



Datasheet

G4000 / G4000 Pro SATA3 Solid State Drive

Version 0.2

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Document Version

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0.1	Primary	2013 Dec	Justin Hsu	Richard Wei
0.2	Modify performance result	2014 Feb	Justin Hsu	Richard Wei

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1. Introduction

1.1 General Description

Pretec G4000 series SSD support SATA III 6.0 Gb/s and compatible SATA II 3.0 Gb/s. SSD Processors is architected to leverage today's densest MLC NAND Flash memory, G4000 Pro use SLC NAND Flash memory. Which available in memory capacities 16GB, 32GB, 64GB and 128GB, this is the best solution for Industrial Equipment as a storage device.

G4000 is designed to meet the stringent demands of server environments and enterprise applications. These new premium offerings are the pinnacle storage option excelling in performance, reliability, and power consumption that offer professionals and enthusiasts an unparalleled computing experience.

1.2 Feature

- Supports SATAIII 6.0Gb/s, SATAII 3.0Gb/s, SATAI 1.5Gb/s and ATA-8 Command Set
- Support Asynchronous, Synchronous (Toggle & ONFI) Nand Flash
- Native Command Queuing support
- S.M.A.R.T. command transport (SCT) technology
- Superior wear-leveling
- Intelligent Flash memory block management
- Up to 40 bits correctable per 512-byte sector (BCH) ECC Recovery
- Self-monitoring
- RoHS CE and FCC compatibility
- Halogen-free
- Shock/Vibration
 - Operating 50G duration 0.5ms half sine wave
 - Vibration 15Gpeak 10~2000Hz with (15mins/Axis) 3axis
- Humidity:
 - 0°C~55°C/5~95% RH 10cycles
- Temperature
 - Standard Operating Temperature: 0°C~70°C
 - Extended Operating Temperature: -40°C~85°C
 - Storage Temperature: -55°C~95°C
- Low Power consumption: 3W Active, 0.4W Idle

Spec

Form factor	Size	Capacity
2.5"	100.10 x 69.85 x 6.9mm	16GB, 32GB, 64GB, 128GB

Performance

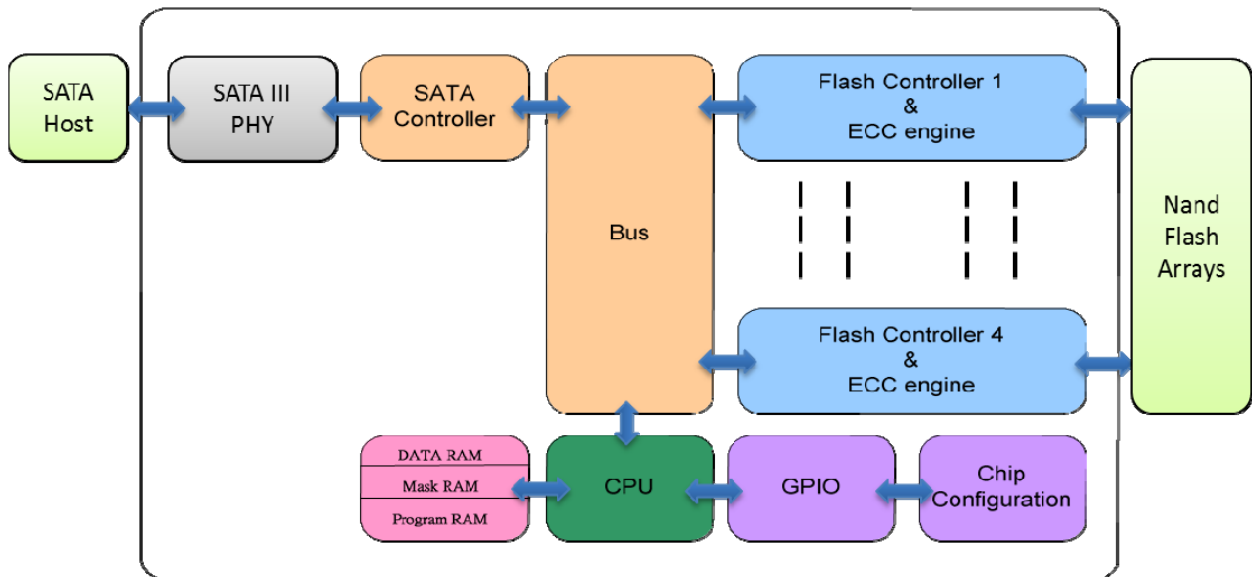
Item	Max Read	Max Write	Random 4K read	Random 4K write
G4000	150 MB/Sec	150 MB/Sec	Up to 5265 IOPS	Up to 6300 IOPS

1.3 Application

Consumer application: Desktops, Laptops, Smart TV, STB, etc.

Industrial PCs: Rugged laptops, military devices, thin clients, POS, telecom, medical instruments, etc.

1.4 SSD Functional Block Diagram



1.5 Part Number Definition

Code	Definition	symbol	Description
X ₁ X ₂	Product	SA	2.5" SSD
X ₃ X ₄ X ₅ X ₆	Model Series	4000	SATA III G4000
X ₇ X ₈ X ₉ X ₁₀	Total Capacity	016G	16GB
		032G	32GB
		064G	64GB
		128G	128GB
X ₁₁	Housing	Q	Non Housing
X ₁₂		-	-
X ₁₃	Operating temperature	C	0°C~70°C
		H	-40°C~85°C
X ₁₄	Solution	A	SLC
		B	MLC

1.6 Ordering Information

Part Number	Capacity	Description
SA4000032GM-CB	32 GB	G4000 32GB SATA III SSD Consumer (0°C~70°C)
SA4000064GM-CB	64 GB	G4000 64GB SATA III SSD Consumer (0°C~70°C)
SA4000128GM-CB	128 GB	G4000 128GB SATA III SSD Consumer (0°C~70°C)

Part Number	Capacity	Description
SA4000032GM-HB	32 GB	G4000 32GB SATA III SSD Industrial (-40°C~85°C)
SA4000064GM-HB	64 GB	G4000 64GB SATA III SSD Industrial (-40°C~85°C)
SA4000128GM-HB	128 GB	G4000 128GB SATA III SSD Industrial (-40°C~85°C)

Part Number	Capacity	Description
SA4000016GM-HA	16 GB	G4000 Pro 16GB SATA III SSD Industrial (-40°C~85°C)
SA4000032GM-HA	32 GB	G4000 Pro 32GB SATA III SSD Industrial (-40°C~85°C)
SA4000064GM-HA	64 GB	G4000 Pro 64GB SATA III SSD Industrial (-40°C~85°C)

1.7 System Performance

G4000

Test program: ATTO

Capacity	Sequential Read Sector	Sequential Write Sector
32GB	143 MB/s	43 MB/s
64GB	150 MB/s	101 MB/s
128GB	150 MB/s	150 MB/s

Test program: CrystalDiskMark 3.0

Capacity	Sequential Read	Sequential Write	4K Read	4K Write	4K QD32 Read	4K QD32 Write
32GB	140 MB/s	44 MB/s	18.74 MB/s	2.12 MB/s	23.75 MB/s	2.11 MB/s
64GB	147 MB/s	100 MB/s	21.06 MB/s	1.99 MB/s	26.54 MB/s	1.56 MB/s
128GB	147 MB/s	143 MB/s	20.42 MB/s	1.00 MB/s	26.76 MB/s	1 MB/s

Actual performance may vary depending on user conditions and environment

G4000 Pro

Test program: ATTO

Capacity	Sequential Read Sector	Sequential Write Sector
16GB	85 MB/s	78 MB/s
32GB	162 MB/s	144 MB/s
64GB	160 MB/s	150 MB/s

Test program: CrystalDiskMark 3.0

Capacity	Sequential Read	Sequential Write	4K Read	4K Write	4K QD32 Read	4K QD32 Write
16GB	84 MB/s	83 MB/s	20.54 MB/s	2.14 MB/s	26.88 MB/s	1.15 MB/s
32GB	155 MB/s	143 MB/s	20.69 MB/s	2.28 MB/s	26.88 MB/s	1.55 MB/s
64GB	156 MB/s	149 MB/s	22.22 MB/s	1.12 MB/s	27.33 MB/s	0.96 MB/s

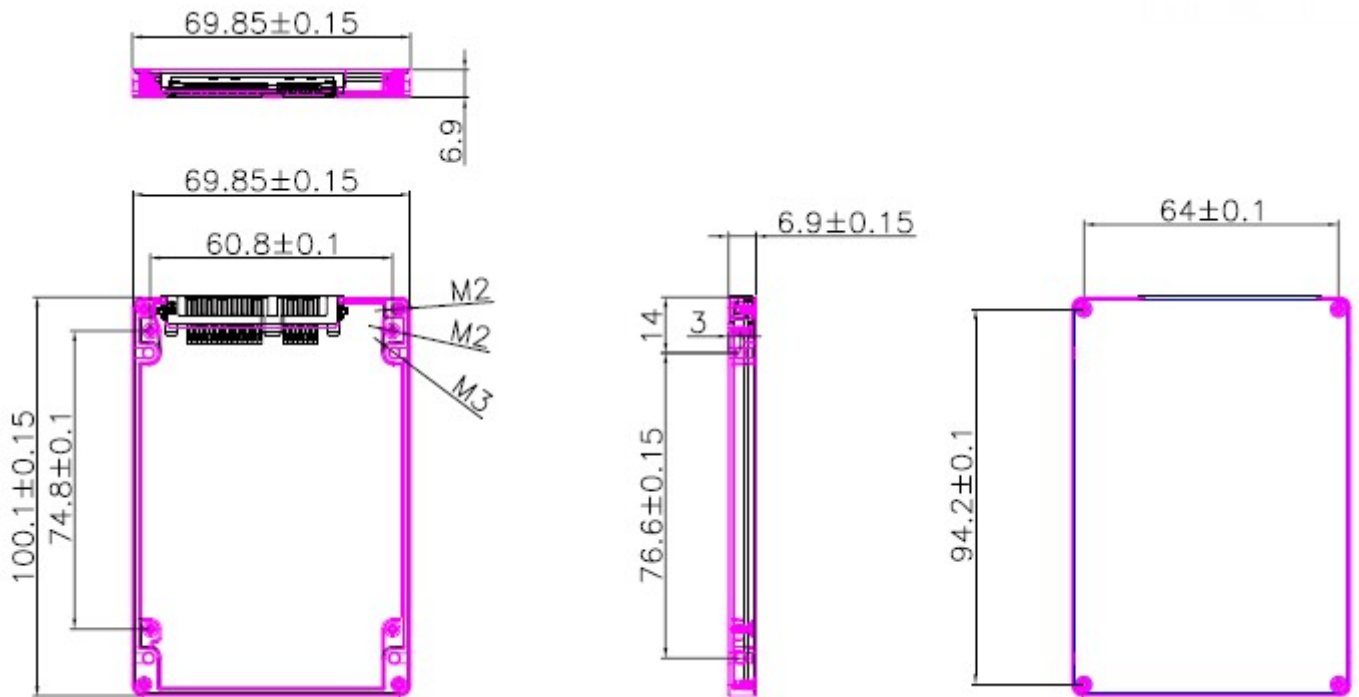
Actual performance may vary depending on user conditions and environment

2. Product Specification

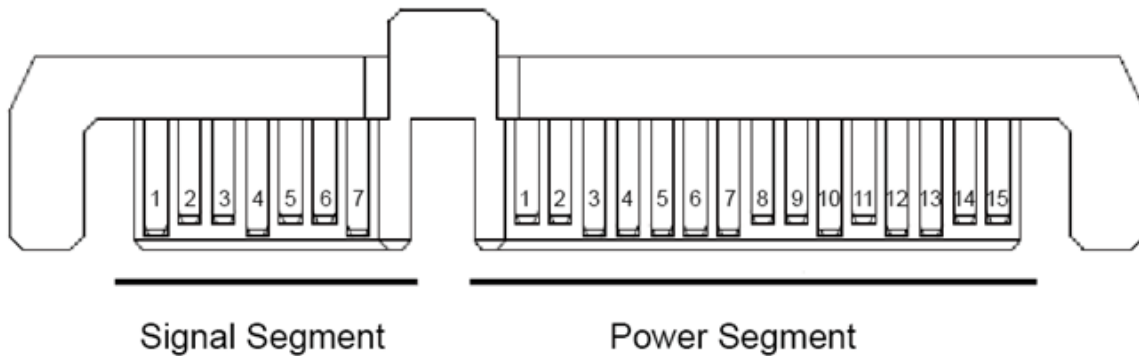
2.1 Dimension

Form Factor	Measures
2.5"	100.1mm x 69.85mm x 6.9mm

2.2 Product Outline



2.3 Pin out



Pin Assignment and Description

Group	No	Type	Description
Signal	S1	GND	2 nd mate
	S2	TXDP	Differential TX positive signal form PHY
	S3	TXDN	Differential TX negative signal form PHY
	S4	GND	2 nd mate
	S5	RXDN	Differential RX negative signal form PHY
	S6	RXDP	Differential RX positive signal form PHY
	S7	GND	2 nd mate
Key and spacing separate and power segments			
Power	P1	V33	3.3Voltage Power Supply (Unused)
	P2	V33	3.3Voltage Power Supply (Unused)
	P3	V33	3.3Voltage pre-charge (Unused), 2 nd mate (Unused)
	P4	GND	1 st mate
	P5	GND	2 nd mate
	P6	GND	2 nd matte
	P7	V5	5Voltage pre-charge, 2 nd mate
	P8	V5	5Voltage Power Supply
	P9	V5	5Voltage Power Supply
	P10	GND	2 nd mate
	P11	DAS/DSS	Device activity signal/Disable staggered spinup
	P12	GND	1 st mate
	P13	V12	12Voltage pre-charge, 2 nd mate(Unused)
	P14	V12	12Voltage Power Supply (Unused)
	P15	V12	12Voltage Power Supply (Unused)

NOTE: Uses 5V power only. 3.3V and 12V power are not used.

3.Command Descriptions

3.1 SUPPORTED ATA COMMANDS

Command Name	Command Code (Hex)	Command Name	Command Code (Hex)
CHECK POWER MODE	E5h	SECURITY ERASE UNIT	F4h
EXECUTE DIAGNOSTICS	90h	SECURITY FREEZE LOCK	F5h
FLUSH CACHE	E7h	SECURITY SET PASSWORD	F1h
IDENTIFY DEVICE	ECh	SECURITY UNLOCK	F2h
IDLE	E3h	SEEK	7xh
IDLE IMMEDIATE	E1h	SET FEATURES	EFh
INITIALIZE DEVICE PARAMETERS	91h	SET MULTIPLE MODE	C6h
READ DMA	C8h	SLEEP	E6h
READ DMA EXT	25h	SMART	B0h
READ FPDMA QUEUED	60h	STANDY	E2h
READ LOG DMA EXT	47h	STANDY IMMEDIATE	E0h
READ LOG EXT	2Fh	WRITE DMA	CAh
READ MULTIPLE	C4h	WRITE DMA EXT	35h
READ SECTOR(S)	20h/21h	WRITE FPDMA QUEUED	61h
READ VERIFY SECTOR(S)	40h/41h	WRITE LOG DMA EXT	57h
RECALIBRATE	10h	WRITE LOG EXT	3Fh
SECURITY DISABLE PASSWORD	F6h	WRITE MULTIPLE	C5h
SECURITY ERASE PREPARE	F3h	WRITE SECTOR(S)	30h/31h

3.2 IDENTIFY DEVICE (ECh)

Word	Value	Description
0	0040h	General information
1	XXXXh	Number of logical cylinders
2	C837h	Specific configuration
3	00XXh	Number of logical heads

4-5	XXXXh	Retired
6	XXXXh	Number of logical sector per logical track
7-8	XXXXh	Reserved for assignment by the CompactFlash_ Association
9	000Eh	Retired
10-19	XXXXh	Serial number (20 ASCII characters)
20-21	XXXXh	Retired
22	003Fh	Obsolete
23-26	XXXXh	Firmware revision (8 ASCII characters)
27-46	XXXXh	Model number (40 ASCII characters)
47	8000h	Number of sectors on multiple commands
48	4000h	Reserved
49	2F00h	Capabilities
50	4000h	Capabilities
51-52	0000h	Obsolete
53	0007h	Reserved
54-58	XXXXh	Obsolete
59	0000h	Multiple sector setting
60-61	XXXXh	Total number of user addressable sectors
62	0000h	Obsolete
63	0007h	Multi-word DMA transfer
64	0003h	Advanced PIO modes supported
65	0078h	Minimum Multiword DMA transfer cycle time per word
66	0078h	Manufacturer's recommended Multiword DMA transfer cycle time
67	0078h	Minimum PIO transfer cycle time without flow control
68	0078h	Minimum PIO transfer cycle time with IORDY flow control
69-74	0000h	Reserved (for future command overlap and queuing)
75	0000h	Queue depth
76	xh	Serial ATA Capabilities
77		Reserved
78	xh	Serial ATA features supported
79	xh	Serial ATA features enabled
80	01FEh	Major version number 0000h or FFFFh = device does not report version
81	0021h	Minor version number
82	0068h	Command set supported.
83	5000h	Command sets supported
84	4000h	Command set/feature supported extension.

85	0008h	Command set/feature enabled.
86	5000h	Command set/feature enabled.
87	4000h	Command set/feature default.
88	xh	Ultra DMA transfer
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	Hardware reset result
94-126	0000h	Reserved
127	0000h	Removable Media Status Notification feature set support
128	0001h	Security status
129-159	0000h	Vendor specific
160-254	0000h	Reserved
255	0000h	Integrity word

Note: X = the content of the word may be fixed or variable.

3.3 SET FEATURES (EFh)

This command set parameter to Features register and set drive's operation. For transfer mode, parameter is set to Sector Count register. This command is used by the host to establish or select certain features.

Value	Function
02h	Enable write cache
03h	Set transfer mode based on value in Sector Count register
55h	Disable read look-ahead feature
82h	Disable write cache
90h	Disable use of SATA feature
AAh	Enable read look-ahead feature

4. Electrical Characteristic

4.1 Supply Voltage

Item	Requirements
Allowable voltage	3.3V \pm 5%
Allowable noise/ripple	100mV p-p or less

4.2 System Power Consumption

Power	Typical
Idle	0.4W
Active	3W

5. S.M.A.R.T Support

5.1 SMART Function Set (B0h)

Performs different processing required for predicting device failures, according to the subcommand specified in the Features register. If the Features register contains an unsupported value, the Aborted Command error is returned. If the SMART function is disabled, any subcommand other than SMART ENABLE OPERATIONS results in the Aborted Command error.

Code	Smart Subcommand
D0h	READ DATA
D1h	READ ATTRIBUTE THRESHOLDS
D2h	ENABLE/DISABLE ATTRIBUTE AUTOSAVE
D3h	SAVE ATTRIBUTE VALUES
D4h	EXECUTE OFF-LINE IMMEDIATE
D5h	READ LOG
D6h	WRITE LOG
D8h	ENABLE OPERATIONS
D9h	DISABLE OPERATIONS
DAh	RETURN STATUS
DBh	ENABLE/DISABLE AUTO OFF-LINE

5.2 SMART READ DATA (B0h/D0h)

This command returns 512-byte SMART Data Structure to the host with PIO data-in protocol. The register file has to contain D0h for Features register, 4Fh for LBA Mid register and C2h for the LBA High register.

Byte	Description
0-1	Data structure revision number
2-13	1st attribute data
14-361	2nd-30th Individual attribute data
362	Off-line data collection status
363	Self-test execution status
364-365	Total time in seconds to complete off-line data collection
366	Reserved
367	Off-line data collection capability
368-369	SMART capability
370	Error logging capability
371	Self-test Failure Checkpoint

372	Short self-test routine recommended polling time(in minutes)
373	Extended self-test routine recommended polling time(in minutes)
374-510	Reserved
511	Data structure Checksum

Byte 2-361: Individual attribute data

Byte	Description
0	Attribute ID
1-2	Status Flag
3	Attribute Value
4	Worst Ever normalized Attribute Value
5-10	Raw Attribute Value
11	Reserved

The attribute ID information is listed in the following table

ID	Description
01h	Read Error Rate
02h	Throughput Performance
03h	Spin Up Time
05h	Reallocated Sector Count
07h	Seek Error Rate
08h	Seek Time performance
09h	Power-On hours Count
0Ah	Spin Retry Count
0Ch	Drive Power Cycle Count
A7h	SSD Protect Mode
A8h	SATA PHY Error Count
A9h	Bad Block Count
AAh	Max Bad Block Count
ADh	Erase Count
AFh	Bad Cluster Table Count
C0h	Unexpected Power Loss Count
C2h	Temperature
C5h	Current Pending Sector Count
F0h	Write Head

5.3 SMART READ ATTRIBUTE THRESHOLD (B0h/D1h)

This command transfers 512 bytes of drive failure threshold data to the host.

Byte	Description
0-1	Data structure revision number
2-361	1 st – 30 th Individual attribute threshold data
362-510	Reserved
511	Data structure checksum

5.4 SMART ENABLE/DISABLE ATTRIBUTE AUTOSAVE (B0h/D2h)

This command enables and disables the optional attribute auto save feature of the device. This command may either allow the device, after some vendor specified event, to save the device updated attributes to non-volatile memory; or this command may cause the auto save feature to be disabled. The state of the attribute auto save feature, either enabled or disabled, shall be preserved by the device during all power and reset events.

A value of zero written by the host into the device's Count field before issuing this command shall cause this feature to be disabled. Disabling this feature does not preclude the device from saving SMART data to non-volatile memory during some other normal operation (e.g., during a power-on or power-off sequence or during an error recovery sequence).

A value of F1h written by the host into the device's Count field before issuing this command shall cause this feature to be enabled. Any other non-zero value written by the host into this field before issuing this command is vendor specific. The meaning of any non-zero value written to this field at this time shall be preserved by the device during all power and reset events.

5.5 SMART SAVE ATTRIBUTE VALUE (B0h/D3h)

Saves any modified attribute values.

5.6 SMART EXECUTE OFF-LINE IMMEDIATE (B0h/D4h)

This command of Non-data input causes the controller to immediately initiate the set of activities that collect SMART data in a off-line mode and then save data to the NAND flash memory, or execute a self-diagnostic test routine in either captive or off-line mode.

SMART EXECUTE OFF-LINE IMMEDIATE Sector Number register values

Value	Description of subcommand to be executed
0	Execute SMART off-line routine immediately in off-line mode
1	Execute SMART Short self-test routine immediately in off-line mode
2	Execute SMART Extended self-test routine immediately in off-line mode
127	Abort off-line mode self-test routine
129	Execute SMART Short self-test routine immediately in captive mode
130	Execute SMART Extended self-test routine immediately in captive mode

5.7 SMART READ LOG (B0h/D5h)

This command returns the indicated log sector contents to the host.

Sector count –specifies the number of sectors to be read from the specified log. The log transferred by the drive shall start at the first sector in the specified log, regardless of the sector count requested.

Sector number indicates the log sector to be returned as described in the following Table.

Log Sector		
Log sector address	Content	R/W
00h	Log directory	RO
01h	SMART error log	RO
02h	Comprehensive SMART error log	RO
04h	Device Statistics log	RO
06h	SMART self-test log	RO
09h	Selective Self-Test log	R/W
30h	Identify Device data log	RO
80h ~9Fh	Host vendor specific	R/W
E0h	SCT Command/Status log	R/W
E1h	SCT Data Transfer log	R/W

5.8 SMART WRITE LOG (B0h/D6h)

This command writes as indicated number of 512 byte data sectors to the indicated log.

5.9 SMART ENABL OPERATIONS (B0h/D8h)

Enables the SMART function. This setting is maintained when the power is turned off and then back on. Once the SMART function is enabled, subsequent SMART ENABLE OPERATIONS commands do not affect any parameters.

5.10 SMART DISABLE OPERATIONS (B0h/D9h)

Disables the SMART function. Upon receiving the command, the drive disables all SMART operations. This setting is maintained when the power is turned off and then back on.

Once this command has been received, all SMART commands other than SMART ENABLE OPERATIONS are aborted with the

Aborted Command error.

This command disables all SMART capabilities including any and all timer and event count functions related exclusively to this feature. After command acceptance, this controller will disable all SMART operations. SMART data in no longer be monitored or saved. The state of SMART is preserved across power cycles.

5.11 SMART RETURN STATUS (B0h/DAh)

Reports the drive reliability status.

Values reported when a predicted defect has not been detected:

Cylinder Low register: 4Fh

Cylinder High register: C2h

Values reported when a predicted defect has been detected:

Cylinder Low register: F4h

Cylinder High register: 2Ch

5.12 SMART ENABLE/DISABLE AUTOMATIC OFF-LINE (B0h/DBh)

Enables (when Sector Count register = "F8h") or disables (Sector Count register = "00h") the automatic off-line data collection function.

The automatic collection is disabled if a value of "00h" is set in the Sector Count register before a subcommand is issued. If automatic collection is disabled, the drive can still save attribute information during normal operation, such as during the power-on/off sequence or error correction sequence.

The automatic collection function is enabled if a value of "F8h" is set in the Sector Count register before the command is issued. Values other than "00h" and "F8h" are vendor-specific.

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