Enterprise SATA 2.5” SSD Specification
SA53P

Version 1.0

Phison Electronics Corporation
Tel: +886-37-586-896 Fax: +886-37-587-868
E-mail: sales@phison.com / suppport@phison.com

Document Number: S-25010

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REVISION HISTORY

Revision	Draft Date	History	Author
1.0	2025/02/13	First release	Eric Chang

PRODUCT OVERVIEW

Capacity
- 240GB, 480GB, 960GB, 1920GB, 3840GB

Form Factor
- 2.5" SSD

SATA Interface
- SATA Gen3

Compliance
- SATA Revision 3.2

Performance[1]
- Sequential Read: up to 530 MB/s
- Sequential Write: up to 500 MB/s
- Random Read: up to 98K IOPS
- Random Write: up to 39K IOPS

Power Consumption[2]
- Active Read (Typ.) < 2.6W
- Active Write (Typ.) < 2.9W
- Idle < 1.6W

Endurance/Reliability
- MTBF: 2.0 million hours
- UBER: < 1 sector per 10^{17} bits read
- DWPD 1
- TBW
  240GB SSD – 438TB
  480GB SSD – 876TB
  960GB SSD – 1752TB
  1920GB SSD – 3504TB
  3840GB SSD – 7008TB

Environmental Specifications
- Temperature Range[3]
  Operating: 0°C ~ 70°C
  Non-operating: -40°C ~ 85°C
- Shock
  Operating: 1000G, 0.5ms
  Non-operating: 1500G, 0.5ms
- Vibration
  Operating: 3.08Grms (7 - 800Hz)
  Non-operating: 20G (20 - 2000Hz)
- Drop: 80cm height
- Bending: 50N force

Compliant
- RoHS compliant

Feature Support
- Hardware Based Power Loss Data Protection
- Thermal throttling
- End-to-End Data Path Protection
- TCG Opal 2.0[4]

Physical Dimension
- 2.5": 100.00mm (L) x 69.85mm (W) x 7.00mm (H)

NOTES:
1. Refer to Chapter 2 for more details
2. Refer to Chapter 4, Section 4.2 Power Consumption for more details.
3. Operation temperature is measured by device temperature sensor. Airflow is suggested and it will allow device to be operated at appropriate temperature for each component during heavy workloads environment.
4. Supported by a separate firmware setting. Further information available upon request.

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1. INTRODUCTION

1.1. General Description

This document describes the specifications of Phison Enterprise SATA Gen3 Solid State Drive. Applying to SATA interface, Phison SSD are ideal storage solution for outstanding performance.

For enterprise-class, the types of form factors are 2.5-inch SSD and the capacities are 240GB, 480GB, 960GB, 1920GB and 3840G.

1.2. SSD List

Table 1-1 SSD List

Model Name	Form Factor	DWPD	Capacity	Security	Part Number
SA53P	2.5”	1	240GB	Non-SED	S1201Y03240GP02256G00
				SED	S1201Y03240GP22256G00
			480GB	Non-SED	S1201Y03480GP02512G00
				SED	S1201Y03480GP22512G00
			960GB	Non-SED	S1201Y03960GP021T0200
				SED	S1201Y03960GP221T0200
			1920GB	Non-SED	S1201Y031T92P022T0400
				SED	S1201Y031T92P222T0400
			3840GB	Non-SED	S1201Y033T84P024T0900
				SED	S1201Y033T84P224T0900

2. PRODUCT SPECIFICATION

2.1. Electrical/Physical Interface

- SATA Interface
- Compliant with SATA Revision 3.2
- Compatible with SATA Gen3/Gen2/Gen1

2.2. Device Capacity

Table 2-1 User Capacity and Addressable Sectors

Model Name	Capacity	User Addressable Sectors	Bytes per Sector
SA53P	240GB	468,862,128	512Bytes
	480GB	937,703,088	
	960GB	1,875,385,008	
	1920GB	3,750,748,848	
	3840GB	7,501,476,528	

NOTES:

1. 1 Gigabyte (GB) is equal to 1,000,000,000 bytes; 1 sector is equal to 512 bytes.
2. The total actual usable capacity of the SSD may be less than the total physical capacity because internal NAND management, SSD format, SSD partition, operating system and so on.

2.3. Performance

2.3.1. Sustained Sequential Read/Write Performance

Table 2-2 Sustained Sequential Read/Write Performance

Model Name	Capacity	Flash Type	Sequential 128KB Read (MB/s)	Sequential 128KB Write (MB/s)
SA53P	240GB	3D TLC	530	350
	480GB		530	500
	960GB		530	500
	1920GB		530	500
	3840GB		530	500

NOTES:

1. Performance is measured with the following conditions
   (a) FIO on Linux: 128KB sequential write with QD32 and 1 job for full drive
   (b) SSD is unformatted drive.
2. Performance Platform
   (a) Operating System: Ubuntu 20.04.2 LTS
   (b) Kernel: Linux version 5.10.32-pim-20211006
   (c) CPU: AMD Ryzen 5 7600X 6-Core Processor
   (d) Motherboard: ASUSTeK COMPUTER INC. ROG STRIX X670E-E GAMING WIFI
   (e) RAM: 32064652 kB
3. Performance may differ according to flash configuration and platform.
4. The tables are for reference only. Any criteria for accepting goods shall be further discussed based on different flash configurations.

2.3.2. Sustained Random Read/Write Performance

Table 2-3 Sustained Random Read/Write Performance

Model Name	Capacity	Flash Type	Random 4KB Read (IOPS)	Random 4KB Write (IOPS)
SA53P	240GB	3D TLC	90K	12K
	480GB		98K	28K
	960GB		98K	32K
	1920GB		98K	39K
	3840GB		98K	36K

NOTES:

1. Performance is measured with the following conditions
   (a) FIO on Linux: 4KB random read/write with QD32 and 1 job for full drive.
   (b) SSD is unformatted drive.
2. Performance Platform
   (a) Operating System: Ubuntu 20.04.2 LTS
   (b) Kernel: Linux version 5.10.32-pim-20211006
   (c) CPU: AMD Ryzen 5 7600X 6-Core Processor
   (d) Motherboard: ASUSTeK COMPUTER INC. ROG STRIX X670E-E GAMING WIFI
   (e) RAM: 32064652 kB
3. 4KB is 4,096 bytes; 8KB is 8,192 bytes.
4. Performance may differ according to flash configuration and platform.
5. The tables are for reference only. Any criteria for accepting goods shall be further discussed based on different flash configurations.

2.3.3. IOPS Consistency

Table 2-4 IOPS Consistency

Model Name	Capacity	Flash Type	Sustained Random 4KB Read	Sustained Random 4KB Write
SA53P	240GB	3D TLC	99%	84%
	480GB		99%	85%
	960GB		99%	75%
	1920GB		99%	78%
	3840GB		99%	76%

NOTES:

1. Performance is measured with the following conditions
   (a) FIO on Linux: 4KB random read/write with QD32 and 1 job for full drive.
   (b) SSD is unformatted drive.
2. Performance Platform
   (a) Operating System: Ubuntu 20.04.2 LTS
   (b) Kernel: Linux version 5.10.32-pim-20211006
   (c) CPU: AMD Ryzen 5 7600X 6-Core Processor
   (d) Motherboard: ASUSTeK COMPUTER INC. ROG STRIX X670E-E GAMING WIFI
   (e) RAM: 32064652 kB
3. IOPS Consistency (%) = (99.9% IOPS) / (Average IOPS) x 100
4. 4KB is 4,096 bytes; 8KB is 8,192 bytes.
5. Performance may differ according to flash configuration and platform.
6. The tables are for reference only. Any criteria for accepting goods shall be further discussed based on different flash configurations.

2.3.4. Latency

Table 2-5 Average Latency

Model Name	Capacity	Flash Type	Sustained Random 4KB Read (us)	Sustained Random 4KB Write (us)
SA53P	240GB	3D TLC	110	80
	480GB		100	40
	960GB		100	30
	1920GB		110	30
	3840GB		100	30

NOTES:

1. Performance is measured with the following conditions
   (a) FIO on Linux with QD1 with 1 job.
   (b) SSD is unformatted drive.
2. Performance Platform
   (a) Operating System: Ubuntu 20.04.2 LTS
   (b) Kernel: Linux version 5.10.32-pim-20211006
   (c) CPU: AMD Ryzen 5 7600X 6-Core Processor
   (d) Motherboard: ASUSTeK COMPUTER INC. ROG STRIX X670E-E GAMING WIFI
   (e) RAM: 32064652 kB
3. Performance may differ according to flash configuration and platform.
4. The tables are for reference only. Any criteria for accepting goods shall be further discussed based on different flash configurations.

2.3.5. Quality of Service (QoS)

Table 2-6 Quality of Service (QoS 99%)

Model Name	Capacity	Flash Type	Quality of Service (99%)			
			Read 4KB, QD=1 (us)	Write 4KB, QD=1 (us)	Read 4KB, QD=32 (us)	Write 4KB, QD=32 (us)
SA53P	240GB	3D TLC	121	95	598	2973
	480GB		118	54	534	1378
	960GB		116	40	398	1360
	1920GB		123	42	411	1086
	3840GB		119	37	376	1140

Table 2-7 Quality of Service (QoS 99.99%)

Model Name	Capacity	Flash Type	Quality of Service (99.99%)			
			Read 4KB, QD=1 (us)	Write 4KB, QD=1 (us)	Read 4KB, QD=32 (us)	Write 4KB, QD=32 (us)
SA53P	240GB	3D TLC	716	299	1041	3298
	480GB		304	100	725	1576
	960GB		190	131	734	1540
	1920GB		163	106	752	1739
	3840GB		842	308	671	2432

NOTES:

1. Quality of Service (QoS) is measured with the following conditions
   (a) FIO test: 4KB transfer size, QD=1, 32 on 4KB random read and write workload on whole LBA range

of drive once the performance performs on steady state and all background operations run normally.

2. Performance Platform
   (a) Operating System: Ubuntu 20.04.2 LTS
   (b) Kernel: Linux version 5.10.32-pim-20211006
   (c) CPU: AMD Ryzen 5 7600X 6-Core Processor
   (d) Motherboard: ASUSTeK COMPUTER INC. ROG STRIX X670E-E GAMING WIFI
   (e) RAM: 32064652 kB
3. According to random 4KB QD=1 and 32 workloads, the result of QoS is the maximum round-trip time which is taken for 99.0% and 99.99% of commands to host.
4. QoS may differ according to flash configuration and platform.
5. The tables are for reference only. Any criteria for accepting goods shall be further discussed based on different flash configurations.

2.4. Reliability

2.4.1. TBW (TeraBytes Written) and DWPD (Drive Write Per Day)

Table 2-8 TBW & DWPD

Model Name	Capacity	TBW (TB)	DWPD
SA53P	240GB	438	1
	480GB	876	1
	960GB	1752	1
	1920GB	3504	1
	3840GB	7008	1

NOTES:
1. The JEDEC Enterprise 219A workload.
2. Warranty is 5 years.
3. DWPD = TBW/ (365 x 5 years x User capacity)

2.4.2. UBER

Table 2-9 UBER

Capacity	UBER
240GB	< 1 sector per 10^{17} bits read
480GB	
960GB	
1920GB	
3840GB	

NOTES:
1. UBER (Uncorrectable Bit Error Rates) means the uncorrectable error per bits read.

2.4.3. MTBF

Table 2-10 MTBF

Capacity	MTBF
240GB	2.0 million hours
480GB	
960GB	
1920GB	
3840GB	

NOTES:

1. MTBF (Mean Time Between Failures) represents the average operational time between failures of the drive.

3. ENVIRONMENTAL SPECIFICATIONS

3.1. Temperature and Humidity

Table 3-1 Temperature and Humidity Specification

Temperature	Operating	0°C to 70°C[1]
	Non-operating	-40°C to 85°C
Temperature Cycle Test	Operating	0°C to 70°C[1]
	Non-operating	-40°C to 85°C
Relative Humidity	Operating	10% to 93%
	Non-operating	10% to 93%

NOTES:

1. Operating temperature is measured by device temperature sensor. Airflow is suggested and it will allow device to be operated at appropriate temperature for each component during heavy workloads environment.

3.2. Mechanical (Shock/Vibration/Drop/Bending)

Table 3-2 Mechanical Test Condition

Shock	Operating	1000G, 0.5ms
	Non-operating	1500G, 0.5ms
Vibration	Operating	3.08Grms (7 - 800Hz)
	Non-operating	20G (20 - 2000Hz)
Drop	Non-operating	80cm
Bending	Non-operating	50N

3.3. Electrostatic Discharge (ESD)

Table 3-3 Electrostatic Discharge (ESD)

Specification	+/- 4KV
EN 55024, CISPR 24 EN 61000-4-2 and IEC 61000-4-2	Device functions are affected, but EUT will be back to its normal or operational state automatically.

3.4. EMI Compliance

Table 3-4 EMI Compliance

Specification
EN 55032, CISPR 32(CE) AS/NZS CISPR 32(CE) ANSI C63.4 (FCC) CNS 15936 (BSMI) VCCI-CISPR 32 (VCCI)

4. ELECTRICAL SPECIFICATIONS

4.1. Supply Voltage

Table 4-1 Supply Voltage

Operating Voltage	5V, + / - 5%
Rise Time (Max/Min)	100 ms / 0.1 ms
Fall Time (Max/Min)	1 s / 10 ms
Min. Off Time1 (under 0.1V)	5 s

NOTES:

1. Minimum time between power removed from SSD (Vcc < 100 mW) and power re-applied to the drive.

4.2. Power Consumption

Table 4-2 Power Consumption

Model Name	Capacity	Power Consumption		
		Active Read(W) (Typ.)	Active Write(W) (Typ.)	Idle(W)
SA53P	240GB	2.3	2.2	1.3
	480GB	2.2	2.6	1.3
	960GB	2.2	2.6	1.4
	1920GB	2.3	2.7	1.4
	3840GB	2.6	2.9	1.6

NOTES:

1. Use iometer with QD32 and worker 1 for 128KB sequential write test to measure the power of active write.
2. Use iometer with QD32 and worker 1 for 4KB random read test to measure the power of active read.
3. The power of idle is measured with DIPM off.
4. Power Consumption may differ according to flash configuration and platform.
5. The average value of power consumption is achieved based on 100% conversion efficiency.
6. The measured power voltage of 2.5” SSD is 5V.

5. PHYSICAL DIMENSION

5.1. Physical Information

Table 5-1 Physical Dimensions and Weight

Parameter	Unit	240GB	480GB	960GB	1920GB	3840GB
Length	mm	100.00 +0.35 / -0.15				
Width	mm	69.85 ± 0.25				
Height	mm	3.50 ± 0.38				
Weight	g	57	57	59	59	60

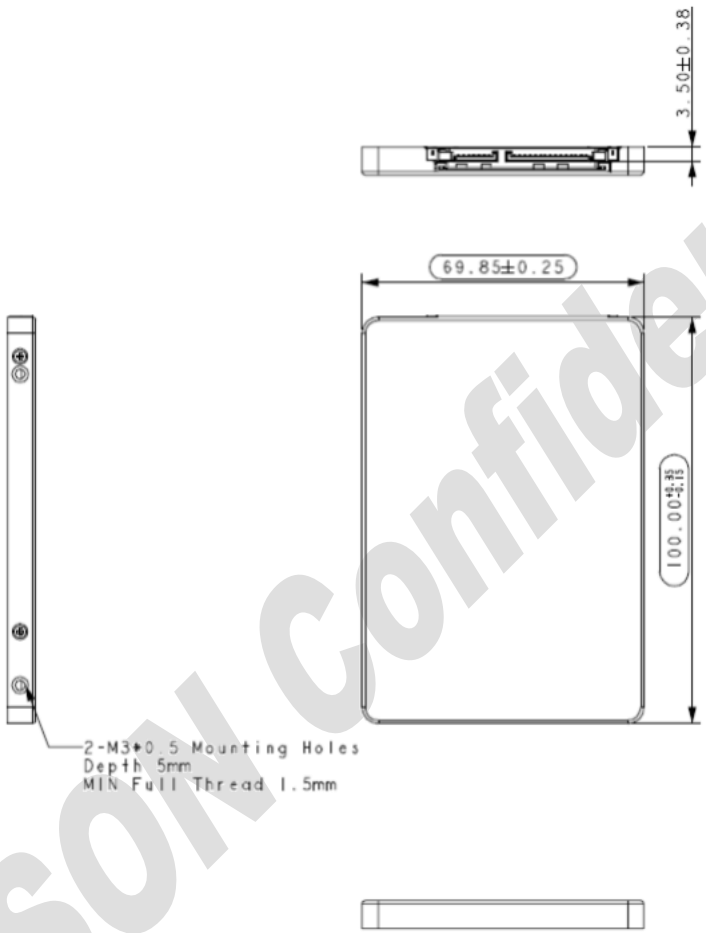

Figure 5-1 2.5" SATA SSD Mechanical Diagram (Top and Side View)

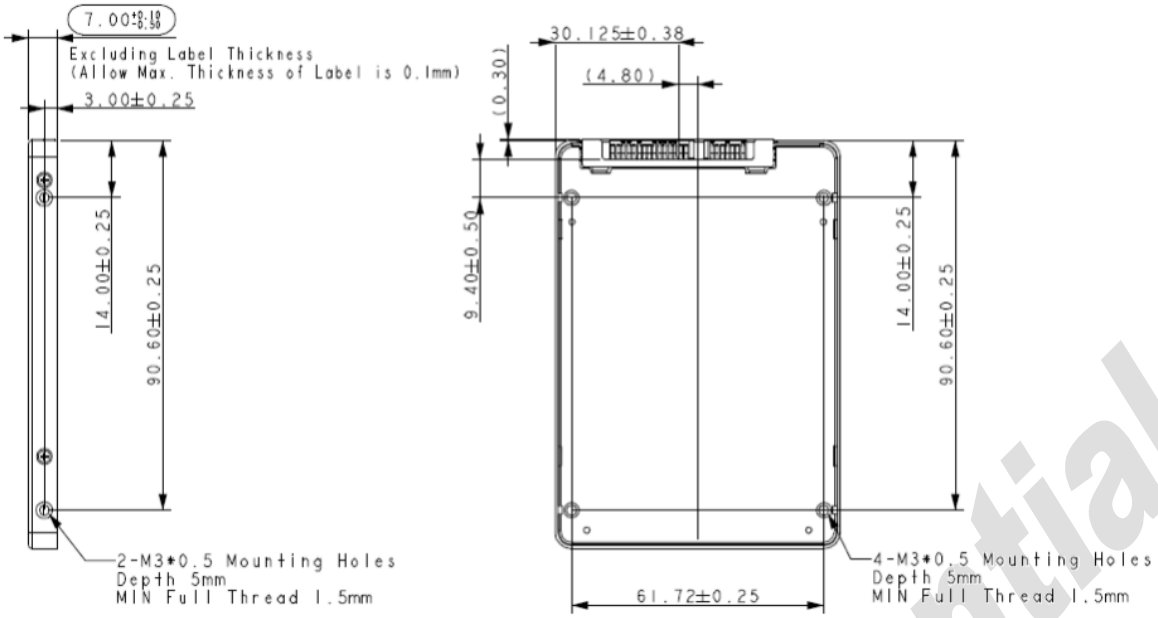

Figure 5-2 2.5” SATA SSD Mechanical Diagram (Bottom and Side View)

6. INTERFACE

6.1. Pin Assignment and Descriptions

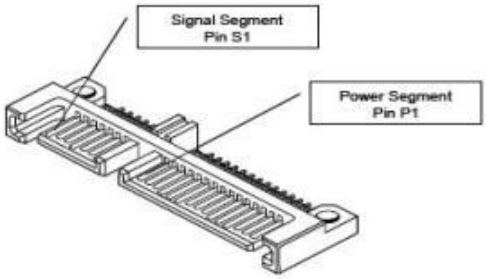

Table 6-1 Signal Segment Pin Assignment and Descriptions

Pin Number	Function
S1	GND
S2	A+ (Differential Signal Pair A)
S3	A – (Differential Signal Pair A)
S4	GND
S5	B – (Differential Signal Pair B)
S6	B+ (Differential Signal Pair B)
S7	GND

Table 6-2 Signal Segment Pin Assignment and Description

Pin Number	Function	NOTE
P1	Not Used (3.3V)	
P2	Not Used (3.3V)	
P3	Not connected	
P4	GND	
P5	GND	
P6	GND	
P7	5V pre-charge	
P8	5V	
P9	5V	
P10	GND	
P11	DAS	Tolerated input voltage(max) is 3.3V
P12	GND	
P13	Not Used (12V pre-charge)	
P14	Not Used (12V)	
P15	Not Used (12V)	

7. SUPPORTED COMMANDS

7.1. ATA Command List

The following ATA command list table is followed by ATA8-ACS3 SPEC.

Table 7-1 ATA Command List

Op Code	Support	Description	Op Code		Support	Description
00h	Y	NOP	B6h	12h	-	NV Cache: QUERY NV CACHE PINNED SET DMA EXT
03h	-	CFA REQUEST EXTENDED ERROR	B6h	13h	-	NV Cache: QUERY NV CACHE MISSES DMA EXT
06h	Y	DATA SET MANAGEMENT	B6h	14h	-	NV Cache: FLUSH NV CACHE
08h	-	DEVICE RESET	C4h		Y	READ MULTIPLE
0Bh	-	REQUEST SENSE DATA EXT	C5h		Y	WRITE MULTIPLE
10h	Y	RECALIBRATE	C6h		Y	SET MULTIPLE MODE
11h-1Fh	-	RECALIBRATE	C7h		-	READ DMA QUEUED
20h	Y	READ SECTOR(S)	C8h		Y	READ DMA
21h	Y	READ SECTOR(S) WITHOUT RETRY	C9h		Y	READ DMA WITHOUT RETRY
22h	-	READ LONG	CAh		Y	WRITE DMA
23h	-	READ LONG WITHOUT RETRY	CBh		Y	WRITE DMA WITHOUT RETRY
24h	Y	READ SECTOR(S) EXT	CCh		-	WRITE DMA QUEUED
25h	Y	READ DMA EXT	CDh		-	CFA WRITE MULTIPLE WITHOUT ERASE
26h	-	READ DMA QUEUED EXT	CEh		Y	WRITE MULTIPLE FUA EXT
27h	Y	READ NATIVE MAX ADDRESS EXT	D1h		-	CHECK MEDIA CARD TYPE
29h	Y	READ MULTIPLE EXT	DAh		-	GET MEDIA STATUS
2Ah	-	READ STREAM DMA EXT	DEh		-	MEDIA LOCK
2Bh	-	READ STREAM EXT	DFh		-	MEDIA UNLOCK
2Fh	Y	READ LOG EXT	E0h		Y	STANDBY IMMEDIATE
30h	Y	WRITE SECTOR(S)	E1h		Y	IDLE IMMEDIATE
31h	Y	WRITE SECTOR(S) WITHOUT RETRY	E2h		Y	STANDBY
32h	-	WRITE LONG	E3h		Y	IDLE
33h	-	WRITE LONG WITHOUT RETRY	E4h		Y	READ BUFFER
34h	Y	WRITE SECTOR(S) EXT	E5h		Y	CHECK POWER MODE
35h	Y	WRITE DMA EXT	E6h		Y	SLEEP
36h	-	WRITE DMA QUEUED EXT	E7h		Y	FLUSH CACHE
37h	Y	SET MAX ADDRESS EXT	E8h		Y	WRITE BUFFER
38h	-	CFA WRITE SECTORS WITHOUT ERASE	E9h		Y	READ BUFFER DMA

Op Code	Support	Description	Op Code			Support	Description
39h	Y	WRITE MULTIPLE EXT	EAh			Y	FLUSH CACHE EXT
3Ah	-	WRITE STREAM DMA EXT	EBh			Y	WRITE BUFFER DMA
3Bh	-	WRITE STREAM EXT	ECh			Y	IDENTIFY DEVICE
3Ch	-	WRITE VERIFY	EDh			-	MEDIA EJECT
3Dh	Y	WRITE DMA FUA EXT	EEh			-	IDENTIFY DEVICE DMA
3Eh	-	WRITE DMA QUEUED FUA EXT	EFh	01h		-	SET FEATURES: Enable 8-bit PIO transfer mode (CFA feature set only)
3Fh	Y	WRITE LOG EXT	EFh	02h		Y	SET FEATURES: Enable write cache
40h	Y	READ VERIFY SECTOR(S)	EFh	03h		Y	SET FEATURES: Set transfer mode based on value in Count field
41h	Y	READ VERIFY SECTOR(S) WITHOUT RETRY	EFh	05h		Y	SET FEATURES: Enable advanced power management
42h	Y	READ VERIFY SECTOR(S) EXT	EFh	06h		-	SET FEATURES: Enable Power-Up In Standby feature set
44h	-	Reserved	EFh	07h		-	SET FEATURES: Power-Up In Standby feature set device spin-up
45h	O	WRITE UNCORRECTABLE EXT	EFh	0Ah		-	SET FEATURES: Enable CFA power mode 1
47h	Y	READ LOG DMA EXT	EFh	0Bh		-	SET FEATURES: Enable Write-Read-Verify feature set
50h	-	FORMAT TRACK	EFh	10h	01h	-	SET FEATURES: Enable use of Serial ATA feature
51h	-	CONFIGURE STREAM	EFh	10h	02h	Y	SET FEATURES: Enable DMA Setup FIS Auto-Activate optimization
57h	Y	WRITE LOG DMA EXT	EFh	10h	03h	Y	SET FEATURES: Enable Device-initiated interface power state (DIPM) transitions
60h	Y	READ FPDMA QUEUED	EFh	10h	04h	-	SET FEATURES: Enable use of Serial ATA feature
61h	Y	WRITE FPDMA QUEUED	EFh	10h	05h	-	SET FEATURES: Enable use of Serial ATA feature
70h	Y	SEEK	EFh	10h	06h	O	SET FEATURES: Enable Software Settings Preservation (SSP)
71-76h	-	SEEK	EFh	10h	07h	Y	SET FEATURES: Enable Device Automatic Partial to Slumber transitions
77h	Y	SET DATE AND TIME EXT	EFh	10h	09h	O	SET FEATURES: Enable Device Sleep

Op Code		Support	Description	Op Code			Support	Description
79-7Fh		-	SEEK	EFh	43h		-	SET FEATURES: Set Maximum Host Interface Sector Times
87h		-	CFA TRANSLATE SECTOR	EFh	44h		-	SET FEATURES: Vendor Specific ECC byte
90h		Y	EXECUTE DEVICE DIAGNOSTIC	EFh	55h		Y	SET FEATURES: Disable read look-ahead feature
91h		Y	INITIALIZE DEVICE PARAMETERS	EFh	5Dh		-	SET FEATURES: Enable release interrupt
92h		Y	DOWNLOAD MICROCODE	EFh	5Eh		-	SET FEATURES: Enable service interrupt
93h		Y	DOWNLOAD MICROCODE DMA	EFh	5Fh		-	SET FEATURES: Enable NDRQ Feature
94h		-	STANDBY IMMEDIATE	EFh	66h		Y	SET FEATURES: Disable reverting to power-on defaults
95h		-	IDLE IMMEDIATE	EFh	81h		-	SET FEATURES: Disable 8-bit PIO transfer mode (CFA feature set only)
96h		-	STANDBY	EFh	82h		Y	SET FEATURES: Disable write cache
97h		-	IDLE	EFh	85h		Y	SET FEATURES: Disable advanced power management
98h		-	CHECK POWER MODE	EFh	86h		-	SET FEATURES: Disable Power-Up In Standby feature set
99h		-	SLEEP	EFh	8Ah		-	SET FEATURES: Disable CFA power mode
A0h		-	PACKET	EFh	8Bh		-	SET FEATURES: Disable Write-Read-Verify feature set
A1h		-	IDENTIFY PACKET DEVICE	EFh	90h	01h	-	SET FEATURES: Disable use of Serial ATA feature
A2h		-	SERVICE	EFh	90h	02h	Y	SET FEATURES: Disable DMA Setup FIS Auto-Activate optimization
B0h	D0h	Y	SMART: READ DATA	EFh	90h	03h	Y	SET FEATURES: Disable Device-initiated interface power state (DIPM) transitions
B0h	D1h	Y	SMART: READ ATTRIBUTE THRESHOLDS	EFh	90h	04h	-	SET FEATURES: Disable use of Serial ATA feature
B0h	D2h	Y	SMART: ENABLE/DISABLE AUTOSAVE	EFh	90h	05h	-	SET FEATURES: Disable use of Serial ATA feature
B0h	D3h	Y	SMART: SAVE ATTRIBUTE VALUES	EFh	90h	06h	Y	SET FEATURES: Disable Software Settings Preservation (SSP)

Op Code		Support	Description	Op Code			Support	Description
B0h	D4h	Y	SMART: EXECUTE OFF-LINE IMMEDIATE	EFh	90h	07h	Y	SET FEATURES: Disable Device Automatic Partial to Slumber transitions
B0h	D5h	Y	SMART: READ LOG	EFh	90h	09h	O	SET FEATURES: Disable Device Sleep
B0h	D6h	Y	SMART: WRITE LOG	EFh	AAh		Y	SET FEATURES: Enable read look-ahead feature
B0h	D8h	Y	SMART: ENABLE OPERATIONS	EFh	BBh		-	SET FEATURES: Default ECC byte
B0h	D9h	Y	SMART: DISABLE OPERATIONS	EFh	C2h		-	SET FEATURES: Disable Automatic Acoustic Management feature set
B0h	DAh	Y	SMART: RETURN STATUS	EFh	C3h		-	SET FEATURES: Enable/Disable the Sense Data Reporting feature set
B0h	DBh	Y	SMART: ENABLE/DISABLE AUTOMATIC OFF-LINE	EFh	CCh		Y	SET FEATURES: Enable reverting to power-on defaults
B0h	E0h	-	SMART: Vendor specific	EFh	DDh		-	SET FEATURES: Disable release interrupt
B1h	C0h	Y	DEVICE CONFIGURATION: RESTORE	EFh	DEh		-	SET FEATURES: Disable SERVICE interrupt
B1h	C1h	Y	DEVICE CONFIGURATION: FREEZE LOCK	EFh	DFh		-	SET FEATURES: Disable NDRQ Feature
B1h	C2h	Y	DEVICE CONFIGURATION: IDENTIFY	F1h			Y	SECURITY SET PASSWORD
B1h	C3h	Y	DEVICE CONFIGURATION: SET	F2h			Y	SECURITY UNLOCK
B1h	C4h	Y	DEVICE CONFIGURATION: IDENTIFY DMA	F3h			Y	SECURITY ERASE PREPARE
B1h	C5h	Y	DEVICE CONFIGURATION: SET DMA	F4h			Y	SECURITY ERASE UNIT
B4h	0000h	O	SANITIZE DEVICE: SANITIZE STATUS EXT	F5h			Y	SECURITY FREEZE LOCK
B4h	0011h	O	SANITIZE DEVICE: CRYPTO SCRAMBLE EXT	F6h			Y	SECURITY DISABLE PASSWORD
B4h	0012h	O	SANITIZE DEVICE: BLOCK ERASE EXT	F8h			Y	READ NATIVE MAX ADDRESS
B4h	0014h	O	SANITIZE DEVICE: OVERWRITE EXT	F9h	00h		Y	SET MAX: SET MAX ADDRESS
B4h	0020h	O	SANITIZE DEVICE: SANITIZE FREEZE LOCK EXT	F9h	01h		Y	SET MAX: SET MAX PASSWORD
B4h	0040h	O	SANITIZE DEVICE: SANITIZE ANTIFREEZE LOCK EXT	F9h	02h		Y	SET MAX: SET MAX LOCK
B6h	00h	-	NV Cache: SET NV CACHE POWER MODE EXT	F9h	03h		Y	SET MAX: SET MAX UNLOCK

Op Code		Support	Description	Op Code		Support	Description
B6h	01h	-	NV Cache: RETURN FROM NV CACHE POWER MODE EXT	F9h	04h	Y	SET MAX: SET MAX FREEZE LOCK
B6h	10h	-	NV Cache: ADD LBA(S) TO NV CACHE PINNED SET DMA EXT	F9h	05h	Y	SET MAX: SET MAX SET PASSWORD DMA
B6h	11h	-	NV Cache: REMOVE LBA(S) FROM NV CACHE PINNED SET DMA EXT	F9h	06h	Y	SET MAX: SET MAX UNLOCK DMA

NOTES: “Y” means “Support”.
“O” means “Option, default No support”.
“-” means “No support”.

7.2. Identify Device Command

The following table details the sector data returned by the IDENTIFY DEVICE command of ATA8-ACS3 SPEC.

Table 7-2 List of Device Identification

Word	F: Fixed V: Variable X: retired/obsolete/reserved	Default Value	ATA Identify Parameter
0	F	0040h	General configuration
1	X	*1	Number of cylinders in the default CHS translation
2	F	C837h	Specific configuration
3	X	0010h	Number of heads in the default CHS translation
4..5	X	0000h	Retired
6	X	003Fh	Number of sectors per track in the default CHS translation
7..8	X	0000h	Reserved for CFA
9	X	0000h	Retired
10..19	V	ASCII	Serial number
20..21	X	0000h	Retired
22	X	0000h	Obsolete
23..26	V	ASCII	Firmware revision
27..46	V	ASCII	Model number
47	X	8010h	READ/WRITE MULTIPLE commands function
48	F	4000h	Trusted Computing feature set options
49	F	2F00h	Capabilities
50	F	4000h	Capabilities
51..52	X	0000h	Obsolete
53	F	0007h	Field validity
54	X	*1	Number of current logical cylinders
55	X	0010h	Number of current logical heads
56	X	003Fh	Number of current sectors per track
57..58	X	*2	Current capacity in sectors
59	V	0110h	Multiple sector setting

Word	F: Fixed V: Variable X: retired/obsolete/reserved	Default Value	ATA Identify Parameter
60..61	V	*3	Total number of user addressable logical sectors for 28-bit commands
62	X	0000h	Obsolete
63	V	0407h	Multiword DMA transfer modes
64	F	0003h	Advanced PIO modes modes
65	F	0078h	Minimum Multiword DMA transfer cycle time per word
66	F	0078h	Manufacturer's recommended Multiword DMA transfer cycle time
67	F	0078h	Minimum PIO transfer cycle time without flow control
68	F	0078h	Minimum PIO transfer cycle time with IORDY flow control
69	F	5F20h	Set Max Password(Support)
70..74	X	0000h	Reserved
75	F	001Fh	Queue depth
76	V	E50Eh	Serial SATA capabilities
77	V	0006/0004/0002h	Serial ATA Additional Capabilities
78	V	004Ch	Serial ATA features supported
79	F	0040h	Serial ATA features enabled
80	F	07F8h	Major version number
81	F	0000h	Minor version number
82	F	746Bh	Commands and feature sets supported
83	F	7D09h	Commands and feature sets supported
84	F	4063h	Commands and feature sets supported
85	F	7469h	Commands and feature sets supported or enabled
86	F	BC09h	Commands and feature sets supported or enabled
87	F	4063h	Commands and feature sets supported
88	F	007Fh	Ultra DMA Modes
89	F	0001h	Time required for Normal Erase mode SECURITY ERASE UNIT command
90	F	0001h	Time required for Enhanced Erase mode SECURITY ERASE UNIT command
91	F	00FEh	Current APM (advanced power management) level value
92	F	FFFEh	Master password identifier
93	F	0000h	Hardware reset result.
94	X	0000h	Obsolete
95	F	0000h	Stream Minimum Request Size
96	F	0000h	Streaming Transfer Time – DMA
97	F	0000h	Streaming Access Latency – DMA and PIO
98..99	F	0000h	Streaming Performance Granularity
100..103	V	*4	Number of User Addressable Logical Sectors

Word	F: Fixed V: Variable X: retired/obsolete/reserved	Default Value	ATA Identify Parameter
104	F	0000h	Streaming Transfer Time – PIO
105	F	0008h	Maximum number of 512-byte blocks per DATA SET MANAGEMENT command
106	F	4000h	Physical sector size/Logical sector size
107	F	0000h	Inter-seek delay for ISO/IEC 7779 standard acoustic testing
108..111	V	0000h	World Wide Name
112..115	X	0000h	Reserved
116	X	0000h	Obsolete
117..118	F	0000h	Logical sector size
119	V	4019h	Commands and feature sets supported
120	V	4019h	Commands and feature sets supported or enabled
121..126	X	0000h	Reserved for expanded supported and enabled settings
127	X	0000h	Obsolete
128	F	0021h	Security status
129..159	V	0000h	Vendor specific
160..167	X	0000h	Reserved for CFA
168	V	Varies	Device Nominal Form Factor shows as below: Nominal Form Factor not reported: 0000h inch: 0001h inch: 0002h 2.5 inch: 0003h 1.8 inch: 0004h mSATA and others: 0005h
169	F	0001h	DATA SET MANAGEMENT command is support
170..173	F	0000h	Additional Product Identifier
174..175	X	0000h	Reserved
176..205	F	0000h	Current media serial number
206	V	0000h	SCT Command Transport
207..208	X	0000h	Reserved
209	F	4000h	Alignment of logical sectors within a physical sector
210..211	F	0000h	Write-Read-Verify Sector Mode 3 Count
212..213	F	0000h	Write-Read-Verify Sector Mode 2 Count
214..216	X	0000h	Obsolete
217	F	0001h	Nominal media rotation rate
218	X	0000h	Reserved
219	X	0000h	Obsolete
220	V	0000h	Current mode of the Write-Read-Verify feature set
221	X	0000h	Reserved
222	V	107Fh	Transport major version number

Word	F: Fixed V: Variable X: retired/obsolete/reserved	Default Value	ATA Identify Parameter
223	F	0000h	Transport minor version number
224..229	X	0000h	Reserved
230..233	F	0000h	Extend Number of User Addressable Sectors
234	F	0001h	Minimum number of 512-byte data blocks per Download Microcode operation
235	F	FFFFh	Maximum number of 512-byte data blocks per Download Microcode operation
236..242	X	0000h	Reserved
243	F	0000h	Security feature 4000 : Self Encrypting Drive
244..254	F	0000h	Reserved
255	V	XXA5h XX is variable	Integrity word (Checksum and Signature)

Table 7-3 List of Device Identification for Each Capacity

Capacity (GB)	*1 (Word 1/Word 54)	*2 (Word 57 – 58)	*3 (Word 60 – 61)	*4 (Word 100 – 103)
240	3FFFh	FBFC10h	FFFFFFFh	1BF244B0
480	3FFFh	FBFC10h	FFFFFFFh	37E436B0
960	3FFFh	FBFC10h	FFFFFFFh	6FC81AB0
1920	3FFFh	FBFC10h	FFFFFFFh	DF8FE2B0
3840	3FFFh	FBFC10h	FFFFFFFh	1BF1F72B0

7.3. SMART Attributes

Table 7-4 SMART Attributes

Attribute ID	Description
01h	Number of Accumulation of Uncorrectable Error
05h	Total Later Bad Blcok Count
09h	Power on Hours Count
0Ch	Drive Power Cycle Count (number of accumulation of power on/off cycles)
A8h	SATA PHY Error Count (record to the drive and will not be cleared. These values include data FIS CRC and command FIS CRC)
AAh	Bad Block Count (early bad count and later bad count)
ABh	Program Fail Count
ACh	Erase Fail Count
ADh	Erase Count (max. erase count and average erase count)
B8h	SATA E3D Error Count
BBh	Flash UNC Error Count
C0h	Number of Unexpected Power Loss
C2h	Temperature (°C)
C6h	SMART Selftest UNC Count
C7h	SATA PHY Error Count (Continue Count)
DAh	Number of Accumulation CRC Error (read/write data FIS CRC error)
E7h	SSD Life Remaining
E9h	NAND Write (GB)
EAh	NAND Read (Sectors)

Attribute ID	Description
EBh	NAND Write (Sectors)
F1h	Host Write (GB)
F2h	Host Read (GB)

8. APPLICATION NOTES

8.1. Wafer Level Chip Scale Packaging (WLCSP) Handling Precautions

There are a lot of components assembled on a single SSD device. Please handle the drive with care especially when it has any WLCSP (Wafer Level Chip Scale Packaging) components such as PMIC, thermal sensor or load switch. WLCSP is one of the packaging technologies that is widely adopted for making smaller footprints, but any bumps or scratches may damage those ultrasmall parts so gentle handling is strongly recommended.

⚠ DO NOT DROP SSD

⚠ INSTALL SSD WITH CARE

⚠ STORE SSD IN A PROPER PACKAGE

9. PRODUCT WARRANTY POLICY

For any other products manufactured and supplied by Phison ("Phison Products"), Phison hereby certify that in the event Phison Product does not conform to the specification for (A) a period instructed by Phison or mutually agreed by Phison and the customer in writing or (B) the period ending on the date at which customer's use of a Phison Product exceeds Phison Product's total Terabytes Written as recorded by or derived from Phison Product's S.M.A.R.T. Attribute, including but not limited to, Phison Product' s drive life is used up in accordance with the S.M.A.R.T. Attribute, whichever occurs earlier("Warranty Period") and such inconformity is confirmed by Phison to be solely attributable to Phison, Phison agrees to repair or replace the nonconforming Phison Product, free of charge.

Notwithstanding the foregoing, the aforementioned warranty shall exclude the inconformity arising from, in relation to or associated with:

(1) alternation, modification, improper use, misuse or excessive use of Phison Product;

(2) failure to comply with Phison's instructions;

(3) Phison's compliance with or use of the instructions, technologies, designs, specifications, devices, materials, components, parts, software and firmware provided, instructed or approved by Buyer (including any of its parents, subsidiaries, affiliates, suppliers, subcontractors or downstream customers);

(4) combination of Phison Product with other materials, components, parts, goods, hardware, firmware or software not supplied by Phison;

(5) any claim brought by a third party who is commonly known as intellectual property right assertion entity or patent troll;

(6) NAND flash itself or NAND flash which is embedded into Phison Products;

(7) Phison's compliance with general industry standards;

(8) other error or failure not solely attributable to Phison's cause (including without limitation, normal wear or tear, manufacturing or assembly wastage, improper operation, virus, unauthorized maintenance or repair).

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10. REFERENCE

The following table is to list out the standards that have been adopted for designing the product.

Table 10-1 List of References

Title	Source
Serial ATA Revision 3.2	http://www.sata-io.org
ATA-8 spec	http://www.t13.org

11. TERMINOLOGY

The following table is to list out the acronyms that have been applied throughout the document.

Table 11-1 List of Terminology

Term	Definitions
LBA	Logical block addressing
MB	Mega-byte
GB	Giga-byte
TB	Tera-byte
MTBF	Mean time between failures
SMART	Self-monitoring, analysis and reporting technology
SSD	Solid state disk