

SiliconDrive III

1.8-inch Micro SATA Drive

SSD-FxxxxS(C/I)-5000

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2679-771246-A02

Document Control Number Definition:

2679-771xxx-	0xx-Px	NRD
Doc Control No.	Doc Revision Level (WD Hard Drives)	Non-Released Document
	Oxx = Released Version	
	Px = Review Cycle	

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SiliconDrive III 1.8-inch Micro SATA Drive

Data Sheet



REVISION HISTORY

Document No.	Release Date	Changes
2679-771246-A02	11/20/09	Updated: <ul style="list-style-type: none"> • Link to supplemental ATA specs document.
2679-771246-A01	11/13/09	Updated: <ul style="list-style-type: none"> • Service life.
2679-771246-A00	11/09/09	Updated: <ul style="list-style-type: none"> • Targeted read transfer rate. • Targeted write transfer rate.
5000FS-03DSR	7/1/09	Updated: <ul style="list-style-type: none"> • New template. • Capacity.
5000FS-02DSR	6/9/09	Updated: <ul style="list-style-type: none"> • Write transfer rate. • Standby rate. • "Projected Operational Life Span" table. • I_{CCS} in the "DC Characteristics" table. • "ATA Commands."
5000FS-01DSR	6/1/09	Updated: <ul style="list-style-type: none"> • Write transfer rate. • Standby and Write power consumption rates/system power requirements. • "System Performance" table. • "Projected Operational Life Span" table. • I_{CCS} in the "DC Characteristics" table. • "ATA Commands." • "IDENTIFY DEVICE Information" table.
5000FS-00DSR	5/26/09	Initial release.

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1.0 DESCRIPTION AND FEATURES

1.1 Overview

The SiliconDrive III 1.8-inch Micro SATA Drive is an optimal time-to-market replacement for hard drives and flash cards in host systems that require low power and scalable storage solutions.

Numerous Western Digital patented and patent-pending application-specific technologies can be integrated into SiliconDrive III to safeguard application data and software IP. Application notes detailing these performance-enhancing options are available under NDA.

SiliconDrive III technology is engineered exclusively for the high performance, high reliability and multi-year product lifecycle requirements of the embedded and communications market. Typical end-market applications include broadband data and voice networks, military systems, flight system avionics, medical equipment, industrial control systems, video surveillance, storage networking, VoIP, wireless infrastructure, and interactive kiosks.

Every SiliconDrive III is integrated with Western Digital's patented PowerArmor and patent-pending SiSMART technologies to virtually eliminate storage system failures.

PowerArmor prevents data corruption and loss from power disturbances by integrating patented technology into every SiliconDrive III.

SiSMART acts as an early warning system to eliminate unscheduled downtime by constantly monitoring and reporting the exact amount of remaining storage system useful life.

1.2 Features

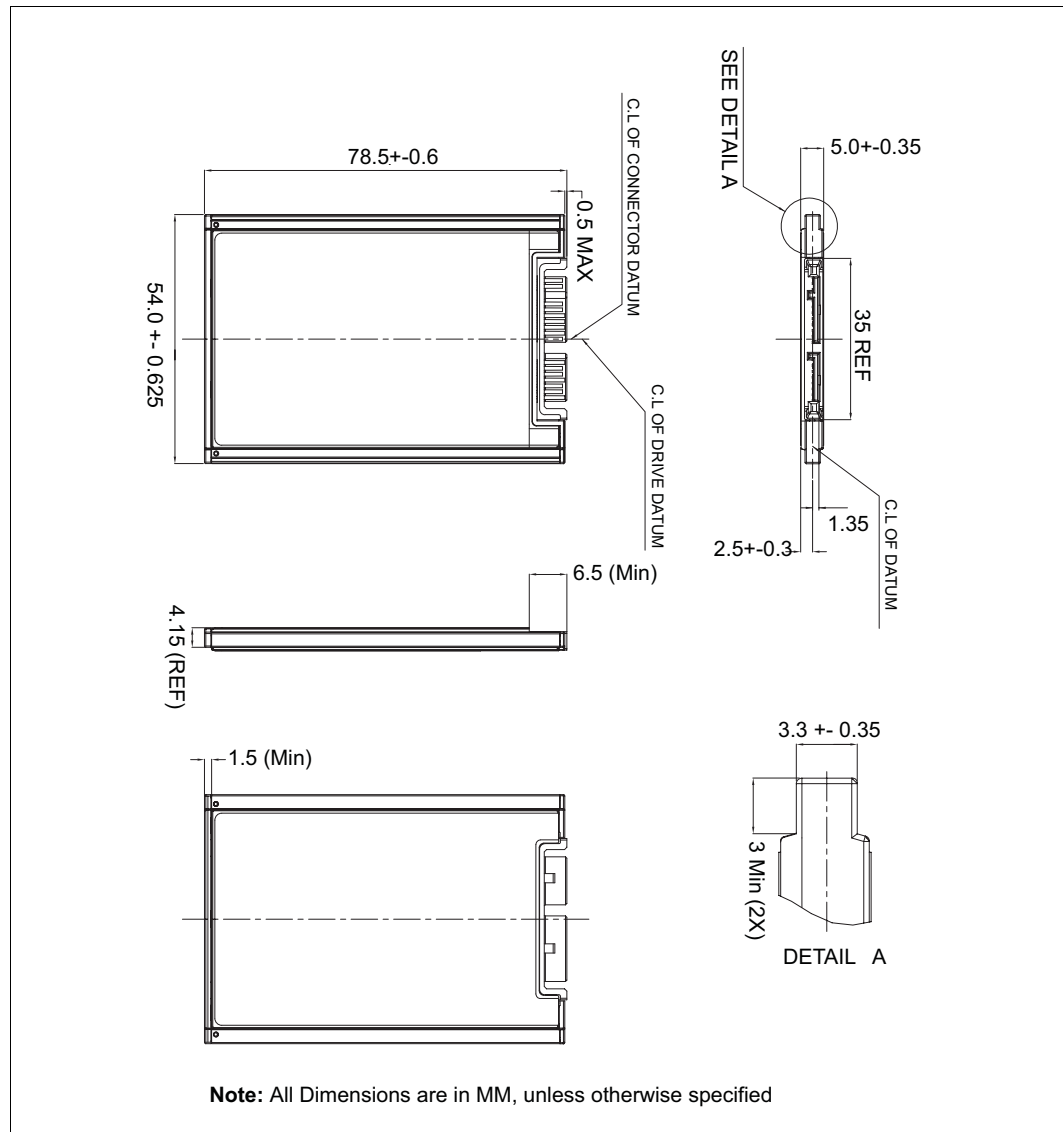
- RoHS 6 of 6 compliant
- Integrated PowerArmor and SiSMART technology
- Available Capacities: 15 GB to 60 GB
- MTBF: 3,000,000 hours
- SATA 3.0 Gbit/s compliant
- Hot-swappable
- Form factor: 1.8-inch micro SATA drive
- Targeted read transfer rate: Up to 100 MB/s
- Targeted write transfer rate: Up to 68 MB/s
- Burst transfer rate: 133 MB/s
- Temperature:
 - -40°C to 85°C (Industrial)
 - 0°C to 70°C (Commercial)
- Power consumption:
 - Standby: 0.7W
 - Read: 1.5W
 - Write: 2W
- Vibration: 16.3gRMS
- Shock: 1000G
- Altitude: 80,000 ft.

2.0 PHYSICAL SPECIFICATIONS

The SiliconDrive III 1.8-inch Micro SATA Drive product is offered in an industry-standard 1.8-inch Micro SATA Drive form factor. See “Part Numbering” on page 27 for details regarding 1.8-inch Micro SATA Drive capacities.

2.1 Physical Dimensions

Figure 2-1. Physical Dimensions



3.0 PRODUCT SPECIFICATIONS

Note: All SiliconDrive III 1.8-inch Micro SATA Drive values quoted are typical at 25°C and nominal supply voltage.

3.1 System Performance

Table 3-1. System Performance

Targeted Read Transfer Rate	Up to 100 MB/s
Targeted Write Transfer Rate	Up to 68 MB/s
Burst Transfer Rate	133 MB/s
Latency (Command to DRQ)	250 μ s

3.2 System Power Requirements

Table 3-2. System Power Requirements

DC Input Voltage	5.0 \pm 10%
Sleep (Standby)	0.7W
Read (Peak)	1.5W
Write (Peak)	2W

3.3 Reliability

Table 3-3. Reliability

MTBF (@ 25°C)	3,000,000 hours
Bit Error Rate	Bit Error Rate: <1 non-recoverable error in 10 ¹⁶ bits read
Data Retention	10 years

3.4 Projected Operational Life Span

Table 3-4. Operational Life Span

SiliconDrive Part#	Capacity	Service Life*		GB Written per Day
SSD-F0060S(C/I)-5000	60 GB	11.5 Years	@	1434.4 GB
SSD-F0030S(C/I)-5000	30 GB	5.7 Years	@	1434.4 GB
SSD-F0015S(C/I)-5000	15 GB	2.9 Years	@	1434.4 GB

* There are unlimited read cycles. Service life is determined using WD's LifeEST calculation at 100% duty cycle with 25% write cycles.

LifeEST is a comprehensive measurement that considers numerous factors to determine the projected life span of a SiliconDrive. A white paper that describes the benefits of LifeEST and how to calculate it can be found at http://www.wdc.com/WDProducts/SSD/whitepapers/en/NAND_Evolution_0812.pdf.

The actual life of a SiliconDrive is dependent on the customer usage model. SiSMART is a patented technology of WD that enables host systems to monitor actual usage of a SiliconDrive in real time. SiSMART measures and reports the remaining life of a SiliconDrive. For more information on SiSMART, refer to the *Eliminating Unscheduled Downtime by Forecasting Useable Life* white paper at http://www.wdc.com/WDProducts/SSD/whitepapers/en/SiliconDrive_SiSMART.pdf.

3.5 Product Capacity Specifications

Table 3-5. Product Capacity Specifications

Product Capacity	Formatted Capacity (Bytes)	Number of Sectors
15GB	15,013,748,736	29,323,728
30 GB	30,016,659,456	58,626,288
60 GB	60,022,480,896	117,231,408

Note: As used for storage capacity, one megabyte (MB) = one million bytes and one gigabyte (GB) = one billion bytes. Total accessible capacity varies depending on operation environment.

3.6 Environmental Specifications

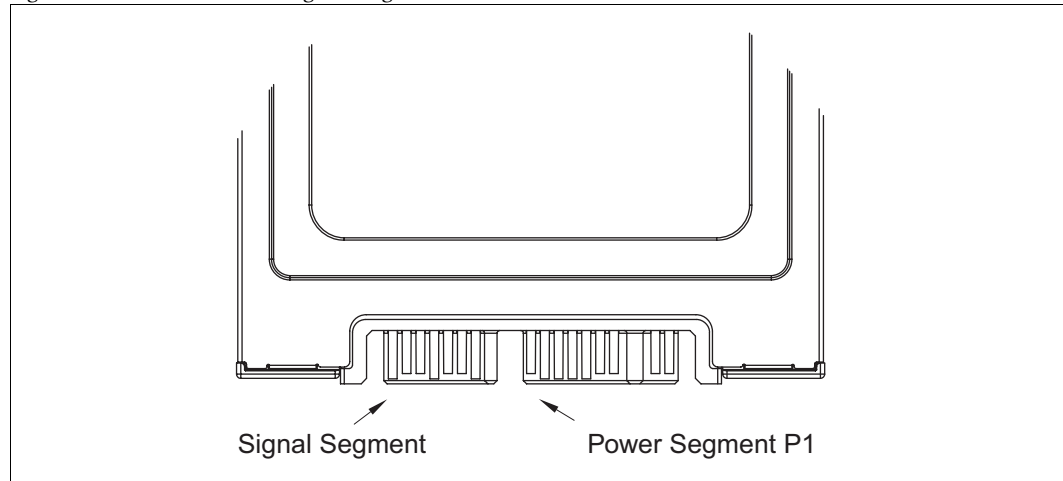
Table 3-6. Environmental Specifications

Temperature	0°C to 70°C (Commercial)-40°C to 85°C (Industrial)
Humidity	8% to 95% non-condensing
Vibration	16.3gRMS, MIL-STD-810F, Method 514.5, Procedure I, Category 24
Shock	1000G, Half-sine, 0.5 ms Duration 50g Pk, MIL-STD-810F, Method 516.5, Procedure I
Altitude	80,000ft, MIL-STD-810F, Method 500.4, Procedure II

4.0 ELECTRICAL SPECIFICATION

The following diagram illustrates the SATA power and signal configuration.

Figure 4-1. SATA Power and Signal Diagram



For 1.8" Micro SATA Drive signal descriptions, pin assignments, and AC characteristics, refer to the D1699 ATA8-ACS specification document. Go to: <http://www.t13.org>.

4.1 Absolute Maximum Ratings

Table 4-1. Absolute Maximum Ratings

Symbol	Parameter	Minimum	Maximum	Units
T _S	Storage Temperature	-55	125	°C
T _A	Operating Temperature	-40	85	°C
V _{CC}	V _{CC} with Respect to GND	-0.5	V _{CC} + 0.5	V
V _{OUT}	Output Voltage	-	5.8	V

4.2 DC Characteristics

Table 4-2. DC Characteristics

Symbol	Parameter	5V ± 10%		Units
		Minimum	Maximum	
V _{CC} 5V	Power Supply Voltage	4.5	5.5	V
I _{CCR}	I _{CC} Read Current	-	300	mA
I _{CCW}	I _{CC} Write Current	-	400	mA
I _{CCS}	I _{CC} Standby Current	-	135	mA

5.0 ATA COMMANDS

The following table specifies which commands are supported by SiliconDrive III. Refer to the for more information on the commands.

Table 5-1. ATA Commands

Command	Command Code	Supported?
NOP	00h	Yes
CFA REQUEST EXTENDED ERROR	03h	No
DEVICE RESET	08h	No
READ SECTOR(S)	20h	Yes
READ SECTOR(S) EXT	24h	Yes
READ DMA EXT	25h	Yes
READ DMA QUEUED EXT	26h	No
READ FPDMA QUEUED	60h	Yes
READ NATIVE MAX ADDRESS EXT	27h	No
READ MULTIPLE EXT	29h	Yes
READ LOG EXT	2Fh	No
WRITE SECTOR(S)	30h	Yes
WRITE SECTOR(S) EXT	34h	Yes
WRITE DMA EXT	35h	Yes
WRITE DMA QUEUED EXT	36h	No
WRITE FPDMA QUEUED	61h	Yes
SET MAX ADDRESS EXT	37h	No
CFA WRITE SECTORS W/OUT ERASE	38h	No
WRITE MULTIPLE EXT	39h	Yes
WRITE LOG EXT	3Fh	No
READ VERIFY SECTOR(S)	40h	Yes
READ VERIFY SECTOR(S) EXT	42h	Yes
SEEK	70h	Yes
CFA TRANSLATE SECTOR	87h	No
EXECUTE DEVICE DIAGNOSTIC	90h	Yes
DOWNLOAD MICROCODE	92h	No
PACKET	A0h	No
IDENTIFY PACKET DEVICE	A1h	No
SERVICE	A2h	No
SMART DISABLE OPERATIONS	B0h	No
SMART ENABLE/DISABLE AUTOSAVE	B0h	No
SMART ENABLE OPERATIONS	B0h	No
SMART EXECUTE OFF_LINE	B0h	No
SMART READ DATA	B0h	No
SMART READ LOG SECTOR	B0h	No

Table 5-1. ATA Commands (Continued)

Command	Command Code	Supported?
SMART RETURN STATUS	B0h	No
SMART WRITE LOG SECTOR	B0h	No
DEVICE CONFIGURATION FREEZE LOCK	B1h	No
DEVICE CONFIGURATION IDENTIFY	B1h	No
DEVICE CONFIGURATION RESTORE	B1h	No
DEVICE CONFIGURATION SET	B1h	No
CFA ERASE SECTORS	C0h	No
READ MULTIPLE	C4h	Yes
WRITE MULTIPLE	C5h	Yes
SET MULTIPLE MODE	C6h	Yes
READ DMA QUEUED	C7h	No
READ DMA	C8h	Yes
WRITE DMA	CAh	Yes
WRITE DMA QUEUED	CCh	No
CFA WRITE MULTIPLE W/OUT ERASE	CDh	No
CHECK MEDIA CARD TYPE	D1h	No
GET MEDIA STATUS	DAh	No
MEDIA LOCK	DEh	No
MEDIA UNLOCK	DFh	No
STANDBY IMMEDIATE	E0h	Yes
IDLE IMMEDIATE	E1h	Yes
STANDBY	E2h	Yes
IDLE	E3h	Yes
READ BUFFER	E4h	Yes
CHECK POWER MODE	E5h	Yes
SLEEP	E6h	Yes
FLUSH CACHE	E7h	Yes
WRITE BUFFER	E8h	Yes
FLUSH CACHE EXT	EAh	Yes
IDENTIFY DEVICE	ECh	Yes
MEDIA EJECT	EDh	No
SET FEATURES (Set Transfer Mode 03h Only)	EFh	Yes
SECURITY SET PASSWORD	F1h	No
SECURITY UNLOCK	F2h	No
SECURITY ERASE PREPARE	F3h	No
SECURITY ERASE UNIT	F4h	No
SECURITY FREEZE LOCK	F5h	No
SECURITY DISABLE PASSWORD	F6h	No
READ NATIVE MAX ADDRESS	F8h	No

Table 5-1. ATA Commands (Continued)

Command	Command Code	Supported?
SET MAX ADDRESS	F9h	No

5.1 Identify Device Information

The information in the following table is returned upon issuing an IDENTIFY DEVICE command to the SiliconDrive III. Fields marked as Reserved or Obsolete in the SATA 2.6 specification are omitted in this table.

Table 5-2. IDENTIFY DEVICE Information

Word	Value		Description
0	0040h	15 7 6	General configuration bit-significant information: 0 = ATA device 0 = Fixed device 1 = Device is not removable
2	C837h	-	Specific configuration
23-26	XXXXh	-	Firmware revision (eight ASCII characters)
27-46	XXXXh	-	Model number (40 ASCII characters)
47	8001h	15-8 7-0 - -	Multiple count: 80h 00h = Reserved 01h-10h = Maximum number of sectors that shall be transferred per interrupt on READ/WRITE MULTIPLE commands 11h-FFh = Reserved
49	0F00h	13 12 11 10 9 8	Capabilities: 0 = Standby timer values shall be managed by the device 0 = Standby timer values shall be managed by the device 1 = IORDY is supported 1 = IORDY may be disabled 1 = LBA is supported 1 = DMA is supported
50	4000h	15 14 0	Capabilities: Shall be set to 0 Shall be set to 1 Shall be set to one to indicate a device specific Standby timer value minimum
53	0007h	2 1	Field validity: 1 = Fields reported in word 88 are valid 1 = Fields reported in words 64-70 are valid
59	0101h	8 7-0	1 = Multiple sector setting is valid Xh = Current setting for number of sectors that shall be transferred per interrupt on R/W Multiple command

Table 5-2. IDENTIFY DEVICE Information (Continued)

Word	Value		Description
60-61	XXXXh	-	Total number of user addressable sectors
63	XXX7h	10 9 8 2 1 0	1/0 = Multiword DMA mode 2 is selected/not selected 1/0 = Multiword DMA mode 1 is selected/not selected 1/0 = Multiword DMA mode 0 is selected/not selected 1 = Multiword DMA mode 2 and below are supported 1 = Multiword DMA mode 1 and below are supported 1 = Multiword DMA mode 0 is supported
64	0003h	7-0	PIO modes supported
65	0078h	15-0	Minimum Multiword DMA transfer cycle time per word: Cycle time in nanoseconds
66	0078h	15-0	Manufacturer's recommended Multiword DMA transfer cycle time: Cycle time in nanoseconds
67	0078h	15-0	Minimum PIO transfer cycle time without flow control: Cycle time in nanoseconds
68	0078h	15-0	Minimum PIO transfer cycle time with IORDY flow control: Cycle time in nanoseconds
75	0000h	4-0	Queue depth: Maximum queue depth - 1
76	0106h	15-13 12 11 10 9 8 2 1 0	Serial ATA capabilities: Reserved 0 = Does not support Native Command Queuing priority information 0 = Does not support Unload while NCQ commands are outstanding 0 = Does not support PHY event counters 0 = Does not support receipt of host-initiated interface power management requests 1 = Supports Native Command Queuing 1 = Supports SATA Gen2 signaling speed (3.0 Gbit/s) 1 = Supports SATA Gen1 signaling speed (1.5 Gbit/s) Shall be set to 0
78	0002h	6 4	Serial ATA features supported: 0 = Does not support software settings preservation 0 = Does not support in-order data delivery

Table 5-2. IDENTIFY DEVICE Information (Continued)

Word	Value		Description
		3	0 = Device does not support initiating interface power management
		2	0 = Does not support DMA Setup Auto-Activate optimization
		1	1 = Does not support non-zero buffer offsets in DMA Setup FIS
		0	Shall be set to 0
79	0000h		Serial ATA features enabled:
		6	0 = Software settings preservation is disabled
		4	0 = In-order data delivery is disabled
		3	0 = Device initiating interface power management is disabled
		2	0 = DMA Setup Auto-Activate Optimization is disabled
		1	0 = Non-zero buffer offsets in DMA Setup FIS is disabled
		0	Shall be cleared to 0
80	0070h		Major version number:
		-	0000h or FFFFh = Device does not report version
		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	0 = Does not support ATA-3
81	0000h		Minor version number:
		-	0000h or FFFFh = device does not report version
82	7008h		Command set supported:
		14	1 = NOP command is supported
		13	1 = READ BUFFER command is supported
		12	1 = WRITE BUFFER command is supported
		10	0 = Host Protected Area feature set is not supported
		9	0 = DEVICE RESET command is not supported
		8	0 = SERVICE interrupt is not supported
		7	0 = Release interrupt is not supported
		6	0 = Look-ahead is not supported
		5	0 = Write cache is not supported
		4	Shall be cleared to 0 to indicate that the PACKET Command feature set is not supported
		3	1 = Mandatory Power Management feature set is supported
		2	0 = Does not support Removable Media feature set

Table 5-2. IDENTIFY DEVICE Information (Continued)

Word	Value		Description
		1	0 = Does not support Security Mode feature set
		0	0 = Does not support SMART feature set
83	5400h	15	Command sets supported: Shall be cleared to 0
		14	Shall be set to 1
		13	1 = FLUSH CACHE EXT command is supported
		12	1 = Mandatory FLUSH CACHE command is supported
		11	0 = Device Configuration Overlay feature set is not supported
		10	1 = 48-bit Address feature set is supported
		9	0 = Automatic Acoustic Management feature set is not supported
		8	0 = SET MAX security extension is not supported
		7	See Address Offset Reserved Area Boot, NCITS TR27:2001
		6	0 = SET FEATURES subcommand is not required to spinup after power-up
		5	0 = Power-Up In Standby feature set is not supported
		4	0 = Removable Media Status Notification feature set is not supported
		3	0 = Advanced Power Management feature set is not supported
		2	0 = CFA feature set is not supported
		1	0 = READ/WRITE DMA QUEUED is not supported
		0	0 = DOWNLOAD MICROCODE command is not supported
84	4000h	15	Command set/feature supported extension: Shall be set to 0
		14	Shall be set to 1
		5	0 = General Purpose Logging feature set is not supported
		3	0 = Media Card Pass Through Command feature set is not supported
		2	0 = Media serial number is not supported
		1	0 = SMART self-test is not supported

Table 5-2. IDENTIFY DEVICE Information (Continued)

Word	Value		Description
		0	0 = SMART error logging is not supported
85	7008h	14 13 12 10 9 8 7 6 5 4 3 2 1 0	Command set/feature enabled: 1 = NOP command is enabled 1 = READ BUFFER command is enabled 1 = WRITE BUFFER command is enabled 0 = Host Protected Area feature set is disabled 0 = DEVICE RESET command is disabled 0 = SERVICE interrupt is disabled 0 = Release interrupt is disabled 0 = Look-ahead is disabled 0 = Write cache is disabled Shall be cleared to 0 to indicate that the PACKET Command feature set is not supported 1 = Power Management feature set is enabled 0 = Removable Media feature set is disabled 0 = Security Mode feature set is disabled 0 = SMART feature set is disabled
86	3400h	13 12 11	Command set/feature enabled: 1 = FLUSH CACHE EXT command is supported 1 = FLUSH CACHE command is supported 0 = Device Configuration Overlay is not supported

Table 5-2. IDENTIFY DEVICE Information (Continued)

Word	Value		Description
		10	1 = 48-bit Address features set is supported
		9	0 = Automatic Acoustic Management feature set is disabled
		8	0 = SET MAX security extension is disabled by SET MAX SET PASSWORD
		7	See Address Offset Reserved Area Boot, NCITS TR27:2001
		6	0 = SET FEATURES subcommand is not required to spin-up after power-up
		5	0 = Power-Up In Standby feature set is disabled
		4	0 = Removable Media Status Notification feature set is disabled
		3	0 = Advanced Power Management feature set is disabled
		2	0 = CFA feature set is disabled
		1	0 = READ/WRITE DMA QUEUED command is not supported
		0	0 = DOWNLOAD MICROCODE command is not supported
87	4000h		Command set/feature default:
		15	Shall be set to 0
		14	Shall be set to 1
		5	0 = General Purpose Logging feature set is not supported
		3	0 = Media Card Pass Through Command feature set is disabled
		2	0 = Media serial number is invalid
		1	0 = SMART self-test is not supported
		0	0 = SMART error logging is not supported
88	XX7Fh		
		13	1/0 = UDMA mode 5 is selected/not selected
		12	1/0 = UDMA mode 4 is selected/not selected
		11	1/0 = UDMA mode 3 is selected/not selected
		10	1/0 = UDMA mode 2 is selected/not selected
		9	1/0 = UDMA mode 1 is selected/not selected
		8	1/0 = UDMA mode 0 is selected/not selected
		6	1 = Ultra DMA mode 6 and below are supported

Table 5-2. IDENTIFY DEVICE Information (Continued)

Word	Value		Description
		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	0000h	-	Time required for security erase unit completion
90	0000h	-	Time required for Enhanced security erase completion
91	0000h	-	Current advanced power management value
92	0000h	-	Master Password Revision Code
93	0000h	-	COMRESET result — the contents of this word shall be cleared to 0
94	0000h	15-8	Vendor's recommended acoustic management value
		7-0	Current automatic acoustic management value
100-103	XXXXh XXXXh XXXXh XXXXh	-	Maximum user LBA for 48-bit Address feature set
127	0000h	1-0	00 = Removable Media Status Notification feature set is not supported
128	0000h	8	Security status: Security level 0 = High
		5	0 = Enhanced security erase is not supported
		4	0 = Security count is not expired
		3	0 = Security is not frozen
		2	0 = Security is unlocked
		1	0 = Security is disabled
		0	0 = Security is not supported

6.0 ATA SPECIFICATIONS

For 1.8" Micro SATA Drive signal descriptions, pin assignments, and AC characteristics, refer to the D1699 ATA8-ACS specification document. Go to: <http://www.t13.org>.

7.0 SALES AND SUPPORT

To order or obtain information on pricing and delivery, contact your WD Sales Representative.

8.0 PART NUMBERING

8.1 Nomenclature

The following table defines the SiliconDrive III 1.8-inch Micro SATA Drive part numbering scheme.

SSD- (Product Family)	F (Form Factor)	YYYY (Capacity)	X (Interface)	X (Temperature)	-5000 (Part Number Suffix)
					K = Kit
					<ul style="list-style-type: none"> I = -40°C to 85°C (Industrial) C = 0°C to 70°C (Commercial)
			S = SATA		
		Capacity: 0015 = 15 GB to 0060 = 60 GB			
	1.8" Micro SATA Drive				
WD's SiliconDrive					

8.2 Part Numbers

The following table lists the SiliconDrive III part numbers.

Table 8-1. Part Numbers

Part Number	Capacity
SSD-F0060S(C/I)-5000	60 GB
SSD-F0030S(C/I)-5000	30 GB
SSD-F0015S(C/I)-5000	15 GB

8.3 RoHS 6 of 6 Product Labeling — Pb-Free Identification Label



The Pb-free identification label indicates that the enclosed components/devices and/or assemblies do not contain any lead (i.e., they are lead-free, as defined in RoHS directive 2002/95/ED). The above symbol is on all RoHS 6 of 6 compliant product labels.

9.0 RELATED DOCUMENTATION

For more information, visit <http://www.wdc.com> or contact your WD Sales Representative.

Table 9-1. Related Documentation

SiliconDrive III	Description	Document
ATA Specification Reference Document	Supplemental ATA specification information.	D1699 ATA8-ACS specification. Go to: http://www.t13.org .
PowerArmor	Eliminates drive corruption.	<i>Eliminating Drive Corruption from Power Disturbances White Paper</i> (http://www.wdc.com/WDProducts/SSD/whitepapers/en/SiliconDrive_PowerArmor.pdf)
SiSMART	Calculates remaining useful life.	<i>Eliminating Unscheduled Downtime by Forecasting Solid State Drive (SSD) Useable Life White Paper</i> (http://www.wdc.com/WDProducts/SSD/whitepapers/en/SiliconDrive_SiSMART.pdf)

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2679-771246-A02
Nov 2009

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