InnoDisk SATADOM i100 Datasheet

InnoDisk Corp. SATADOM i100 Ultra Datasheet

Rev. 1.0

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REVISION HISTORY

Revision	Description	Date
Rev 1.0	First released	Feb 2010

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1. Product Introduction

1.1 Overview

InnoDisk Serial ATA Disk on Module Ultra (SATADOM i100 U) series supports SATA II standard (3.0Gb/s) interface with good performance and thus performs faster data transfer rate. Sustain read can reach up to 100MB per second (max), and sustain write reach up to 50MB per second (max). Moreover, InnoDisk SATADOM i100 U is designed as the smallest form factor size that could enhance compatibility with various design applications. InnoDisk SATADOM i100 U is within compact design. Particularly the 7th pin of standard SATA 7pin connector can optionally be the built-in power VCC pin. In other words, it could be connected directly to the SATA on-board socket on customers' system without additional power cable. Another advanced design of InnoDisk SATADOM i100 U is the connector with latch and thus such innovative mechanical design could improve data transfer reliability while device operating. With the locked connector design, it could enhance anti-vibration mechanism of InnoDisk SATADOM i100 U.

InnoDisk SATADOM i100 U 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 i100 U can work under harsh environment. InnoDisk SATADOM i100 U 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 i100 U picture

1.3 Product Features

- Interface: Serial ATA II (3.0Gbps)

- Capacity:

    ◆ 2GB~32GB

- Data transfer rate:

    ◆ Read - 100 MB/sec. (max.)

    ◆ Write - 50MB/sec. (max.)

- Compact Design: Build-in VCC Power pin (pin 7)

- Access time: 0.7ms

- Error Correction Function

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

- Dimension:

    ◆ 39.4x25x6.5mm (32GB: 39.4x25x9.3mm)

- Weight: 10g±2g

2. Specifications

2.1 Environmental Specifications

2.1.1 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 i100 U

Reliability	Test Conditions
Vibration	7 Hz to 2000 Hz, 20G, 3 axes
Mechanical Shock	Duration: 0.5ms, 1500G, 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 i100 U 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 i100 U MTBF

Product	Condition	MTBF (Hours)
InnoDisk SATADOM i100 U	Telcordia SR-332 GB, 25°C	> 3,000,000

2.3 Power Requirement

2.3.1 DC Input Voltage

5V (±5%) single power supply operation

2.3.2 Power Consumption

Table 3: InnoDisk SATADOM i100 U power consumption

Parameter	mA
Sustained Read	145
Sustained Write	170
IDLE	39
Note: Measured with 16GB (SLC) device	

2.4 Certificate

- **CE and FCC Compatibility**

  InnoDisk SATADOM i100 U conforms to CE and FCC requirements.

- **RoHS Compliance**

  InnoDisk SATADOM i100 U is fully compliant with RoHS directive.

3. Theory of operation

3.1 Overview

Figure 2 shows the operation of InnoDisk SATADOM i100 U from the system level, including the major hardware blocks. As the diagram shown, SATA II controller communicates with SATA II host interface directly. Also SATA II controller supports one flash IC.
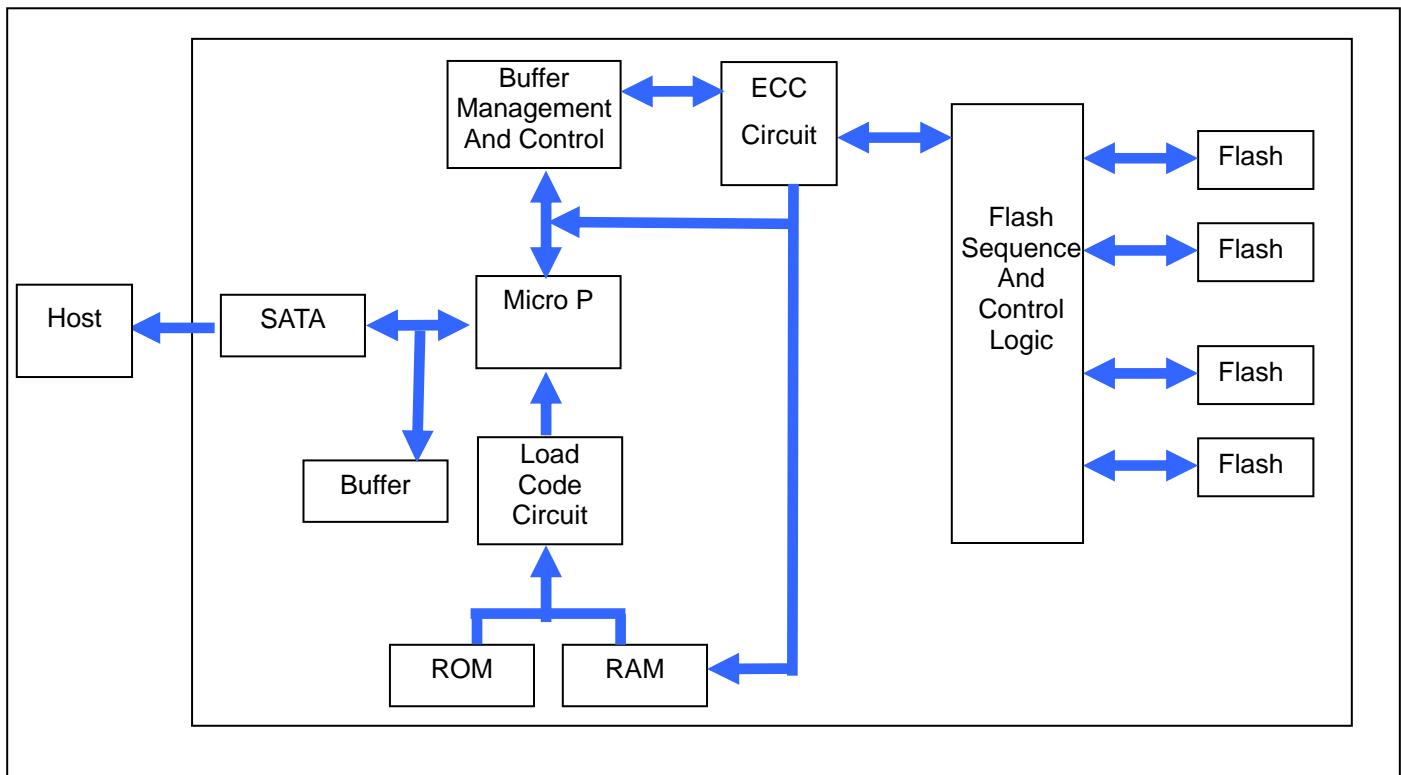
Figure 2: InnoDisk SATADOM i100 U Block Diagram

3.2 SATA II Controller

The SATA II controller is 3.0Gbps, and supports hot-plug. This SATA II controller support four flash IC and communicates with host interface, this SATA II controller can support the flash ICs both for 2kbyte and 4kbyte per 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 i100 U uses a static 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 6.25% 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 Block 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 SATADOM Pin Directions
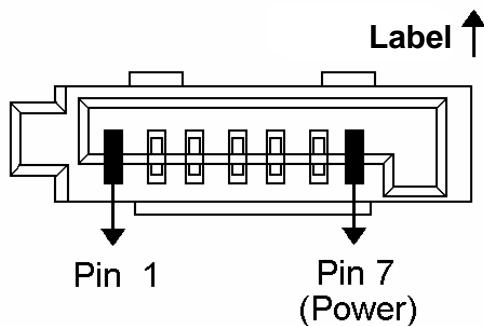
Figure 3: Signal Segment and Power Segment

4.2 Electrical Connections for InnoDisk SATADOM i100 U

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 II 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 i100 U can be configured as a boot device.

4.4 Write protect

When write protect switch is switched-on, write protect function would be enabled, and ATA write command would be aborted, which can prevent the disk from modification and deletion. Write-protected data in disk could only be read, that is, users could not write to it, edit it, append data to it, or delete it. InnoDisk SATADOM i100 U is applied to real time detect function, it detects WP pin signal. Once write prohibition state detection signal pin is pulled high, write/erase operation is prohibited. ATA write command would be aborted, that is, write protect function would be enabled. On the contrary, write protect function would be disabled, when the function is switched-off. The SATADOM i100 U write protect switch on and off direction is show as the below figure.

Figure 4: Write protect switch on and off direction

5. Specifications

5.1 Pin Assignment

InnoDisk SATADOM i100 U is designed within SATA II Interface. Particularly, its built-in power pin enables the device more compactable. Table 4 demonstrates InnoDisk SATADOM i100 U pin assignments.

Table 4: InnoDisk SATADOM i100 U 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
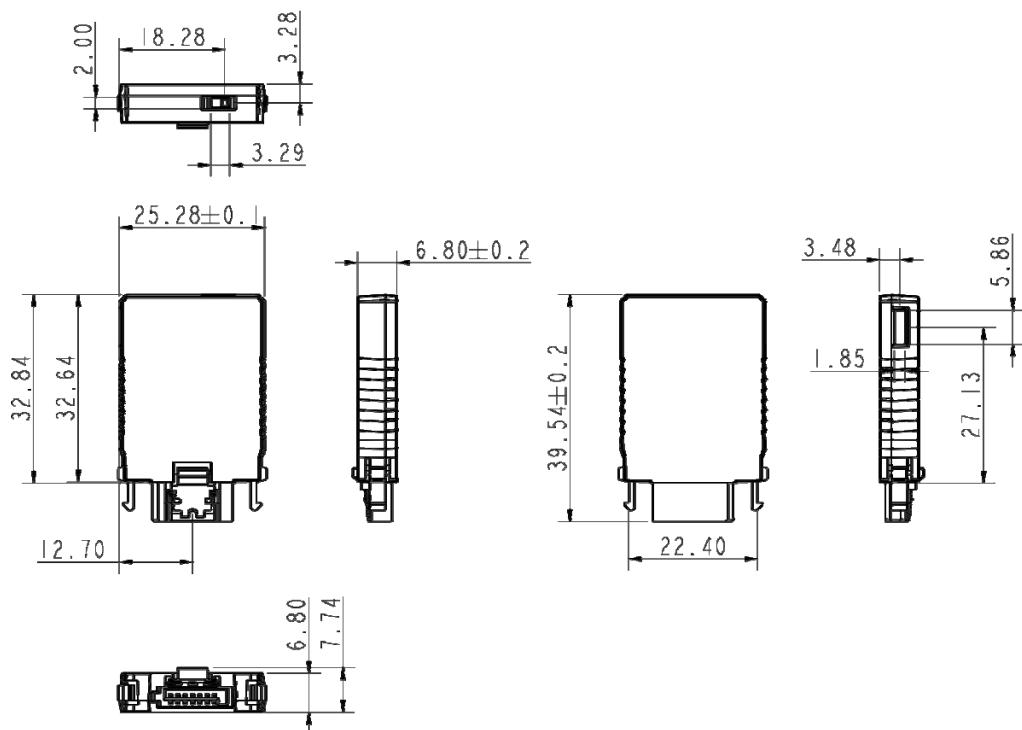
Figure 5: InnoDisk SATADOM i100 U mechanical dimensions
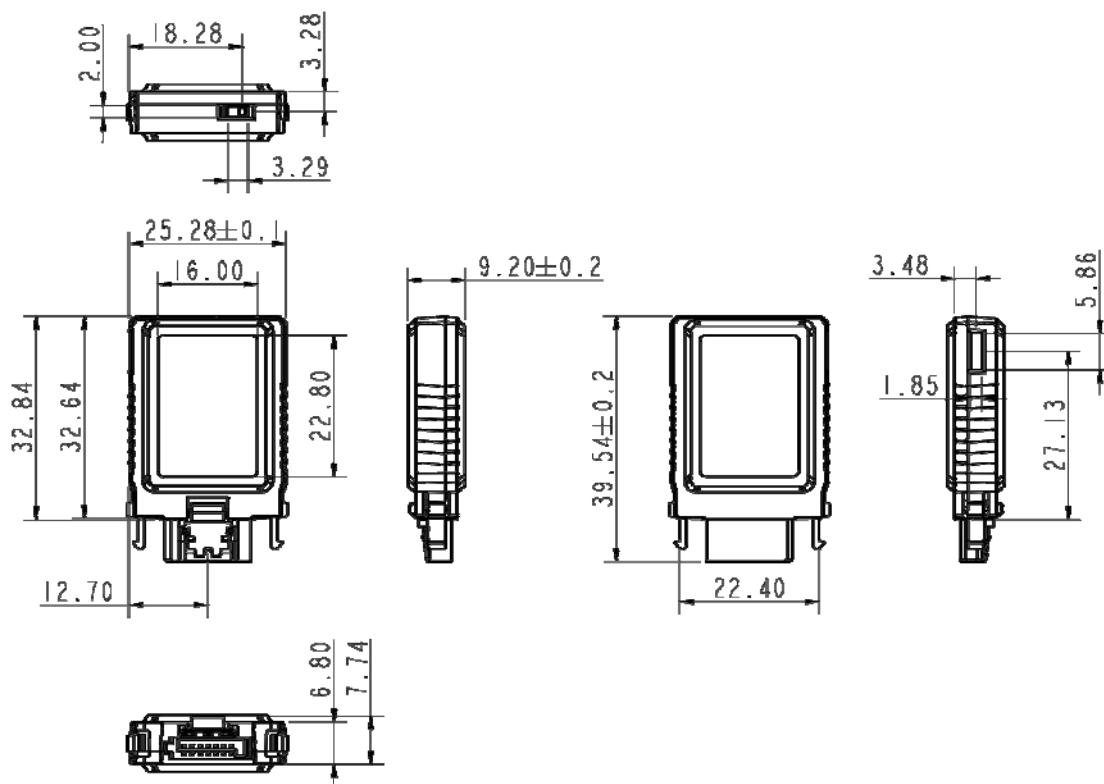
Figure 6: InnoDisk SATADOM i100 U mechanical dimensions (32G)

5.3 Performance

    A.   Burst Speed Rate: 300MB/sec.

    B.   Data Transfer Rate

◆   Sustained Read: 100MB/sec (max.)

◆   Sustained Write: 50MB/sec (max.)

5.4 Seek Time

InnoDisk SATADOM i100 U is not a magnetic rotating design. There is no seek or rotational latency required.

5.5 NAND Flash Memory

InnoDisk SATADOM i100 U uses Single Level Cell (SLC) NAND, which is non-volatility, high reliability and high speed memory storage. For SLC, there are only two statuses 0 or 1 of one cell. Read or Write data to flash memory for SSD is controlled by micro processor.

6. Supported ATA Commands

InnoDisk SATADOM i100 U supports the commands listed in Table 5.

Table 5: InnoDisk SATADOM i100 U ATA Commands

Class	Command	Code	FR	SC	SN	CY	DH	LBA
1	Check Power Mode	98H or E5H	-	-	-	-	D	-
1	Execute Device Diagnostic	90H	-	-	-	-	D	-
1	Erase Sector(s)	C0H	-	Y	Y	Y	Y	Y
2	Format Track	50H	-	Y	-	Y	Y	Y
1	Identify Device	ECH	-	-	-	-	D	-
1	NOP	00H	-	-	-	-	D	-
1	Read Buffer	E4H	-	-	-	-	D	-
1	Read Long Sector	22H or 23H	-	-	Y	Y	Y	Y
1	Read Verify Sector(s)	40H or 41H	-	Y	Y	Y	Y	Y
1	Recalibrate	1XH	-	-	-	-	D	-
1	Seek	7XH	-	-	Y	Y	Y	Y
1	Set Multiple Mode	C6H	-	Y	-	-	D	-
1	Set Sleep Mode	99H or E6H	-	-	-	-	D	-
1	Standby	96H or E2H	-	-	-	-	D	-
1	Standby Immediate	94H or E0H	-	-	-	-	D	-
2	Write Buffer	E8H	-	-	-	-	D	-

Defines:

FR: Feature Register

SC: Sector Count Register

SN: Sector Number Register

CY: Cylinder Registers

DH: Card/Device/Head Register

LBA: LBA Block Address Mode Supported

6.1 Check power mode – 98H or E5H

Table 6: Check power mode information

Register	7	6	5	4	3	2	1	0
Command(7)	98h or E5h							
C/D/H(6)	X			Drive	X			
Cylinder High(5)	X							
Cylinder Low(4)	X							
Sector Number(3)	X							
Sector Count(2)	X							
Feature(1)	X							

This command checks the power mode. If the CompactFlash Storage is in, going to, or recovering from the sleep mode, the SATADOM sets BSY, sets the Sector Count Register to 00h, clears BSY and generates an interrupt. If the SATADOM is in idle mode, the SATADOM sets BSY, sets the Sector Count Register to FFh, clears BSY and generates an interrupt.

6.2 Execute Device Diagnostic – 90H

Table 7: Execute device diagnostic information

Register	7	6	5	4	3	2	1	0
Command(7)	90h							
C/D/H(6)	X			Drive	X			
Cylinder High(5)	X							
Cylinder Low(4)	X							
Sector Number(3)	X							
Sector Count(2)	X							
Feature(1)	X							

This command performs the internal diagnostic tests implemented by the SATADOM. When the diagnostic command is issued in the True IDE Mode, the Drive bit is ignored and the diagnostic command is executed by both the Master and the Slave with the Master responding with status for both devices. The Diagnostic codes are shown in Table 34. Diagnostic Codes are returned in the Error Register at the end of the command.

Table 8: Diagnostic

Code	Error Type

01h	No Error Detected
02h	Formatter Device Error
03h	Sector Buffer Error
04h	ECC Circuitry Error
05h	Controller Microprocessor Error
8Xh	Slave Error in True IDE Mode

6.3 Erase Sector(s) – C0H

Table 9: Erase sector information

Register	7	6	5	4	3	2	1	0
Command(7)	C0h							
C/D/H(6)	1	LBA	1	Drive	Head (LBA 27-24)			
Cylinder High(5)	Cylinder High (LBA 23-16)							
Cylinder Low(4)	Cylinder Low (LBA 15-8)							
Sector Number(3)	Sector Number (LBA 7-0)							
Sector Count(2)	Sector Count							
Feature(1)	X							

This command is used to pre-erase and condition data sectors in advance of a Write without Erase or Write Multiple without Erase command. There is no data transfer associated with this command but a Write Fault error status can occur.

6.4 Format Track – 50H

Table 10: Format track information

Register	7	6	5	4	3	2	1	0
Command(7)	50h							
C/D/H(6)	1	LBA	1	Drive	Head (LBA 27-24)			
Cylinder High(5)	Cylinder High (LBA 23-16)							
Cylinder Low(4)	Cylinder Low (LBA 15-8)							
Sector Number(3)	X (LBA 7-0)							
Sector Count(2)	Count(LBA mode only)							
Feature(1)	X							

This command writes the desired head and cylinder of the selected drive with a vendor unique data pattern (typically FFh or 00h). To remain host backward compatible, the SATADOM expects a sector buffer of data from the host to follow the command with the same protocol as the Write Sector(s) command although the

information in the buffer is not used by the SATADOM. If LBA=1 then the number of sectors to format is taken from the Sec Cnt register (0=256). The use of this command is not recommended.

6.5 Identify Device – ECH

Table 11: Identify device information

Register	7	6	5	4	3	2	1	0
Command(7)	Ech							
C/D/H(6)	X	X	X	Drive	X			
Cylinder High(5)	X							
Cylinder Low(4)	X							
Sector Number(3)	X							
Sector Count(2)	X							
Feature(1)	X							

The Identify Device command enables the host to receive parameter information from the SATADOM. This command has the same protocol as the Read Sector(s) command. The parameter words in the buffer have the arrangement and meanings defined in Table 35. All reserved bits or words are zero. Hosts should not depend in Obsolete words in Identify Device containing 0. Table 35 specifies each filed in the data returned by the Identify Device Command. In Table 35, X indicates a numeric nibble vale specific to the card and aaaa indicates an ASCII string specific to the particular drive.

Table 12: IDENTIFY DEVICE information

Word	Description	Value
0	General configuration bit-significant information: 15 0 = ATA device 14-8 Retired 7 1 = removable media device 6 Obsolete 5-3 Retired 2 Response incomplete 1 Retired 0 Reserved	0040h
1	Obsolete	XXXXh

2	Specific configuration	C837h
3	Obsolete	00XXh
4-5	Retired	0000h
6	Obsolete	XXXXh
7-8	Reserved for assignment by the CompactFlash™ Association	0000h
9	Retired	0000h
10-19	Serial number (20 ASCII characters)	20 ASCII characters
20-21	Retired	0000h
22	Obsolete	0000h
23-26	Firmware revision (8 ASCII characters)	8 ASCII characters
27-46	Model number (40 ASCII characters)	40 ASCII characters
47	15-8 80h 7-0 00h = Reserved 01h-FFh = Maximum number of sectors that shall be transferred per interrupt on READ/WRITE MULTIPLE commands	8001h
48	Reserved	0000h
49	Capabilities 15-1 Reserved for the IDENTIFY PACKET DEVICE command. 13 1 = Standby timer values as specified in this standard are supported 0 = Standby timer values shall be managed by the device 12 Reserved for the IDENTIFY PACKET DEVICE command. 11 1 = IORDY supported 0 = IORDY may be supported 10 1 = IORDY may be disabled 9 1 = LBA supported 8 1 = DMA supported. 7-0 Retired	0F00h
50	Capabilities	4001h

	15 Shell be cleared to zero	
	14: Shall be set to one	
	13- Reserved	
	2	
	1 Obsolete	
	0 Shall be set to one to indicate a device specific Standby timer value minimum.	
51	Obsolete	0000h
52	Obsolete	0000h
53	15-3 Reserved 2 1 = the fields reported in word 88 are valid 0 = the fields reported in word 88 are not valid 1 1 = the fields reported in words (70:64) are valid 0 = the fields reported in words (70:64) are not valid 0 Obsolete	0007h
54	Number of current logical cylinders	XXXXh
55	Number of current logical heads	XXXXh
56	Number of current logical sectors per logical track	XXXXh
57-58	Current capacity in sectors	XXXXh
59	15-9 Reserved 8 1 = Multiple sector setting is valid 7-0 xxh = Current setting for number of sectors that shall be transferred per interrupt on R/W Multiple command	01XXh
60-61	Total number of user addressable sectors	XXXXXX XXh
62	Obsolete	0000h
63	15-11 Reserved 10 1 = Multiword DMA mode 2 is selected 0 = Multiword DMA mode 2 is not selected 9 1 = Multiword DMA mode 1 is selected 0 = Multiword DMA mode 1 is not selected 8 1 = Multiword DMA mode 0 is selected 0 = Multiword DMA mode 0 is not selected 7-3 Reserved 2 1 = Multiword DMA mode 2 and below are supported 1 1 = Multiword DMA mode 1 and below are supported	0X07h

	0	1 = Multiword DMA mode 0 is supported	
64	15-8	Reserved	0003h
	7-0	PIO modes supported	
65	Minimum Multiword DMA transfer cycle time per word		0078h
	15-0	Cycle time in nanoseconds	
66	Manufacturer's recommended Multiword DMA transfer cycle time		0078h
	15-0	Cycle time in nanoseconds	
67	Minimum PIO transfer cycle time without flow control		0078h
	15-0	Cycle time in nanoseconds	
68	Minimum PIO transfer cycle time with IORDY flow control		0078h
	15-0	Cycle time in nanoseconds	
69-70	Reserved (for future command overlap and queuing)		0000h
71-74	Reserved for the IDENTIFY PACKET DEVICE command.		0000h
75	Queue depth		0000h
	15-5	Reserved	
	4-0	Maximum queue depth – 1	
76	Serial ATA capabilities		0006h
	15-13	Reserved	
	12	Supports Native Command Queuing priority information	
	11	Supports Unload while NCQ commands outstanding	
	10	Supports Phy event counters	
	9	Supports receipt of host-initiated interface power management requests	
	8	Supports Native Command Queuing	
	7-3	Reserved for future Serial ATA signaling speed grades	
	2	1 = Supports Serial ATA Gen2 signaling speed (3.0 Gbps)	
	1	1 = Supports Serial ATA Gen1 signaling speed (1.5 Gbps)	
	0	Shall be cleared to zero	
77	Reserved		0000h
78	Serial ATA features supported		0048h
	15-7	Reserved	
	6	1 = Supports software settings preservation	
	5	Reserved	

	4	1 = Supports in-order data delivery	
	3	1 = Device supports initiating interface power management	
	2	1 = Supports DMA Setup Auto-Activate optimization	
	1	1 = Supports non-zero buffer offsets in DMA Setup FIS	
	0	Shall be cleared to zero	
79	Serial ATA features enabled		0040h
	15-7	Reserved	
	6	1 = Software settings preservation enabled	
	5	Reserved	
	4	1 = In-order data delivery enabled	
	3	1 = Device initiating interface power management enabled	
	2	1 = DMA Setup Auto-Activate optimization enabled	
	1	1 = Non-zero buffer offsets in DMA Setup FIS enabled	
	0	Shall be cleared to zero	
80	Major version number 0000h or FFFFh = device does not report version		00FCh
	15	Reserved	
	14	Reserved for ATA/ATAPI-14	
	13	Reserved for ATA/ATAPI-13	
	12	Reserved for ATA/ATAPI-12	
	11	Reserved for ATA/ATAPI-11	
	10	Reserved for ATA/ATAPI-10	
	9	Reserved for ATA/ATAPI-9	
	8	Reserved for ATA/ATAPI-8	
	7	1 = supports ATA/ATAPI-7	
	6	1 = supports ATA/ATAPI-6	
	5	1 = supports ATA/ATAPI-5	
	4	1 = supports ATA/ATAPI-4	
	3	Obsolete	
	2	Obsolete	
	1	Obsolete	
	0	Reserved	
81	Minor version number 0000h or FFFFh = device does not report version		0021h
82	Command set supported.		706Bh
	15	Obsolete	

	14	1 = NOP command supported	
	13	1 = READ BUFFER command supported	
	12	1 = WRITE BUFFER command supported	
	11	Obsolete	
	10	1 = Host Protected Area feature set supported	
	9	1 = DEVICE RESET command supported	
	8	1 = SERVICE interrupt supported	
	7	1 = release interrupt supported	
	6	1 = look-ahead supported	
	5	1 = write cache supported	
	4	Shall be cleared to zero to indicate that the PACKET Command feature set is not supported.	
	3	1 = mandatory Power Management feature set supported	
	2	1 = Removable Media feature set supported	
	1	1 = Security Mode feature set supported	
	0	1 = SMART feature set supported	
83		Command sets supported.	7401h
	15	Shall be cleared to zero	
	14	Shall be set to one	
	13	1 = FLUSH CACHE EXT command supported	
	12	1 = mandatory FLUSH CACHE command supported	
	11	1 = Device Configuration Overlay feature set supported	
	10	1 = 48-bit Address feature set supported	
	9	1 = Automatic Acoustic Management feature set supported	
	8	1 = SET MAX security extension supported	
	7	See Address Offset Reserved Area Boot, INCITS TR27:2001	
	6	1 = SET FEATURES subcommand required to spinup after power-up	
	5	1 = Power-Up In Standby feature set supported	
	4	1 = Removable Media Status Notification feature set supported	
	3	1 = Advanced Power Management feature set supported	
	2	1 = CFA feature set supported	
	1	1 = READ/WRITE DMA QUEUED supported	
	0	1 = DOWNLOAD MICROCODE command supported	

		Command set/feature supported extension	
84	15	Shall be cleared to zero	4040h
	14	Shall be set to one	
	13	1 = IDLE IMMEDIATE with UNLOAD FEATURE supported	
	12	Reserved for technical report	
	11	Reserved for technical report	
	10	1 = URG bit supported for WRITE STREAM DMA EXT and WRITE STREAM EXT	
	9	1 = URG bit supported for READ STREAM DMA EXT and READ STREAM EXT	
	8	1 = 64-bit World wide name supported	
	7	1 = WRITE DMA QUEUED FUA EXT command supported	
	6	1 = WRITE DMA FUA EXT and WRITE MULTIPLE FUA EXT commands supported	
	5	1 = General Purpose Logging feature set supported	
	4	1 = Streaming feature set supported	
	3	1 = Media Card Pass Through Command feature set supported	
	2	1 = Media serial number supported	
	1	1 = SMART self-test supported	
	0	1 = SMART error logging supported	
85		Command and feature sets supported or enabled	
	15	Obsolete	0
	14	1 = NOP command enabled	1
	13	1 = READ BUFFER command enabled	1
	12	1 = WRITE BUFFER command enabled	1
	11	Obsolete	0
	10	1 = Host Protected Area feature set enabled	0
	9	1 = DEVICE RESET command enabled	0
	8	1 = SERVICE interrupt enabled	0
	7	1 = release interrupt enabled	0
	6	1 = look-ahead enabled	X
	5	1 = Write Cache enabled	X
	4	Shall be cleared to zero to indicate that the PACKET Command feature set is not supported.	0
	3	1 = Power Management feature set enabled	1

	2	1 = Removable Media feature set enabled	0
	1	1 = Security Mode feature set enabled	X
	0	1 = SMART feature set enabled	X
86		Command set/feature enabled	3401h
	15-14	0 = Reserved	
	13	1 = FLUSH CACHE EXT command supported	
	12	1 = FLUSH CACHE command supported	
	11	1 = Device Configuration Overlay supported	
	10	1 = 48-bit Address features set supported	
	9	1 = Automatic Acoustic Management feature set enabled	
	8	1 = SET MAX security extension enabled by SET MAX SET PASSWORD	
	7	See Address Offset Reserved Area Boot, INCITS TR27:2001	
	6	1 = SET FEATURES subcommand required to spin-up after power-up	
	5	1 = Power-Up In Standby feature set enabled	
	4	1 = Removable Media Status Notification feature set enabled	
	3	1 = Advanced Power Management feature set enabled	
	2	1 = CFA feature set enabled	
	1	1 = READ/WRITE DMA QUEUED command supported	
	0	1 = DOWNLOAD MICROCODE command supported	
87		Command and feature sets supported or enabled	4040h
	15	Shall be cleared to zero	
	14	Shall be set to one	
	13	1 = IDLE IMMEDIATE with UNLOAD FEATURE supported	
	12	Reserved for technical report-	
	11	Reserved for technical report-	
	10	1 = URG bit supported for WRITE STREAM DMA EXT and WRITE STREAM EXT	
	9	1 = URG bit supported for READ STREAM DMA EXT and READ STREAM EXT	
	8	1 = 64 bit World wide name supported	
	7	1 = WRITE DMA QUEUED FUA EXT command supported	
	6	1 = WRITE DMA FUA EXT and WRITE MULTIPLE FUA	

		EXT commands supported	
	5	1 = General Purpose Logging feature set supported	
	4	1 = Valid CONFIGURE STREAM command has been executed	
	3	1 = Media Card Pass Through Command feature set enabled	
	2	1 = Media serial number is valid	
	1	1 = SMART self-test supported	
	0	1 = SMART error logging supported	
88	15	Reserved	XX7Fh
	14	1 = Ultra DMA mode 6 is selected 0 = Ultra DMA mode 6 is not selected	
	13	1 = Ultra DMA mode 5 is selected 0 = Ultra DMA mode 5 is not selected	
	12	1 = Ultra DMA mode 4 is selected 0 = Ultra DMA mode 4 is not selected	
	11	1 = Ultra DMA mode 3 is selected 0 = Ultra DMA mode 3 is not selected	
	10	1 = Ultra DMA mode 2 is selected 0 = Ultra DMA mode 2 is not selected	
	9	1 = Ultra DMA mode 1 is selected 0 = Ultra DMA mode 1 is not selected	
	8	1 = Ultra DMA mode 0 is selected 0 = Ultra DMA mode 0 is not selected	
	7	Reserved	
	6	1 = Ultra DMA mode 6 and below are supported	
	5	1 = Ultra DMA mode 5 and below are supported	
	4	1 = Ultra DMA mode 4 and below are supported	
	3	1 = Ultra DMA mode 3 and below are supported	
	2	1 = Ultra DMA mode 2 and below are supported	
	1	1 = Ultra DMA mode 1 and below are supported	
	0	1 = Ultra DMA mode 0 is supported	
89	Time required for security erase unit completion		0000h
90	Time required for Enhanced security erase completion		0000h
91	Current advanced power management value		0000h
92	Master Password Revision Code		0000h

93	COMRESET result. The contents of this word shall be cleared to zero.	0000h
94	15-8 Vendor's recommended acoustic management value. 7-0 Current automatic acoustic management value.	0000h
95	Stream Minimum Request Size	0000h
96	Streaming Transfer Time – DMA	0000h
97	Streaming Access Latency – DMA and PIO	0000h
98-99	Streaming Performance Granularity	0000h
100-103	Maximum user LBA for 48-bit Address feature set.	XXXXh
104	Streaming Transfer Time – PIO	0000h
105	Reserved	0000h
106	Physical sector size / Logical Sector Size 15 Shall be cleared to zero 14 Shall be set to one 13 1 = Device has multiple logical sectors per physical sector. 12 1= Device Logical Sector Longer than 256 Words 11-4 Reserved 3-0 2^x logical sectors per physical sector	4000h
107	Inter-seek delay for ISO-7779 acoustic testing in microseconds	0000h
108	15-12 NAA (3:0) 11-0 IEEE OUI (23:12)	0000h
109	15-4 IEEE OUI (11:0) 3-0 Unique ID (35:32)	0000h
110	15-0 Unique ID (31:16)	0000h
111	15-0 Unique ID (15:0)	0000h
112-115	Reserved for world wide name extension to 128 bits	0000h
116	Reserved for technical report-	0000h
117-118	Words per Logical Sector	0000h
119-120	Reserved	0000h
121-126	Reserved	0000h
127	Removable Media Status Notification feature set support 15-2 Reserved 1-0 00 = Removable Media Status Notification feature set not supported 01 = Removable Media Status Notification feature supported	0000h

	10 = Reserved	
	11 = Reserved	
128	Security Status	
	15-9 Reserved	0
	8 Security level 0 = high, 1 = Maximum	X
	7-6 Reserved	0
	5 1= Enhanced security erase supported	0
	4 1= Security count expired	0
	3 1 = Security frozen	X
	2 1 = Security locked	X
	1 1 = Security enabled	X
	0 1 = Security supported	1
129-159	Vendor specific	XXXXh
160	CFA power mode 1	0000h
	15 Word 160 supported	
	14 Reserved	
	13 CFA power mode 1 is required for one or more commands implemented by the device	
	12 CFA power mode 1 disabled	
	11-0 Maximum current in ma	
161-175	Reserved for assignment by the CompactFlash™ Association	0000h
176-205	Current media serial number	0000h
206-254	Reserved	0000h
255	Integrity word	XXXXh
	15-8 Checksum	
	7-0 Signature	

6.6 NOP – 00H

Table 13: NOP information

Register	7	6	5	4	3	2	1	0
Command(7)	00h							
C/D/H(6)	X			Drive	X			
Cylinder High(5)	X							
Cylinder Low(4)	X							
Sector Number(3)	X							
Sector Count(2)	X							
Feature(1)	X							

This command always fails with the SATADOM returning command aborted.

6.7 Read Buffer – E4H

Table 14: Read buffer information

Register	7	6	5	4	3	2	1	0
Command(7)	E4h							
C/D/H(6)	X			Drive	X			
Cylinder High(5)	X							
Cylinder Low(4)	X							
Sector Number(3)	X							
Sector Count(2)	X							
Feature(1)	X							

The Read Buffer command enables the host to read the current contents of the SATADOM's sector buffer. This command has the same protocol as the Read Sector(s) command.

6.8 Read Long Sector – 22H or 23H

Table 15: Read long sector information

Register	7	6	5	4	3	2	1	0
Command(7)	22h or 23h							
C/D/H(6)	1	LBA	1	Drive	Head (LBA 27-24)			
Cylinder High(5)	Cylinder High (LBA 23-16)							
Cylinder Low(4)	Cylinder Low (LBA 15-8)							

Sector Number(3)	Sector Number (LBA 7-0)
Sector Count(2)	X
Feature(1)	X

The Read Long command performs similarly to the Read Sector(s) command except that is returns 516 bytes of data instead of 512 bytes. During a Read Long command, the SATADOM does not check the ECC bytes to determine   if there consists of 512 bytes of data transferred in word mode followed by 4 bytes of ECC data transferred in byte mode. This command has the same protocol as the Read Sector(s) command. Use of this command is not recommended.

6.9 Read Sector(s) – 20H or 21H

Table 16: Read sector information

Register	7	6	5	4	3	2	1	0
Command(7)	20h or 21h							
C/D/H(6)	1	LBA	1	Drive	Head (LBA 27-24)			
Cylinder High(5)	Cylinder High (LBA 23-16)							
Cylinder Low(4)	Cylinder Low (LBA 15-8)							
Sector Number(3)	Sector Number (LBA 7-0)							
Sector Count(2)	Sector Count							
Feature(1)	X							

This command reads from 1 to 256 sectors as specified in the Sector Count Register. A sector count of 0 requests 256 sectors. The transfer begins at the sector specified in the Sector Number Register. When this command is issued and after each sector of data (except the last one) has buffer, sets DRQ, cleats BSY, and generates an interrupt. The host then reads the 512 bytes of data from the buffer.

At command completion, the Command Block Registers contain the cylinder, head and sector number of the last sector read. If an error occurs, the read terminates at the sector where the error occurred. The command Block Registers contain the cylinder head, and sector number of the sector 2where the error occurred. The flawed data is pending in the sector buffer.

6.10 Read Verify Sector(s) – 40H or 41H

Table 17: Read verify sector information

Register	7	6	5	4	3	2	1	0
Command(7)	40h or 41h							
C/D/H(6)	1	LBA	1	Drive	Head (LBA 27-24)			
Cylinder High(5)	Cylinder High (LBA 23-16)							
Cylinder Low(4)	Cylinder Low (LBA 15-8)							
Sector Number(3)	Sector Number (LBA 7-0)							
Sector Count(2)	Sector Count							
Feature(1)	X							

This command is identical to the Read Sectors command, except that DRQ is never set and no data is transferred to the host. When the command is accepted, the SATADOM sets BSY. When the requested sectors have been verified, the SATADOM clears BSY and generates an interrupt. Upon command completion, the Command Block Registers contain the cylinder, head, and sector number of the last sector verified. If an error occurs, the Read Verify Command terminates at the sector where the error occurs. The Command Block Registers contain the cylinder, head and sector number of the sector where the error occurred. The Sector Count Register contains the number of sectors not yet verified.

6.11 Recalibrate – 1XH

Table 18: Recalibrate information

Register	7	6	5	4	3	2	1	0
Command(7)	1Xh							
C/D/H(6)	1	LBA	1	Drive	X			
Cylinder High(5)	X							
Cylinder Low(4)	X							
Sector Number(3)	X							
Sector Count(2)	X							
Feature(1)	X							

This command is effectively a NOP command to the SATADOM and is provided for compatibility.

6.12 Seek – 7XH

Table 19: Seek information

Register	7	6	5	4	3	2	1	0
Command(7)	7Xh							

C/D/H(6)	1	LBA	1	Drive	Head (LBA 27-24)
Cylinder High(5)	Cylinder High (LBA 23-16)				
Cylinder Low(4)	Cylinder Low (LBA 15-8)				
Sector Number(3)	X (LBA 7-0)				
Sector Count(2)	X				
Feature(1)	X				

This command is effectively a NOP command to the SATADOM although it does perform a range check of cylinder and head or LBA address and returns an error if the address is out of range.

6.13 Set Multiple Mode – C6H

Table 20: Set multiple mode information

Register	7	6	5	4	3	2	1	0
Command(7)	C6h							
C/D/H(6)	X			Drive	X			
Cylinder High(5)	X							
Cylinder Low(4)	X							
Sector Number(3)	X							
Sector Count(2)	Sector Count							
Feature(1)	X							

This command enables the SATADOM to perform Read and Write Multiple operations and establishes the block count for these commands. The Sector Count Register is loaded with the number of sectors per block. Upon receipt of the command, the SATADOM sets BSY to 1 and checks the Sector Count Register. If the Sector Count Register contains a valid value and the block count is supported, the value is loaded and execution is enabled for all subsequent Read Multiple and Write Multiple commands. If the Sector Count Register contains 0 when the command is issued, Read and Write Multiple commands are disabled. At power on, or after a hardware or (unless disabled by a Set Feature command) software reset, the default mode is Read and Write multiple disabled.

6.14 Set Sleep Mode – 99H or E6H

Table 21: Set sleep mode information

Register	7	6	5	4	3	2	1	0
Command(7)	99h or E6h							

Register	7	6	5	4	3	2	1	0
C/D/H(6)	X			Drive	X			
Cylinder High(5)	X							
Cylinder Low(4)	X							
Sector Number(3)	X							
Sector Count(2)	X							
Feature(1)	X							

This command causes the SATADOM to set BSY, enter the Sleep mode, clear BSY and generate an interrupt. Recovery from sleep mode is accomplished by simply issuing another command (a reset is permitted but not required). Sleep mode is also entered when internal timers expire so the host does not need to issue this command except when it wishes to enter Sleep mode immediately. The default value for the timer is 5 milliseconds.

6.15 Standby – 96H or E2H

Table 22: Standby information

Register	7	6	5	4	3	2	1	0
Command(7)	96h or E2h							
C/D/H(6)	X			Drive	X			
Cylinder High(5)	X							
Cylinder Low(4)	X							
Sector Number(3)	X							
Sector Count(2)	X							
Feature(1)	X							

This command causes the SATADOM to set BSY, enter the Sleep mode, clear BSY and return interrupt immediately. Recovery from sleep mode is accomplished by simply issuing another command (a reset is not required).

6.16 Standby Immediate – 94H or E0H

Table 23: Standby immediate information

Register	7	6	5	4	3	2	1	0
Command(7)	94h or E0h							
C/D/H(6)	X			Drive	X			
Cylinder High(5)	X							
Cylinder Low(4)	X							
Sector Number(3)	X							

Sector Count(2)	X
Feature(1)	X

This command causes the SATADOM to set BSY, enter the Sleep mode, clear BSY and return the interrupt immediately. Recovery from sleep mode is accomplished by simply issuing another command (a reset is not required).

6.17 Write Buffer – E8H

Table 24: Write buffer information

Register	7	6	5	4	3	2	1	0
Command(7)	E8h							
C/D/H(6)	X			Drive	X			
Cylinder High(5)	X							
Cylinder Low(4)	X							
Sector Number(3)	X							
Sector Count(2)	X							
Feature(1)	X							

The Write Buffer command enables the host to overwrite contents of the SATADOM's sector buffer with any data pattern desired. This command has the same protocol as the Write Sector(s) command and transfer 512 bytes.

6.18 Security

6.18.1 Security Set Password

6.18.1.1 Command Code
    F1h
6.18.1.2 Feature Set
    Security Mode feature set
6.18.1.3 Protocol
    PIO data-out
6.18.1.4 Inputs

Table 25: Security set password command for inputs information

Register	7	6	5	4	3	2	1	0
Features	Na							
Sector Count	Na							

LBA Low	Na				
LBA Mid	Na				
LBA High	Na				
Device	obs	Na	obs	Na	Na
Command	F1h				

Device –

> DEV shall specify the selected device.

Normal Outputs

Table 26: Security set password command for normal outputs information

Register	7	6	5	4	3	2	1	0
Error	Na							
Sector Count	Na							
LBA Low	Na							
LBA Mid	Na							
LBA High	Na							
Device	obs	Na	obs	DEV	Na			
Status	BSY	DRDY	DF	Na	DRQ	Na	Na	ERR

Device register

> DEV shall indicate the selected device.

Status register

> **BSY** will be cleared to zero indicating command completion
>
> **DRDY** will be set to one.
>
> **DF** (Device Fault) will be set to zero.
>
> **DRQ** will be cleared to zero
>
> **ERR** will be set to zero.

6.18.1.5 Error Outputs

Table 27: Security set password command for error outputs information

Register	7	6	5	4	3	2	1	0
Error	Na	Na	Na	Na	Na	ABRT	Na	Na
Sector Count	Na							
LBA Low	Na							
LBA Mid	Na							
LBA High	Na							
Device	obs	Na	obs	DEV	Na			
Status	BSY	DRDY	DF	Na	DRQ	Na	Na	ERR

Error Register

ABRT may be set to one if the device is not able to complete the action requested by the command

Device register

DEV shall indicate the selected device.

Status register

BSY will be cleared to zero indicating command completion

DRDY will be set to one.

DF (Device Fault) should be set to one if a device fault has occurred.

DRQ will be cleared to zero

ERR will be set to one if an Error register bit is set to one.

6.18.1.6   Prerequisites

DRDY set to one.

6.18.1.7   Description

This command transfer 512 byte of data from the host. Table 10 defines the content of this information. The data transferred controls the function of this command. Table 11 defines the interaction of the identifier and security level bits.

The revision code field shall be returned in the IDENTIFY DEVICE word 92. The valid revision codes are 0001h through FFFEh. A value of 0000h or FFFFh indicates that the Master Password Revision Code is not supported.

Table 28: Security set password command's data content

Word	Content
0	Control Word
	Bit 0 Identifier 0=set User password
	1=set Master password
	Bits (7:1) Reserved
	Bit(8) Security level 0=High
	1=Maximum
	Bits(15:9) Reserved
1-16	Password(32 bytes)
17	Master Password Revision Code()
18-255	Reserved

Table 29: Security Set password command's identifier and security level bit interaction

Identifier	Level	Command result

User	High	The password supplied with the command shall be saved as the new User password. The Lock mode shall be enabled from the next power-on or hardware reset. The device shall than be unlocked by either the User password it the previously set Master password.
User	Maximum	The password supplied with the command shall be saved as the new User password. The lock mode shall be enabled from the next power-on or hardware reset. The device shall then be unlocked by only the User password. The Master password previously set is still stored in the device but shall not be unlock
Master	High or Maximum	This combination shall set a Master password but shall not enable or disable the Lock mode. The security level is not changed. Master password revision code set to the value in Master Password Revision Code field.

6.18.2 Security Unlock

6.18.2.3 Command Code

F2h

6.18.2.4 Feature Set

Security Mode feature set

6.18.2.5 Protocol

PIO data-out

6.18.2.6 Inputs

Table 30: Security unlock command for inputs information

Register	7	6	5	4	3	2	1	0
Features	Na							
Sector Count	Na							
LBA Low	Na							
LBA Mid	Na							
LBA High	Na							
Device	obs	Na	obs	Na	Na			
Command	F2h							

Device register–

DEV shall specify the selected device.

Normal Outputs

Table 31: Security unlock command for inputs information

Register	7	6	5	4	3	2	1	0
Error	Na							
Sector Count	Na							
LBA Low	Na							
LBA Mid	Na							
LBA High	Na							
Device	obs	Na	obs	DEV	Na			
Status	BSY	DRDY	DF	Na	DRQ	Na	Na	ERR

Device register

    DEV shall indicate the selected device.

Status register

    BSY will be cleared to zero indicating command completion

    DRDY will be set to one.

    DF (Device Fault) will be set to zero.

    DRQ will be cleared to zero

    ERR will be set to zero.

6.18.2.7 Error Outputs

    The device shall return aborted if the device is in Frozen mode.

Table 32: Security unlock command for inputs information

Register	7	6	5	4	3	2	1	0
Error	Na	Na	Na	Na	Na	ABRT	Na	Na
Sector Count	Na							
LBA Low	Na							
LBA Mid	Na							
LBA High	Na							
Device	obs	Na	obs	DEV	Na			
Status	BSY	DRDY	DF	Na	DRQ	Na	Na	ERR

Error Register

    ABRT may be set to one if the device is not able to complete the action requested by the command

Device register

    DEV shall indicate the selected device.

Status register

BSY will be cleared to zero indicating command completion

DRDY will be set to one.

DF (Device Fault) should be set to one if a device fault has occurred.

DRQ will be cleared to zero

ERR will be set to one if an Error register bit is set to one.

6.18.2.8   Prerequisites

DRDY set to one.

6.18.2.9   Description

This command transfers 512 bytes of data from the host. Table13 defines the content of this information. If the Identifier bit is set to Master and the device is in high security level, then the password supplied shall be compared with the stored Master password. If the device is in maximum security level then the unlock shall be rejected.

If the Identifier bit is set to user then the device shall compare the supplied password with the stored User password. If the password compare fails then the device shall return command aborted to the host and decrements the unlock counter. This counter shall be initially set to five and shall decremented for each password mismatch when SECURITY UNLOCK and SECURITY ERASE UNIT commands shall be command aborted until a power-on reset or a hardware reset. SECURITY UNLOCK commands issued when the device is unlocked have no effect on the unlock counter.

6.18.3 Security Erase Prepare

6.18.3.3   Command Code

F3h

6.18.3.4   Feature Set

Security Mode feature set

6.18.3.5   Protocol

Non-data

6.18.3.6   Inputs

Table 33: Security erase prepare command for inputs information

Register	7	6	5	4	3	2	1	0
Features	Na							

Sector Count	Na				
LBA Low	Na				
LBA Mid	Na				
LBA High	Na				
Device	obs	Na	obs	Na	Na
Command	F3h				

Device register–

　　　DEV shall specify the selected device.

Normal Outputs

Table 34: Security erase prepare command for normal outputs information

Register	7	6	5	4	3	2	1	0
Error	Na							
Sector Count	Na							
LBA Low	Na							
LBA Mid	Na							
LBA High	Na							
Device	obs	Na	obs	DEV	Na	Na	Na	Na
Status	BSY	DRDY	DF	Na	DRQ	Na	Na	ERR

Device register

　　　DEV shall indicate the selected device.

Status register

　　　BSY will be cleared to zero indicating command completion

　　　DRDY will be set to one.

　　　DF (Device Fault) will be set to zero.

　　　DRQ will be cleared to zero

　　　ERR will be set to zero.

6.18.3.7　Error Outputs

　　　The device shall return aborted if the device is in Frozen mode.

Table 35: Security erase prepare command for error outputs information

Register	7	6	5	4	3	2	1	0
Error	Na	Na	Na	Na	Na	ABRT	Na	Na
Sector Count	Na							
LBA Low	Na							
LBA Mid	Na							
LBA High	Na							
Device	obs	Na	obs	DEV	Na			

Status	BSY	DRDY	DF	Na	DRQ	Na	Na	ERR

Error Register

ABRT shall be set to one if the device is in Frozen mode. ABRT may be set to one if the device is not able to complete the action requested by the command

Device register

DEV shall indicate the selected device.

Status register

BSY will be cleared to zero indicating command completion

DRDY will be set to one.

DF (Device Fault) should be set to one if a device fault has occurred.

DRQ will be cleared to zero

ERR will be set to one if an Error register bit is set to one.

6.18.3.8 Prerequisites

DRDY set to one.

6.18.3.9 Description

The SECURITY ERASE PREPARE command shall be issued immediately before the SECURITY ERASE UNIT command to enable device erasing and unlocking. This command prevents accidental loss of data on the device.

6.18.4 Security Erase Unit

6.18.4.3 Command Code

F4h

6.18.4.4 Feature Set

Security Mode feature set

6.18.4.5 Protocol

PIO data-out.

6.18.4.6 Inputs

Table 36: Security erase unit command for inputs information

Register	7	6	5	4	3	2	1	0
Features	Na							
Sector Count	Na							
LBA Low	Na							
LBA Mid	Na							

LBA High	Na							
Device	obs	Na	obs	Na	Na	Na	Na	Na
Command	F4h							

Device register–

    DEV shall specify the selected device.

Normal Outputs

Table 37: Security erase unit command for normal outputs information

Register	7	6	5	4	3	2	1	0
Error	Na							
Sector Count	Na							
LBA Low	Na							
LBA Mid	Na							
LBA High	Na							
Device	obs	Na	obs	DEV	Na	Na	Na	Na
Status	BSY	DRDY	DF	Na	DRQ	Na	Na	ERR

Device register

    DEV shall indicate the selected device.

Status register

    BSY shall be cleared to zero indicating command completion

    DRDY shall be set to one.

    DF (Device Fault) will be set to zero.

    DRQ shall be cleared to zero

    ERR shall be cleared to zero.

6.18.4.7 Error Outputs

    The device shall return aborted if the device is in Frozen mode, not preceded by a SECURITY ERASE PREPARE command, if Enhance Erase is specified but not supported, or if the data area is not successfully overwritten.

Table 38: Security erase unit command for error outputs information

Register	7	6	5	4	3	2	1	0
Error	Na	Na	Na	Na	Na	ABRT	Na	Na
Sector Count	Na							
LBA Low	Na							
LBA Mid	Na							
LBA High	Na							

Device	obs	Na	obs	DEV	Na			
Status	BSY	DRDY	DF	Na	DRQ	Na	Na	ERR

Error Register

ABRT shall be set to one if the device is in Frozen mode, not preceded by a SECURITY ERASE PREPARE command, or if the data area is not successfully overwritten. ABRT may be set to one if the device is not able to complete the action requested by the command.

Device register

DEV shall indicate the selected device.

Status register

BSY will be cleared to zero indicating command completion

DRDY will be set to one.

DF (Device Fault) should be set to one if a device fault has occurred.

DRQ will be cleared to zero

ERR will be set to one if an Error register bit is set to one.

6.18.4.8 Prerequisites

DRDY set to one. This command shall be immediately preceded by a SECURITY ERASE PREPARE command.

6.18.4.9 Description

This command transfer 512 bytes of data from the host. Table12 defines the content of this information. If the password does not match the password previously saved by the device, the device shall reject the command with command aborted.

The SECURITY ERASE PREPARE command shall be completed immediately prior to the SECURITY ERASE UNIT command. If the device receives a SECURITY ERASE UNIT command without an immediately prior SECURITY ERASE PREPARE command, the device shall command abort the SECURITY ERASE UNIT command.

When Normal Erase mode is specified, the SECURITY ERASE UNIT command shall write binary zeroes to all user data areas. The Enhanced Erase mode is optional. When Enhanced Erase Mode is specified, the device shall write predetermined data patterns to all user areas. In Enhanced Erase mode, all previously written user data shall be overwritten, including sectors that are no longer in use due to reallocation.

This command shall disable the device Lock mode, however, the Master password shall still be stored internally within the device and may be reactivated later a new User password is set.

Table 39: Security erase unit password information

Word	Content

0	Control Word
	
	Bit 0 Identifier 0=Compare User password
	                                   1= Compare Master password
	Bit 1 Erase mode 0=Normal Erase
	                                    1=Enhanced Erase
	Bit(15:2) Reserved

1-16	Password (32 Bytes)
17-255	Reserved

6.18.5 Security Freeze Lock

6.18.5.3 Command Code

     F5h

6.18.5.4 Feature Set

     Security Mode feature set

6.18.5.5 Protocol

     Non-data.

6.18.5.6 Inputs

Table 40: Security freeze lock for inputs information

Register	7	6	5	4	3	2	1	0
Features	Na							
Sector Count	Na							
LBA Low	Na							
LBA Mid	Na							
LBA High	Na							
Device	Obs	Na	obs	Na	Na	Na	Na	Na
Command	F5h							

Device register–

     DEV shall specify the selected device.

Normal Outputs

Table 41: Security freeze lock for normal outputs information

Register	7	6	5	4	3	2	1	0
Error	Na							
Sector Count	Na							
LBA Low	Na							
LBA Mid	Na							
LBA High	Na							
Device	Obs	Na	obs	DEV	Na	Na	Na	Na
Status	BSY	DRDY	DF	Na	DRQ	Na	Na	ERR

Device register

DEV shall indicate the selected device.

Status register

BSY shall be cleared to zero indicating command completion

DRDY shall be set to one.

DF (Device Fault) will be set to zero.

DRQ shall be cleared to zero

ERR shall be cleared to zero.

6.18.5.7   Error Outputs

The device shall return aborted if the device is in Frozen mode, not preceded by a SECURITY ERASE PREPARE command, if Enhance Erase is specified but not supported, or if the data area is not successfully overwritten.

Table 42: Security freeze lock for error outputs information

Register	7	6	5	4	3	2	1	0
Error	Na	Na	Na	Na	Na	ABRT	Na	Na
Sector Count	Na							
LBA Low	Na							
LBA Mid	Na							
LBA High	Na							
Device	Obs	Na	obs	DEV	Na			
Status	BSY	DRDY	DF	Na	DRQ	Na	Na	ERR

Error Register

ABRT shall be set to one if the device is in locked mode. ABRT may be set to one if the device is not able to complete the action requested by the command.

Device register

DEV shall indicate the selected device.

Status register

BSY will be cleared to zero indicating command completion

DRDY will be set to one.

DF (Device Fault) should be set to one if a device fault has occurred.

DRQ will be cleared to zero

ERR will be set to one if an Error register bit is set to one.

6.18.5.8 Prerequisites

DRDY set to one.

6.18.5.9 Description

The SECURITY FREEZE LOCK command shall set the device to Frozen mode. After command completion any other commands that update the device Lock mode shall be command aborted. Frozen mode shall be disabled by power-off or hardware reset. If SECURITY FREEZE LOCK shall be issued when the device in Frozen mode, the command executes and the device shall remain in Frozen mode.

Command disabled by SECURITY FREEZE LOCK are:

- SECUIRTY SET PASSWORD
- SECURITY UNLOCK
- SECURITY DISABLE PASSWORD
- SECURITY ERASE PREPARE
- SECURITY ERASE UNIT

6.18.6 Security Disable Password

6.18.6.3 Command Code

F6h

6.18.6.4 Feature Set

Security Mode feature set

6.18.6.5 Protocol

PIO data-out.

6.18.6.6 Inputs

Table 43: Security disable password command for inputs information

Register	7	6	5	4	3	2	1	0
Features	Na							
Sector Count	Na							
LBA Low	Na							
LBA Mid	Na							

	7	6	5	4	3	2	1	0
LBA High	Na							
Device	obs	Na	obs	Na	Na	Na	Na	Na
Command	F6h							

Device register–

　　DEV shall specify the selected device.

Normal Outputs

Table 44: Security disable password command for normal outputs information

Register	7	6	5	4	3	2	1	0
Error	Na							
Sector Count	Na							
LBA Low	Na							
LBA Mid	Na							
LBA High	Na							
Device	obs	Na	obs	DEV	Na	Na	Na	Na
Status	BSY	DRDY	DF	Na	DRQ	Na	Na	ERR

Device register

　　DEV shall indicate the selected device.

Status register

　　BSY shall be cleared to zero indicating command completion

　　DRDY shall be set to one.

　　DF (Device Fault) will be set to zero.

　　DRQ shall be cleared to zero

　　ERR shall be cleared to zero.

6.18.6.7　Error Outputs

　　The device shall return aborted if the device is in Locked mode, or device is in Frozen mode.

Table 45: Security disable password command for error outputs information

Register	7	6	5	4	3	2	1	0
Error	Na	Na	Na	Na	Na	ABRT	Na	Na
Sector Count	Na							
LBA Low	Na							
LBA Mid	Na							
LBA High	Na							
Device	obs	Na	obs	DEV	Na			
Status	BSY	DRDY	DF	Na	DRQ	Na	Na	ERR

Error Register

ABRT may be set to one if the device is not able to complete the action requested by the command.

Device register

DEV shall indicate the selected device.

Status register

BSY will be cleared to zero indicating command completion

DRDY will be set to one.

DF (Device Fault) should be set to one if a device fault has occurred.

DRQ will be cleared to zero

ERR will be set to one if an Error register bit is set to one.

6.18.6.8   Prerequisites

DRDY set to one. Device shall be in Unlocked mode.

6.18.6.9   Description

The SECURITY DISABLE PASSWORD command transfer 512 bytes of data from the host. Table 13 defines the content of this information. If the password selected by word 0 matches the password previously saved by the device, the device shall disable the Lock mode. This command shall not change the Master password. The Master password shall be reactivated when a User password if set.

Table 46: Security disable password command content

Word	Content
0	Control Word Bit 0 Identifier 0=Compare User password 1= Compare Master password Bit(15:1) Reserved
1-16	Password (32 Bytes)
17-255	Reserved

6.19 SMART

Individual SMART commands are identified by the value placed in the Feature register.

Table 47: SMART Feature register values

Value	Command
D0h	SMART Read Data
D2h	SMART Enable/Disable Attribute Autosave
D8h	SMART ENABLE OPERATIONS
D9h	SMART DISABLE OPERATIONS

Dah	SMART Return Status

6.19.1 SMART Read Data

6.19.1.1 Command Code

B0h with a Feature register value of D0h

6.19.1.2 Feature Set

Smart Feature Set

- Operation when the SMART feature set is implemented.

6.19.1.3 Protocol

Non-data

6.19.1.4 Inputs

Table 48: SMART command for inputs information

Register	7	6	5	4	3	2	1	0
Features	D0h							
Sector Count	Na							
LBA Low	Na							
LBA Mid	4Fh							
LBA High	C2h							
Device	Na							
Command	B0h							

Normal Outputs

Table 49: SMART command for normal outputs information

Register	7	6	5	4	3	2	1	0
Error	Na							
Sector Count	Na							
LBA Low	Na							
LBA Mid	Na							
LBA High	Na							
Device	Na							
Status	BSY	DRDY	DF	1	DRQ	Na	Na	ERR

Status register-

BSY will be cleared to zero indicating command completion.

DRDY will be set to one.

DF (Device Fault) will be cleared to zero.

DRQ shall be cleared to zero.

ERR shall be cleared to zero.

6.19.1.5 Prerequisites

DRDY set to one. SMART enabled.

6.19.1.6 Description

This command returns the Device SMART data structure to the host.

Table 50: SMART data structure

BYTE	Description
0-385	Reserved (00h)
386-387	Number of System & Invalid blocks in the chip 0
...	...
416-417	Number of System & Invalid blocks in the chip 15
418-419	Number of erased blocks in the chip 0
...	...
448-449	Number of erased blocks in the chip 15
450-451	Total number of blocks per chip
452-500	Reserved(na)
501 -503	The maximum value of erased in the each block
504	Chip number inclued the maximum erased block
505-510	Reserved(00h)
511	Check sum(The compliment of 2 of the summed value from byte 0 to byte 510(without carry))

6.19.2 SMART RETURN STATUS

6.19.2.1 Command Code

B0h with a Feature register value of DAh

6.19.2.2 Feature Set

Smart Feature Set

6.19.2.3 Protocol

Non-data

6.19.2.4 Inputs

Table 51: SMART Command for inputs information

Register	7	6	5	4	3	2	1	0
Features	DAh							
Sector Count	Na							

LBA Low	Na
LBA Mid	4Fh
LBA High	C2h
Device	Na
Command	B0h

6.19.2.5 Normal Outputs

Table 52: SMART command for normal outputs information

Register	7	6	5	4	3	2	1	0
Error	Na							
Sector Count	Na							
LBA Low	Na							
LBA Mid	4F or F4							
LBA High	C2 or 2C							
Device	Na							
Status	BSY	DRDY	DF	1	DRQ	CORR	Na	ERR

LBA Mid register-

4Fh (when the system is normal) F4h (when system is abnormal)

LBA Mid register-

C2hwhen the system is normal) 2Chwhen system is abnormal)

Status register-

BSY will be cleared to zero indicating command completion.

DF (Device Fault) will be cleared to zero.

DRQ shall be cleared to zero.

ERR shall be cleared to zero.

6.19.2.6 Prerequisites

SMART enabled.

6.19.2.7 Description

This command returns " system abnormal" when the number of deleted blocks is less than 10, or maximum erased frequency exceed set value when user initialized.

6.19.3 SMART Enable/Disable Attribute Autosave

This command is used to switch enable/disable of attribute autosave function, it is considered as a NOP process in this device

Table 53: SMART command for normal input parameters information

Register	7	6	5	4	3	2	1	0
Features	D2h							
Sector Count	Na							
LBA Low	Na							
LBA Mid	4Fh							
LBA High	C2h							
Device	Obs	Na	obs	DEV	Na	Na	Na	Na
Command	B0h							

6.19.4 SMART ENABLE OPERATIONS

6.19.4.1   Command Code

B0h with a Feature register value of D8h

6.19.4.2   Feature Set

Smart Feature Set

6.19.4.3   Protocol

Non-data

6.19.4.4   Inputs

Table 54: SMART Enable command for inputs information

Register	7	6	5	4	3	2	1	0
Features	D8h							
Sector Count	Na							
LBA Low	Na							
LBA Mid	4Fh							
LBA High	C2h							
Device	Na							
Command	B0h							

6.19.4.5   Normal Outputs

Table 55: SMART command for normal outputs information

Register	7	6	5	4	3	2	1	0
Error	Na							
Sector Count	Na							
LBA Low	Na							
LBA Mid	Na							
LBA High	Na							
Device	Na							
Status	BSY	DRDY	DF	Na	DRQ	Na	Na	ERR

Status register-

 BSY will be cleared to zero indicating command completion.

 DRDY will be set to one.

 DF (Device Fault) will be cleared to zero.

 DRQ shall be cleared to zero.

 ERR shall be cleared to zero.

6.19.4.6 Prerequisites

 DRDY set to one.

6.19.4.7 Description

 This command enables access to all SMART capabilities within device.

6.19.5 SMART DISABLE OPERATIONS

6.19.5.1 Command Code

 B0h with a Feature register value of D9h

6.19.5.2 Feature Set

 Smart Feature Set

6.19.5.3 Protocol

 Non-data

6.19.5.4 Inputs

Table 56: SMART DISABLE Command for inputs information

Register	7	6	5	4	3	2	1	0
Features	D9h							
Sector Count	Na							
LBA Low	Na							
LBA Mid	4Fh							
LBA High	C2h							
Device	Na							

Command	B0h

6.19.5.5 Normal Outputs

Table 57: SMART command for normal outputs information

Register	7	6	5	4	3	2	1	0
Error	Na							
Sector Count	Na							
LBA Low	Na							
LBA Mid	Na							
LBA High	Na							
Device	Na							
Status	BSY	DRDY	DF	Na	DRQ	Na	Na	ERR

Status register-

BSY will be cleared to zero indicating command completion.

DRDY will be set to one.

DF (Device Fault) will be cleared to zero.

DRQ shall be cleared to zero.

ERR shall be cleared to zero.

6.19.5.6 Prerequisites

DRDY set to one. SMART enabled.

6.19.5.7 Description

This command disables all SMART capabilities within device.

7 Device Parameters

InnoDisk SATATDOM device parameters listed in Table 58.

Table 58: InnoDisk SATADOM i100 U Device parameters

Capacity	Cylinders	Heads	Sectors	LBA
2GB	3900	16	63	3,932,160
4GB	7801	16	63	7,864,320
8GB	15,603	16	63	15,728,640
16GB	16,383	16	63	31,457,280
32GB	16,383	16	63	62,586,880

8 InnoDisk Part Number Rule

CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	D	E	0	H	-	5	1	2	D	3	1	C	X	-		
Description	Disk	EDC4000 40-pin, vertical			-	Capacity			Category			Operation Temp.	Internal Control	-	Customized Code	
Definition																

Code 1st (Disk)		EUX：USB EDC, Vertical
D：Disk		* code 5th : A/B/C/D/E/F for EDC horizontal type only
Code 2nd ~ 4th (Form Factor)		**Code 6th ~8th (Capacity)**
E0H：40-pin EDC, InnoLite EDC, Vertical		128：128MB
E4H：44-pin EDC, Vertical		256：256MB
E0P：40-pin EDC, Horizontal		512：512MB
E4P：44-pin EDC, Horizontal		01G：1GB
ES8：SATADOM, Vertical Low Profile		02G：2GB
ES9：SATADOM, Vertical High Profile		04G：4GB
ES8B：SATADOM, Horizontal Low Profile		08G：8GB
ES9B：SATADOM, Horizontal High Profile		16G：16GB
ESI：SATADOM i series, InnoLite SATADOM		32G：32GB
ESIH：SATADOM i00 Ultra (no hook)		64G：64GB
ESIU：SATADOM i00 Ultra		A28：128GB
C1M：CF, Type I, InnoLite iCF		B56：256GB
C1S：CF Write Protect		C12：512GB
C1T：CFast		
1ST：1.8" Flash Disk SATA10000		
2ST：2.5" Flash Disk SATA10000		
2D6：2.5" Flash Disk ATA6000		
2D8：2.5" Flash Disk ATA8000-J		
2S6 **:** 2.5" Flash Disk SATA6000		
2SR：2.5" Flash Disk SATA20000-R		
2SH：2.5" Flash Disk SATA20000-H		
2DM：2.5" ATA CF Mirroring Disk		
EUP：USB EDC, USB EDC-S3252H Horizontal, pin pitch 2.0mm		
EUF：USB EDC, USB EDC-S3252H Horizontal, pin pitch 2.54mm		

CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	D	E	0	H	-	5	1	2	D	3	1	C	X	-		
Description	Disk	EDC4000 40-pin, vertical			-	Capacity			Category			Operation Temp.	Internal Control	-	Customized Code	

Definition

Code 9th ~ 11th (Series)	Code 12th (Operation Temperature)
D11：CF Mirroring Disk / ATA6000 / SATA6000	C：Standard Grade (0 ~ +70 ℃)
D31：EDC4000 / iCF 4000	W：Industrial Grade
D91：EDC8000 / iCF 8000	K：Standard grade with coating
D51：InnoLite iCF / InnoLite EDC	T：W/T grade with coating
J11：InnoLite SATADOM	**Code 13th (Internal Control Code)**
T11：SATADOM	1: 1st PCB version, default setting
T21：SATADOM i100, SATADOM i100 Ultra, CFast 100	2: 2nd PCB version, default setting
J12：CFast 80, SATA10000, SATA20000-R, ATA8000-J	3: Removable Mode +UltraDMA
J13：SATA10000, SATA20000-R, ATA8000-J	4: Preformat, Fixed Mode + PIO Mode 4
J22：InnoRobust SATA SSD, InnoRobust Ultra SATA SSD,	5: Pre-formatted (iCF4000 only) + UltraDMA 4
InnoRobust PATA SSD	6: Pre-formatted + Removable (iCF4000 only)+UltraDMA 4
J23：InnoRobust Ultra SATA SSD	7: Fixed Mode + PIO Mode 4
U51：USB EDC	8: Fixed Mode + MwDMA Mode 2
I21：USB EDC-S3252H	9: Removable Mode + PIO Mode 4
	*3~9 is for 4000 series (removable for iCF)
	Code 14th (Channel of data transfer)
	S: Single Channel
	D: Dual Channel
	* apply for EDC/iCF 4000 and SATA4000

9 Appendix

9.1 Power cable specifications
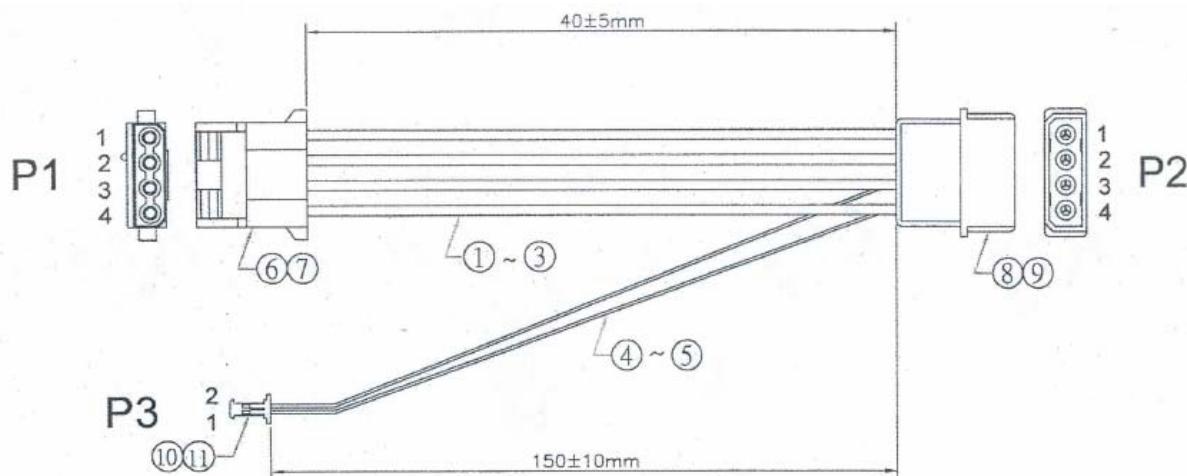
Figure 7: SATADOM power cable mechanical drawing

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