	Jan., 2014
1.2	Modify pin assignment	Apr., 2014
1.3	Add random performance	Oct., 2014
1.4	Modify TBW based on NAND Flash specifications and remove the random performance	Feb., 2015
1.5	Add 1GB/2GB information	Jul., 2015
1.6	Update mechanical dimensions	Aug., 2015
1.7	Update Product Overview	Jun., 2016
1.8	Remove EOL Product	Dec., 2025

List of Tables

TABLE 1: DEVICE PARAMETERS	7
TABLE 2: PERFORMANCE	7
TABLE 3: INNODISK MSATA MINI 3SE POWER REQUIREMENT	7
TABLE 4: POWER CONSUMPTION	7
TABLE 5: TEMPERATURE RANGE FOR MSATA MINI 3SE	8
TABLE 6: SHOCK/VIBRATION TESTING FOR MSATA MINI 3SE	8
TABLE 7: MSATA MINI 3SE MTBF	8
TABLE 8: INNODISK MSATA MINI 3SE PIN ASSIGNMENT	9

List of Figures

FIGURE 1: INNODISK MSATA MINI 3SE	6
FIGURE 2: INNODISK MSATA MINI 3SE BLOCK DIAGRAM	12
FIGURE 3: SIGNAL SEGMENT AND POWER SEGMENT	14

1. Product Overview

1.1 Introduction of Innodisk MSATA MINI 3SE

Innodisk mSATA mini 3SE is designed as the standard Mini PCIe form factor with SATA interface, and supports SATA III standard (6.0Gb/s) with excellent performance. The form factor refers to the MO-300 / MO-300B specification which established by JEDEC. Regarding of mechanical interference, Innodisk mSATA mini 3SE absolutely replaces the traditional hard disk and makes personal computer, in any field, smaller and easier.

Innodisk mSATA mini 3SE effectively reduces the booting time of operation system and the power consumption is less than hard disk drive (HDD), and complies with ATA protocol, no additional drives are required, and can be configured as a boot device or data storage device

1.2 Product View and Models

Innodisk mSATA mini 3SE is available in follow capacities within SLC flash ICs.

[mSATA mini 3SE 4GB](#)

[mSATA mini 3SE 8GB](#)

[mSATA mini 3SE 16GB](#)

[mSATA mini 3SE 32GB](#)



Figure 1: Innodisk mSATA mini 3SE

1.3 SATA Interface

Innodisk mSATA mini 3SE 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 mSATA mini 3SE is compliant with Serial ATA Gen 1, Gen 2 and Gen 3 specification (Gen 3 supports 1.5Gbps /3.0Gbps/6.0Gbps data rate).

2. Product Specifications

2.1 Capacity and Device Parameters

mSATA mini 3SE device parameters are shown in Table 1.

Table 1: Device parameters

Capacity	Cylinders	Heads	Sectors	LBA	User capacity
4GB	7773	16	63	7835184	3,825
8GB	15525	16	63	15649200	7,641
16GB	16383	16	63	31277232	15,272
32GB	16383	16	63	62533296	30,533

2.2 Performance

Burst Transfer Rate: 6.0Gbps

Table 2: Performance

Capacity	4GB	8GB	16GB	32GB
Sequential Read (max.)	220 MB/sec	250 MB/sec	290 MB/sec	300 MB/sec
Sequential Write (max.)	50 MB/sec	60 MB/sec	120 MB/sec	130 MB/sec

Note: the information is based on CrystalDiskMark 3.01 with file size 1000MB test patent

2.3 Electrical Specifications

2.3.1 Power Requirement

Table 3: Innodisk mSATA mini 3SE Power Requirement

Item	Symbol	Rating	Unit
Input voltage	V _{IN}	+3.3 DC +- 5%	V

2.3.2 Power Consumption

Table 4: Power Consumption

Mode	Power Consumption (mA)
Read	140 (max.)
Write	150 (max.)
Idle	100 (max.)

* Target: 32GB mSATA mini 3SE

2.4 Environmental Specifications

2.4.1 Temperature Ranges

Table 5: Temperature range for mSATA mini 3SE

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 mSATA mini 3SE

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 mSATA mini 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.

Table 7: mSATA mini 3SE MTBF

Product	Condition	MTBF (Hours)
Innodisk mSATA mini 3SE	Telcordia SR-332 GB, 25°C	>3,000,000

2.5 CE and FCC Compatibility

mSATA mini 3SE conforms to CE and FCC requirements.

2.6 RoHS Compliance

mSATA mini 3SE is fully compliant with RoHS directive.

2.7 Reliability

Parameter	Value
Read Cycles	Unlimited Read Cycles
Wear-Leveling Algorithm	Support
Bad Blocks Management	Support
Error Correct Code	Support
TBW	
4GB	216 (Sequential write)
8GB	432 (Sequential write)
16GB	864 (Sequential write)
32GB	1728 (Sequential write)

2.8 Transfer Mode

mSATA mini 3SE support following transfer mode:

Serial ATA III 6.0Gbps

Serial ATA II 3.0Gbps

Serial ATA I 1.5Gbps

2.9 Pin Assignment

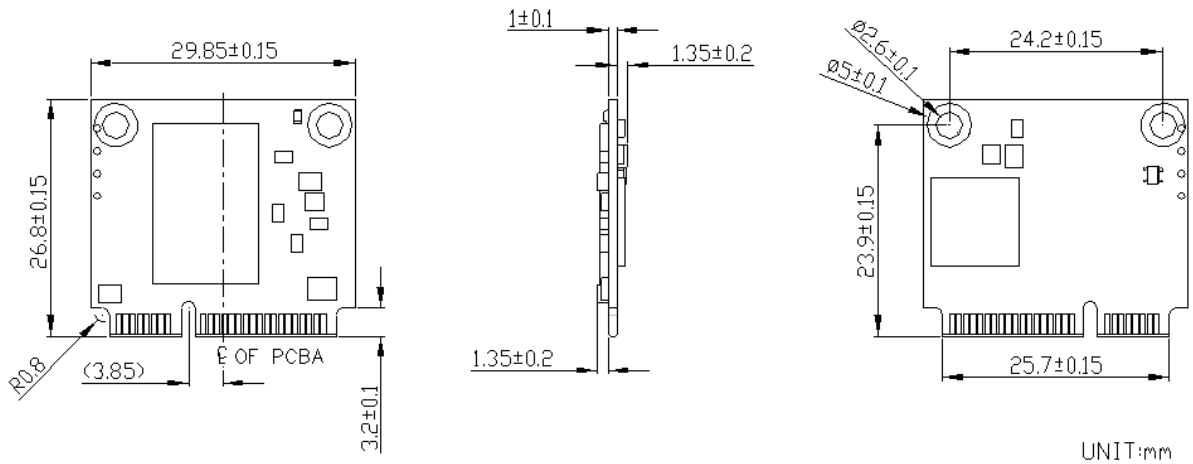
Innodisk mSATA mini 3SE uses a standard SATA pin-out. See Table 8 for mSATA mini 3SE pin assignment.

Table 8: Innodisk mSATA mini 3SE Pin Assignment

Signal Name	Pin #	Pin #	Signal Name
GND	51	52	+3.3V
DAS	49	50	GND
NC	47	48	NC
NC	45	46	NC
NC	43	44	NC
+3.3V	41	42	NC
+3.3V	39	40	GND
GND	37	38	NC

GND	35	36	NC
RX+	33	34	GND
RX-	31	32	NC
GND	29	30	NC
GND	27	28	NC
TX-	25	26	GND
TX+	23	24	+3.3V
GND	21	22	NC
NC	19	20	NC
NC	17	18	GND
GND	15	16	NC
NC	13	14	NC
NC	11	12	NC
GND	9	10	NC
NC	7	8	NC
NC	5	6	NC
NC	3	4	GND
NC	1	2	+3.3V

2.10 Mechanical Dimensions



2.11 Assembly Weight

An Innodisk mSATA mini 3SE within flash ICs, 32GB's weight is 8 grams approximately.

2.12 Seek Time

Innodisk mSATA mini 3SE is not a magnetic rotating design. There is no seek or rotational latency required.

2.13 NAND Flash Memory

Innodisk mSATA mini 3SE 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 mSATA mini 3SE from the system level, including the major hardware blocks.

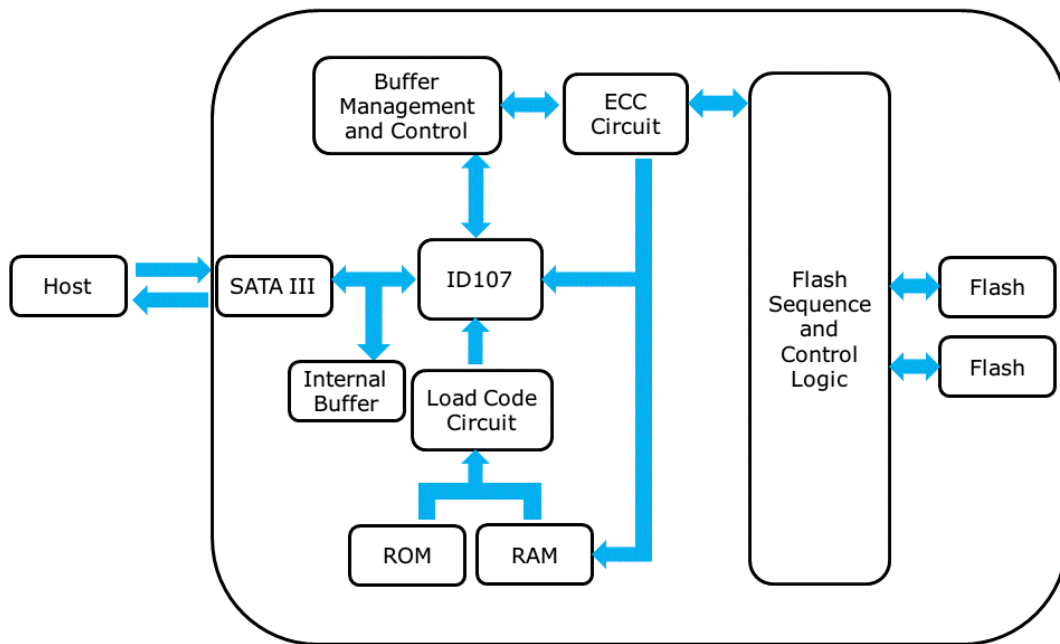


Figure 2: Innodisk mSATA mini 3SE Block Diagram

Innodisk mSATA mini 3SE 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 mSATA mini 3SE is designed with ID 107, 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 2 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 mSATA mini 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.

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.

4. Installation Requirements

4.1 mSATA mini 3SE Pin Directions

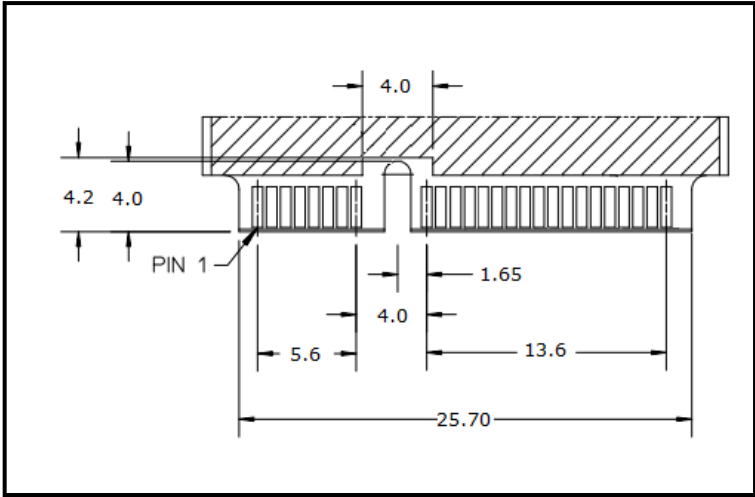


Figure 3: Signal Segment and Power Segment

4.2 Electrical Connections for mSATA mini 3SE

A Serial ATA device may be either directly connected to a host or connected to a host through an adaptor card. The SATA interface has a separate connector for the power supply. Please refer to the pin description for further details.

4.3 Device Drive

No additional device drives are required. The Innodisk mSATA mini 3SE 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	21
	D	E	M	S	M	-	3	2	G	D	0	7	S	C	B	D	B	-	X	X	X
Definition																					
Code 1st (Disk)											Code 14th (Operation Temperature)										
D: Disk											C: Standard Grade (0°C ~ +70°C)										
Code 2nd (Feature set)											W: Industrial Grade (-40°C ~ +85°C)										
E : Embedded series											Code 15th (Internal control)										
Code 3rd ~5th (Form factor)											1~9: TSOP PCB version.										
MSM: mSATA mini											A~Z: BGA PCB version.										
Code 7th ~9th (Capacity)											Code 16th (Channel of data transfer)										
04G: 4GB				08G: 8GB							S: Single Channel										
16G: 16GB				32G: 32GB							D: Dual Channels										
Code 10th ~12th (Controller)											Code 17th (Flash Type)										
D07: 3SE Series											B: Toshiba SLC										
Code 13th (Flash mode)											Code 19th~21st (Customize code)										
A: Asynchronous NAND																					
S: Synchronous NAND.																					