**Datasheet**

# *InnoDisk SATADOM Datasheet*

## InnoDisk Corp. SATADOM Datasheet

## Rev. 2.0

**AmpliconBenelux.com** | **IT and Instrumentation for Industry**

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## REVISION HISTORY

| Revision | Description | Date |
|---|---|---|
| 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 |
| 1.2 | Modify mechanical dimension and storage temperature | Aug 2008 |
| 1.3 | Modify operating temperature | Aug 2008 |
| 1.4 | Add Low-Profile SATADOM Mechanical dimension | Nov 2008 |
| 1.41 | Update Low-Profile SATADOM type name | Dec 2008 |
| 1.5 | Add High-Profile Horizontal B Type | Jan 2009 |
| 1.6 | Add Industrial Grade temperature range | Feb 2009 |
| 1.61 | Add Input Power voltage tolerance | Feb 2009 |
| 1.7 | 1. Update mechanical dimensions<br>2. Update mechanical figures for vertical type<br>(add power connector position) | June 2009 |
| 1.8 | Modify power supply requirement | July 2009 |
| 1.9 | Release high profile vertical type R and L | Sep 2009 |

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## 1. Product Introduction

### 1.1 Overview

InnoDisk Serial ATA Disk on Module (SATADOM) supports SATA I standard (1.5Gb/s) interface 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$^{th}$ pin of 7pin header. In other words, is 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

**High-profile**          **Low-profile**

**Figure 1: SATADOM vertical picture**

**iNNODISK**®
Beyond your imagination

**R-type**                    **L-type**

**Figure 2: SATADOM vertical type R and L picture**

**High-profile**              **Low-profile**

**Figure 3: SATADOM horizontal type B picture**

**Low-Profile**

**Figure 4: SATADOM horizontal type D picture**

## 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: Build-in Power pin (pin 7)

- Access time: 2ms

- Error Correction Function

    ◆ Built-in ECC corrects up to 8-bit per 512-Byte

- Dimension

    ◆ Vertical

High-profile: 20.8mmx32.8mmx8.0mm (WxLxH)

-R type: 20.5mmx32.8mmx8.0mm (WxLxH)

-L type: 20.5mmx32.8mmx8.0mm (WxLxH)

Low-profile: 32.8mmx29.6x8.0mm (WxLxH)

    ◆ Horizontal

High-profile: 18.0mmx30.3mmx11.4mm (WxLxH)

Low-profile: 30mmx20.3mmx11.4mm (WxLxH)

- Weight: 5g

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## 2. Specifications

### 2.1 Environmental Specifications

#### 2.1.2 Temperature Range

- Operating Temperature Range

    - Standard Grade: 0°C to +70°C

    - Industrial Grade: -40°C to +85°C

- Storage Temperature Range

    - Standard / Industrial 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**

| Reliability | Test Conditions |
|---|---|
| Vibration | 7 Hz to 2000 Hz, 5g, 3 axes |
| Mechanical Shock | Duration: 10ms, 50 g, 3 axes |

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## 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 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 (±5%) 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*

| Parameter | mA |
|---|---|
| Sustained Read | 155 |
| Sustained Write | 170 |
| IDLE | 105 |
| Note: Measured with 8GB device | |

### 2.4 Physical Specification

#### 2.4.1 Certificate

· **CE and FCC Compatibility**

InnoDisk SATADOM conforms to CE and FCC requirements.

· **RoHS Compliance**

InnoDisk SATADOM is fully compliant with RoHS directive.

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## 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.
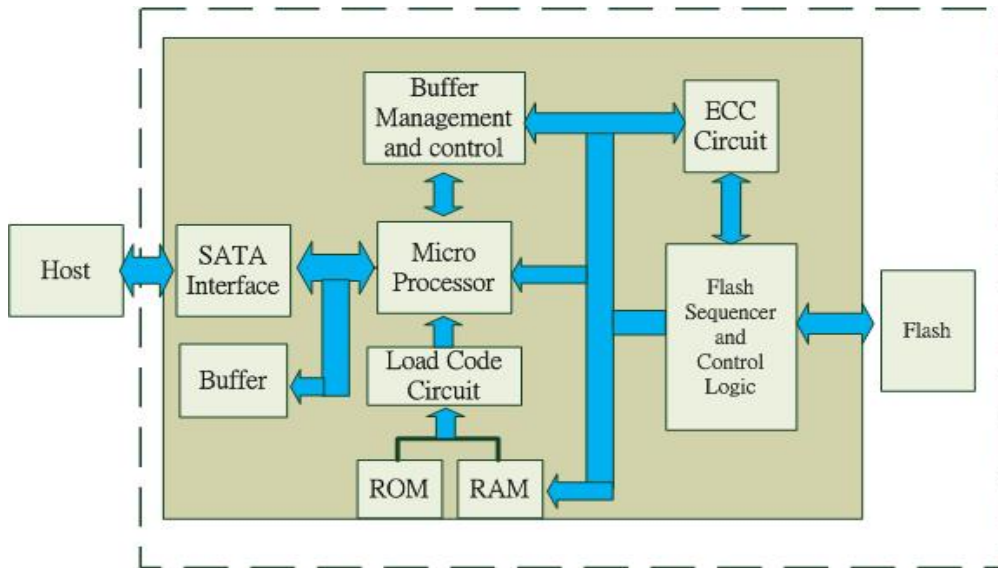


**Figure 5: InnoDisk SATADOM Block Diagram**

### 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.

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## 4. Installation Requirements
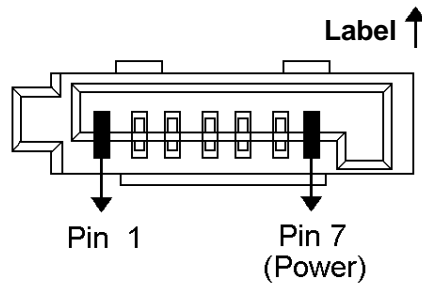
### 4.1 SATA DOM Pin Directions



**Figure 6: 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 drivers 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 7: SATADOM high-profile vertical type mechanical dimensions**
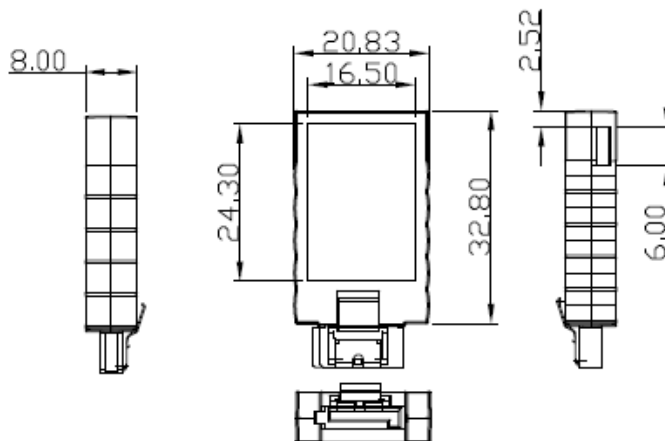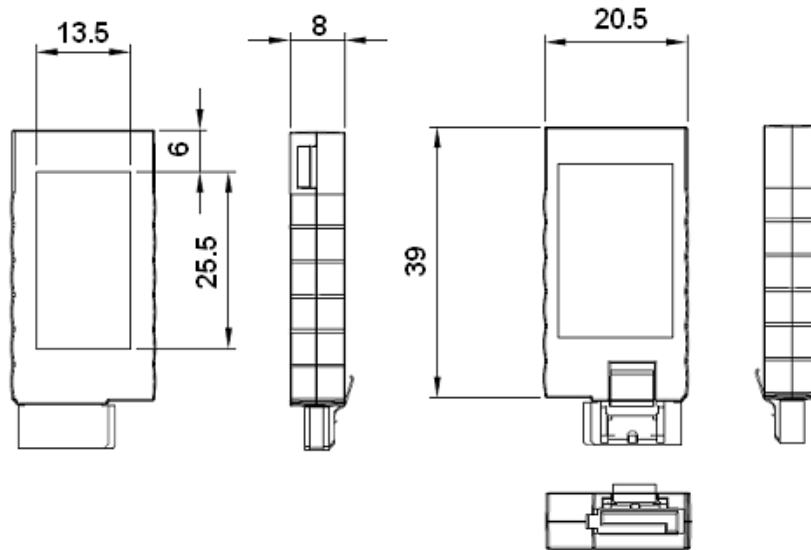
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## A. Type R

**Figure 8: SATADOM high-profile vertical type R mechanical dimensions**

## B. Type L

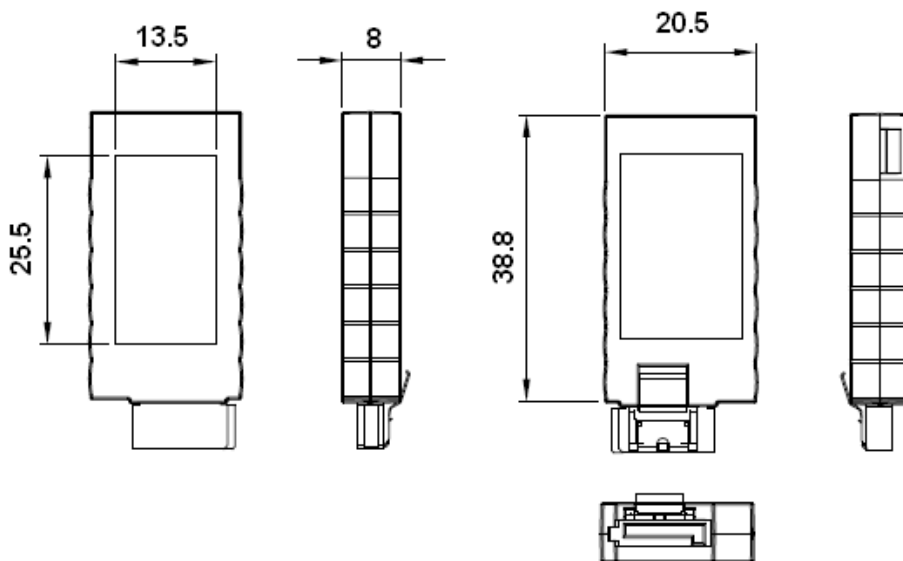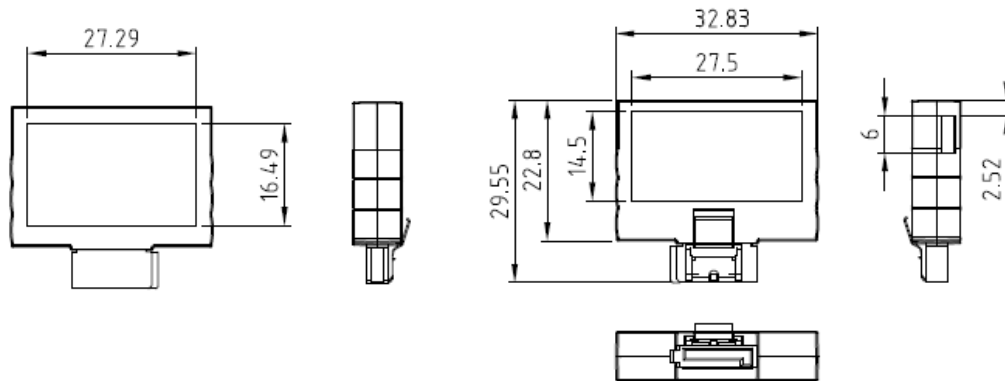**Figure 9: SATADOM high-profile vertical type L mechanical dimensions**

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**Figure 10: SATADOM low-profile vertical type mechanical dimensions**
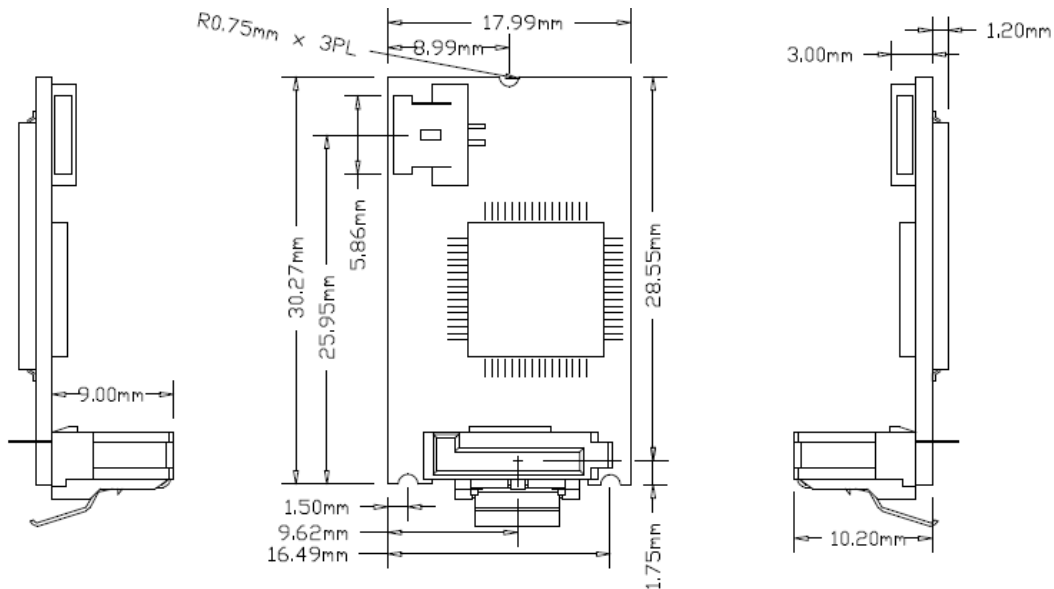
### 5.2.2  Horizontal type

### A. Type B



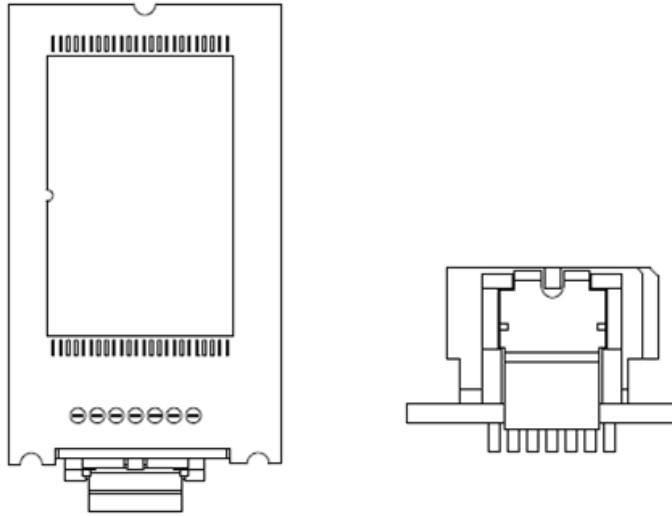**Figure 11: SATADOM high-profile horizontal type B mechanical dimensions**

**Figure 12: SATADOM high-profile horizontal type B mechanical dimensions**

**Figure 13: SATADOM low-profile horizontal type B mechanical dimensions**

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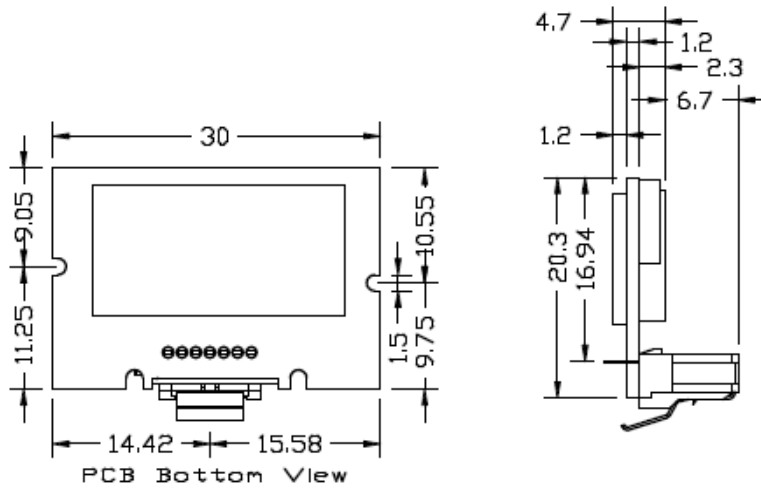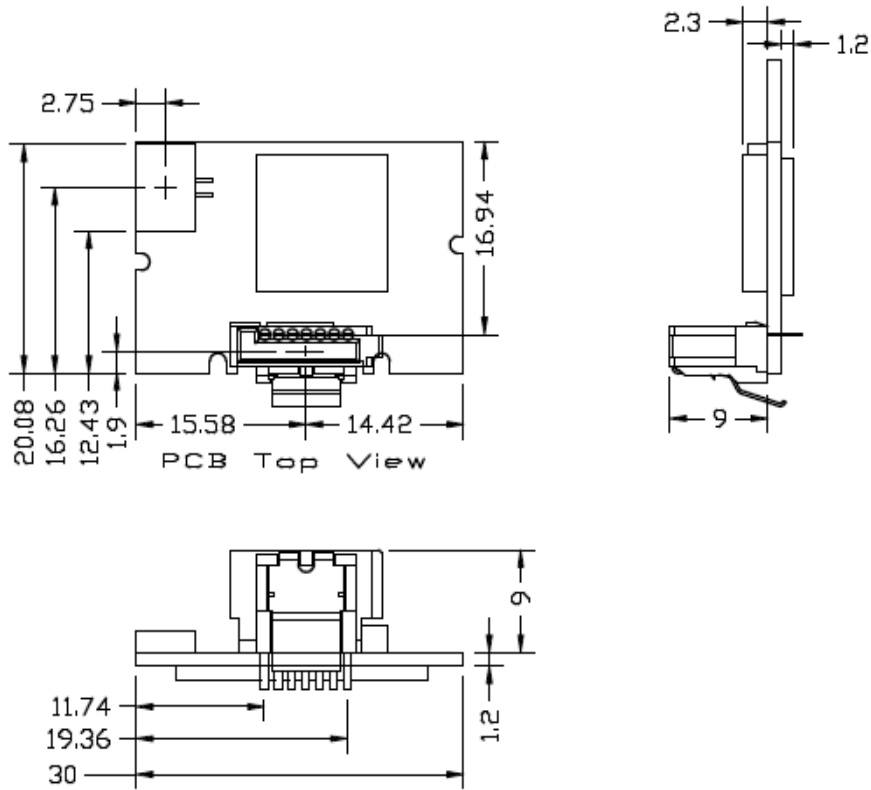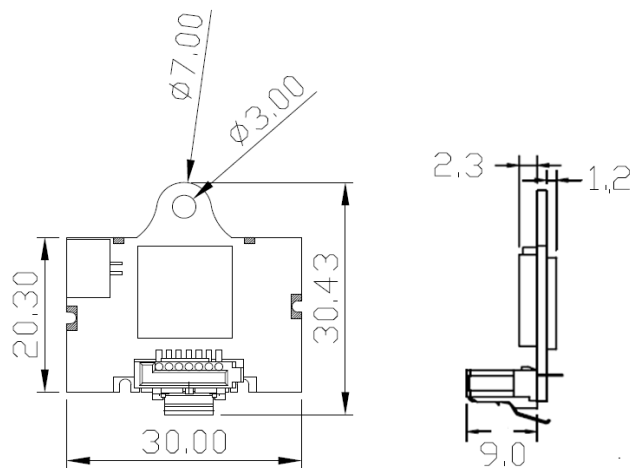**Figure 14: SATADOM low-profile horizontal type B mechanical dimensions**

### B. Type D

**Figure 15: SATADOM low-profile horizontal type D mechanical dimensions**
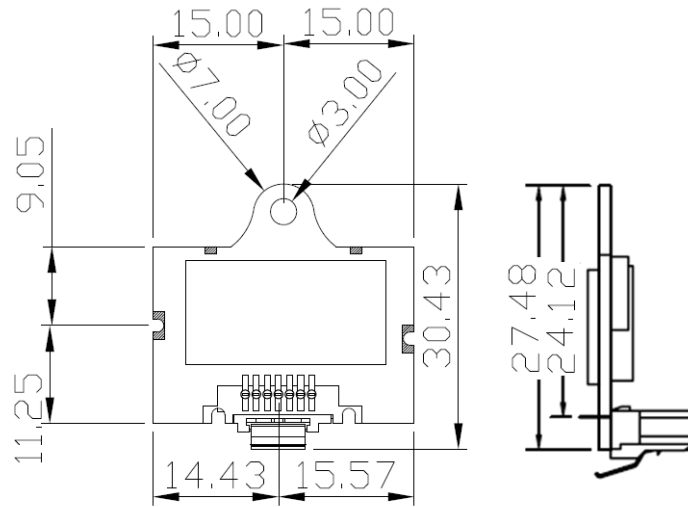
**Figure 16: SATADOM low-profile horizontal type D mechanical dimensions**

### 5.3 Performance

A. Burst Speed Rate: 150MB/sec.
B. 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

Power supply requirement: DC 5.0V±0.5V

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## 6. Supported ATA Commands

InnoDisk SATADOM supports the commands listed in Table 7.

**Table 5: 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 |

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## 7. Device Parameters

InnoDisk SATATDOM device parameters listed in Table 8.

**Table 6: InnoDisk SATADOM Device parameters**

| Capacity | Cylinders | Heads | Sectors | LBA |
|----------|-----------|-------|---------|----------|
| 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 |

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## 8. Appendix

### 8.1 Power cable specifications
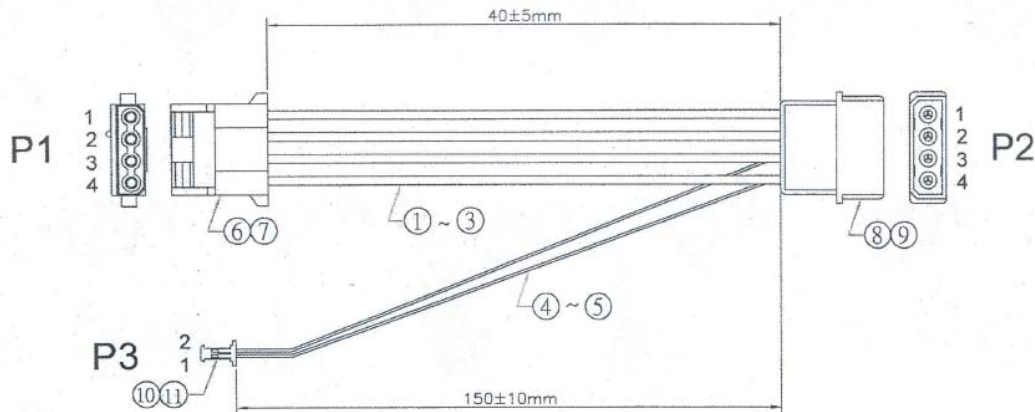
**Figure 17: SATADOM power cable mechanical drawing**

| 11 | 9-1-1256-G-P | MOX1.25 TERMINAL | GOLD | 2 |
|---|---|---|---|---|
| 10 | 9-1-1256-H-02 | MOX1.25-51146 2PIN HOUSING | IVORY | 1 |
| 9 | 9-1-3025-T-T-S | AMP5.08 大4P MALE TERMINAL(EQU) | TIN | 4 |
| 8 | 9-1-3025-H-04 | AMP5.08 大4P FEMALE HOUSING(EQU) | WHITE | 1 |
| 7 | 9-1-3022-T-T-S | AMP5.08 大4P FEMALE TERMINAL(EQU) | TIN | 4 |
| 6 | 9-1-3022-H-04 | AMP5.08 大4P MALE HOUSING(EQU) | WHITE | 1 |
| 5 | 6-1095-28-2 | UL1095 28AWG L=160mm | RED | 1 |
| 4 | 6-1095-28-0 | UL1095 28AWG L=160mm | BLACK | 1 |
| 3 | 6-1007-18-4 | UL1007 18AWG L=55mm | YELLOW | 1 |
| 2 | 6-1007-18-2 | UL1007 18AWG L=55mm | RED | 1 |
| 1 | 6-1007-18-0 | UL1007 18AWG L=55mm | BLACK | 2 |