

PHISON



BA50P

M.2 2280

Version 1.3

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REVISION HISTORY

Revision	Draft Date	History
1.0	2024/05/23	First release
1.1	2024/07/10	Add OPAL part numbers
1.2	2024/07/23	Update warranty policy
1.3	2025/05/23	Update format, consistency, TBW, QoS, dimension, identify device command, SMART attributes and product warranty policy

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PRODUCT OVERVIEW

Capacity

- 240GB, 480GB, 960GB

Form Factor

- M.2 2280

SATA Interface

- SATA Gen3

Compliance

- Serial ATA Revision 3.2

Performance¹

- Sequential Read: up to 530 MB/s
- Sequential Write: up to 500 MB/s
- Random Read: up to 98K IOPS
- Random Write: up to 30K IOPS

Power Consumption²

- Active Read (Avg. RMS) < 2.2W
- Active Write (Avg. RMS) < 2.8W
- Idle < 1.3W

Endurance/Reliability

- MTBF: 2.0 million hours
- UBER: < 1 sector per 10¹⁷ bits read
- DWPD 1
- TBW
240GB SSD – 438TB
480GB SSD – 876TB
960GB SSD – 1752TB

Environmental Specifications

- Temperature Range³
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: 20N force

Certifications and Declarations

- CE, FCC, BSMI, VCCI, UKCA, RCM, ICES, KCC, CB, UL

Compliant

- RoHS compliant

Feature Support

- Hardware Based Power Loss Data Protection
- Thermal throttling
- End-to-End Data Path Protection
- TCG Opal 2.0⁴

Physical Dimension

- M.2 2280: 80.00mm (L) x 22.00mm (W) x 4.10mm (H)

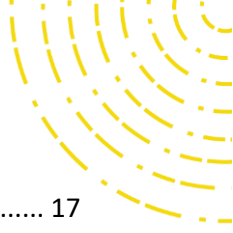
NOTES:

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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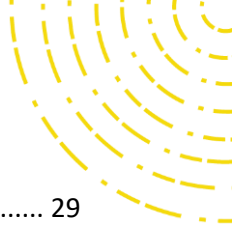


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1. INTRODUCTION

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 M.2 2280 SSD and the capacities are 240GB, 480GB and 960GB.

1.2. SSD List

Table 1-1 SSD List

Model Name	Form Factor	DWPD	Capacity	Security	Part Number
BA50P	M.2 2280	1	240GB	Non-SED	B1200K01240GP01256G00
				SED	B1200K01240GP21256G00
			480GB	Non-SED	B1200K01480GP01512G00
				SED	B1200K01480GP21512G00
			960GB	Non-SED	B1200K01960GP011T0200
				SED	B1200K01960GP211T0200



2. PRODUCT SPECIFICATIONS

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
BA50P	240GB	468,862,128	512Bytes
	480GB	937,703,088	
	960GB	1,875,385,008	

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. Sequential Read/Write Performance

Table 2-2 Sequential Read/Write Performance

Model Name	Capacity	Flash Type	Sequential 128KB (QD=32, Job=1)	
			Read (MB/s)	Write (MB/s)
BA50P	240GB	3D TLC	530	290
	480GB		530	480
	960GB		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. Random Read/Write Performance

Table 2-3 Random Read/Write Performance

Model Name	Capacity	Flash Type	Random 4KB (QD=32, Job=1)	
			Read (IOPS)	Write (IOPS)

BA50P	240GB	3D TLC	60K	10K
	480GB		90K	15K
	960GB		98K	30K

NOTES:

- Performance is measured with the following conditions
 - FIO on Linux: 4KB random read/write with QD32 and 1 job for full drive.
 - SSD is unformatted drive.
- Performance Platform
 - Operating System: Ubuntu 20.04.2 LTS
 - Kernel: Linux version 5.10.32-pim-20211006
 - CPU: AMD Ryzen 5 7600X 6-Core Processor
 - Motherboard: ASUSTeK COMPUTER INC. ROG STRIX X670E-E GAMING WIFI
 - RAM: 32064652 kB
- 4KB is 4,096 bytes; 8KB is 8,192 bytes.
- Performance may differ according to flash configuration and platform.
- 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	Random 4KB (QD=32, Job=1)	
			Read	Write
BA50P	240GB	3D TLC	98%	92%
	480GB		97%	92%
	960GB		98%	90%

NOTES:

- Performance is measured with the following conditions
 - FIO on Linux: 4KB random read/write with QD32 and 1 job for full drive.
 - SSD is unformatted drive.
- Performance Platform
 - Operating System: Ubuntu 20.04.2 LTS
 - Kernel: Linux version 5.10.32-pim-20211006
 - CPU: AMD Ryzen 5 7600X 6-Core Processor
 - Motherboard: ASUSTeK COMPUTER INC. ROG STRIX X670E-E GAMING WIFI
 - RAM: 32064652 kB
- $IOPS \text{ Consistency (\%)} = (99.9\% \text{ IOPS}) / (\text{Average IOPS}) \times 100$
- 4KB is 4,096 bytes; 8KB is 8,192 bytes.
- Performance may differ according to flash configuration and platform.
- 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 Latency

Model Name	Capacity	Flash Type	Random 4KB (QD=1, Job=1)	
			Read (us)	Write (us)
BA50P	240GB	3D TLC	120	80
	480GB		120	50
	960GB		120	30

NOTES:

- Performance is measured with the following conditions
 - 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 QoS (99%)

Model Name	Capacity	Flash Type	4KB Random Read/Write Quality of Service (QoS=99%)			
			(QD=1, Job=1)		(QD=32, Job=1)	
			Read (us)	Write (us)	Read (us)	Write (us)
BA50P	240GB	3D TLC	139	98	1384	2839
	480GB		141	66	701	1763
	960GB		143	42	471	1054

Table 2-7 QoS (99.99%)

Model Name	Capacity	Flash Type	4KB Random Read/Write Quality of Service (QoS=99.99%)			
			(QD=1, Job=1)		(QD=32, Job=1)	
			Read (us)	Write (us)	Read (us)	Write (us)
BA50P	240GB	3D TLC	214	166	1780	2873
	480GB		220	133	1127	1832
	960GB		186	101	666	1161

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
------------	----------	----------	------

BA50P	240GB	438	1
	480GB	876	
	960GB	1752	

NOTES:

1. The JEDEC Enterprise 219A workload.
2. Warranty is 5 years.
3. $DWPD = TBW / (365 \times 5 \text{ years} \times \text{User capacity})$

2.4.2. UBER

Table 2-9 UBER

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

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	

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:

- 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. Thermal Throttling

Table 3-2 Thermal Throttling Table

Thermal Management Temperature(TMT)	Condition	Throttled Performance
TMT1	Flash reaches 68°C	Decline 10% of max CE
TMT2	Flash reaches 70°C	Decline 20% of max CE
TMT Protect	Flash reaches 80°C	Forced to 1 CE
TMT Fatal	Controller reaches 120°C	Save data to NAND and shut down power

3.3. Airflow Profile

Figure 3-1 depicts the minimum airflow a BA50P SSD needs to operate without triggering thermal throttling at different ambient temperatures.

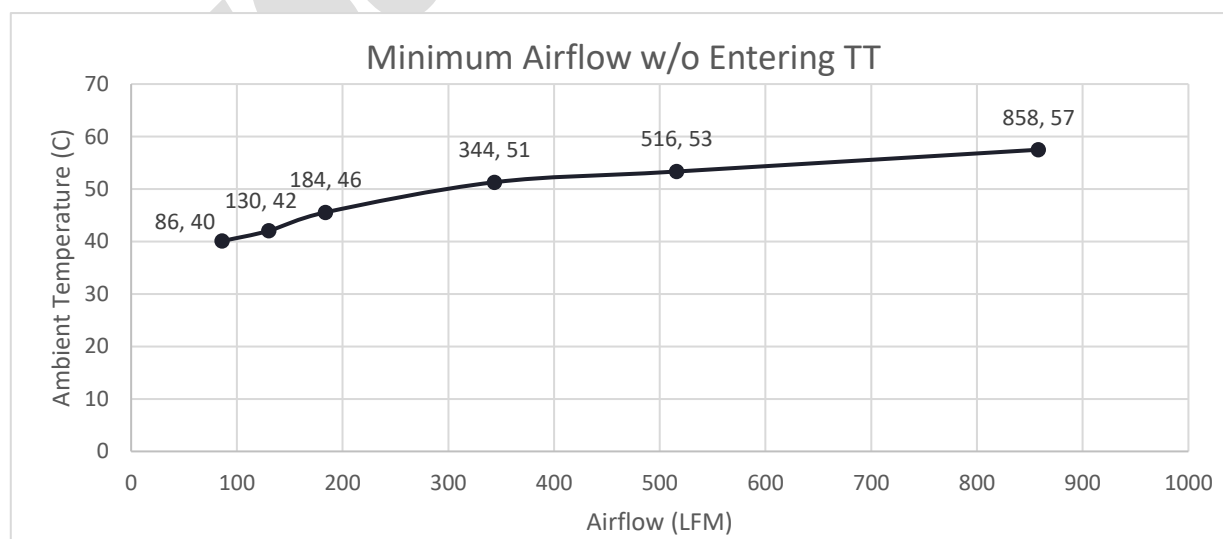


Figure 3-1 BA50P Airflow Curve

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

Table 3-3 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	20N

3.5. Electrostatic Discharge (ESD)

Table 3-4 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.

3.6. EMI Compliance

Table 3-5 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	3.3V, + / - 5%
Rise Time (Max/Min)	100 ms / 0.1 ms
Fall Time (Max/Min)	1 s / 10 ms
Min. Off Time ¹ (under 0.1V)	5 s

NOTES:

1. Minimum time between power removed from SSD ($V_{cc} < 100$ mW) and power re-applied to the drive.

4.2. Power Consumption

Table 4-2 Power Consumption

Model Name	BA50P		
Capacity	240GB	480GB	960GB
128KB Sequential READ (Average RMS, W)	1.9	2.0	2.0
128KB Sequential WRITE (Average RMS, W)	2.2	2.8	2.7
4KB Random READ (Average RMS, W)	1.7	2.1	2.2
4KB Random WRITE (Average RMS, W)	2.2	2.8	2.8
4KB 70/30 Random READ/WRITE (Average RMS, W)	2.0	2.5	3.0
Idle (Average RMS, W)	1.2	1.2	1.3

NOTES:

1. Power consumption is measured in average RMS on full speed mode.
2. Power consumption is measured with the following conditions
 - (a) Power Consumption: 128KB sequential read/write & 4KB random read/write for full drive.
 - (b) SSD is unformatted drive.
3. Power consumption 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.
5. 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

4.3. Inrush Current

Table 4-3 Inrush Current

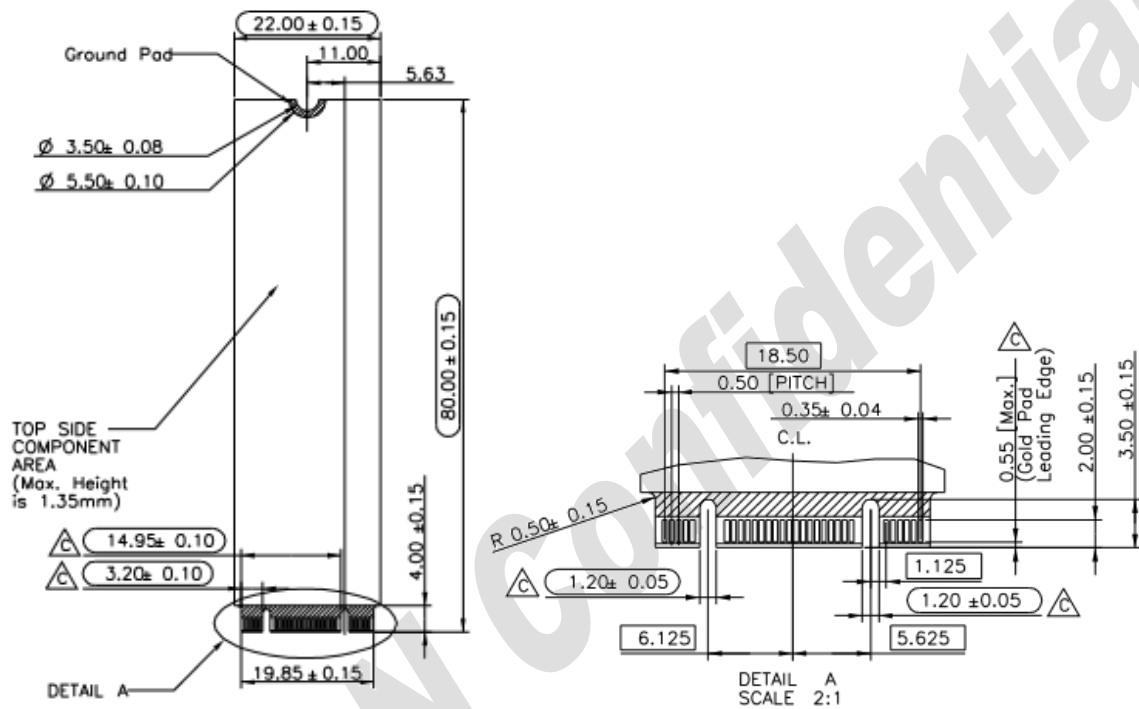
Inrush Current	240GB	480GB	960GB
3.3V	2A		

5. PHYSICAL DIMENSION

5.1. Physical Information

Table 5-1 Physical Dimensions and Weight

Parameter	Unit	240GB	480GB	960GB
Length	mm	80.00 \pm 0.15		
Width	mm	22.00 \pm 0.15		
Height	mm	4.10 \pm 0.08		
Weight	g	8	9	9



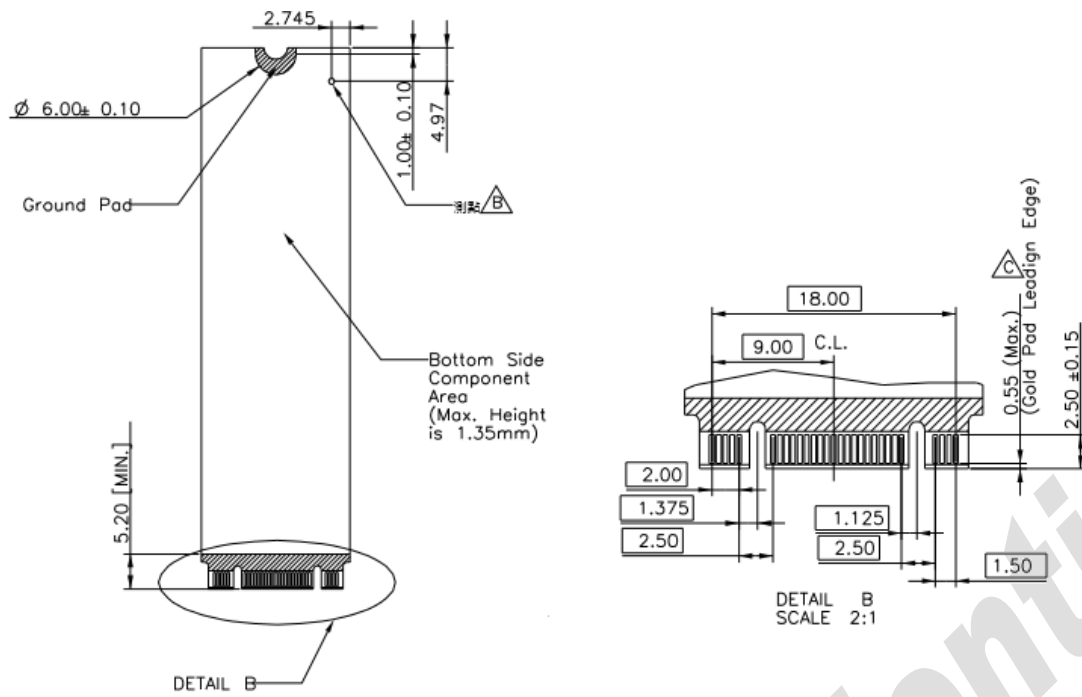


Figure 5-2 M.2 2280 SATA SSD Mechanical Diagram (Bottom View)

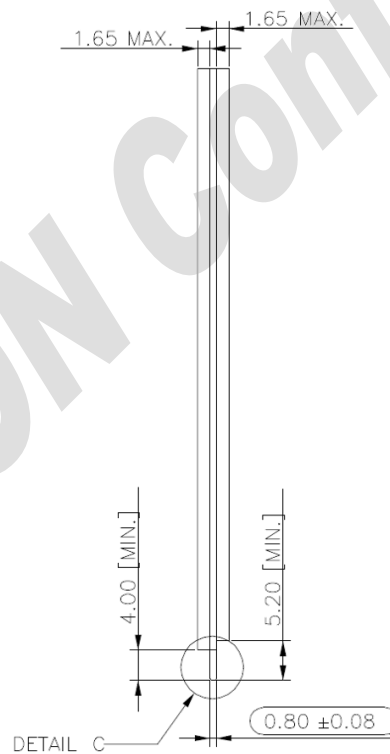


Figure 5-3 M.2 2280 SATA SSD Mechanical Diagram (Side View)

6. INTERFACE

6.1. Pin Assignment and Descriptions

Table 6-1 defines the signal assignment of the internal NGFF connector for SSD usage, described in the PCI Express M.2 Specification version 1.0 of the PCI-SIG.

Table 6-1 Signal Segment Pin Assignment and Descriptions

Pin No.	SATA Pin	Description
1	CONFIG_3	Ground
2	3.3V	Supply pin
3	GND	Ground
4	3.3V	Supply pin
5	N/C	No Connect
6	N/C	No Connect
7	N/C	No Connect
8	N/C	No Connect
9	N/C or GND Note	No Connect or Ground
10	DAS/DSS# (O) (OD)	Status indicators via LED devices that will be provided by the system Active Low. A pulled-up LED with series current limiting resistor should allow for 9mA when On.
11	N/C	No Connect
12	Module Key	
13	Module Key	
14	Module Key	
15	Module Key	
16	Module Key	
17	Module Key	
18	Module Key	
19	Module Key	
20	N/C	No Connect
21	CONFIG_0	Ground
22	N/C	No Connect
23	N/C	No Connect
24	N/C	No Connect
25	N/C	No Connect
26	N/C	No Connect
27	GND	Ground
28	N/C	No Connect
29	N/C	No Connect
30	N/C	No Connect
31	N/C	No Connect
32	N/C	No Connect
33	GND	Ground
34	N/C	No Connect
35	N/C	No Connect
36	N/C	No Connect
37	N/C	No Connect

38	DEVSLP (I)	Device Sleep, Input. When driven high the host is informing the SSD to enter a low power state
39	GND	Ground
40	N/C	No Connect
41	SATA-B+	SATA differential signals in the SATA specification
42	N/C	No Connect
43	SATA-B-	SATA differential signals in the SATA specification
44	N/C	No Connect
45	GND	Ground
46	N/C	No Connect
47	SATA-A-	SATA differential signals in the SATA specification
48	N/C	No Connect
49	SATA-A+	SATA differential signals in the SATA specification
50	N/C	No Connect
51	GND	Ground
52	N/C	No Connect
53	N/C	No Connect
54	N/C	No Connect
55	N/C	No Connect
56	Reserved for MFG Data	No Connect
57	GND	Ground
58	Reserved for MFG Clock	No Connect
59	Module Key	
60	Module Key	
61	Module Key	
62	Module Key	
63	Module Key	
64	Module Key	
65	Module Key	
66	Module Key	
67	N/C	No Connect
68	SUSCLK (I) (0/3.3V)	No Connect
69	CONFIG_1	Ground
70	3.3V	Supply pin
71	GND	Ground
72	3.3V	Supply pin
73	GND	Ground
74	3.3V	Supply pin
75	CONFIG_2	Ground

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		-	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	E9h		Y	READ BUFFER DMA

		WITHOUT ERASE					
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	Y	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	-	SET FEATURES: Enable Device Sleep	
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	EFh	90h	06h	Y	SET FEATURES: Disable

			ATTRIBUTE VALUES					Software Settings Preservation (SSP)
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	-	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:	F9h	01h		Y	SET MAX: SET MAX

			SANITIZE FREEZE LOCK EXT				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
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

Word	F: Fixed V: Variable X: retired/obsolete/reserved	Default Value	ATA Identify Parameter
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
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

Word	F: Fixed V: Variable X: retired/obsolete/reserved	Default Value	ATA Identify Parameter
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
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	ASCII	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

Word	F: Fixed V: Variable X: retired/obsolete/reserved	Default Value	ATA Identify Parameter
			feature set
221	X	0000h	Reserved
222	V	107Fh	Transport major version number
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)

7.3. SMART Attributes

Table 7-3 SMART Attributes

Attribute ID	Description
01h	Number of Accumulation of Uncorrectable Error
05h	Total Later Bad Block 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	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)
EBh	NAND Write (Sectors)
F1h	Host Write (GB)
F2h	Host Read (GB)

8. PRODUCT COMPLIANCE

Table 8-1 Product Regulatory Compliance and Certifications

Category	Certifications
EMC	CE
	FCC
	BSMI
	VCCI
	UKCA
	RCM
	ICES
	KCC
	CB
Safety	UL



9. PRODUCT WARRANTY POLICY

Complete information regarding Phison's warranties to the Phison brand enterprise SSD product ("Product(s)") is listed below.

This limited warranty covers any defects in material or workmanship in the new Products accompanied by this limited warranty statement. This limited warranty does not apply to any Products on which the original identification information has been altered, obliterated or removed; that has not been handled or packaged correctly; that has been sold as secondhand; or that has been resold contrary to U.S.A. and other applicable export regulations.

Duration of Warranty

For any other Product manufactured and supplied by Phison, Phison hereby certifies that in the event Product does not conform to the specification for (A) a period of five (5) years from the date of Phison's delivery of the Product or (B) the period ending on the date at which use of the Product exceeds Product's total terabytes written as recorded by or derived from Product's S.M.A.R.T. Attribute, including but not limited to, 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's sole and maximum obligation shall be to repair or replace the nonconforming Product, free of charge, in Phison's sole discretion.

Exclusion of the Warranty

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

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