

# ***InnoDisk SATADOM Datasheet***

**InnoDisk Corp. SATADOM Datasheet**

**Ver. 1.1**

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## REVISION HISTORY

<b>Revision</b>	<b>Description</b>	<b>Date</b>
Preliminary	First released	May 2008
1.0	Add mechanical dimensions and electrical specifications	June 2008
1.1	Clarify horizontal type A and B	June 2008

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## 1. Product Introduction

### 1.1 Overview

InnoDisk Serial ATA Disk on Module (SATADOM) supports SATA I standard (1.5Hz) with good performance and thus performs faster data transfer rate. Sustain read is 24MB (Max) per second, and sustain write is 14MB (Max) per second. Moreover, InnoDisk SATADOM is designed as the smallest form factor size that could enhance compatibility with various design applications. InnoDisk SATADOM is within compact design, particularly it has built-in power pin as the 7<sup>th</sup> pin of 7pin header. In other words, it could be connected to the SATA port without additional power cable. Another advanced design of InnoDisk SATADOM is the connector with lock and thus such innovative mechanical design could improve data transfer reliability while device operating. With the locked connector design, it could enhance anti-shock and anti-vibration mechanism of InnoDisk SATADOM.

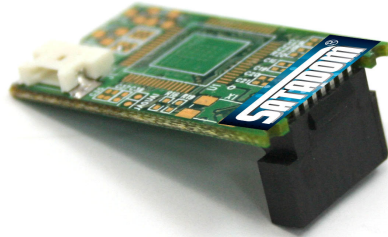
InnoDisk SATADOM is also suitable in industrial field. It effectively reduces the booting time of operation system and the power consumption is less than hard disk drive (HDD). InnoDisk SATADOM can work under harsh environment. InnoDisk SATADOM complies with ATA protocol, no additional drives are required, and the SSD can be configured as a boot device or data storage device.

### 1.2 Product Picture

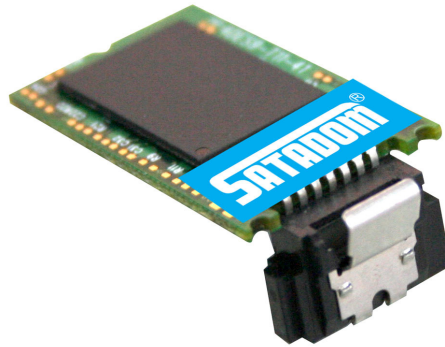
**Figure 1: InnoDisk SATADOM picture (vertical)**



**Figure 2: InnoDisk SATADOM picture (horizontal-type A)**



**Figure 3: InnoDisk SATADOM picture (horizontal-type B)**



### 1.3 Product Features

- Interface: Serial ATA standard Rev. 1.0a (Gen 1: 1.5Gbps)
- NAND Flash Memory Interface:
  - ◆ 8-bit access
  - ◆ 4kbyte/page
- Capacity: 128MB~8GB
- Form factor: Smallest size on the world
- Data transfer rate: Read- 24MB/sec., Write- 14MB/sec.
- Burst Transfer Rate: 150MB/sec.
- Compact Design: Buil-in Power pin (pin 7)



- Access time: 2ms
- Error Correction Function
  - ◆ Built-in ECC corrects up to 8-bit per 512-Byte
- Dimension: 20.5mmx39.2mmx8.0mm (WxLxH)
- Weight: 5g

## 2. Specifications

### 2.1 Environmental Specifications

#### 2.1.2 Temperature Range

- Operating Temperature Range
  - Standard Grade: -10°C to +70°C
- Storage Temperature Range
  - Standard Grade: -55°C to +95°C

#### 2.1.2 Humidity

Relative Humidity: 10-95%, non-condensing

#### 2.1.3 Shock and Vibration

***Table 1: Shock/Vibration Testing for InnoDisk SATADOM***

<b>Reliability</b>	<b>Test Conditions</b>
Vibration	7 Hz to 2000 Hz, 5g, 3 axes
Mechanical Shock	Duration: 10ms, 50 g, 3 axes

## 2.2 System Reliability

### 2.2.1 ECC Technology

High reliability based on the internal error correct code (ECC) function. Built-in ECC corrects up to 8-bit per 512-Byte.

### 2.2.2 Mean Time between Failures (MTBF)

Table 2 summarizes the MTBF prediction results for various InnoDisk SATADOM configurations. The analysis is 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: InnoDisk SATADOM MTBF**

Product	Condition	MTBF (Hours)
InnoDisk SATADOM	Telcordia SR-332 GB, 25°C	> 3,000,000

### 2.2.3 Read/Write Endurance

- Write /Erase Cycles: 2,000,000 Erase Cycles.
- Data Retention: 10 years.
- Support Wear-Leveling Algorithm
- Support Bad Blocks Management

### 2.2.4 Transfer Mode

InnoDisk SATADOM supports the following transfer mode:

- PIO Mode: 0~4
- Multiword DMA: 0~2
- Ultra DMA: 0~2

## 2.3 Power Requirement

### 2.3.1 DC Input Voltage

5V single power supply operation

### 2.3.2 Power Mode

Auto stand-by and sleep mode

### 2.3.3 Power Consumption

**Table 3: InnoDisk SATADOM power consumption**

<b>Parameter</b>	<b>mA</b>
Sustained Read	155
Sustained Write	170
IDLE	105
Note: Measured with 8GB device	

## 2.4 Physical Specification

### 2.4.1 Enclosure Material

PC mechanical cover and UL-94

### 2.4.2 Dimension

20.9x39.2x8 mm (WxLxH)

### 2.4.3 Certificate

- **CE and FCC Compatibility**

InnoDisk SATADOM conforms to CE and FCC requirements.

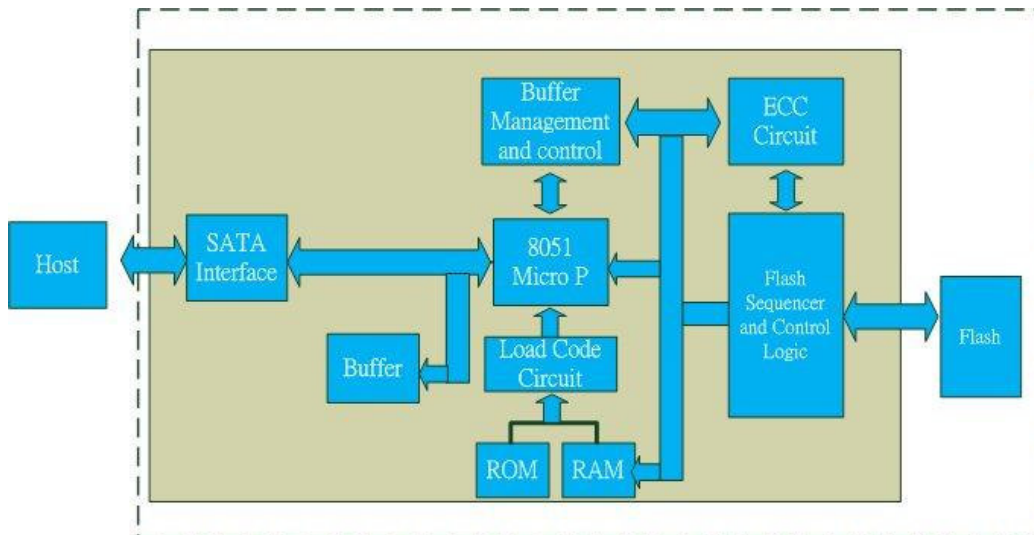
- **RoHS Compliance**

InnoDisk SATADOM is fully compliant with RoHS directive.

### 3. Theory of operation

#### 3.1 Overview

Figure 2 shows the operation of InnoDisk SATADOM from the system level, including the major hardware blocks. As the diagram shown, SATA I controller communicates with SATA I host interface directly. Also SATA I controller supports one flash IC.



**Figure 4: InnoDisk SATADOM Block Diagram**

#### 3.2 SATA I Controller

The SATA I bridge controller is 1.5 Gbps (Gen. 1), and support hot-plug. Refer to SATA I controller support one flash IC and communicates with host interface, this SATA I controller only support the flash ICs within 4kbyte/page.

#### 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 8 bits per 512 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.

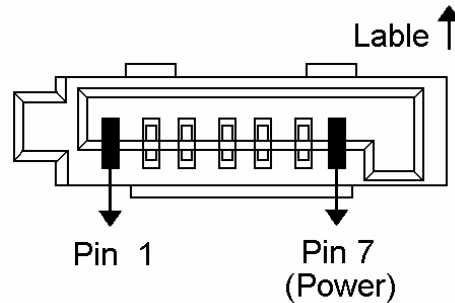
InnoDisk SATADOM uses a wear-leveling algorithm to ensure that consecutive writes of a specific sector are not written physically to the same page and block in the flash. This spreads flash media usage evenly across all pages, thereby extending flash lifetime.

### 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. The Bad Blocks will not exceed more than 3% of the total device volume. 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.

## 4. Installation Requirements

### 4.1 FiD 2.5 SATA DOM Pin Directions



**Figure 5: Signal Segment and Power Segment**

### 4.2 Electrical Connections for InnoDisk SATADOM

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 1meter.

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 SATADOM can be configured as a boot device.

## 5. Specifications

### 5.1 Pin Assignment

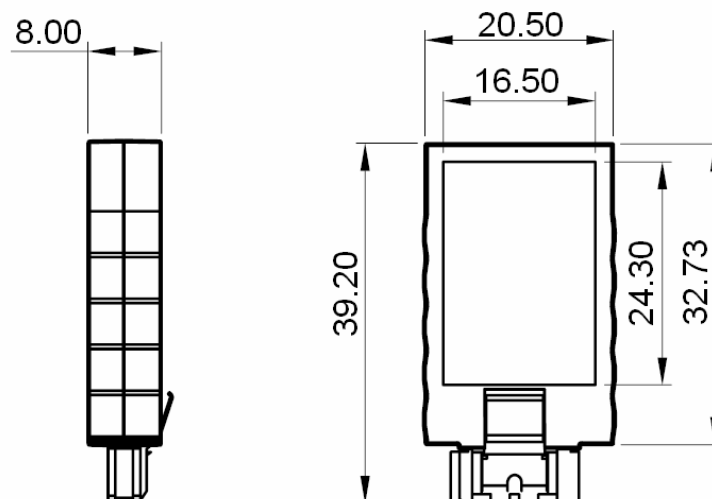
InnoDisk SATADOM is designed within SATA interface. Particularly, its built-in power pin enables the device more compactable. Table 3 demonstrates InnoDisk SATADOM pin assignments.

**Table 4: InnoDisk SATADOM Pin Assignment**

7Pin	Signal	Function
Pin 1	GND	Shielding
Pin 2	A+	Differential signal to A
Pin 3	A-	Differential signal to A-
Pin 4	GND	Shielding
Pin 5	B-	Differential signal to B
Pin 6	B+	Differential signal to B
Pin 7	GND/VCC (+5V)	Shielding/Power

### 5.2 Mechanical Dimensions

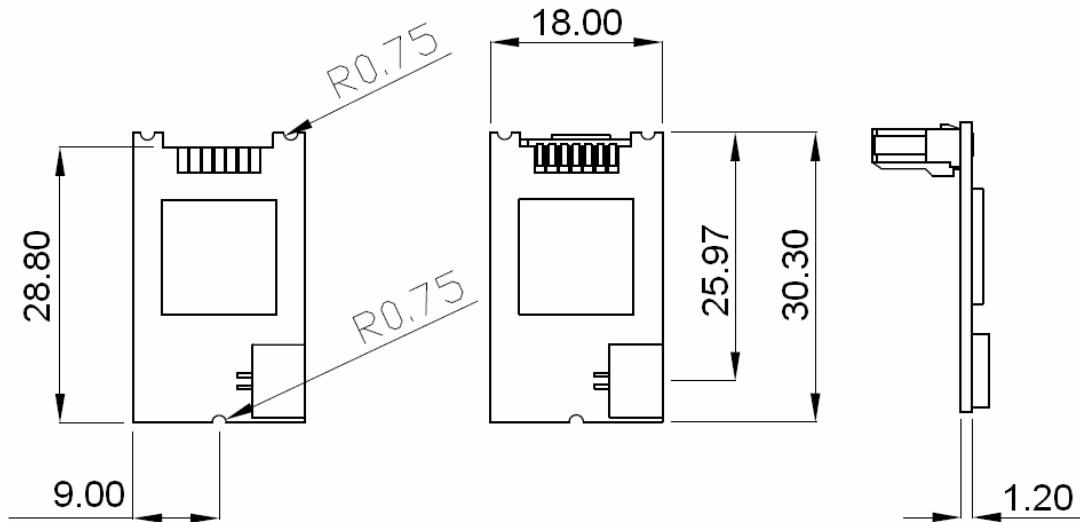
#### 5.2.1 Vertical type



**Figure 6: InnoDisk SATADOM mechanical dimensions (vertical)**

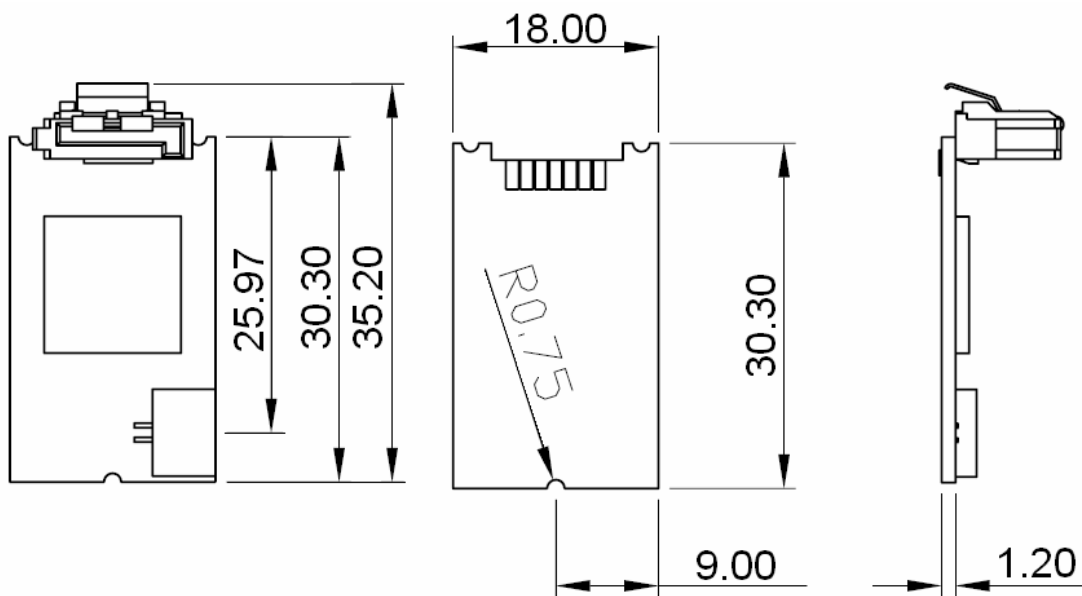
### 5.2.2 Horizontal type

- Type A



**Figure 7: InnoDisk SATADOM mechanical dimensions (horizontal type A)**

- Type B



**Figure 8: InnoDisk SATADOM mechanical dimensions (horizontal type B)**



### 5.3 Performance

- Burst Speed Rate: 150MB/sec.
- Data Transfer Rate
  - ◆ Sustained Read: 24MB/sec (max.)
  - ◆ Sustained Write: 14MB/sec (max.)

### 5.4 Seek Time

InnoDisk SATADOM is not a magnetic rotating design. There is no seek or rotational latency required.

### 5.5 NAND Flash Memory

InnoDisk SATADOM 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 micro processor.

### 5.6 Electrical Specifications

#### 5.6.1 Absolute Maximum Ratings

**Table 5: InnoDisk Absolute Maximum Ratings**

Item	Symbol	Rating	Unit
DC Power Supply	VDDO	-0.3 ~ +4.5	V
	VDDC	-0.3 ~ +2.5	V
	AVDDH	-0.3 ~ +4.5	V
	AVDDL	-0.3 ~ +2.5	V
Input voltage	VIN	-0.3~VDDO+0.3	V
Out current	IOUT	26 (4mA/8mA buffer)	mA
Storage temperature	TSTG	-55~+125	°C

## 5.6.2 DC Characteristics

**Table 6: InnoDisk SATADOM DC Characteristics**

Item	Symbol	Standard Value			Unit	Measurement Condition
		Min	Typ	Max		
Input voltage (TTL level)	$V_{IH}$	2.0	VDDO	VDDO+0.3	V	
	$V_{IL}$	-0.3	0.0	0.8	V	
Schmidt trigger input (TTL level)	$V_+$	1.1	-	2.0	V	
	$V_-$	0.8	-	1.7	V	
	$V_h$	0.3	-	-	V	
Output voltage	$V_{OH}$	2.4	-	-	V	
	$V_{OL}$	-	-	0.4	V	VDDO=3.0V Ioh=4mA or 8mA
Input leak current	$I_{IL}$	-5	-	5	uA	$V_i=0V$ or VDDO
Output leak current	$I_{OZ}$	-5	-	5	uA	Hi-Z state
Pull-Up resistance	$R_U$	10.0	-	100.0	k $\Omega$	$V_i=0V$
Pull-Down resistance	$R_D$	10.0	-	100.0	k $\Omega$	$V_i=VDDO$

## 6. Supported ATA Commands

InnoDisk SATADOM supports the commands listed in Table 7.

**Table 7: InnoDisk SATADOM ATA Commands**

Command Name	Command Code	Support
Check Power Mode	E5H (98H)	Yes
Execute Device Diagnostic	90H	Yes
Format Track	(50H)	Yes
Identify Device	ECH	Yes
Idle	E3H (97H)	Yes
Idle immediate	E1H (95H)	Yes
Initialize Device Parameters	(91H)	Yes
NOP	00H	Yes
Read Buffer	E4H	Yes
Read Long Sector	(22H or 23H)	Yes
Read Multiple	C4H	Yes
Read Sector(s)	20H or 21H	Yes
Read Verify Sector	40H or 41H	Yes
Read DMA	C8H	Yes
Recalibrate	(1XH)	Yes
Seek	70H	Yes
Set Features	EFH	Yes
Set Multiple Mode	C6H	Yes
Set Sleep Mode	E6H (99H)	Yes
Standby	E2H (96H)	Yes
Standby Immediate	E0H (94H)	Yes
Write Buffer	E8H	Yes
Write Multiple	C5H	Yes
Write Sector	30H	Yes
Write DMA	CAH	Yes
Write Verify	(3CH)	Yes
Security Set Password	F1H	Yes
Security Unlock	F2H	Yes
Security Erase Prepare	F3H	Yes
Security Erase Unit	F4H	Yes
Security Freeze Lock	F5H	Yes
Security Disable Password	F6H	Yes

## 7. Device Parameters

InnoDisk SATADOM device parameters listed in Table 8.

***Table 8: InnoDisk SATADOM Device parameters***

<b>Capacity</b>	<b>Cylinders</b>	<b>Heads</b>	<b>Sectors</b>	<b>LBA</b>
128MB	249	16	63	250992
256MB	499	16	63	502992
512MB	999	16	63	1006992
1GB	1950	16	63	1965600
2GB	3900	16	63	3931200
4GB	7801	16	63	7863408
8GB	15603	16	63	15727824