



SATA DOM (6Gbps) SSD Specification

Version 1.1

Product Overview

- **Capacity**
 - 1GB up to 128GB
- **SATA Interface**
 - SATA Revision 3.0
 - SATA 1.5Gbps, 3Gbps, and 6Gbps interface
- **Flash Interface**
 - Flash Type: SLC/EconoSLC™/MLC
 - 1pcs to 4pcs of TSOP/BGA flash
- **Performance**
 - Read: up to 520 MB/s
 - Write: up to 200 MB/s
- **Power Consumption**^{Note1}
 - Active mode: <2,000mW
 - Idle mode: 295mW
- **TBW (Terabyte Written)**^{Note2}
 - 370 TBW for 128GB (MLC)
- **MTBF**
 - More than 2,000,000 hours
- **Advanced Flash Management**
 - Static and Dynamic Wear Leveling
 - Bad Block Management
 - TRIM
 - NCQ
 - SMART
 - Over-Provision
 - Firmware Update
- **Low Power Management**
 - DIPM/HIPM Mode
- **Temperature Range**
 - Commercial: 0°C ~ 70°C
 - Industrial: -40°C ~ 85°C
 - Storage: -40°C ~ 85°C
- **RoHS compliant**

Notes:

1. Please see “4.2 Power Consumption” for details.
2. Please see “TBW (Terabyte Written)” in Chapter 2” for details.

Performance and Power Consumption

Flash Process	Capacity	Flash Structure	Performance		Power Consumption		
			CrystalDiskMark		Read (mW)	Write (mW)	Idle (mW)
			Read (MB/s)	Write (MB/s)			
A19nm	1GB	1GB x 1	95	35	540	450	125
	2GB	2GB X 1	95	35	540	450	125
	4GB	4GB x 1	90	35	540	450	125
	8GB	4GB x 2	210	50	1,094	756	195
	16GB	4GB x 4, TSOP	460	50	2,080	1,415	290
	32GB	8GB x 4, TSOP	510	100	2,180	1,615	290
	64GB	16GB x 4, TSOP	520	190	2,340	2,305	295
	128GB	32GB x4, TSOP	520	360	2,340	3,425	295

NOTE:

For more details on Power Consumption, please refer to Chapter 4.2.

*For 19nm BGA flash, please refer to section 2, under “supported NAND flash” for more details.

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1. INTRODUCTION

1.1. General Description

Envoy's SATA DOM SSD delivers all the advantages of Flash Disk technology with Serial ATA III interface, including being fully compliant with SATA DOM form factor, providing low power consumption compared to traditional hard drive and hot-swapping when removing/replacing/upgrading flash disks. The capacity could provide a wide range up to 128GB and the performance reach up to 520MB/s read as well as 360MB/s write based on Toshiba's toggle MLC flash (with 256MB/512MB DDR3 cache enabled and measured by CrystalDiskMark v3.0). Meanwhile, the power consumption is much lower than traditional Hard Drives.

1.2. Controller Block Diagram

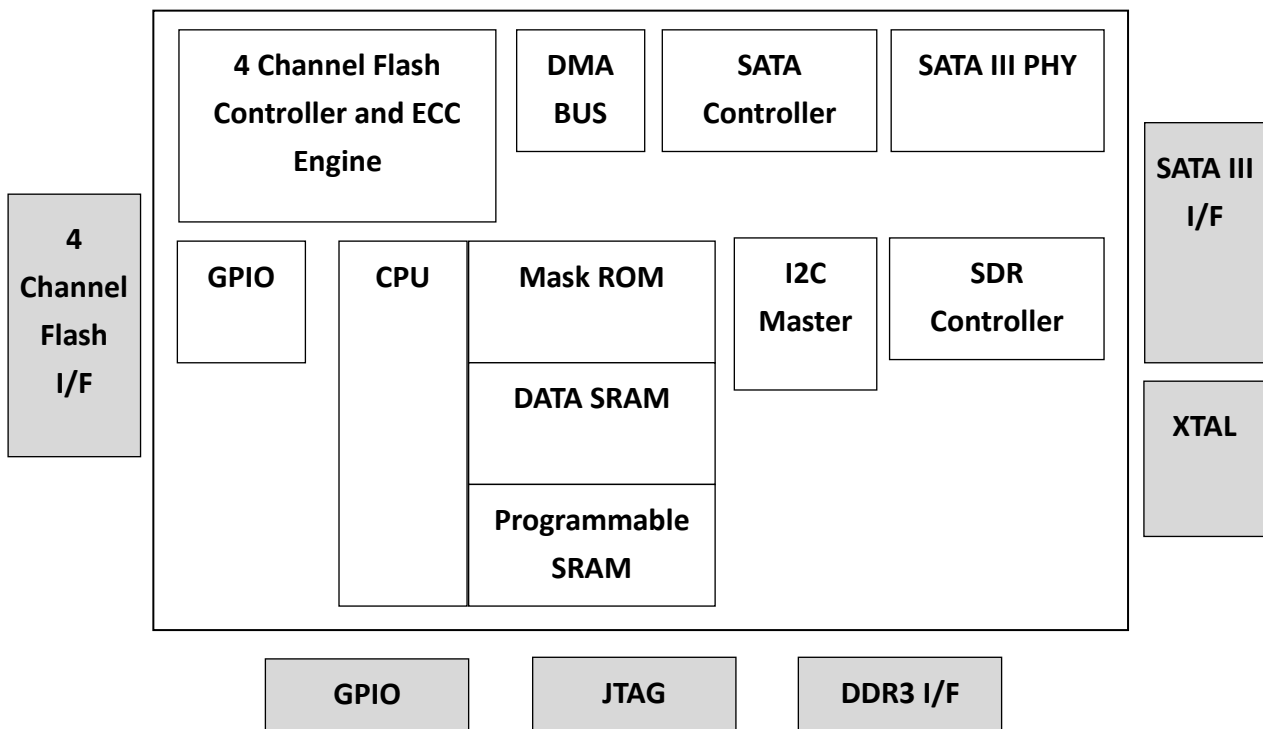


Figure 1-1 ENVOY's' SATA DOM SSD Controller Block Diagram

1.3. Product Block Diagram

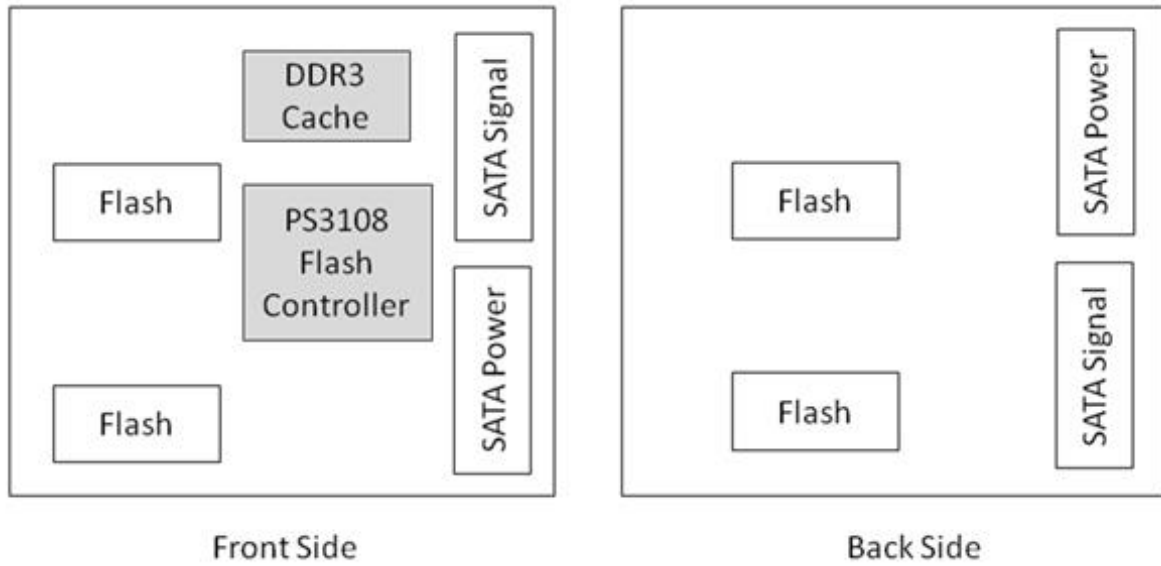


Figure 1-2 ENVOY SATA DOM SSD Product Block Diagram

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, ENVOY'S SATA SSD applies the BCH 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, and in most cases, the flash media are not used evenly. If some areas get updated more frequently than others, the lifetime of the device would be reduced significantly. Thus, Wear Leveling technique is applied to extend the lifespan of NAND Flash by evenly distributing write and erase cycles across the media.

Envoy Data Memory 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 include one or more invalid bits, and their reliability is not guaranteed. Blocks that are identified and marked as bad by the manufacturer are referred to as “Initial Bad Blocks”. Bad blocks that are developed during the lifespan of the flash are named “Later Bad Blocks”. Envoy Data Memory implements an efficient bad block management algorithm to detect the factory-produced bad blocks and manages any bad blocks that appear with use. This practice further prevents data being stored into bad blocks and 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 which blocks of data are no longer in use and can be removed permanently. Thus, the SSD will perform the erase action, which prevents unused data from occupying blocks all the time.

1.4.5. SMART

SMART, an acronym for Self-Monitoring, Analysis and Reporting Technology, is an open standard that allows a hard disk 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 of impending failures while there is still time to perform proactive actions, such as copy data to another device.

1.4.6. Over-Provision

Over Provisioning refers to the inclusion of extra NAND capacity in a SSD, which is not visible and cannot be used by users. 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 upgraded when new features are added, compatibility issues are fixed, or read/write performance gets improved.

1.5. Low Power Management

1.5.1. 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. Power Loss Protection: Flushing Mechanism

Power Loss Protection is a mechanism to prevent data loss during unexpected power failure. DRAM is a volatile memory and frequently used as temporary cache or buffer between the controller and the NAND flash to improve the SSD performance. However, one major concern of the DRAM is that it is not able to keep data during power failure. Accordingly, the ENVOY applies the **GuaranteedFlush** Technology, which requests the controller to transfer data to the cache. DDR performs as a cache, and its sizes include 256MB or 512MB. Only when the data is fully committed to the NAND flash will the controller send acknowledgement (ACK) to the host. Such implementation can prevent false-positive performance and the risk of power cycling issues.

Additionally, it is critical for a controller to shorten the time the in-flight data stays in the cache. Thus, Envoy Data Memory's PS3108 applies an algorithm to reduce the amount of data resides in the cache to provide a better performance. This **SmartCacheFlush** technology allows incoming data to only have a "pit stop" in the cache and then move to the NAND flash at once. If the flash is jammed due to particular file sizes (random 4K), the cache will be treated as an "organizer", consolidating incoming data into groups before written into the flash to improve write amplification.

In sum, with this Flush Management, ENVOY proves to provide the reliability required by consumer, industrial, and enterprise-level application.

1.7. Advanced Device Security Features

1.7.1. 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, the SSD controller will empty its storage blocks and return to its factory default settings.

1.7.2. Write Protect

When a SSD contains too many bad blocks and data are continuously written in, then the SSD might not be used 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.

1.8. SSD Lifetime Management

1.8.1. 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:

$$TBW = [(NAND\ Endurance) \times (SSD\ Capacity) \times (WLE)] / WAF$$

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.

WLE: Wear Leveling Efficiency (WLE) represents the ratio of the average amount of erases on all the blocks to the erases on any block at maximum.

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.

1.9. An Adaptive Approach to Performance Tuning

1.9.1. Throughput

Based on the available space of the disk, ENVOY 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, ENVOY will slow down the read/write processing, and implement garbage collection to release memory. Hence, read/write performance will become slower.

1.9.2. 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, ENVOY 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.

2. PRODUCT SPECIFICATIONS

- **Capacity**
 - From 1GB to 128GB
- **Electrical/Physical Interface**
 - SATA Interface
 - Compliant with SATA Revision 3.0
 - Compatible with SATA 1.5Gbps, 3Gbps and 6Gbps interface
 - NCQ support up to queue depth = 32
 - Support power management
 - Support expanded register for SATA protocol 48 bits addressing mode
 - Embedded BIST function for SATA PHY for low cost mass production
- **Supported NAND Flash**
 - Toshiba A19nm MLC and 24nm SLC, Toggle1.0 and Toggle2.0
 - Support 16k page MLC large block NAND Flash
 - Support ONFI 3.0 and Toggle 2.0 interface: 5 channels at maximum
 - Contain 1pcs to 4pcs of TSOP/BGA Flash
- **ECC Scheme**
 - ENVOY's 1.8" SSD can correct up to 72 bits error in 1K Byte data.
- **UART function**
- **GPIO**
- **Support SMART and TRIM commands**

● Performance

Flash Process	Capacity	Flash Structure	Performance		Power Consumption		
			CrystalDiskMark		Read (mW)	Write (mW)	Idle (mW)
			Read (MB/s)	Write (MB/s)			
A19nm	1GB	1GB x 1	95	35	540	450	125
	2GB	2GB X 1	95	35	540	450	125
	4GB	4GB x 1	90	35	540	450	125
	8GB	4GB x 2	210	50	1,094	756	195
	16GB	4GB x 4, TSOP	460	50	2,080	1,415	290
	32GB	8GB x 4, TSOP	510	100	2,180	1,615	290
	64GB	16GB x 4, TSOP	520	190	2,340	2,305	295
	128GB	32GB x4, TSOP	520	360	2,340	3,425	295

NOTES:

1. The performance was measured using CrystalDiskMark with SATA 6Gbps host.
2. Samples were built using Toshiba 19nm / A19nm Toggle MLC NAND Flash.
3. Performance may differ according to flash configuration, DDR configuration, and platform.
4. The table above is for reference only. The criteria for MP (mass production) and for accepting goods shall be discussed based on different flash configuration.

*For BGA flash, please refer to section 2, under “supported NAND flash” for more details.

● TBW (Terabytes Written)

Capacity	Flash Structure	TBW
1GB	1GB x 1	2.5
2GB	2GB x 1	5
4GB	4GB x 1	11
8GB	4GB x 2	22
16GB	4GB x 4	44
32GB	8GB x 4	93
64GB	16GB x 4	178
128GB	32GB x 4	353

NOTES:

1. Samples were built using Toshiba 19nm / A19nm MLC NAND Flash.
2. TBW may differ according to flash configuration, SDR configuration and platform.
3. The endurance of SSD could be estimated based on users’ behaviors, NAND endurance cycles, and write amplification factor. It is not guaranteed by the flash vendor.

3. ENVIRONMENTAL SPECIFICATIONS

3.1. Environmental Conditions

3.1.1. Temperature and Humidity

- Temperature:
 - ◆ Storage: -40°C to 85°C
 - ◆ Commercial Temp: 0°C to 70°C
 - ◆ Industrial Temp: -40°C to 85°C
- Humidity:
 - ◆ Commercial Temp: RH 90% under 40°C (operational)
 - ◆ Industrial Temp: RH 95% under 55°C (operational)

Table 3-1 High Temperature Test Condition

	Temperature	Humidity	Test Time
Operation (“C” Temp)	70°C	0% RH	72 hours
Operation (“I” Temp)	85°C	0% RH	72 hours
Storage (“C” Temp)	85°C	0% RH	72 hours
Storage (“I” Temp)	85°C	0% RH	168 hours

Result: No any abnormality is detected.

Table 3-2 Low Temperature Test Condition

	Temperature	Humidity	Test Time
Operation (“C” Temp)	0°C	0% RH	72 hours
Operation (“I” Temp)	-40°C	0% RH	72 hours
Storage (“C” Temp)	-40°C	0% RH	72 hours
Storage (“I” Temp)	-40°C	0% RH	168 hours

Result: No any abnormality is detected.

Table 3-3 High Humidity Test Condition

	Temperature	Humidity	Test Time
Operation (“C” Temp)	40°C	93% RH	24 hours
Operation (“I” Temp)	55°C	95% RH	72 hours
Storage (“C” Temp)	40°C	95% RH	72 hours
Storage (“I” Temp)	55°C	95% RH	96 hours

Result: No any abnormality is detected.

Table 3-4 Temperature Cycle Test

	Temperature	Test Time	Cycle
Operation (“C” Temp)	0°C	30 min	10 cycles
	70°C	30 min	
Operation (“I” Temp)	-40°C	30 min	20 cycles
	85°C	30 min	
Storage (“C” Temp)	-40°C	30 min	10 cycles
	85°C	30 min	
Storage (“I” Temp)	-40°C	30 min	50 cycles
	85°C	30 min	

Result: No any abnormality is detected.

3.1.2. Shock

Table 3-5 ENVOY’S SATA DOM SSD Shock Specification

	Acceleration Force	Half Sin Pulse Duration	Number of Shocks
Non-operational	1500G	0.5ms	6 faces, 5 times each
Operational	1500G	0.5ms	6 faces, 5 times each

Result: No any abnormality is detected when power on.

3.1.3. Vibration

Table 3-6 ENVOY’S SATA DOM SSD Vibration Specification

	Condition		Vibration Orientation
	Frequency/Displacement	Frequency/Acceleration	
Operational	20Hz~80Hz/1.52mm	80Hz~2000Hz/20G	X, Y, Z axis/60 min for each

Result: No any abnormality is detected when power on.

3.1.4. Drop

Table 3-7 ENVOY’S SATA DOM SSD Drop Specification

	Height of Drop	Number of Drop
Non-operational	80cm free fall	6 face of each unit, 2 times

Result: No any abnormality is detected when power on.

3.1.5. Bending

Table 3-8 ENVOY’S SATA DOM SSD Bending Specification

	Force	Action
Non-operational	≥ 50N	Hold 1min/5times

Result: No any abnormality is detected when power on.

3.1.6. Torque

Table 3-9 ENVOY'S SATA DOM SSD Torque Specification

	Force	Action
Non-operational	0.5 N-m or 10 deg	Hold 5min/5times

Result: No any abnormality is detected when power on.

3.1.7. Electrostatic Discharge (ESD)

Table 3-10 ENVOY'S SATA DOM SSD Contact ESD Specification

Device	Capacity	Temperature	Relative Humidity	+/- 4KV	Result
SATA DOM	128GB	24.0°C	49% (RH)	Device functions are affected, but EUT will be back to its normal or operational state automatically.	PASS

3.1.8. EMI Compliance

- FCC: CISPR22
- CE: EN55022
- BSMI 13438

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 Envoy Data Memory's SATA DOM SSD is more than 1,000,000 hours.

3.3. Certification & Compliance

- RoHS
- SATA III (SATA Rev. 3.0)
- Up to ATA/ATAPI-8 (Including S.M.A.R.T)

4. ELECTRICAL SPECIFICATIONS

4.1. Supply Voltage

Table 4-1 Supply Voltage of ENVOY'S SATA DOM SSD

Parameter	Rating
Operating Voltage	3.3V +/- 5% (Default)
	5V +/- 5% (Option)
Maximum Ripple	100mV, 0~30MHz

4.2. Power Consumption

Flash Process	Capacity	Flash Structure	Power Consumption		
			Read (mW)	Write (mW)	Idle (mW)
A19nm	1GB	1GB x 1	540	450	125
	2GB	2GB X 1	540	450	125
	4GB	4GB x 1	540	450	125
	8GB	4GB x 2	1,094	756	195
	16GB	4GB x 4, TSOP	2,080	1,415	290
	32GB	8GB x 4, TSOP	2,180	1,615	290
	64GB	16GB x 4, TSOP	2,340	2,305	295
	128GB	32GB x4, TSOP	2,340	3,425	295

Table 4-2 Power Consumption of ENVOY'S SATA DOM SSD

Unit: mW

NOTES:

1. The average value of power consumption is achieved based on 100% conversion efficiency.
2. The measured power voltage is 3.3V.
3. Samples were built of Toshiba 19nm / A19nm MLC Toggle NAND Flash and measured under ambient temperature.
4. Sequential R/W is measured while testing 4000MB sequential R/W 5 times by CystalDiskMark.
5. Power Consumption may differ from flash configuration, DDR configuration, or platform.

5. INTERFACE

5.1. Pin Assignment and Descriptions

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	Type	Function
P1	V ₃₃	3.3V Power Input
P2	GND	GND

6. SUPPORTED COMMANDS

6.1. ATA Command List

Table 6-1 ATA Command List

Op Code	Description	Op Code	Description
E5h	Check power mode	F6h	Security Disable Password
06h	Data Set management	F3h	Security Erase Prepare
B1H	DCO	F4h	Security Erase Unit
92h	Download Microcode PIO	F5h	Security Freeze Lock
93h	Download Microcode DMA	F1h	Security Set Password
90h	Execute drive diagnostic	F2h	Security Unlock
E7h	Flush cache	70h	Seek
Eah	Flush cache Ext	Efh	Set features
Ech	Identify device	F9h	Set Max Address
E3h	Idle	37h	Set Max Address Ext
E1h	Idle immediate	C6h	Set multiple mode
91h	Initialize drive parameters	E6h	Sleep
E4h	Read buffer	B0h	Smart
C9h	Read DMA (w/o retry)	E2h	Standby
C8h	Read DMA (w/retry)	E0h	Standby immediate
25h	Read DMA Ext	E8h	Write buffer
60h	Read FPDMA QUEUED	CBh	Write DMA (w/o retry)
2Fh	Read Log Ext	Cah	Write DMA (w/retry)
C4h	Read multiple	35h	Write DMA Ext
29h	Read multiple Ext	3Dh	Write DMA FUA Ext
F8h	Read native max address	61h	Write FPDMA QUEUED
27h	Read native max Ext	3Fh	Write Log Ext
21h	Read sector(s) (w/o retry)	C5h	Write multiple
20h	Read sector(s) (w/retry)	39h	Write multiple Ext
24h	Read sector(s) Ext	Ceh	Write multiple FUA Ext
42h	Read Verify Ext	31h	Write sector(s) (w/o retry)
41h	Read verify sector(s) (w/o retry)	30h	Write sector(s) (w/retry)
40h	Read verify sector(s) (w/retry)	34h	Write sector(s) Ext
10h	Recalibrate	45h	Write uncorrectable

6.2. Identify Device Data

The following table details the sector data returned by the IDENTIFY DEVICE command.

Table 6-2 List of Device Identification

Word	F: Fixed V: Variable X: Both	Default Value	Description
0	F	0040h	General configuration bit-significant information
1	X	*1	Obsolete – Number of logical cylinders
2	V	C837h	Specific configuration
3	X	0010h	Obsolete – Number of logical heads (16)
4-5	X	00000000h	Retired
6	X	003Fh	Obsolete – Number of logical sectors per logical track (63)
7-8	V	00000000h	Reserved for assignment by the Compact Flash Association
9	X	0000h	Retired
10-19	F	Varies	Serial number (20 ASCII characters)
20-21	X	0000h	Retired
22	X	0000h	Obsolete
23-26	F	Varies	Firmware revision (8 ASCII characters)
27-46	F	Varies	Model number (xxxxxxx)
47	F	8010h	7:0- Maximum number of sectors transferred per interrupt on MULTIPLE commands
48	F	0000h	Reserved
49	F	2F00h	Capabilities
50	F	4000h	Capabilities
51-52	X	000000000h	Obsolete
53	F	0007h	Words 88 and 70:64 valid
54	X	*1	Obsolete – Number of logical cylinders
55	X	0010h	Obsolete – Number of logical heads (16)
56	X	003Fh	Obsolete – Number of logical sectors per track (63)
57-58	X	*2	Obsolete – Current capacity in sectors
59	F	0110h	Number of sectors transferred per interrupt on MULTIPLE commands
60-61	F	*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 modes supported
65	F	0078h	Minimum Multiword DMA transfer cycle time per word

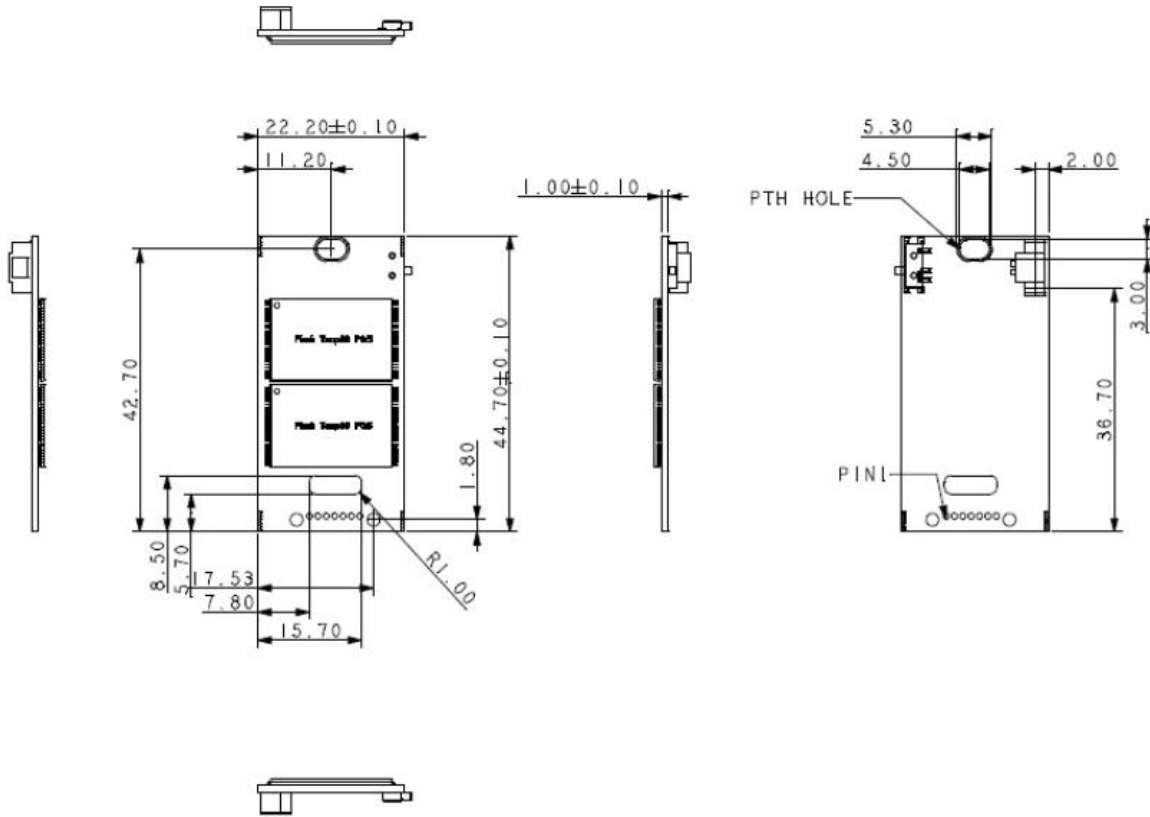
Word	F: Fixed V: Variable X: Both	Default Value	Description
66	F	0078h	Manufacturer's recommended Multiword DMA transfer cycle time
67	F	0078h	Minimum PIO transfer cycle time without flow control
68	F	0078h	Minimum PIO transfer cycle time with IORDY flow control
69	F	0100h	Additional Supported (support download microcode DMA)
70	F	0000h	Reserved
71-74	F	0000000000000000 0h	Reserved for the IDENTIFY PACKET DEVICE command
75	F	001Fh	Queue depth
76	F	C70Eh	Serial SATA capabilities
77	F	0000h	Reserved for future Serial ATA definition
78	F	004Ch	Serial ATA features supported
79	V	0040H	Serial ATA features enabled
80	F	01F8h	Major Version Number
81	F	0000h	Minor Version Number
82	F	346bh	Command set supported
83	F	7D09h	Command set supported
84	F	6063h	Command set/feature supported extension
85	V	3469h	Command set/feature enabled
86	V	bc01h	Command set/feature enabled
87	V	6023h	Command set/feature default
88	V	007Fh	Ultra DMA Modes
89	F	001Eh	Time required for security erase unit completion
90	F	001Eh	Time required for Enhanced security erase completion
91	V	0000h	Current advanced power management value
92	V	FFFEh	Master Password Revision Code
93	F	0000h	Hardware reset result. The contents of the bits (12:0) of this word can be changed only during the execution of hardware reset.
94	V	0000h	Vendor's recommended and actual acoustic management value
95	F	0000h	Stream Minimum Request Size
96	V	0000h	Streaming Transfer Time – DMA
97	V	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

Word	F: Fixed V: Variable X: Both	Default Value	Description
104	V	0000h	Streaming Transfer Time – PIO
105	F	0000h	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-7779 acoustic testing in microseconds
108-111	F	0000000000000000 0h	Unique ID
112-115	F	0000000000000000 0h	Reserved
116	V	0000h	Reserved
117-118	F	00000000h	Words per logical Sector
119	F	4015h	Supported settings
120	F	4015h	Command set/Feature Enabled/Supported
121-126	F	0h	Reserved
127	F	0h	Removable Media Status Notification feature set support
128	V	0021h	Security status
129-159	X	0h	Vendor specific
160	F	0h	Compact Flash Association (CFA) power mode 1
161-167	X	0h	Reserved for assignment by the CFA
168	F	3h 2.5 inch 4h 1.8 inch 5h Less than 1.8 inch	Device Nominal Form Factor
169	F	0001h	DATA SET MANAGEMENT command is supported
170-173	F	0h	Additional Product Identifier
174-175		0h	Reserve
176-205	V	0h	Current media serial number
206	F	0h	SCT Command Transport(
207-208	F	0h	Reserved
209	F	4000h	Alignment of logical blocks within a physical block
210-211	V	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		0000h	NV Cache relate (not support)
217	F	0001h	Non-rotating media device
218	F	0h	Reserved
219	F	0h	NV Cache relate (not support)

Word	F: Fixed V: Variable X: Both	Default Value	Description
220	V	0h	Write read verify feature set current mode
221		0h	Reserved
222	F	103Fh	Transport major version number
223	F	0h	Transport minor version number
224-229		0h	reserved
230-233		0h	Extend number of user addressable sectors
234		0001h	Minimum number of 512-byte data blocks per DOWNLOAD MICROCODE command for mode 03h
235		00FFh	Maximum number of 512-byte data blocks per DOWNLOAD MICROCODE command for mode 03h
236-254	F	0h	Reserved
255	X	XXA5h XX is variable	Integrity word (Checksum and Signature)

7. PHYSICAL DIMENSION

Dimensions: 44.70 mm (L) x 22.20 mm (W) x 1.00 mm (H)



Notes :

1.  = Max Component Height
2.  = No Component
3.  = No Component / Signal Vias / Signal Copper
4. General Tolerance 0.1mm

8. PART NUMBERS

Table 8-1 Part Numbers

Part Number	Description	Operating Temp Range
EN-F09001GDSC	1GB SATA DOM SSD SLC C Temp 7mm	0°C ~ 70°C
EN-F09001GDSI	1GB SATA DOM SSD SLC I Temp 7mm	-40°C ~ 85°C
EN-F09002GDSC	2GB SATA DOM SSD SLC C Temp 7mm	0°C ~ 70°C
EN-F09002GDSI	2GB SATA DOM SSD SLC I Temp 7mm	-40°C ~ 85°C
EN-F09004GDSC	4GB SATA DOM SSD SLC C Temp 7mm	0°C ~ 70°C
EN-F09004GDSI	4GB SATA DOM SSD SLC I Temp 7mm	-40°C ~ 85°C
EN-F09008GDSC	8GB SATA DOM SSD SLC C Temp 7mm	0°C ~ 70°C
EN-F09008GDSI	8GB SATA DOM SSD SLC I Temp 7mm	-40°C ~ 85°C
EN-F09016GDSC	16GB SATA DOM SSD SLC C Temp 7mm	0°C ~ 70°C
EN-F09016GDSI	16GB SATA DOM SSD SLC I Temp 7mm	-40°C ~ 85°C
EN-F09032GDSC	32GB SATA DOM SSD SLC C Temp 7mm	0°C ~ 70°C
EN-F09032GDSI	32GB SATA DOM SSD SLC I Temp 7mm	-40°C ~ 85°C
EN-F09064GDSC	64GB SATA DOM SSD SLC C Temp 7mm	0°C ~ 70°C
EN-F09064GDSI	64GB SATA DOM SSD SLC I Temp 7mm	-40°C ~ 85°C
EN-F0904GDPC	4GB SATA DOM SSD EconoSLC™ C Temp 7mm	0°C ~ 70°C
EN-F0904GDPI	4GB SATA DOM SSD EconoSLC™ I Temp 7mm	-40°C ~ 85°C
EN-F0908GDPC	8GB SATA DOM SSD EconoSLC™ C Temp 7mm	0°C ~ 70°C
EN-F0908GDPI	8GB SATA DOM SSD EconoSLC™ I Temp 7mm	-40°C ~ 85°C
EN-F09016GDPC	16GB SATA DOM SSD EconoSLC™ C Temp 7mm	0°C ~ 70°C
EN-F09016GDPI	16GB SATA DOM SSD EconoSLC™ I Temp 7mm	-40°C ~ 85°C
EN-F09032GDPC	32GB SATA DOM SSD EconoSLC™ C Temp 7mm	0°C ~ 70°C
EN-F09032GDPI	32GB SATA DOM SSD EconoSLC™ I Temp 7mm	-40°C ~ 85°C
EN-F09064GDPC	64GB SATA DOM SSD EconoSLC™ C Temp 7mm	0°C ~ 70°C
EN-F09064GDPI	64GB SATA DOM SSD EconoSLC™ I Temp 7mm	-40°C ~ 85°C

Part Number	Description	Operating Temp Range
EN-F0908GDMC	8GB SATA DOM SSD MLC C Temp 7mm	0°C ~ 70°C
EN-F0908GDMI	8GB SATA DOM SSD MLC I Temp 7mm	-40°C ~ 85°C
EN-F09016GDMC	16GB SATA DOM SSD MLC C Temp 7mm	0°C ~ 70°C
EN-F09016GDMI	16GB SATA DOM SSD MLC I Temp 7mm	-40°C ~ 85°C
EN-F09032GDMC	32GB SATA DOM SSD MLC C Temp 7mm	0°C ~ 70°C
EN-F09032GDMI	32GB SATA DOM SSD MLC I Temp 7mm	-40°C ~ 85°C
EN-F09064GDMC	64GB SATA DOM SSD MLC C Temp 7mm	0°C ~ 70°C
EN-F09064GDMI	64GB SATA DOM SSD MLC I Temp 7mm	-40°C ~ 85°C
EN-F09128GDMC	128GB SATA DOM SSD MLC C Temp 7mm	0°C ~ 70°C
EN-F09128GDMI	128GB SATA DOM SSD MLC I Temp 7mm	-40°C ~ 85°C

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)
DIPM	Device initiated power management
HIPM	Host initiated power management
LBA	Logical block addressing
MB	Mega-byte
MTBF	Mean time between failures
NCQ	Native command queue
SATA	Serial advanced technology attachment
SDR	Synchronous dynamic-random access memory
S.M.A.R.T.	Self-monitoring, analysis and reporting technology
SSD	Solid state disk