盛光科技股份有限公司
Most I & T Corporation

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Serial ATA Flash Disk

Product Specification

V2.1

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Contents:

1 Product Information

The Serial ATA Flash Disk is solid-state design for serial and parallel ATA translation interface. It is an ideal replacement for standard SATA hard disk by no errors even under extreme shock and vibration conditions. The Serial ATA Flash Disk is extremely small and highly suitable for rugged environments, thus providing an excellent solution for space limitations. It is compatible with all consumer applications designed for data storage, allowing simple use for the end user.

The Serial ATA Flash Disk is SATA interface compatible and offering various capacities. It has low power consumption and can operate from a single 3.3/5.0 Volt power supply. The operating temperature grade is commercial operating temperature grade (0℃~+70℃). The Serial ATA Flash Disk has 2.5 inch and 1.8 inch for optional.

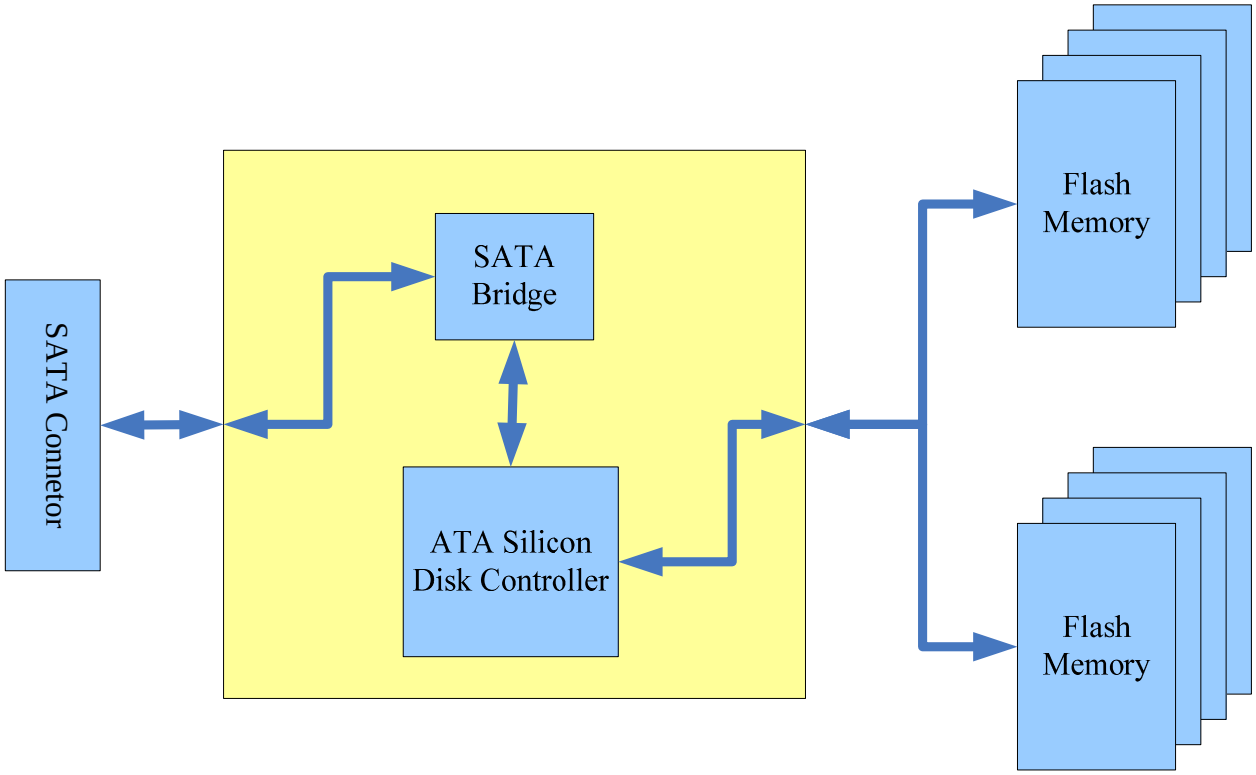
2 System Features

- Serial ATA 1.0a Specification compliant.
- SATA 7+15 pins combo connector.
- Low Power Consumption.
- Optional designs for 2.5 inch and 1.8inch.
- High reliability assured based on the internal Error Correcting Code function.
- Reliable wear-leveling algorithm to ensure the best of flash endurance.
- Excellent performance supporting Ultra DMA Mode.
- Capacity supported: 128MB, 256MB, 512MB, 1GB, 2GB, 4GB, 8GB, 16GB and 32GB (unformatted).

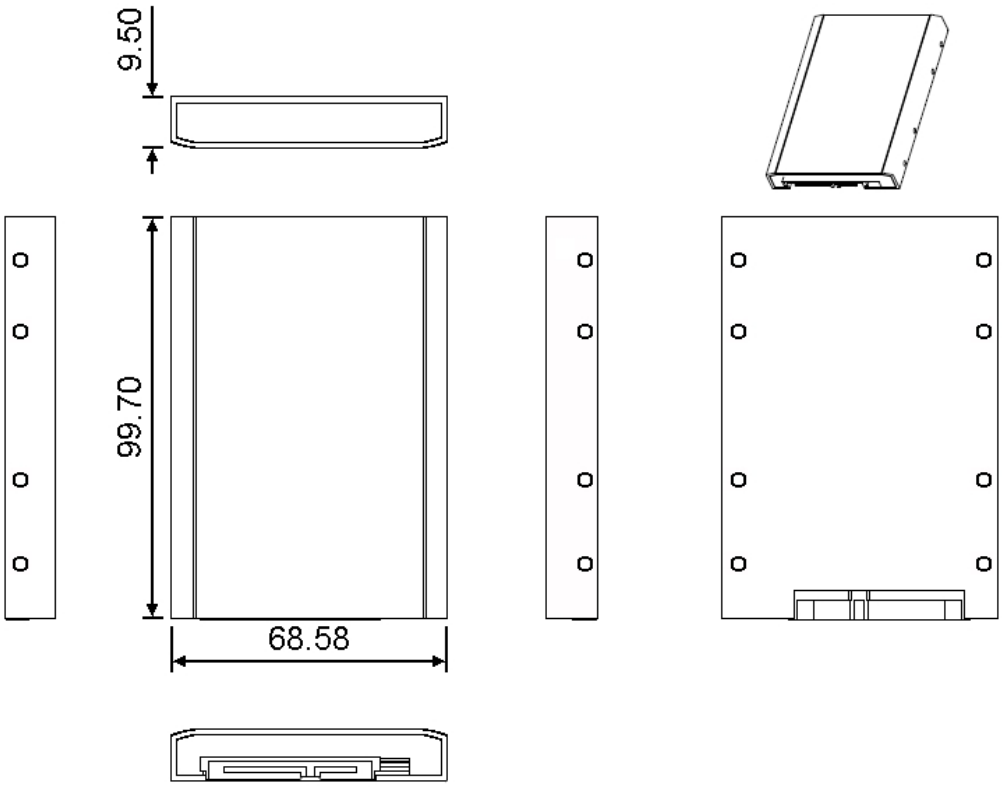
3 Specifications

Compatibility		Serial ATA 1.0a Specification	
Form Factor		2.5inch or 1.8inch	
Connector Types		Standard 7+15-pin male Serial ATA connector	
System Performance			
Data Transfer Mode		UDMA Mode	
SLC Type Flash	Sequential Read	Max up to 50Mbytes / sec.	
	Sequential Write	Max up to 40Mbytes / sec.	
MLC Type Flash	Sequential Read	Max up to 40Mbytes / sec.	
	Sequential Write	Max up to 30Mbytes / sec.	
Environmental Specification			
Standard Temperature		Operation	0ºC ~ +70ºC
		Non-operation	-20ºC ~ +80ºC
Vibration		Operation max	20 G
		Non-operation max	20 G
Humidity		Operation max	5~95% non-condensing
		Non-operation max	5~95% non-condensing
Shock		Operation max	1500 G
		Non-operation max	1500 G
Reliability			
MTBF		> 1,000,000 hours	
Error Code Correction		4 bits ECC Code	
Endurance		Greater than 1,000,000 cycles logically contributed by Wear-leveling and advanced bad sector management algorithms	
Data Reliability		< 1 non-recoverable error 10^{14} bits read	
Data Retention		10 years	
Power Consumption			
Power Voltage		+5V ± 10%	
Read		240mA(Typ.)	
Write		250mA(Typ.)	
Idle		130mA(Typ.)	

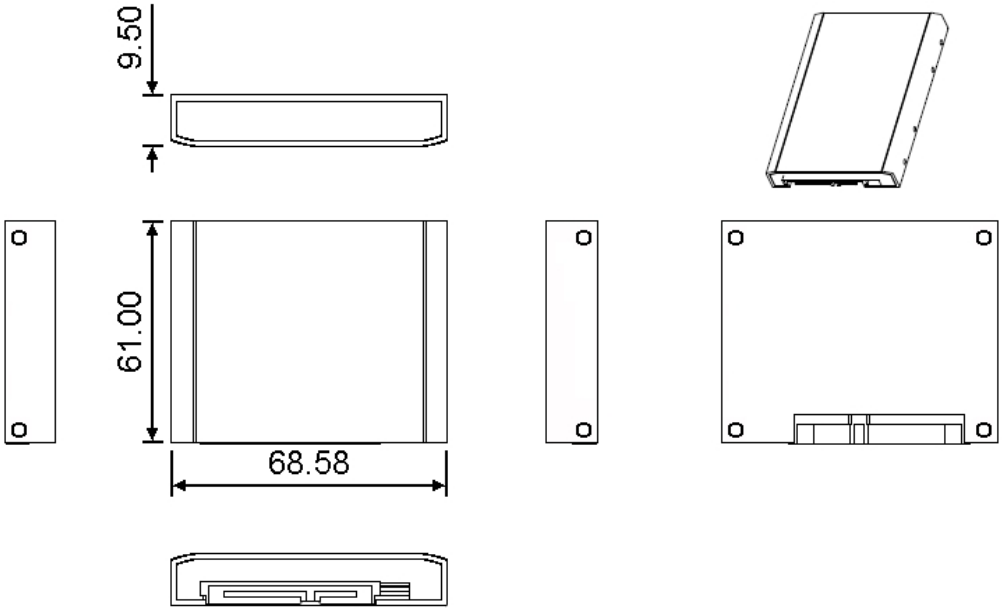
4 Block Diagram



5 Dimension



2.5 inch Form Factor



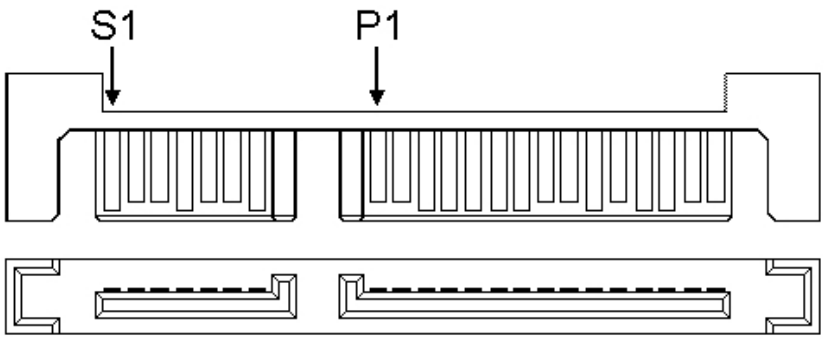
1.8 inch Form Factor

6 Pin Assignments

	Pin Number	Name	Type
Signal Segment	S1	GND	2nd mate
	S2	A+	Differential signal pair A
	S3	A-	
	S4	GND	2nd mate
	S5	B-	Differential signal pair B
	S6	B+	
	S7	GND	2nd mate
Power Segment	P1	V_{33}	3.3 V power
	P2	V_{33}	3.3 V power
	P3	V_{33}	3.3 V power, pre-charge, 2nd mate
	P4	GND	1st mate
	P5	GND	2nd mate
	P6	GND	2nd mate
	P7	V_5	5 V power, pre-charge, 2nd mate
	P8	V_5	5 V power
	P9	V_5	5 V power
	P10	GND	2nd mate
	P11	Reserved	1. The pin corresponding to P11 in the backplane receptacle connector is also reserved 2. The corresponding pin to be mated with P11 in the power cable receptacle connector shall always be grounded
	P12	GND	1st mate
	P13	V_{12}	12 V power, pre-charge, 2nd mate
	P14	V_{12}	12 V power
	P15	V_{12}	12 V power

Note:

1. *All pins are in a single row, with a 1.27 mm (.050") pitch.*



7 Capacity Specifications

The follow table is the default number of heads, sectors/track and cylinders.

SLC type Flash				
Unformatted Capacity	Cylinder	Head	Sector	CHS Capacity
128MB	246	16	63	126,328,832
256MB	493	16	63	253,739,008
512MB	987	16	63	508,690,432
1GB	1,974	16	63	1,017,954,304
2GB	3,949	16	63	2,037,219,328
4GB	7,899	16	63	4,075,061,248
8GB	15,798	16	63	8,150,712,320
16GB	33,704	15	63	16,302,768,128

MLC type Flash				
Unformatted Capacity	Cylinder	Head	Sector	CHS Capacity
256MB	485	16	63	249,610,240
512MB	971	16	63	500,432,896
1GB	1,942	16	63	1,001,439,232
2GB	3,884	16	63	2,003,697,664
4GB	7,769	16	63	4,007,985,152
8GB	15,538	16	63	8,016,560,128
16GB	33,149	15	63	16,034,299,904
32GB	66,298	15	63	32,069,222,400

8 Electrical Specifications

Symbol	Parameter	Rating	Units
V_{CC}	Power Supply	-0.3 to 5.5	V
V_{IN}	Input Voltage	-0.3 to V_{CC} +0.3	V
V_{OUT}	Output Voltage	-0.3 to V_{CC} +0.3	V
V_{CCQ}	Power supply for host I/O and embedded regulator	-0.6 to 5.5	V
V_{IN_HOST}	Input voltage for host I/O	-0.3 to V_{CCQ} +0.3	V
V_{OUT_HOST}	Output voltage for host I/O	-0.3 to V_{CCQ} +0.3	V
T_{OPR}	Commercial temperature grade	0° to +70°	℃
T_{STG}	Storage temperature	-55° to 150°	℃

9 DC Characters

Symbol	Parameter	Condition	MIN	TYP	MAX	Unit
DC sink current	I_{OL}		8			mA
Internal pull-up current			40		160	uA
Input low-voltage	V_{IL}				0.8	V
Input high-voltage	V_{IH}		2.0		5.0	V
Output low-voltage	V_{OL}		0		0.4	V
Output high-voltage	V_{OH}		2.6		3.6	V

10 AC Characters

Symbol	Parameter	Condition	MIN	TYP	MAX	Unit
Rising slew-rate			0.4	0.7	1.0	V/ns
Falling slew-rate			0.4	0.7	1.0	V/ns
Device Capacitance	C device				27	pF

11 Command Descriptions

11.1 Command Set

The following table summarizes the command defined in ATAPI-5 specification and lists the commands supported.

No.	Command set	Code	FR[1]	SC[1]	SN[1]	CY[1]	DR[1]	HD[1]	LBA[1]
1	CFA Erase Sector(s)	C0h	—	Y	Y	Y	Y	Y	Y
2	CFA Request Extended Error Code	03h	—	—	—	—	Y	—	—
3	CFA Translate Sector	87h	—	Y	Y	Y	Y	Y	Y
4	CFA Write Multiple w/o Erase	CDh	—	Y	Y	Y	Y	Y	Y
5	CFA Write Sector w/o Erase	38h	—	Y	Y	Y	Y	Y	Y
6	Check Power Mode	E5h	—	—	—	—	Y	—	—
7	Execute Device Diagnostic	90h	—	—	—	—	Y	—	—
8	Identify Device	ECh	—	—	—	—	Y	—	—
9	Idle	E3h	—	Y	—	—	Y	—	—
10	Idle Immediate	E1h	—	—	—	—	Y	—	—
11	Initialize Device Parameters	91h	—	Y	—	—	Y	Y	—
12	Read Buffer	E4h	—	—	—	—	Y	—	—
13	Read DMA	C8h	—	Y	Y	Y	Y	Y	Y
14	Read Multiple	C4h	—	Y	Y	Y	Y	Y	Y
15	Read Sector(s)	20h	—	Y	Y	Y	Y	Y	Y
16	Read Verify Sector(s)	40h	—	Y	Y	Y	Y	Y	Y
17	Seek	70h	—	—	Y	Y	Y	Y	Y
18	Set Features	EFh	Y	C	—	—	Y	—	—
19	Set Multiple Mode	C6h	—	Y	—	—	Y	—	—
20	Sleep	E6h	—	—	—	—	Y	—	—
21	Standby	E2h	—	—	—	—	Y	—	—
22	Standby Immediate	E0h	—	—	—	—	Y	—	—
23	Write Buffer	E8h	—	—	—	—	Y	—	—
24	Write DMA	CAh	—	Y	Y	Y	Y	Y	Y
25	Write Multiple	C5h	—	Y	Y	Y	Y	Y	Y
26	Write Sector	30h	—	Y	Y	Y	Y	Y	Y

Note:

1. *FR: Feature Register*
   SC: Sector Count register
   SN: Sector Number register
   CY: Cylinder Low/High register
   DR: Drive bit of Drive/Head register
   HD: Head No. (bit0-bit3) of Drive/Head register
   LBA: Logical Block Address Mode Supported.
2. *Y: Set up;*
   —: Not set up;
   C: The register contains command specific data

11.2 Descriptions

(1) CFA Erase Sector(s)

This command pre-erases and conditions from 1 to 256 sectors in the Sector Count register. This command must be issued in advance of CFA Write without Erase or CFA Write Multiple without Erase command to increase the execution speed of the write operation.

(2) CFA Request Extended Error Code

This command requests extended error information for the previous command. The extended error code is returned to the host in the Error Register.

(3) CFA Translate Sector

This command allows the host a method of determining the exact times a user sector has been erased and programmed. This controller will respond with a 512-byte buffer of information containing the desired cylinder, head and sector, including its Logical Address.

(4) CFA Write Multiple w/o Erase

This command is similar to Write Multiple command with the exception that an implied erase before write operation is not performed.

(5) CFA Write Sector w/o Erase

This command is similar to the Write Sector(s) command with the exception that an implied erase before write operation is not performed.

(6) Check Power Mode

This command allows the host to determine the current power mode of the device. This command will not cause this controller to change power mode.

(7) Execute Device Diagnostic

This command causes the controller to perform the internal diagnostic tests.

(8) Identify Device

This command enables the host to receive parameter information from the device. The following table specifies each field in the data returned by Identify Device command. Some values that are denoted “C” in the F/V column can be customized using the software provided by Afaya, please contact the representatives from Afaya.

Word address	F/V[1]	Description	Value
0	F X F X	General configuration bit-significant information: 15 0 = ATA device 14-8 Reserved. 7 0 = the device is a fixed disk 6-0 Reserved.	044Ah
1	V	Number of logical cylinders	xxxxh[1]
2	V	Specific configuration	0000h
3	F	Number of logical heads	xxxxh
4 - 5	X	Reserved	xxxxh
6	F	Number of logical sectors per logical track	xxxxh
7 - 8	X	Reserved	xxxxh
9	X	Reserved	0000h
10 to 19	C	Serial number (20 ASCII characters)	aaaa[2]
20	X	Reserved	0001h
21 - 22	X	Reserved	0004h
23 - 26	F	Firmware revision (8 ASCII characters)	aaaa
27 - 46	C	Model number (40 ASCII characters)	aaaa
47	F F	15-8 80h 7-0 01h = Maximum number of sector on Read/Write Multiple command	8001h
48	F	Reserved	0000h
49	F F F F F F F X	Capabilities 15-14 Reserved 13 0 = Standby timer is managed by this controller 12 Reserved 11 1 = IORDY supported. 10 1 = IORDY may be disabled. 9 1 = LBA mode addressing supported. 8 1 = DMA supported. 7 – 0 Reserved	0F00h
50	F	15- 0 0000h = the contents of word 50 is not valid.	0000h
51	F	Reserved.	0200h
52	X	Reserved	0000h
53	F F F	15- 3 Reserved. 2 1 = the field reported in word 88 are valid 1 1 = the field reported in word (70:64) are valid 0 1 = the field reported in word 54-58 are valid	0007h
54	V	Number of current logical cylinders	xxxxh
55	V	Number of current logical heads	xxxxh

56	V	Number of current logical sectors per track		xxxxh
57- 58	V	Current capacity in sectors		xxxxh
59	F V V	15- 9 8 7- 0	Reserved 1 = multiple sector setting is valid xxh = current setting for number of sectors that is transferred per interrupt on R/W Multiple commands.	0101h
60 - 61	F	Total number of user addressable sectors		xxxxh
62	X	Reserved		0000h
63	F V F F F F	15-11 10- 8 7- 3 2 1 0	Reserved. Multiword DMA mode 2-0 selected. Reserved. 1 = Multiword DMA mode 2, 1 and 0 are supported. 1 = Multiword DMA mode 1 and 0 are supported. 1 = Multiword DMA mode 0 is supported.	0407h
64	F C F	15- 2 1 0	Reserved 1 = PIO mode 4 is supported. 1 = PIO mode 3 is supported.	0003h
66	F	15- 0	0078h = minimum Multiword DMA transfer cycle time = 120 nano seconds.	0078h
67	F	15- 0	0078h = recommended Multiword DMA transfer cycle time = 120 nano seconds.	0078h
68	F	15- 0	0078h = minimum PIO transfer cycle time without flow control = 120 nano seconds.	0078h
69	F	15- 0	0078h = minimum PIO transfer cycle time with IORDY flow control = 120 nano seconds.	0078h
69 - 79	F	Reserved		0000h
80	F	15- 0	0000h = Major version number is not reported.	0000h
81	F	15- 0	0000h = Minor version number is not reported.	0000h
82	 X F F F X F F F F F	Command set supported. 15 14 13 12 11 10 9 8 7 6	 Reserved. 1 = NOP command supported. 1 = READ BUFFER command supported. 1 = WRITE BUFFER command supported. Reserved. 1 = Host Protected Area feature set supported. 1 = DEVICE RESET command supported. 1 = SERVICE interrupt supported. 1 = release interrupt supported. 1 = look-ahead supported.	3000h

	F	5	1 = write cache supported.	
	F	4	1 = Shall be cleared to zero.	
	F	3	1 = mandatory power management feature set supported.	
	F	2	1 = Removable Media feature set supported.	
	F	1	1 = Security Mode feature set supported.	
	F	0	1 = SMART feature set supported.	
83 - 84	F	15- 0	0000h = features/command sets supported are not indicated.	0000h
85		Command set/ feature enabled.		3000h
	X	15	Reserved.	
	F	14	1 = NOP command enabled.	
	F	13	1 = READ BUFFER command enabled.	
	F	12	1 = WRITE BUFFER command enabled.	
	X	11	Reserved.	
	V	10	1 = Host Protected Area feature set enabled.	
	F	9	1 = DEVICE RESET command enabled.	
	V	8	1 = SERVICE interrupt enabled.	
	V	7	1 = release interrupt enabled.	
	V	6	1 = look-ahead enabled.	
	V	5	1 = write cache enabled.	
	F	4	1 = Shall be cleared to zero.	
	F	3	1 = power management feature set enabled.	
	F	2	1 = Removable Media feature set enabled.	
	V	1	1 = Security Mode feature set enabled.	
	V	0	1 = SMART feature set enabled.	
85 - 87	F	15- 0	0000h = features/command sets enabled are not indicated.	0000h
88	F	15-13	Reserved.	001Fh
	V	12	1 = Ultra DMA mode 4 is selected	
	V	11	1 = Ultra DMA mode 3 is selected.	
	V	10	1 = Ultra DMA mode 2 is selected	
	V	9	1 = Ultra DMA mode 1 is selected.	
	V	8	1 = Ultra DMA mode 0 is selected.	
	F	7- 5	Reserved	
	C	4	1 = Ultra DMA mode 4 and below are supported.	
	F	3	1 = Ultra DMA mode 3 and below are supported.	
	C	2	1 = Ultra DMA mode 2 and below are supported.	

	F C	1 0	1 = Ultra DMA mode 1 and below are supported. 1 = Ultra DMA mode 0 is supported.	
89	F	Time required for security erase unit completion. 15- 0	0000h = value not specified.	0000h
90	F	Time required for Enhanced security erase unit completion. 15- 0	0000h = value not specified.	0000h
91	V	Current advanced power management value 15- 0	0000h = value not specified.	0000h
92	V	Master Password Revision Code.		0000h
93	V	Reserved.		0000h
94	V	15- 0	0000h = Automatic Acoustic Management feature set is not supported.	0000h
95 - 99	F	Reserved		0000h
100 - 103	V	The 48-bit Address feature set is not supported.		0000h
104 - 126	F	Reserved.		0000h
127	F F	Removable Media Status Notification feature set support 15 - 2 1- 0	Reserved. 00b = This feature set is not supported.	0000h
128	F F	Security Status 15 - 9 8 - 0	Reserved. 000h = Security Mode Feature set is no supported.	0000h
129 - 159	X	Reserved		0000h
160	F	15- 0	0000h = the CFA Power Mode 1 is not supported.	0000h
161 - 162	F	Reserved.		0000h
163	F	Reserved.		0000h
164	F	Reserved.		001Bh
165 - 175	F	Reserved.		aaaa
176 - 205	F	Current media serial number is not indicated.		0000h
206 - 254	F	Reserved.		0000h
255	F	Integrity word 15- 8 7 -0	Checksum Signature.	0000h

Note:

1. *F/V = Fixed/Variable content*
   F = the content of the word is fixed and does not change.
   V = the content of the word is variable and may be changed depending on the state of the device, commands executed.
   X = the content of the word may be fixed or variable.
   C = vendor specific data which can be customized before device shipping.

2. *aaaa indicates an ASCII vendor string; x indicates a numeric nibble value.*

(9) Idle

This command allows the host to place the device in the Idle mode and also set the Standby timer.

(10) Idle Immediate

This command allows the host to immediately place the device in the Idle mode.

(11) Initialize Device Parameters

This command enables the host to set the number of sectors per track and number of heads per cylinder.

(12) Read Buffer

This command enables the host to read the current contents of the device's sector buffer.

(13) Read DMA

This command allows the host to read data using the DMA data transfer protocol.

(14) Read Multiple

This command reads the a number of sectors specified in the Sector Count register. The number of sectors per block is defined by the content of word 59 in the Identify Device response. A successful Set Multiple Mode command has to precede this command.

(15) Read Sector(s)

This command reads from 1 to 256 sectors as specified in the Sector Count register. A sector count of 0 will be treated as 256 sectors. The transfer begins at the sector specified in the LBA Low, LBA Mid, LBA High and Device registers.

(16) Read Verify Sector(s)

This command is identical to Read Sector(s) command, except that DRQ is never set and no data is transferred to the host.

(17) Seek

This command allows the host to provide advanced notification that particular data may be requested by the host in a subsequent command.

(18) Set Features

This command is used by the host to establish parameters that affect the execution of certain features. The following table defines all features that are supported by this controller. If any subcommand input value is not supported or is invalid, this controller will return command aborted.

Feature	Operation
01h	Reserved.
02h	Enable Write Cache.
03h	Set transfer mode based on value in Sector Count register.
05h	Enable Advanced Power Management.
09h	Reserved.
0Ah	Reserved.
44h	Reserved.
55h	Disable Read Look Ahead feature.
66h	Disable reverting to power-on defaults.
69h	Reserved.
81h	Reserved.
82h	Disable Write Cache.
85h	Disable Advanced Power Management.
89h	Reserved.
8Ah	Reserved.
96h	Reserved.
97h	Reserved.
9Ah	Reserved.
AAh	Enable Read Lock Ahead feature.
BBh	Reserved.
CCh	Enable reverting to power-on defaults.

(19) Set Multiple Mode

Upon receipt of this command, the controller will perform Read and Write Multiple operations and establishes the block count for these commands. This controller will set BSY to 1 and checks the Sector Register for the number of sectors per block.

(20) Sleep

Upon receipt of this command, the controller will set BSY and enter Sleep mode, clear BSY and generate an interrupt.

(21) Standby

This command will cause the device to enter Standby mode. The value in the Sector Count register is used to determine the time programmed into the Standby timer.

(22) Standby Immediate

This command will cause the device to immediately enter Standby mode.

(23) Write Buffer

This command allows the host to overwrite contents of a sector buffer with any data pattern desired.

(24) Write DMA

This command allows the host to write data using the DMA data transfer protocol.

(25) Write Multiple

This command is similar to the Write Sector(s) command. Interrupts are not presented on each sector but on the transfer of a block that contains the number of sectors defined by Set Multiple.

(26) Write Sector

This command writes from 1 to 256 sectors as specified in the Sector Count register. A sector count of 0 will be treated as 256 sectors. This controller will interrupt for each DRQ block transferred.

12 Ordering Information

12.1 2.5 inch Form Factor

Capacity	Standard Temperature
128MB	SFD-25SM128MBCFX[1]
256MB	SFD-25SM256MBCFX[1]
512MB	SFD-25SM512MBCFX[1]
1GB	SFD-25SM001GBCFX[1]
2GB	SFD-25SM002GBCFX[1]
4GB	SFD-25SM004GBCFX[1]
8GB	SFD-25SM008GBCFX[1]
16GB	SFD-25SM016GBCFX[1]
32GB	SFD-25SM032GBCFX[1]

Note:
1. X[1]: Transfer Mode. (P: PIO Mode 4, U: UDMA Mode4)

12.2 1.8 inch Form Factor

Capacity	Standard Temperature
128MB	SFD-18SM128MBCFX[1]
256MB	SFD-18SM256MBCFX[1]
512MB	SFD-18SM512MBCFX[1]
1GB	SFD-18SM001GBCFX[1]
2GB	SFD-18SM002GBCFX[1]
4GB	SFD-18SM004GBCFX[1]
8GB	SFD-18SM008GBCFX[1]
16GB	SFD-18SM016GBCFX[1]
32GB	SFD-18SM032GBCFX[1]

Note:
1. X[1]: Transfer Mode. (P: PIO Mode 4, U: UDMA Mode4)

12.3 Product Number decoder

$X_1X_2X_3$-$X_4X_5X_6X_7X_8X_9X_{10}X_{11}X_{12}X_{13}X_{14}X_{15}$

$X_1X_2X_3$: Product Name
SFD: SATA Flash Disk

X_4X_5: Connector Position
25: 2.5 inch form factor
18: 1.8 inch form factor

X_6X_7: Controller Chip
SM: SMI-SM223

$X_8X_9X_{10}X_{11}X_{12}$: Product Capacity
128MB: 128M Byte
256MB: 256M Byte
512MB: 512M Byte
001GB: 1G Byte
002GB: 2G Byte
004GB: 4G Byte
008GB: 8G Byte
016GB: 16G Byte
032GB: 32G Byte

X_{13}: Operation Temperature
C: Standard Temperature(0~+70℃)

X_{14}: Disk Mode
F: Fix Disk Mode

X_{15}: Transfer Mode
P: PIO Mode 4
U: UDMA Mode4