

PHISON



SA50E

2.5"

Version 1.4

Phison Electronics Corporation

Tel: +886-37-586-896 Fax: +886-37-587-868

E-mail: sales@phisonenterprise.com / support@phisonenterprise.com



Phison may make changes to specifications, components and product description at any time without notice. PHISON and the Phison logo are trademarks of Phison Electronics Corporation, registered in the United States and other countries. Products and specifications discussed herein are for reference purposes only. Copies of documents which include information of part number or ordering number, or other materials may be obtained by emailing us at sales@phisonenterprise.com or support@phisonenterprise.com.

©2025 Phison Electronics Corp. All Rights Reserved.

PHISON Confidential



REVISION HISTORY

Revision	Draft Date	History
1.0	2024/05/23	First release
1.1	2024/06/18	Add OPAL part numbers
1.2	2024/07/23	Update warranty policy
1.3	2025/02/21	Update disclaimer, TBW and ATA command list
1.4	2025/05/23	Update format, bending spec, identify device command, SMART attributes and product warranty policy

PHISON Confidential

PRODUCT OVERVIEW

Capacity

- 480GB, 960GB, 1920GB, 3840GB

Form Factor

- 2.5" SSD

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 77K IOPS

Power Consumption²

- Active Read (Avg. RMS) < 2.7W
- Active Write (Avg. RMS) < 3.5W
- Idle < 1.7W

Endurance/Reliability

- MTBF: 2.0 million hours
- UBER: < 1 sector per 10¹⁷ bits read
- DWPD 3
- TBW
480GB SSD – 2628TB
960GB SSD – 5256TB
1920GB SSD – 10512TB

3840GB SSD – 21024TB

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: 50N 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

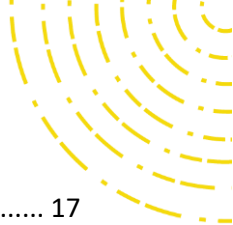
- 2.5": 100.00mm(L)x69.85mm(W)x7.00mm(H)

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.

TABLE OF CONTENTS

REVISION HISTORY	3
PRODUCT OVERVIEW	4
TABLE OF CONTENTS	5
LIST OF FIGURES.....	7
LIST OF TABLES.....	8
1. INTRODUCTION.....	10
1.1. General Description	10
1.2. SSD List.....	10
2. PRODUCT SPECIFICATIONS.....	11
2.1. Electrical/Physical Interface.....	11
2.2. Device Capacity.....	11
2.3. Performance	11
2.3.1. Sequential Read/Write Performance	11
2.3.2. Random Read/Write Performance	11
2.3.3. IOPS Consistency.....	12
2.3.4. Latency.....	12
2.3.5. Quality of Service (QoS).....	13
2.4. Reliability	14
2.4.1. TBW (TeraBytes Written) and DWPD (Drive Write Per Day)	14
2.4.2. UBER	14
2.4.3. MTBF.....	14
3. ENVIRONMENTAL SPECIFICATIONS.....	15
3.1. Temperature and Humidity.....	15
3.2. Thermal Throttling.....	15
3.3. Airflow Profile.....	15
3.4. Mechanical (Shock/Vibration/Drop/Bending)	16
3.5. Electrostatic Discharge (ESD)	16
3.6. EMI Compliance.....	16
4. ELECTRICAL SPECIFICATIONS.....	17
4.1. Supply Voltage	17



4.2. Power Consumption 17

4.3. Inrush Current..... 17

5. **PHYSICAL DIMENSION** **18**

5.1. Physical Information 18

6. **INTERFACE** **20**

6.1. Pin Assignment and Descriptions 20

7. **SUPPORTED COMMANDS**..... **21**

7.1. ATA Command List 21

7.2. Identify Device Command 25

7.3. SMART Attributes 28

8. **PRODUCT COMPLIANCE** **29**

9. **PRODUCT WARRANTY POLICY** **30**

10. **REFERENCE** **32**

PHISON Confidential



LIST OF FIGURES

Figure 3-1 SA50E Airflow Curve 16

Figure 5-1 2.5" SATA SSD Mechanical Diagram (Top and Side View) 18

Figure 5-2 2.5" SATA SSD Mechanical Diagram (Bottom and Side View)..... 19

Figure 6-1 2.5" SATA SSD Pin Assignment..... 20

PHISON Confidential



LIST OF TABLES

Table 1-1 SSD List	10
Table 2-1 User Capacity and Addressable Sectors	11
Table 2-2 Sequential Read/Write Performance	11
Table 2-3 Random Read/Write Performance	11
Table 2-4 IOPS Consistency	12
Table 2-5 Latency	12
Table 2-6 QoS (99%)	13
Table 2-7 QoS (99.99%)	13
Table 2-8 TBW & DWPD	14
Table 2-9 UBER	14
Table 2-10 MTBF	14
Table 3-1 Temperature and Humidity Specification	15
Table 3-2 Thermal Throttling Table	15
Table 3-3 Mechanical Test Condition	16
Table 3-4 Electrostatic Discharge (ESD)	16
Table 3-5 EMI Compliance	16
Table 4-1 Supply Voltage	17
Table 4-2 Power Consumption	17
Table 4-3 Inrush Current	17
Table 5-1 Physical Dimensions and Weight	18
Table 6-1 Signal Segment Pin Assignment and Descriptions	20
Table 6-2 Signal Segment Pin Assignment and Description	20
Table 7-1 ATA Command List	21

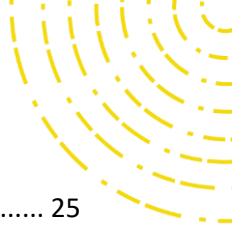


Table 7-2 List of Device Identification..... 25

Table 7-3 SMART Attributes..... 28

Table 8-1 Product Regulatory Compliance and Certifications 29

Table 10-1 List of References 32

PHISON Confidential

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 480GB, 960GB, 1920GB and 3840GB.

1.2. SSD List

Table 1-1 SSD List

Model Name	Form Factor	DWPD	Capacity	Security	Part Number
SA50E	2.5"	3	480GB	Non-SED	S1201K00480GE02640G00
				SED	S1201K00480GE22640G00
			960GB	Non-SED	S1201K00960GE021T2800
				SED	S1201K00960GE221T2800
			1920GB	Non-SED	S1201K001T92E022T5600
				SED	S1201K001T92E222T5600
			3840GB	Non-SED	S1201K003T84E025T1200
				SED	S1201K003T84E225T1200

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
SA50E	480GB	937,703,088	512Bytes
	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. 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)
SA50E	480GB	3D TLC	500	440
	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. 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)
SA50E	480GB	3D TLC	95K	40K
	960GB		98K	67K
	1920GB		98K	77K
	3840GB		98K	68K

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
SA50E	480GB	3D TLC	98%	91%
	960GB		98%	95%
	1920GB		98%	84%
	3840GB		98%	84%

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
- $\text{IOPS Consistency (\%)} = (99.9\% \text{ IOPS}) / (\text{Average IOPS}) \times 100$
- 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)
SA50E	480GB	3D TLC	130	30
	960GB		125	30

	1920GB		130	30
	3840GB		125	30

NOTES:

- Performance is measured with the following conditions
 - FIO on Linux with QD1 with 1 job.
 - 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
- 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.

2.3.5. 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)
SA50E	480GB	3D TLC	138	35	618	806
	960GB		134	34	411	823
	1920GB		138	35	428	962
	3840GB		132	34	378	765

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)
SA50E	480GB	3D TLC	199	101	1019	970
	960GB		191	101	552	1728
	1920GB		185	102	577	3031
	3840GB		238	110	505	3063

NOTES:

- Quality of Service (QoS) is measured with the following conditions
 - 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.
- 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
- 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.
- QoS 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.

2.4. Reliability

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

Table 2-8 TBW & DWPD

Model Name	Capacity	TBW (TB)	DWPD
SA50E	480GB	2628	3
	960GB	5256	
	1920GB	10512	
	3840GB	21024	

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
480GB	< 1 sector per 10 ¹⁷ bits read
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
480GB	2.0 million hours
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. 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 SA50E SSD needs to operate without triggering thermal throttling at different ambient temperatures.

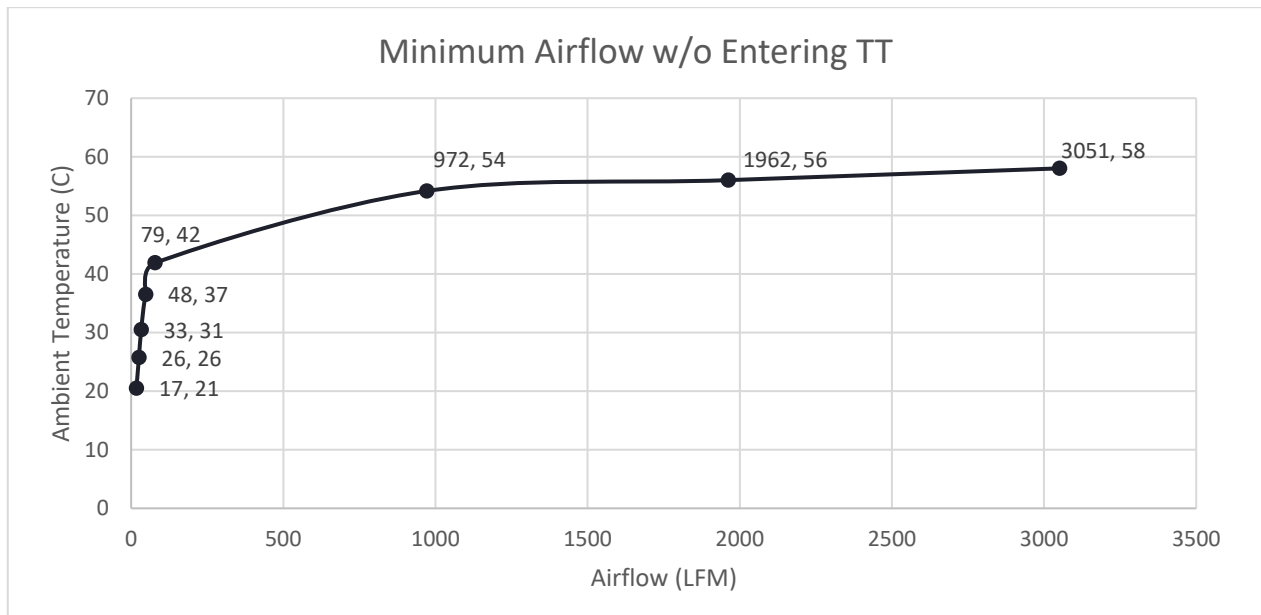


Figure 3-1 SA50E Airflow Curve

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	50N

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	5V, + / - 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	SA50E			
Capacity	480GB	960GB	1920GB	3840GB
128KB Sequential READ (Average RMS, W)	2.0	2.2	2.3	2.5
128KB Sequential WRITE (Average RMS, W)	2.8	3.0	3.1	3.5
4KB Random READ (Average RMS, W)	2.1	2.3	2.4	2.7
4KB Random WRITE (Average RMS, W)	2.6	2.7	2.8	3.0
4KB 70/30 Random READ/WRITE (Average RMS, W)	2.3	2.8	2.5	2.8
Idle (Average RMS, W)	1.3	1.4	1.5	1.7

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	480GB	960GB	1920GB	3840GB
5V	2A			

5. PHYSICAL DIMENSION

5.1. Physical Information

Table 5-1 Physical Dimensions and Weight

Parameter	Unit	480GB	960GB	1920GB	3840GB
Length	mm	100.00 +0.35 / -0.15			
Width	mm	69.85 ± 0.25			
Height	mm	7.00 +0.10 / -0.50			
Weight	g	59	60	62	64

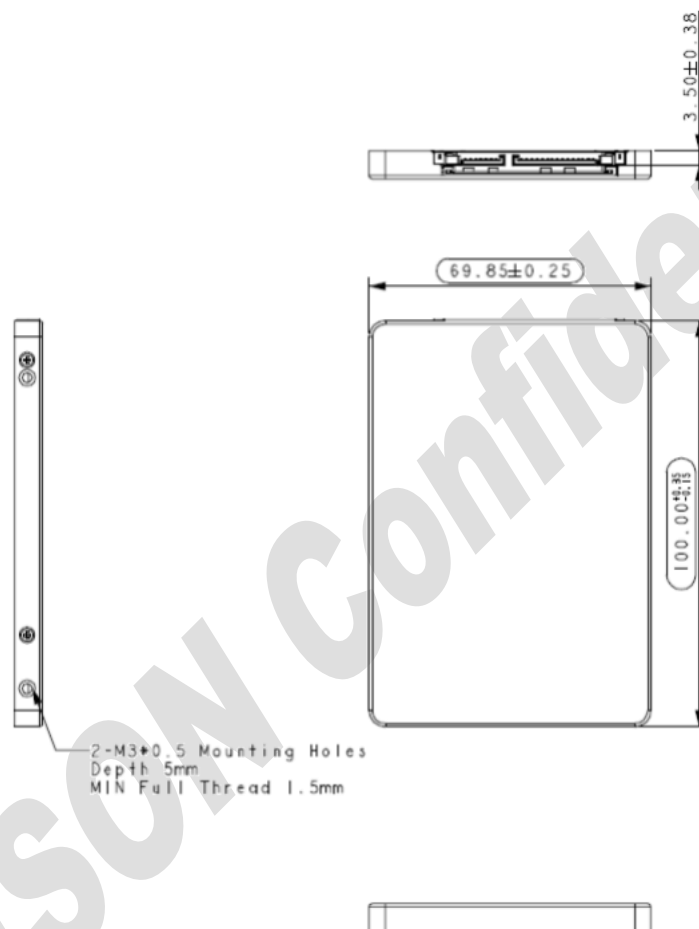


Figure 5-1 2.5" SATA SSD Mechanical Diagram (Top and Side View)

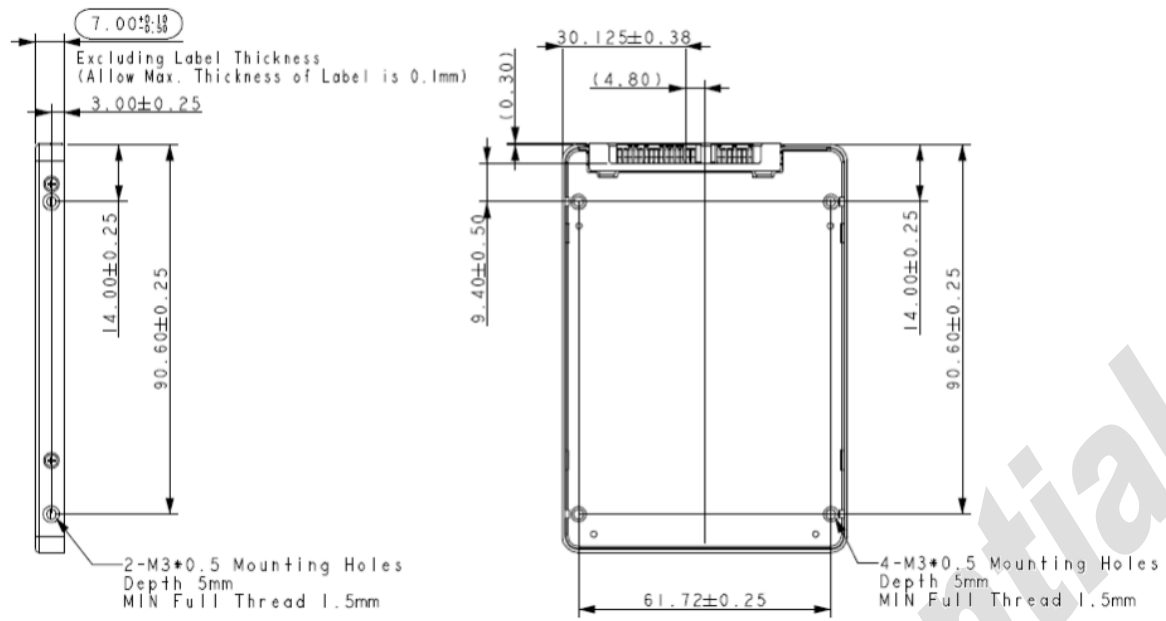


Figure 5-2 2.5" SATA SSD Mechanical Diagram (Bottom and Side View)

6. INTERFACE

6.1. Pin Assignment and Descriptions

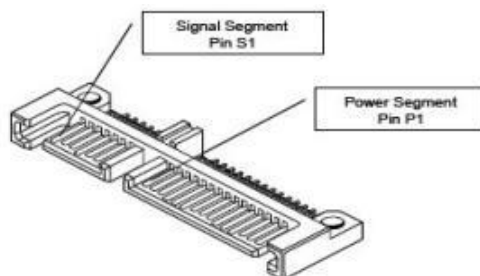


Figure 6-1 2.5" SATA SSD Pin Assignment

Table 6-1 Signal Segment Pin Assignment and Descriptions

Pin No.	Description
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 No.	Description	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		-	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
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).

Disclaimer

NOTWITHSTANDING ANYTHING ELSE SET FORTH HEREIN, AND TO THE EXTENT NOT PROHIBITED BY APPLICABLE LAW, PHISON SHALL NOT BE LIABLE WITH RESPECT TO PRODUCTS UNDER ANY CONTRACT, NEGLIGENCE, STRICT LIABILITY OR OTHER LEGAL OR EQUITABLE THEORY FOR ANY LOST DATA, LOST REVENUES, LOST SAVINGS, LOST PROFITS OR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING FROM THE PURCHASE OR USE OF OR INABILITY TO USE PHISON PRODUCTS, EVEN IF PHISON HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

UNLESS OTHERWISE AGREED TO BY PHISON IN WRITING, PHISON DOES NOT RECOMMEND NOR WARRANT PRODUCTS FOR USE IN LIFE SUPPORT, NUCLEAR, MEDICAL, MILITARY, TRANSPORTATION, AUTOMOTIVE (UNLESS OTHERWISE DEFINED BY PHISON AS "AUTOMOTIVE GRADE PRODUCT"), AVIATION, AEROSPACE INDUSTRY OR OTHER APPLICATIONS WHEREIN A FAILURE OR DEFECT OF THE PHISON PRODUCT MIGHT THREATEN LIFE, INJURY, HEALTH OR LOSS OF SIGNIFICANT AMOUNT OF MONEY ("CRITICAL USE"), AND BUYER AND USER HEREBY ASSUME ALL RISK OF ANY CRITICAL USE OF PRODUCT.

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

PHISON Confidential