Phison SATA 2.5” SSD (SB262-Small Plastic) (PS3117-S17T) KIOXIA TLC Specification

Version 1.0

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Document Number: S-21194

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REVISION HISTORY

Revision	Draft Date	History	Author
1.0	2021/10/05	First release	Patti Chen

PRODUCT OVERVIEW

- **Capacities**
  - 256, 512, 1024, 2048 GB
- **Form Factor**
  - 2.5 Inch
- **SATA Interface**
  - SATA III
  - SATA Revision 3.2
- **Flash Interface**
  - Transfer rate up to 533 MBps
  - Up to 4pcs of BGA132/152 flash
- **Performance**[1]
  - Read: up to 550 MB/s
  - Write: up to 500 MB/s
- **Reliability**
  - Mean Time Between Failure (MTBF) 2,000,000 hours
- **Advanced Flash Management**
  - Dynamic Wear Leveling
  - Bad Block Management
  - TRIM
  - SMART
  - Over-Provision
  - Firmware Update
  - SmartZIP™
- **Power Consumption**[2]
  - Power supply of 2.5” SSD: 5V±5%
  - Active Mode (Typ.) < 1,360 mW
  - Idle < 210 mW
  - DEVSLP mode: < 4.9 mW
- **Temperature Range**[3]
  - Operation: 0°C ~ 70°C
  - Storage: -40°C ~ 85°C
- **RoHS-Compliant**

NOTE:

1. Refer to Chapter 2 for more details
2. Refer to Section 4.2 power consumption for more details
3. The operation temperature means the case temperature, in which can be decided via the S.M.A.R.T.

PERFORMANCE AND POWER CONSUMPTION

Capacity	Flash Structure	Performance				Power Consumption	
		CrystalDiskMark		ATTO		Read (mW)	Write (mW)
		Read (MB/s)	Write (MB/s)	Read (MB/s)	Write (MB/s)		
256GB	128GBx2, BGA KIC BiCS5 TLC	550	500	550	520	1180	1180
512GB	128GBx4, BGA KIC BiCS5 TLC	550	510	550	520	1250	1220
1024GB	512GBx2, BGA KIC BiCS5 TLC	550	510	550	520	1360	1280
2048GB	512GBx4, BGA KIC BiCS5 TLC	550	510	550	520	1340	1260

Notes:

1. Performance is measured based on the following conditions:
   A. CrystalDiskMark 6.0.0, 1GB range, QD=32T1
   B. IOMeter, 1GB range, 4K data size, QD=32T1
   C. ATTO, transfer size 512 byte to 64 MB
2. Power consumption is measured during the sequential read and write operations performed by CrystalDiskMark with the conditions.

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1. INTRODUCTION

1.1. General Description

Phison’s PS3117 2.5” SATA Solid State Disk (SSD) delivers all the advantages of flash disk technology with Serial ATA I/II/III interface, including being fully compliant with standard 2.5-inch form factor, providing low power consumption compared to traditional hard drive and hot-swapping when removing/replacing/upgrading flash disks. The device is designed based on the standard 7-pin interface for data segment and 15-pin for power segment, as well as operating at a maximum operating frequency of 200MHz with 30MHz external crystal. Its capacity could provide a wide range up to 4TB. Moreover, it can reach up to 550MB/s read as well as 500MB/s write high performance based on 16CE and Toggle 3.0/4.0 TLC/QLC flash.

1.2. Controller Block Diagram

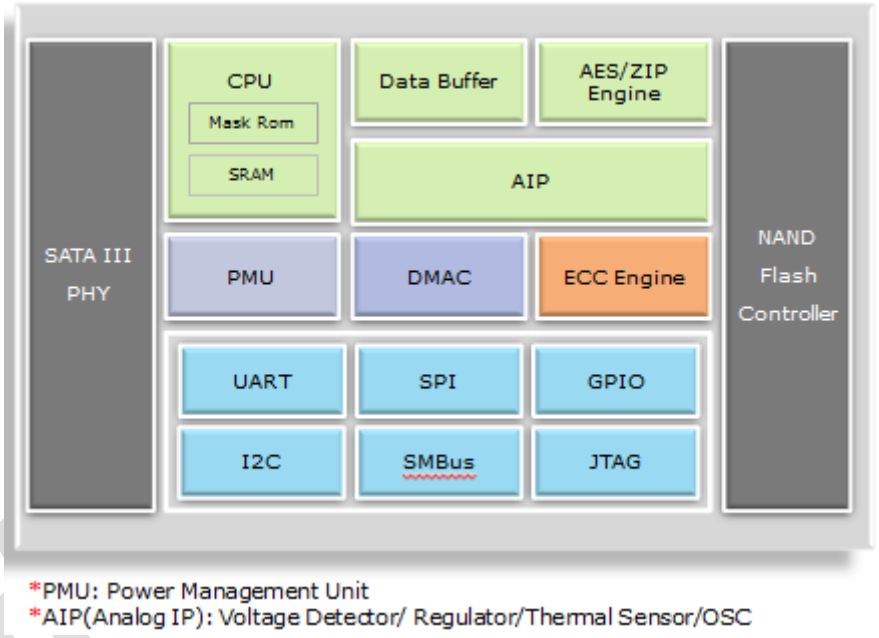


Figure 1-1 PS3117 2.5’’ SATA SSD Controller Block Diagram

1.3. Product Block Diagram

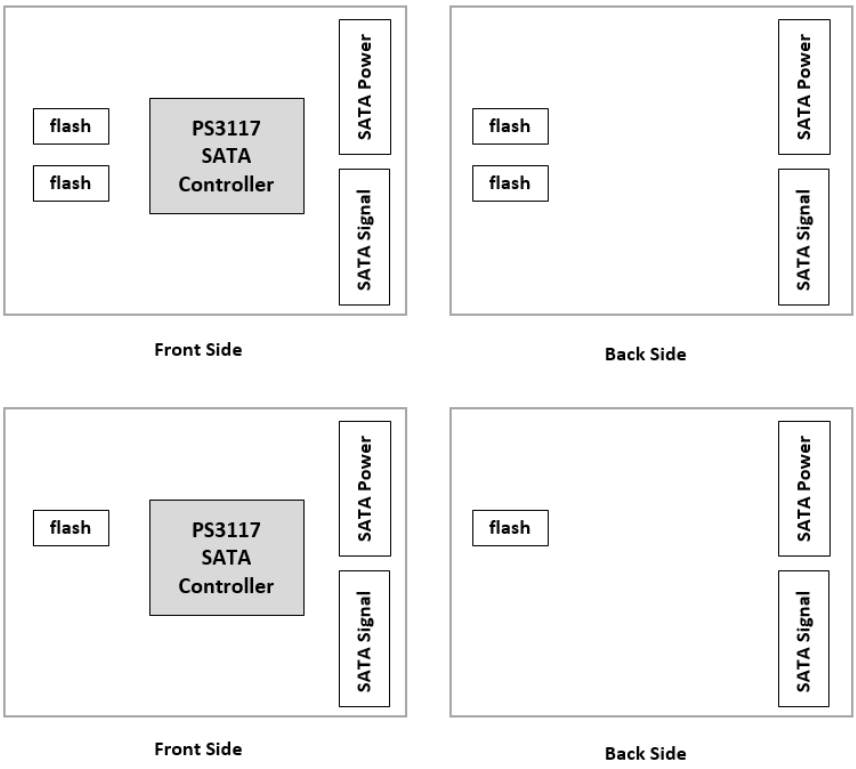


Figure 1-2 PS3117 2.5’’ SATA SSD Product Block

1.4. Flash Management

1.4.1. Error Correction Code (ECC)

Flash memory cells will deteriorate with use, which might generate random bit errors in the stored data. Thus, PS3117 2.5’’ SATA SSD applies the LDPC (Low Density Parity Check) of ECC algorithm, which can detect and correct errors occur during read process, ensure data been read correctly, as well as protect data from corruption.

1.4.2. Wear Leveling

NAND flash devices can only undergo a limited number of program/erase cycles, when flash media is not used evenly, some blocks get updated more frequently than others and the lifetime of device would be reduced significantly. Thus, wear leveling is applied to extend the lifespan of NAND flash by evenly distributing write and erase cycles across the media.

Phison provides advanced wear leveling algorithm, which can efficiently spread out the flash usage through the whole flash media area. Moreover, by implementing both dynamic and static wear leveling algorithms, the life expectancy of the NAND flash is greatly improved.

1.4.3. Bad Block Management

Bad blocks are blocks that do not function properly or contain more invalid bits causing stored data unstable, and their reliability is not guaranteed. Blocks that are identified and marked as bad by the manufacturer are referred to as “Early Bad Blocks”. Bad blocks that are developed during the lifespan of the flash are named “Later Bad Blocks”. Phison implements an efficient bad block management algorithm to detect the factory-produced bad blocks and manages bad blocks that appear with use. This practice prevents data being stored into bad blocks and further improves the data reliability.

1.4.4. TRIM

TRIM is a feature which helps improve the read/write performance and speed of solid state drives (SSD). Unlike hard disk drives (HDD), SSDs are not able to overwrite existing data, so the available space gradually becomes smaller with each use. With the TRIM command, the operating system can inform the SSD so that blocks of data that are no longer in use can be removed permanently. Thus, the SSD will perform the erase action, which prevents unused data from occupying blocks at all time.

1.4.5. SMART

SMART, an acronym for Self-Monitoring, Analysis and Reporting Technology, is an open standard that allows a solid state drive to automatically detect its health and report potential failures. When a failure is recorded by SMART, users can choose to replace the drive to prevent unexpected outage or data loss. Moreover, SMART can inform users impending failures while there is still time to perform proactive actions, such as save data to another device.

1.4.6. Over-Provision

Over Provisioning refers to the preserving additional area beyond user capacity in a SSD, which is not visible to users and cannot be used by them. However, it allows a SSD controller to utilize additional space for better performance and WAF. With Over Provisioning, the performance and IOPS (Input/Output Operations per Second) are improved by providing the controller additional space to manage P/E cycles, which enhances the reliability and endurance as well. Moreover, the write amplification of the SSD becomes lower when the controller writes data to the flash.

1.4.7. Firmware Upgrade

Firmware can be considered as a set of instructions on how the device communicates with the host. Firmware will be upgradable when new features are added, compatibility issues are fixed, or read/write performance gets improved.

1.4.8. Thermal Throttling

The purpose of thermal throttling is to prevent any components in a SSD from over-heating during read and write operations. PS3117 is designed with an on-die thermal sensor and with its accuracy, firmware can apply different levels of throttling to achieve the purpose of protection efficiently and proactively via SMART reading.

1.5. Low Power Management

1.5.1. DEVSLP Mode (Optional)

With the increasing need of aggressive power/battery life, SATA interfaces include a new feature, Device Sleep (DEVSLP) mode, which helps further reduce the power consumption of the device. DEVSLP enables the device to completely power down the device PHY and other sub-systems, making the device reach a new level of lower power operation. The DEVSLP does not specify the exact power level a device can achieve in the DEVSLP mode, but the power usage can be dropped down to 5mW or less.

1.5.2. DIPM/HIPM Mode

SATA interfaces contain two low power management states for power saving: Partial and Slumber modes. For Partial mode, the device has to resume to full operation within 10 microseconds, whereas the device will spend 10 milliseconds to become fully operational in the Slumber mode. SATA interfaces allow low power modes to be initiated by Host (HIPM, Host Initiated Power Management) or Device (DIPM, Device Initiated Power Management). As for HIPM, Partial or Slumber mode can be invoked directly by the software. For DIPM, the device will send requests to enter Partial or Slumber mode.

1.6. Advanced Device Security Features

1.6.1. Secure Erase

Secure Erase is a standard ATA command and will write all "0xFF" to fully wipe all the data on hard drives and SSDs. When this command is issued, SSD controller will erase its storage blocks and return to its factory default settings.

1.6.2. Write Protect

When a SSD contains too many bad blocks and data are continuously written in, then the SSD might not be usable anymore. Thus, Write Protect is a mechanism to prevent data from being written in and protect the accuracy of data that are already stored in the SSD.

1.6.3. Crypto Erase

Crypto Erase (TCG) is a feature that erases all data of an OPAL-activated SSD drive by resetting the cryptographic key of the disk. Since the key is modified, the previously encrypted data will become useless, achieving the purpose of data security.

1.6.4. Physical Presence SID (PSID)

Physical Presence SID (PSID) is defined by TCG OPAL as a 32-character string and the purpose is to revert SSD back to its manufacturing setting when the drive is still OPAL-activated. PSID code can be printed on a SSD label when an OPAL-activated SSD supports PSID revert feature.

1.7. SSD Lifetime Management

1.7.1. Thermal Monitor (Optional)

Thermal monitors are devices for measuring temperature, and can be found in SSDs in order to issue warnings when SSDs go beyond a certain temperature. The higher temperature the thermal monitor detects, the more power the SSD consumes, causing the SSD to get aging quickly. Hence, the processing speed of a SSD should be under control to prevent temperature from exceeding a certain range. Meanwhile, the SSD can achieve power savings.

1.7.2. Terabytes Written (TBW)

TBW (Terabytes Written) is a measurement of SSDs' expected lifespan, which represents the amount of data

written to the device. To calculate the TBW of a SSD, the following equation is applied:

TBW = [(NAND Endurance) x (SSD Capacity)] / [WAF]

NAND Endurance: NAND endurance refers to the P/E (Program/Erase) cycle of a NAND flash.

SSD Capacity: The SSD capacity is the specific capacity in total of a SSD.

WAF: Write Amplification Factor (WAF) is a numerical value representing the ratio between the amount of data that a SSD controller needs to write and the amount of data that the host's flash controller writes. A better WAF, which is near 1, guarantees better endurance and lower frequency of data written to flash memory.

TBW in this document is based on JEDEC 219 workload.

1.8. Adaptive Approach to Performance Tuning

1.8.1. Throughput

Based on the available space of the disk, PS3117 will regulate the read/write speed and manage the performance of throughput. When there still remains a lot of space, the firmware will continuously perform read/write action. There is still no need to implement garbage collection to allocate and release memory, which will accelerate the read/write processing to improve the performance. Contrarily, when the space is going to be used up, PS3117 will slow down the read/write processing, and implement garbage collection to release memory. Hence, read/write performance will become slower.

1.8.2. Predict & Fetch

Normally, when the host tries to read data from the SSD, the SSD will only perform one read action after receiving one command. However, PS3117 applies Predict & Fetch to improve the read speed. When the host issues sequential read commands to the SSD, the SSD will automatically expect that the following will also be read commands. Thus, before receiving the next command, flash has already prepared the data. Accordingly, this accelerates the data processing time, and the host does not need to wait so long to receive data.

1.8.3. SmartZIP™

Write data to the NAND Flash costs time. To improve the write speed performance, PS3117 launches with compression technique—SmartZIP™.

Whether a file could be compressed or not depending on the file type, for file types have redundancy data

pattern, through our embedded encode engine, we could reduce the amount of data that is actually written to the Flash. Comparing to the SSD without the compression, write efficiency is raised and the SSD endurance is also improved since Flash could be benefit from less data written for a longer SSD lifetime.

2. PRODUCT SPECIFICATIONS

■ Capacity

- From 256GB up to 2048GB
- Support 48-bit addressing mode

■ Electrical/Physical Interface

- Compliant with SATA Revision 3.2
- Compatible with SATA 1.5Gbps, 3Gbps and 6Gbps interface
- Support power management
- Support expanded register for SATA protocol 48 bits addressing mode
- Embedded BIST function for SATA PHY for low cost mass production
- Support 3D TLC/QLC NAND flash
- Supply voltage of NAND flash I/O: 1.2V/1.8V

■ Supported NAND Flash

- Support up to 16 Flash Chip Enables (CE) within single design
- Support up to 4 pcs of BGA132/152 flash
- Support 8-bit I/O NAND Flash
- Support Toggle 3.0/4.0 and ONFI 4.0 interface

■ ECC Scheme

- PS3117 2.5" SSD applies the LDPC (Low Density Parity Check) of ECC algorithm.

■ UART/ GPIO

■ LBA Range

- IDEMA standard

■ Support SMART and TRIM commands

■ TBW

Table 2-1 Performance of PS3117-S17 + BiCS series

Capacity	Flash Structure	TBW
256GB	128GBx2, BGA KIC BiCS5 TLC	120
512GB	128GBx4, BGA KIC BiCS5 TLC	250
1024GB	512GBx2, BGA KIC BiCS5 TLC	500
2048GB	512GBx4, BGA KIC BiCS5 TLC	1000

Notes:

1. Samples were built using KIOXIA BiCS5 NAND flash.
2. TBW may differ according to flash configuration and platform.
3. The test followed JEDEC 219A client endurance workload.
4. The endurance of SSD could be estimated based on user behavior, NAND endurance cycles, and write amplification factor. It is not guaranteed by flash vendor.

■ Performance

Table 2-2 Performance of PS3117-S17 + BiCS5 series

Capacity	Flash Structure	Sequential (CDM)		ATTO	
		Read (MB/s)	Write (MB/s)	Read (MB/s)	Write (MB/s)
256GB	128GBx2, BGA KIC BiCS5 TLC	550	500	550	520
512GB	128GBx4, BGA KIC BiCS5 TLC	550	510	550	520
1024GB	512GBx2, BGA KIC BiCS5 TLC	550	510	550	520
2048GB	512GBx4, BGA KIC BiCS5 TLC	550	510	550	520

Notes:

1. Performance was estimated based on KIOXIA BiCS5 series TLC NAND flash.

3. ENVIRONMENTAL SPECIFICATIONS

3.1. Environmental Conditions

3.1.1. Temperature and Humidity

Table 3-1 High Temperature

	Temperature	Humidity
Operation	70°C	0% RH
Storage	85°C	0% RH

Table 3-2 Low Temperature

	Temperature	Humidity
Operation	0°C	0% RH
Storage	-40°C	0% RH

Table 3-3 High Humidity

	Temperature	Humidity
Operation	40°C	90% RH
Storage	40°C	93% RH

Table 3-4 Temperature Cycling

	Temperature
Operation	0°C
	70°C[1]
Storage	-40°C
	85°C

Notes:

1. The operation temperature is measured by the case temperature, in which can be decided via the S.M.A.R.T. Airflow is suggested and it will allow device to be operated at appropriate temperature for each component during heavy workloads environment.

3.1.2. Shock

Table 3-5 Shock

	Acceleration Force
Non-operational	1500G

3.1.3. Vibration

Table 3-6 Vibration

	Condition	
	Frequency/Displacement	Frequency/Acceleration
Non-operational	20Hz~80Hz/1.52mm	80Hz~2000Hz/20G

3.1.4. Drop

Table 3-7 Drop

	Height of Drop	Number of Drop
Non-operational	80cm free fall	6 face of each unit

3.1.5. Bending

Table 3-8 Bending

	Force	Action
Non-operational	≥ 20N	Hold 1min/5times

3.1.6. Torque

Table 3-9 Torque

	Force	Action
Non-operational	0.5N-m or ±2.5 deg	Hold 1min/5times

3.1.7. Durability

Table 3-10 Durability

	Condition
operational	1000 mating cycles

3.1.8. Electrostatic Discharge (ESD)

Table 3-11 ESD

	+/- 4KV
Contact ESD	Device functions are affected, but EUT will be back to its normal or operational state automatically.

3.1.9. EMI Compliance

Table 3-12 EMI

Specification
● FCC : ANSI C63.4
● CE : EN 55032, CISPR32
● BSMI : CNS 13438
● VCCI : VCCI-CISPR32

3.2. MTBF

MTBF, an acronym for Mean Time Between Failures, is a measure of a device's reliability. Its value represents the average time between a repair and the next failure. The measure is typically in units of hours. The higher the MTBF value, the higher the reliability of the device.

The predicted result of Phison's PS3117 2.5'' SATA SSD is more than 2,000,000 hours.

3.3. Certification & Compliance

Table 3-13 Certification & Compliance

Specification
● RoHS
● WHQL
● SATA III (SATA Rev. 3.2)
● UNH-IOL NVM Express Logo
● Up to ATA/ATAPI-8 (Including S.M.A.R.T)

4. ELECTRICAL SPECIFICATIONS

4.1. Supply Voltage

Table 4-1 Supply Voltage

Parameter	Rating
Operating Voltage	5V ± 5%

4.2. Power Consumption

Table 4-2 Power Consumption in mW

Capacity	Flash Structure	Power Consumption					
		Read (mW)	Write (mW)	Partial (mW)	Slumber (mW)	Idle (mW)	DEVSLP (mW)
256GB	128GBx2, BGA KIC BiCS5 TLC	1180	1180	60	20	200	4.9
512GB	128GBx4, BGA KIC BiCS5 TLC	1250	1220	60	20	210	4.9
1024GB	512GBx2, BGA KIC BiCS5 TLC	1360	1280	60	20	210	4.9
2048GB	512GBx4, BGA KIC BiCS5 TLC	1340	1260	70	30	200	4.9

Notes:

1. The average value of power consumption is achieved based on 100% conversion efficiency.
2. The measured power voltage is 5V.
3. Samples were built using KIOXIA BiCS5. It’s measured under ambient temperature.
4. Sequential R/W is measured while testing 1GB sequential R/W 5 times by CrystalDiskMark. DEVSLP is measured while entering device sleep mode for 5 minutes.
5. Power Consumption may differ according to flash configuration and platform.

5. INTERFACE

5.1. Pin Assignment and Descriptions

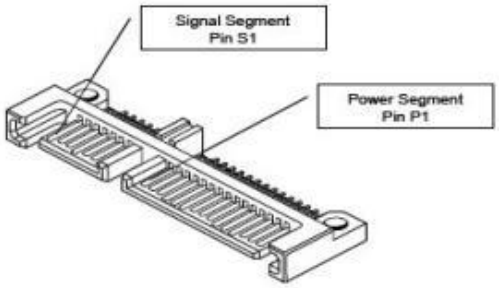


Figure 5-1 PS3117 2.5’’ SATA SSD Pin Assignment

Table 5-1 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 5-2 Power Segment Pin Assignment and Descriptions

Pin Number	Function
P1	Not Used (3.3V)
P2	Not Used (3.3V)
P3	DEVSLP
P4	GND
P5	GND
P6	GND
P7	5V pre-charge
P8	5V
P9	5V
P10	GND
P11	Reserved
P12	GND
P13	Not Used (12V pre-charge)
P14	Not Used (12V)
P15	Not Used (12V)

6. SUPPORTED COMMANDS

6.1. ATA Command List

The following ATA command list table is followed by ATA8-ACS4 SPEC.

Table 6-1 ATA Command List

Op Code	Description	Op Code			Description
00h	NOP	E1h			Idle Immediate
06h	Data Set Management	E2h			Standby
10h-1Fh	Recalibrate	E3h			Idle
20h	Read Sectors	E4h			Read Buffer
21h	Read Sectors without Retry	E5h			Check Power Mode
24h	Read Sectors EXT	E6h			Sleep
25h	Read DMA EXT	E7h			Flush Cache
27h	Read Native Max Address EXT	E8h			Write Buffer
29h	Read Multiple EXT	E9h			READ BUFFER DMA
2Fh	Read Log EXT	EAh			Flush Cache EXT
30h	Write Sectors	EBh			Write Buffer DMA
31h	Write Sectors without Retry	ECh			Identify Device
34h	Write Sectors EXT	EFh			Set Features
35h	Write DMA EXT	90h			Execute Device Diagnostic
37h	Set Native Max Address EXT	91h			Initialize Device Parameters
39h	Write Multiple EXT	92h			Download Microcode
3Dh	Write DMA FUA EXT	93h			Download Microcode DMA
3Fh	Write Long EXT	B0h			SMART
40h	Read Verify Sectors	EFh	02h		Enable volatile write cache
41h	Read Verify Sectors without Retry	EFh	03h		Set transfer mode
42h	Read Verify Sectors EXT	EFh	05h		Enable the APM feature set
47h	Read Log DMA EXT	EFh	10h		Enable use of SATA features et
57h	Write Log DMA EXT	EFh	10h	02h	Enable DMA Setup FIS Auto-Activate optimization
60h	Read FPDMA Queued	EFh	10h	03h	Enable Device-initiated interface power state (DIPM) transitions
61h	Write FPDMA Queued	EFh	10h	06h	Enable Software Settings Preservation (SSP)
70h-76h	Seek	EFh	10h	07h	Enable Device Automatic Partial to Slumber transitions
79h-7Fh	Seek	EFh	10h	09h	Enable Device Sleep
C9h	Read DMA without Retry	EFh	55h		Disable read look-ahead
CAh	Write DMA	EFh	66h		Disable reverting to power-on defaults
CBh	Write DMA without Retry	EFh	82h		Disable volatile write cache

Op Code			Description	Op Code			Description
CEh			Write Multiple FUA EXT	EFh	85h		Disable the APM feature set
E0h			Standby Immediate	EFh	90h		Disable use of SATA feature set
C4h			Read Multiple	EFh	90h	02h	Disable DMA Setup FIS Auto-Activate optimization
C5h			Write Multiple	EFh	90h	03h	Disable Device-initiated interface power state (DIPM) transitions
C6h			Set Multiple Mode	EFh	90h	06h	Disable Software Settings Preservation (SSP)
C8h			Read DMA	EFh	90h	07h	Disable Device Automatic Partial to Slumber transitions
B0h	D0h		SMART READ DATA	EFh	90h	09h	Disable Device Sleep
B0h	D2h	00h	SMART READ ATTRIBUTE THRESHOLDS	EFh	90h	02h	Disable DMA Setup FIS Auto-Activate optimization
B0h	D2h	F1h	SMART ENABLE ATTRIBUTE AUTOSAVE	EFh	90h	03h	Disable Device-initiated interface power state (DIPM) transitions
B0h	D4h		SMART EXECUTE OFF-LINE IMMEDIATE	EFh	90h	06h	Disable Software Settings Preservation (SSP)
B0h	D5h		SMART READ LOG	EFh	90h	07h	Disable Device Automatic Partial to Slumber transitions
B0h	D6h		SMART WRITE LOG	EFh	90h	09h	Disable Device Sleep
B0h	D8h		SMART ENABLE OPERATIONS	EFh	AAh		Enable read look-ahead
B0h	D9h		SMART DISABLE OPERATIONS	EFh	CCh		Enable reverting to power-on defaults
B0h	DAh		SMART RETURN STATUS	F1h			Security Set Password
B1h	C0h		DEVICE CONFIGURATION RESTORE	F2h			Security Unlock
B1h	C2h		DEVICE CONFIGURATION IDENTIFY	F3h			Security Erase Prepare
B1h	C3h		DEVICE CONFIGURATION SET	F4h			Security Erase Unit
B1h	C4h		DEVICE CONFIGURATION IDENTIFY DMA	F5h			Security Freeze Lock
B1h	C5h		DEVICE CONFIGURATION SET DMA	F6h			Security Disable Password
F9h	01h		SET MAX SET PASSWORD	F8h			Read Native Max Address
F9h	02h		SET MAXLOCK	F9h			Set Max Address
F9h	03h		SET MAX UNLOCK				
F9h	04h		SET MAX FREEZE LOCIK				

6.2. Identify Device Data

The following table details the sector data returned by the IDENTIFY DEVICE command of ATA8-ACS4 SPEC.

Table 6-2 List of Device Identification

Word	F: Fixed V: Variable X: retired/obsolete /reserved	Default Value	Description
0	F	0040h	General configuration bit-significant information
1	X	***1**	Obsolete
2	F	C837h	Specific configuration
3	X	0010h	Obsolete
4-5	X	0000h	Retired
6	X	003Fh	Obsolete
7-8	X	0000h	Reserved for assignment by the Compact Flash Association
9	X	0000h	Retired
10-19	V	Varies	Serial number (ATA string)
20-21	X	0000h	Retired
22	X	0000h	Obsolete
23-26	V	Varies	Firmware revision (ATA string?
27-46	V	Varies	Model number (ATA string)
47	F	8010h	7:0- Maximum number of sectors transferred per interrupt on MULTIPLE commands
48	F	4000h	Trusted Computing feature set options
49	F	2F00h	Capabilities
50	F	4000h	Capabilities
51-52	X	0000h	Obsolete
53	F	0007h	Words 88 and 70:64 valid
54	X	***1**	Obsolete
55	X	0010h	Obsolete
56	X	003Fh	Obsolete
57	X	***2**	Obsolete
58	X	00FBh	Obsolete
59	F	0110h	Number of sectors transferred per interrupt on MULTIPLE commands
60-61	V	***3**	Maximum number of sector (28bit LBA mode)
62	X	0000h	Obsolete
63	F	0407h	Multi-word DMA modes supported/selected
64	F	0003h	PIO mode 3 and mode 4 supported
65	F	0078h	Minimum Multiword DMA transfer cycle time per word

Word	F: Fixed V: Variable X: retired/obsolete /reserved	Default Value	Description
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	1F00h	Additional Supported (support download microcode DMA)
70	X	0000h	Reserved
71-74	X	0000h	Reserved for the IDENTIFY PACKET DEVICE command
75	F	001Fh	Queue depth
76	F	C50Eh	Serial SATA capabilities
77	F	0006h	Serial ATA Additional Capabilities
78	F	044Ch	Serial ATA features supported
79	F	0040h	Serial ATA features enabled
80	F	0FF8h	Major Version Number
81	F	0000h	Minor Version Number
82	F	746Bh	Command and feature sets supported
83	F	7D09h	Command and feature sets supported
84	F	4163h	Command and feature sets supported
85	F	7469h	Command set/feature enabled
86	F	BC01h	Command set/feature enabled
87	F	4163h	Command set/feature default
88	F	007Fh	Ultra DMA Modes
89	F	000Ah	Time required for security erase unit completion
90	F	001Eh	Time required for Enhanced security erase completion
91	F	0000h	Current advanced power management value
92	F	FFFEh	Master Password Revision Code
93	F	0000h	Hardware reset result. For SATA devices, word 93 shall be set to the value 0000h.
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**	Maximum user LBA for 48 bit Address feature set
104	F	0000h	Streaming Transfer Time – PIO
105	F	0004h	Maximum number of 512-byte blocks per DATA SET MANAGEMENT command

Word	F: Fixed V: Variable X: retired/obsolete /reserved	Default Value	Description
106	F	4000h	Physical sector size/Logical sector size
107	F	0000h	Inter-seek delay for ISO-7779 acoustic testing
108-111	V	Varies	World Wide Name
112-115	X	0000h	Reserved
116	X	0000h	Reserved for TLC
117-118	F	0000h	Words per logical Sector
119	F	4018h	Supported settings
120	F	4018h	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
129-140	V	Varies	Vendor specific
141	V	Varies	Vendor specific
142-159	V	Varies	Vendor specific
160	X	0000h	Reserved for CFA
161-167	X	0000h	Reserved for CFA
168	V	Varies	Device Nominal Form Factor
169	F	0001h	DATA SET MANAGEMENT command is supported
170-173	F	0000h	Additional Product Identifier
174-175	X	0000h	Reserved
176-205	F	0000h	Current media serial number
206	F	0000h	SCT Command Transport
207-208	X	0000h	Reserved
209	F	4000h	Alignment of logical blocks within a physical block
210-211	F	0000h	Write-Read-Verify Sector Count Mode 3 (not support)
212-213	F	0000h	Write-Read-Verify Sector Count Mode 2 (not support)
214-216	X	0000h	Obsolete
217	F	0001h	Nominal media rotation rate
218	X	0000h	Reserved
219	X	0000h	NV Cache relate (not support)
220	V	0000h	Write read verify feature set current mode
221	X	0000h	Reserved
222	F	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

Word	F: Fixed V: Variable X: retired/obsolete /reserved	Default Value	Description
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	FFFEh	Minimum number of 512-byte data blocks per Download Microcode operation
236-254	X	0000h	Reserved
255	F	XXA5h XX is variable	Integrity word (Checksum and Signature) Bit[15:8] Checksum

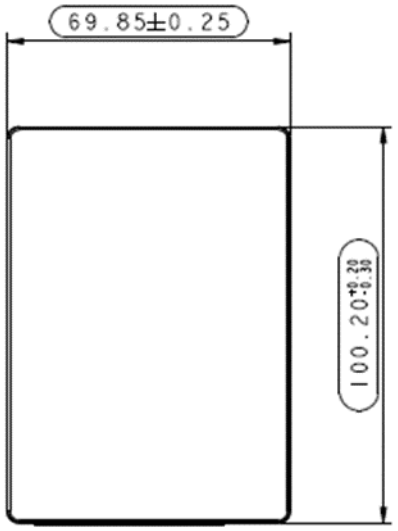
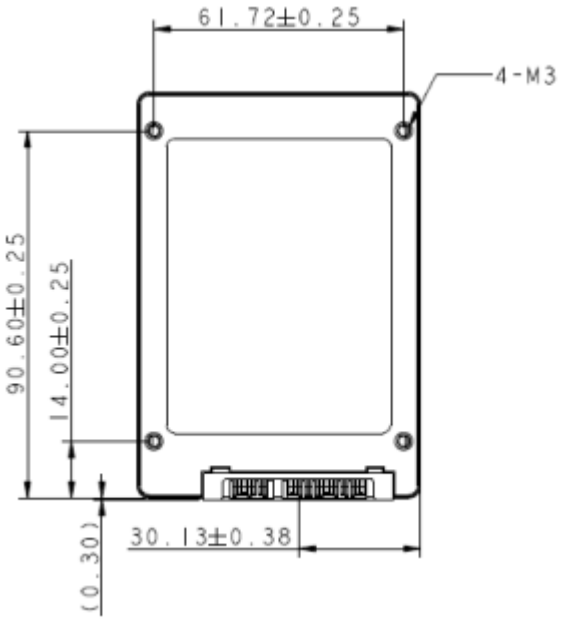
Table 6-3 List of Device Identification for Each Capacity

Capacity (GB)	*1 (Word 1/Word 54)	*2 (Word 57 – 58)	*3 (Word 60 – 61)	*4 (Word 100 – 103)
256	3FFFh	FBFC10h	FFFFFFFh	1DCF32B0h
480	3FFFh	FBFC10h	FFFFFFFh	37E436B0h
512	3FFFh	FBFC10h	FFFFFFFh	3B9E12B0
960	3FFFh	FBFC10h	FFFFFFFh	6FC81AB0h
1024	3FFFh	FBFC10h	FFFFFFFh	773BD2B0h
2048	3FFFh	FBFC10h	FFFFFFFh	EE7752B0h

7. PHYSICAL DIMENSION

Form factor: 2.5” SSD

Dimensions: 100mm (L) x 69.85mm (W) x 7.00mm (H)

View Direction	Diagram
Top	
Bottom	

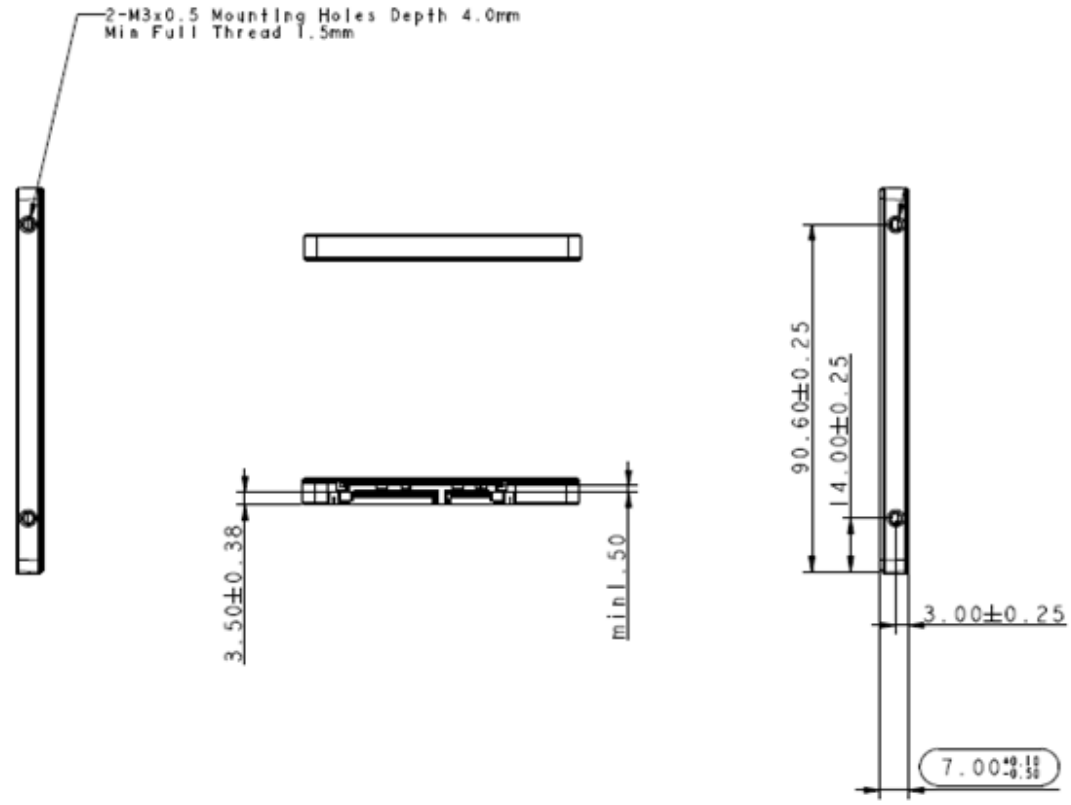
View Direction	Diagram
Side	

Figure 7-1 Product Mechanical Diagram and Dimensions

8. REFERENCES

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

Table 8-1 List of Standards References

Title	Acronym/Source
RoHS	Restriction of Hazardous Substances Directive; for further information, please contact us at sales@phison.com or support@phison.com.
Serial ATA Revision 3.2	http://www.sata-io.org
ATA-8 spec	http://www.t13.org
FCC: CISPR22	Federal Communications Commission; for further information, please contact us at sales@phison.com or support@phison.com.
CE: EN55022	Consumer electronics certification; for further information, please contact us at sales@phison.com or support@phison.com.
BSMI: 13438	The Bureau of Standards, Metrology and Inspection; for further information, please contact us at sales@phison.com or support@phison.com.

9. TERMINOLOGY

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

Table 9-1 List of Terminology

Term	Definitions
ATTO	Commercial performance benchmark application
DDR	Double data rate (SDRAM)
ASPM	Active States Power Management
APST	Autonomous Power State Transition
LBA	Logical block addressing
MB	Mega-byte
GB	Giga-byte
TB	Tera-byte
MTBF	Mean time between failures
PCIe	PCI Express / Peripheral Component Interconnect Express
S.M.A.R.T.	Self-monitoring, analysis and reporting technology
SSD	Solid state disk

10. PRODUCT WARRANTY POLICY

In the event the Product does not conform to the specification within Phison agreed warranty period and such inconformity is solely attributable to Phison’s cause, Phison agrees at its discretion replace or repair the nonconforming Product. 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 the Product;

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

(3) Phison’s compliance with customer (including customer’s suppliers, subcontractors or downstream customers) indicated instructions, technologies, designs, specifications, materials, components, parts;

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

(5) 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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