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Serial ATA Flash Drive

AS22A Product Specifications

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Version 2.2

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Specifications Overview:

- **Compliance with SATA Revision 3.2**
  - SATA 6.0 Gbps interface
  - Backward compatible with SATA 1.5 and 3.0 Gbps interfaces
- **Capacity**
  - 16GB - 512GB
- **Performance***
  - Sequential read: Up to 560 MB/sec
  - Sequential write: Up to 540 MB/sec
  - Random read (4K): Up to 84850 IOPS
  - Random write (4K): Up to 86060 IOPS
- **Flash Management**
  - Global Wear Leveling
  - S.M.A.R.T.
  - Power Failure Management
  - TRIM
- **NAND Flash Type:** 3D TLC
- **MTBF:** > 1,500,000 hours
- **Endurance (in Terabytes Written: TBW)**
  - 16 GB: 8 TBW
  - 32 GB: 16 TBW
  - 64 GB: 42 TBW
  - 128 GB: 75 TBW
  - 256 GB: 180 TBW
  - 512 GB: 425 TBW
- **Temperature Range**
  - Operating:
    Standard: 0°C to 70°C
  - Storage: -40°C to 70°C
- **Supply Voltage**
  - 3.3V (Operating Voltage)
- **Power Consumption***
  - Active mode:
    < 1,350 mW
  - Idle mode:
    < 300 mW
- **Connector Type**
  - Internal mSATA connector for SSD usage
- **Form Factor**
  - m SATA
  - Dimensions:50.8 x 29.85 x 4, unit: mm
- **Shock & Vibration****
  - Shock:1,500 G
  - Frequency/Displacement: 20Hz~80Hz/1.52mm
  - Frequency/Acceleration: 80Hz~2000Hz/20G
- **SATA Power Management Modes**
- **RoHS Compliant**

*Varies from capacities. The values for performances and power consumptions presented are typical and may vary depending on flash configurations or platform settings.
**Non-operating

Table of Contents

1. General Descriptions

1.1 Introduction

Apacer AS22A SSD (Solid State Drive) consists of semiconductor devices using 3D TLC NAND flash memory that provide excellent reliability and high performance for storage media. Apacer AS22A does not contain any moving parts such as platter (disk) and head media, and thus it makes the better storage solution with higher performance, reduced latencies and low power consumption for notebooks, tablets and industrial PCs. Apacer AS22A delivers all the advantages of flash memory technologies and is fully compliant with the Serial ATA I/II/III (SATA) interface and internal mSATA connector for SSD usage.

1.2 Performance

Performance of Apacer AS22A SSD is listed below in Table 1-2.

Table 1-2 Performance Specifications

Performance	16GB	32GB	64GB	128GB	256GB	512GB
Sequential Read (MB/s) CDM	290	300	550	550	550	550
Sequential Write (MB/s) CDM	100	125	255	450	490	490
Sequential Read (MB/s) ATTO	560	560	560	560	560	560
Sequential Write (MB/s) ATTO	540	540	540	540	540	540
Random Read IOPS (4K)	16600	18862	35721	65402	84850	75811
Random Write IOPS (4K)	22488	29873	61445	81994	86060	68331

1.3 Pin Assignments

Table 1-3 defines the signal assignment of the internal mSATA connector for SSD usage.

Table 1-3 Pin Assignment and Description of Apacer AS22A

Pin #	mSATA Pin	Description
1	NC	No Connect
2	+3.3V	3.3V Source
3	NC	No Connect
4	DGND	Digital GND
5	NC	No Connect
6	NC	No Connect
7	NC	No Connect
8	NC	No Connect
9	DGND	Digital GND
10	NC	No Connect
11	NC	No Connect
12	NC	No Connect
13	NC	No Connect
14	NC	No Connect
15	DGND	Digital GND
16	NC	No Connect
17	NC	No Connect
18	DGND	Digital GND
19	NC	No Connect
20	NC	No Connect
21	SATA GND	SATA Ground Return Pin
22	NC	No Connect
23	TXP (out)	Host Receiver Differential Signal Pair
24	+3.3V	3.3V Source
25	TXN (out)	Host Receiver Differential Signal Pair
26	SATA GND	SATA Ground Return Pin
27	SATA GND	SATA Ground Return Pin
28	NC	No Connect
29	SATA GND	SATA Ground Return Pin
30	NC	No Connect
31	RXN (in)	Host Transmitter Differential Signal Pair
32	NC	No Connect

33	RXP (in)	Host Transmitter Differential Signal Pair
34	DGND	Digital GND
35	SATA GND	SATA Ground Return Pin
36	NC	No Connect
37	SATA GND	SATA Ground Return Pin
38	NC	No Connect
39	+3.3V	3.3V Source
40	DGND	Digital GND
41	+3.3V	3.3V Source
42	NC	No Connect
43	NC	No Connect
44	DEVSLP	Enter/Exit DevSleep
45	NC	Reserved pin
46	NC	No Connect
47	NC	Reserved pin
48	NC	No Connect
49	DAS	Device Activity Signal
50	DGND	Digital GND
51	GND	Default connect to GND
52	+3.3V	3.3V Source

2. Software Interface

2.1 ATA Command Set

Table 2-1 summarizes the ATA commands supported by Apacer AS22A SSD.

Table 2-1 ATA Command Set

Op Code		Description	Op Code			Description
00h		NOP	C9h			Read DMA without Retry
06h		Data Set Management	CAh			Write DMA
10h-1Fh		Recalibrate	CBh			Write DMA without Retry
20h		Read Sectors	CEh			Write Multiple FUA EXT
21h		Read Sectors without Retry	E0h			Standby Immediate
24h		Read Sectors EXT	E1h			Idle Immediate
25h		Read DMA EXT	E2h			Standby
27h		Read Native Max Address EXT	E3h			Idle
29h		Read Multiple EXT	E4h			Read Buffer
2Fh		Read Log EXT	E5h			Check Power Mode
30h		Write Sectors	E6h			Sleep
31h		Write Sectors without Retry	E7h			Flush Cache
34h		Write Sectors EXT	E8h			Write Buffer
35h		Write DMA EXT	E9h			READ BUFFER DMA
37h		Set Native Max Address EXT	EAh			Flush Cache EXT
38h		CFA WriteSectorsWithoutErase	EBh			Write Buffer DMA
39h		Write Multiple EXT	ECh			Identify Device
3Dh		WriteDMA FUA EXT	EFh			Set Features
3Fh		Write Long EXT	EFh	02h		Enable volatile write cache
40h		Read Verify Sectors	EFh	03h		Set transfer mode
41h		Read Verify Sectors without Retry	EFh	05h		Enable the APM feature set
42h		Read Verify Sectors EXT	EFh	10h		Enable use of SATA features et
44h		Zero EXT	EFh	10h	02h	Enable DMA Setup FIS Auto-Activate optimization
45h		WriteUncorrectableEXT	EFh	10h	03h	Enable Device-initiated interface power state (DIPM) transitions
47h		ReadLogDMA EXT	EFh	10h	06h	Enable Software Settings Preservation (SSP)
57h		WriteLogDMA EXT	EFh	10h	07h	Enable Device Automatic Partial to Slumber transitions
60h		Read FPDMA Queued	EFh	10h	09h	Enable Device Sleep
61h		Write FPDMA Queued	EFh	55h		Disable read look-ahead
70h-7Fh		Seek	EFh	66h		Disable reverting to power-on defaults
90h		Execute Device Diagnostic	EFh	82h		Disable volatile write cache
91h		Initialize Device Parameters	EFh	85h		Disable the APM feature set
92h		Download Microcode	EFh	90h		Disable use of SATA feature set
93h		Download MicrocodeDMA	EFh	90h	02h	Disable DMA Setup FIS Auto-Activate optimization
B0h		SMART	EFh	90h	03h	Disable Device-initiated interface power state (DIPM) transitions
B0h	D0h	SMART READ DATA	EFh	90h	06h	Disable Software Settings Preservation (SSP)
B0h	D1h	SMART READ ATTRIBUTE THRESHOLDS	EFh	90h	07h	Disable Device Automatic Partial

						to Slumber transitions
B0h	D2h	SMART ENABLE/DISABILE ATTRIBUTE AUTOSAVE	EFh	90h	09h	Disable Device Sleep
B0h	D3h	SMART SAVE ATTRIBUTE VALUES	EFh	AAh		Enable read look-ahead
B0h	D4h	SMART EXECUTE OFF-LINE IMMEDIATE	EFh	CCh		Enable reverting to power-on defaults
B0h	D5h	SMART READ LOG	F1h			Security Set Password
B0h	D6h	SMART WRITE LOG	F2h			Security Unlock
B0h	D8h	SMART ENABLE OPERATIONS	F3h			Security Erase Prepare
B0h	D9h	SMART DISABLE OPERATIONS	F4h			Security Erase Unit
B0h	DAh	SMART RETURN STATUS	F5h			Security Freeze Lock
B0h	DBh	SMART ENABLE/DISABILE AUTOMATIC OFF-LINE	F6h			Security Disable Password
B1h		Device Configuration	F8h			Read Native Max Address
B4h		Sanitize	F9h			Set Max Address
C4h		Read Multiple	F9h		01h	SET MAX SET PASSWORD
C5h		Write Multiple	F9h		02h	SET MAXLOCK
C6h		Set Multiple Mode	F9h		03h	SET MAX UNLOCK
C8h		Read DMA	F9h		04h	SET MAX FREEZE LOCIK

2.2 S.M.A.R.T.

S.M.A.R.T. is an abbreviation for Self-Monitoring, Analysis and Reporting Technology, a self-monitoring system that provides indicators of drive health as well as potential disk problems. It serves as a warning for users from unscheduled downtime by monitoring and displaying critical drive information. Ideally, this should allow taking proactive actions to prevent drive failure and make use of S.M.A.R.T. information for future product development reference.

Apacer devices use the standard S.M.A.R.T. command B0h to read data out from the drive to activate our S.M.A.R.T. feature that complies with the ATA/ATAPI specifications. S.M.A.R.T. Attribute IDs shall include initial bad block count, total later bad block count, maximum erase count, average erase count, power on hours and power cycle. When the S.M.A.R.T. Utility running on the host, it analyzes and reports the disk status to the host before the device reaches in critical condition.

Note: Attribute IDs may vary from product models due to various solution design and supporting capabilities.

Apacer memory products come with S.M.A.R.T. commands and subcommands for users to obtain information of drive status and to predict potential drive failures. Users can take advantage of the following commands/subcommands to monitor the health of the drive.

Code	SMART Subcommand
D0h	READ DATA
D1h	READ ATTRIBUTE THRESHOLDS
D2h	Enable/Disable Attribute Autosave
D4h	Execute Off-line Immediate
D5h	Read Log (optional)
D6h	Write Log (optional)
D8h	Enable Operations
D9h	Disable operations
DAh	Return Status

General S.M.A.R.T. attribute structure

Byte	Description
0	ID (Hex)
1 – 2	Status flag
3	Value
4	Worst
5*-11	Raw Data

*Byte 5: LSB

S.M.A.R.T. attribute ID list

ID (Hex)	Attribute Name
9 (0x09)	Power-on hours
12 (0x0C)	Power cycle count
163 (0xA3)	Max. erase count
164 (0xA4)	Avg. erase count
166 (0xA6)	Total later bad block count
167 (0xA7)	SSD Protect Mode (vendor specific)
168 (0xA8)	SATA PHY Error Count
175 (0xAF)	Bad Cluster Table Count
192 (0xC0)	Unexpected Power Loss Count
194 (0xC2)	Temperature
241 (0xF1)	Total sectors of write

3. Flash Management

3.1 Global Wear Leveling

Flash memory devices differ from Hard Disk Drives (HDDs) in terms of how blocks are utilized. For HDDs, when a change is made to stored data, like erase or update, the controller mechanism on HDDs will perform overwrites on blocks. Unlike HDDs, flash blocks cannot be overwritten, and each P/E cycle wears down the lifespan of blocks gradually. Repeatedly program/erase cycles performed on the same memory cells will eventually cause some blocks to age faster than others. This would bring flash storages to their end of service term sooner. Global wear leveling is an important mechanism that levels out the wearing of all blocks so that the wearing-down of all blocks can be almost evenly distributed. This will increase the lifespan of SSDs.

3.2 Power Failure Management

Power Failure Management plays a crucial role when experiencing unstable power supply. Power disruption may occur when users are storing data into the SSD. In this urgent situation, the controller would run multiple write-to-flash cycles to store the metadata for later block rebuilding. This urgent operation requires about several milliseconds to get it done. At the next power up, the firmware will perform a status tracking to retrieve the mapping table and resume previously programmed NAND blocks to check if there is any incompleteness of transmission.

3.3 TRIM

TRIM is a SATA command that helps improve the read/write performance and efficiency of solid-state drives (SSD). The command enables the host operating system to inform SSD controller which blocks contain invalid data, mostly because of the erase commands from host. The invalid will be discarded permanently and the SSD will retain more space for itself.

3.4 SATA Power Management

Complying with SATA 6.0 Gb/s specifications, the SSD supports the following SATA power saving modes:

- ACTIVE: PHY ready, full power, Tx & Rx operational
- PARTIAL: Reduces power, resumes in under 10 µs (microseconds)
- SLUMBER: Reduces power, resumes in under 10 ms (milliseconds)
- HIPM: Host-Initiated Power Management
- DIPM: Device-Initiated Power Management
- AUTO-SLUMBER: Automatic transition from partial to slumber.

Note: The behaviors of power management features would depend on host/device settings.

4. Reliability Specifications

4.1 Environmental

Environmental specifications of Apacer AS22A SSD are shown in Table 4-1.

Table 4-1 Environmental Specifications

Environment	Specifications
Temperature	0°C to 70°C (Standard)
	-40°C to 70°C (Non-operating)
Vibration	Non-operating: Sine wave, 15(G), 10~2000(Hz), Operating: Random, 7.69(Grms), 20~2000(Hz)
Shock	Non-operating: Acceleration, 1,500 G, 0.5 ms Operating: Peak acceleration, 50 G, 11 ms

4.2 Mean Time Between Failures (MTBF)

Mean Time Between Failures (MTBF) is predicted based on reliability data for the individual components in AS22A. The prediction result for AS22A is more than 2,000,000 hours.

Note: The MTBF is predicated and calculated based on "Telcordia Technologies Special Report, SR- 332, Issue 2" method.

4.3 Certification and Compliance

Apacer AS22A SSD complies with the following standards:

- CE
- FCC
- RoHS

4.4 Endurance

The endurance of a storage device is predicted by TeraBytes Written based on several factors related to usage, such as the amount of data written into the drive, block management conditions, and daily workload for the drive. Thus, key factors, such as Write Amplifications and the number of P/E cycles, can influence the lifespan of the drive.

Table 4-2 Endurance Specifications

Capacity	TeraBytes Written
16 GB	8.00
32 GB	16.00
64 GB	42.00
128 GB	75.00
256 GB	180.00
512 GB	425.00

Note:

- The measurement assumes the data written to the SSD for test is under a typical and constant rate.
- The measurement follows the standard metric: 1 TB (Terabyte) = 1,000 GB.
- The estimated values are based on JEDEC Enterprise endurance workload comprised of random data with the payload size distribution with sequential write behavior.

5. Electrical Specifications

5.1 Operating Voltage

Table 5-1 lists the supply voltage for AS22A.

Table 5-1 Operating Range

Item	Range
Supply Voltage	3.3V ± 5%

5.2 Power Consumption

Table 5-2 lists the power consumption for AS22A.

Table 5-2 Power Consumption

Mode	16GB	32GB	64GB	128GB	256GB	512GB
Read (mW)	930	950	1215	1300	1350	1470
Write (mW)	835	850	1020	1350	1400	1620
Idle (mW)	300	300	300	300	300	300

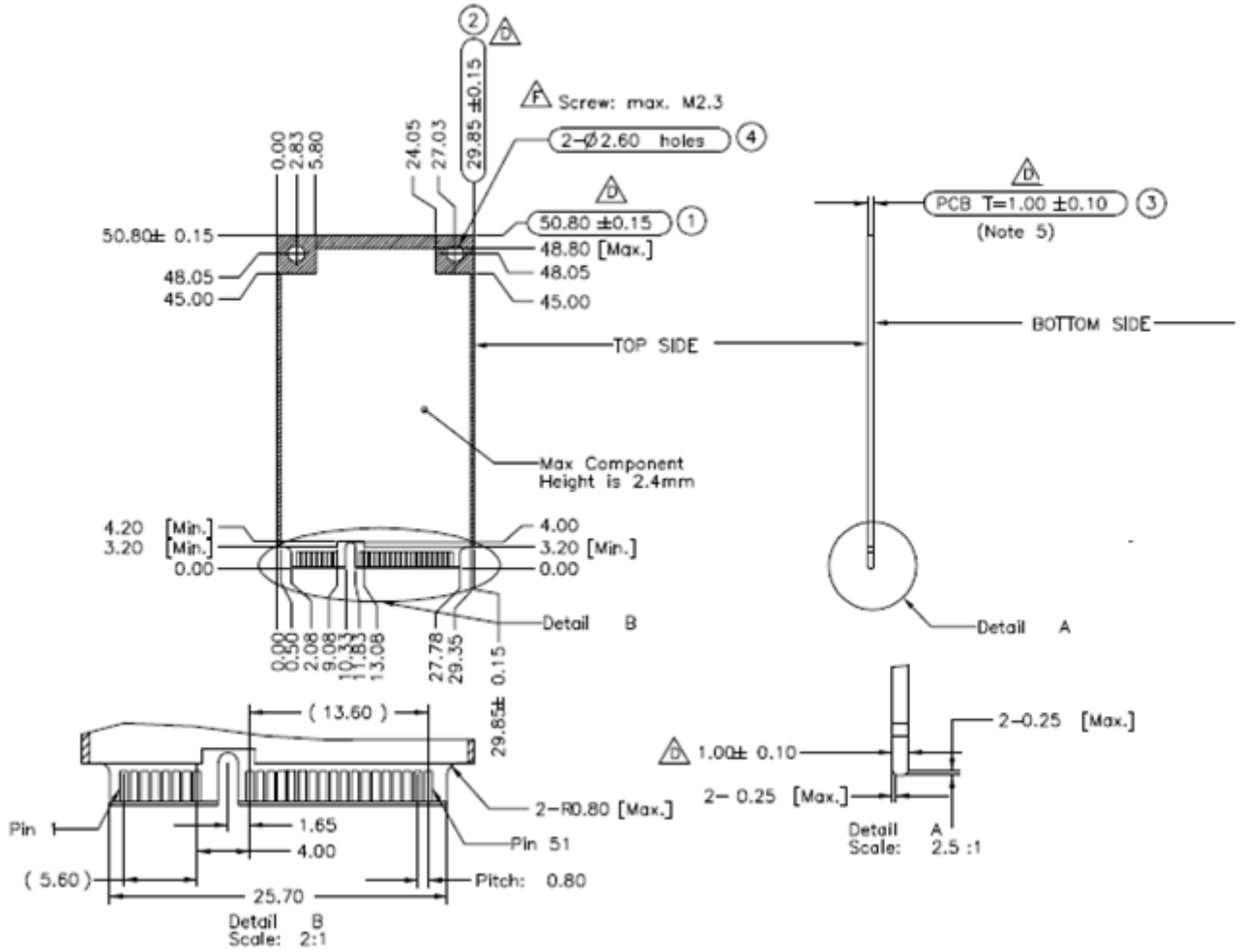
Note:
*All values are typical and may vary depending on flash configurations or host system settings.
**Active power is an average power measurement performed using CrystalDiskMark with 128KB sequential read/write transfers.

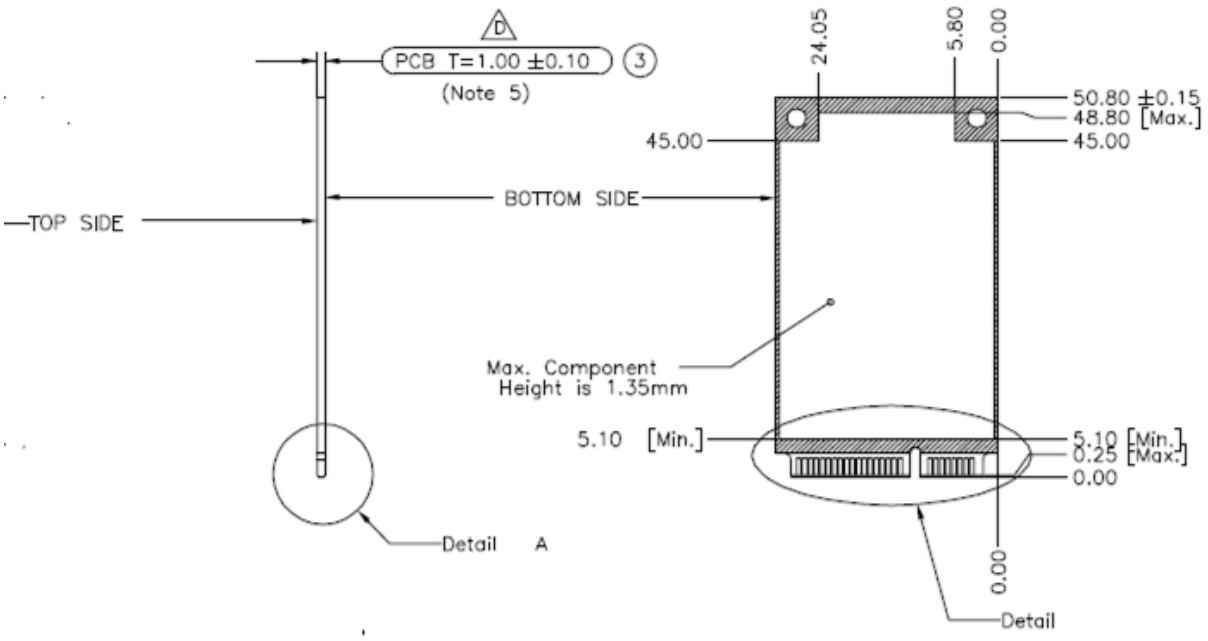
6. Physical Characteristics

6.1 Physical Dimensions

Figure 6-1 Physical Dimensions

Dimension: 50.8mm (L) x 29.85mm (W) x 4mm (H)





Notes :

1. ▨ = Max Component Height is
2. ▨ = No Component
3. ▨ = No Component / Signal Vias / Signal Copper/Print
4. General Tolerance : ±0.1mm

△D 5. Card Thickness applies accross tab and includes plating and/or metalization

△E 6. Check Point: ① ~ ④

△F 7. Screw Max. Size M2.3

6.2 Part Number Listing

Capacity	Bulk P/N
16GB	85.DA310.B011C
32GB	85.DA320.B011C
64GB	85.DA340.B011C
128GB	85.DA360.B011C
256GB	85.DA3A0.B011C
512GB	85.DA3E0.B011C

Revision History

Revision	Description	Date
1.0	Official release	8/9/2018
2.0	Document layout change	8/20/2018
2.1	Part number added	2/6/2019
2.2	Bookmark updated	4/16/2019

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