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Serial ATA Flash Drive

AS33A Product Specifications

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Version 2.2

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Specifications Overview:

- **Compliance with SATA Revision 3.1**
  - SATA 6.0 Gbps interface
  - Backward compatible with SATA 1.5 and 3.0 Gbps interfaces
- **Capacity**
  - 32GB – 1024GB
- **Performance***
  - Sequential read: Up to 560 MB/sec
  - Sequential write: Up to 540 MB/sec
  - Random read (4K): Up to 80896 IOPS
  - Random write (4K): Up to 75237 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)**
  - 32 GB: 16 TBW
  - 64 GB: 42 TBW
  - 128 GB: 75 TBW
  - 256 GB: 180 TBW
  - 512 GB: 425 TBW
  - 1024 GB: 835 TBW
- **Temperature Range**
  - Operating:
    Standard: 0°C to 70°C
  - Storage: -40°C to 70°C
- **Supply Voltage**
  - 5.0 V ± 5%
- **Power Consumption***
  - Active mode:
    <1,985 mW
  - Idle mode:
    <340 mW
- **Connector Type**
  - 7-pin SATA signal connector
  - 15-pin SATA power connector
- **Form Factor**
  - 2.5”
  - Dimensions with 7mm enclosure: 100.00 x 69.85 x 6.90, unit: mm
- **Shock & Vibration****
  - Shock:1,500 G
  - Vibration: 15 G
- **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 AS33A 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 AS33A 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 AS33A delivers all the advantages of flash memory technologies and is fully compliant with the Serial ATA I/II/III (SATA) interface and standard 2.5-inch storage drive form factor.

1.2 Performance

Performance of Apacer AS33A SSD is listed below in Table 1-2.

Table 1-2 Performance Specifications

Performance	32GB	64GB	128GB	256GB	512GB	1024GB
Sequential Read (MB/s) CDM	300	550	550	550	550	550
Sequential Write (MB/s) CDM	125	255	450	490	490	500
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)	18862	35721	65402	84850	75811	80896
Random Write IOPS (4K)	29873	61445	81994	86060	68331	75237

1.3 Pin Assignments

Table 1-3 describes the SFD signal segment, and Table1-4, power segment.

Figure 1-1 SATA Connectors

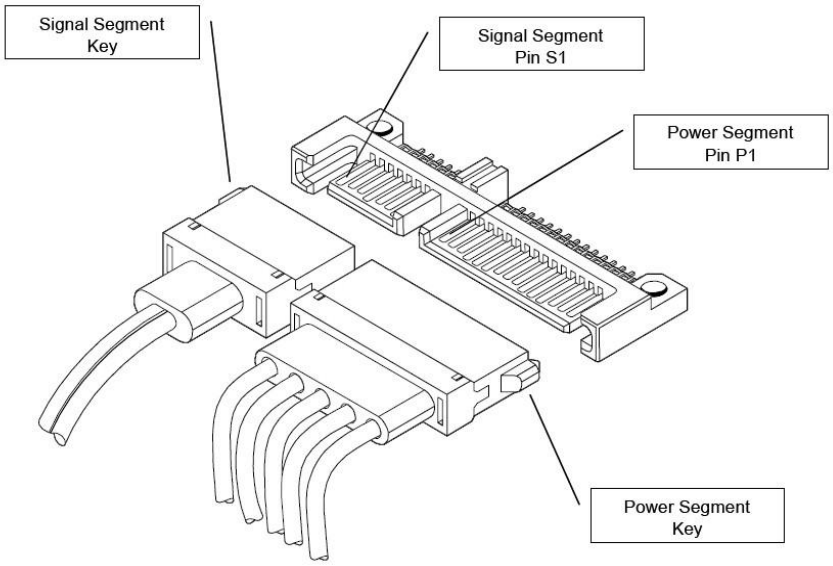


Table 1-3 Signal Segment

Pin	Type	Description
S1	GND	
S2	RxP	+ Differential Receive Signal
S3	RxN	- Differential Receive Signal
S4	GND	
S5	TxN	- Differential Transmit Signal
S6	TxP	+ Differential Transmit Signal
S7	GND	

Table 1-4 Power Segment

Pin	Signal/Description
P1	Unused (3.3V)
P2	Unused (3.3V)
P3	Device Sleep
P4	Ground
P5	Ground
P6	Ground
P7	5V
P8	5V
P9	5V
P10	Ground
P11	DAS
P12	Ground
P13	Unused (12V)
P14	Unused (12V)
P15	Unused (12V)

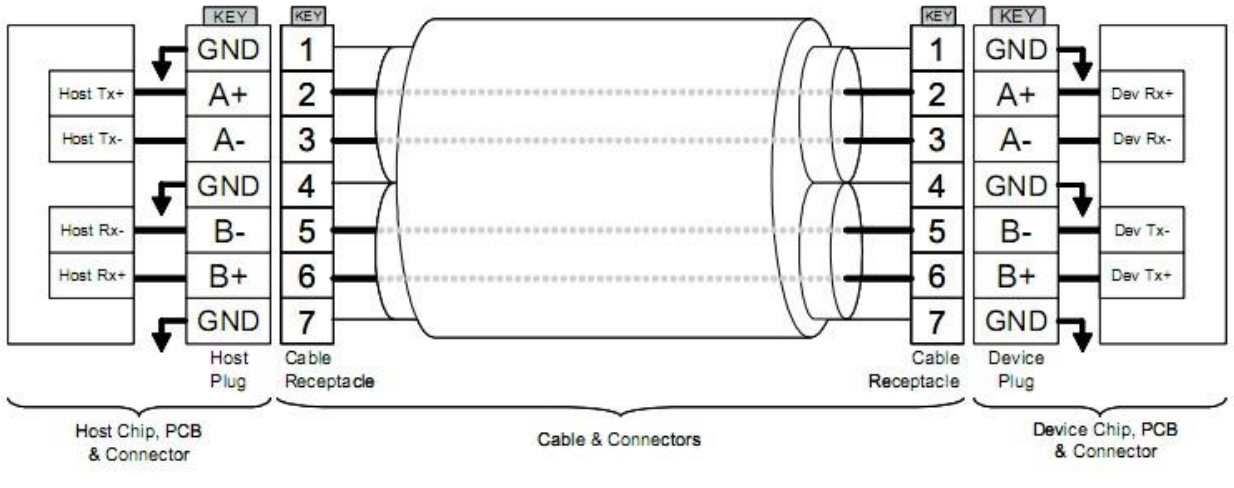


Figure 1-2 SATA Cable/Connector Connection Diagram

The connector on the left represents the Host with TX/RX differential pairs connected to a cable. The connector on the right shows the Device with TX/RX differential pairs also connected to the cable. Notice also the ground path connecting the shielding of the cable to the Cable Receptacle.

2. Software Interface

2.1 Command Set

Table 2-1 summarizes the ATA commands supported by Apacer AS33A SSD.

Table 2-1 Command Set

Code	Command	Code	Command
E5h	Check Power Mode	F6h	Security Disable Password
90h	Execute Diagnostics	F3h	Security Erase Prepare
E7h	Flush Cache	F4h	Security Erase Unit
ECh	Identify Device	F5h	Security Freeze Lock
E3h	Idle	F1h	Security Set Password
E1h	Idle Immediate	F2h	Security Unlock
91h	Initialize Device Parameters	7Xh	Seek
C8h	Read DMA	EFh	Set Features
25h	Read DMA EXT	C6h	Set Multiple Mode
60h	Read FPDMA Queued	E6h	Sleep
47h	Read Log DMA EXT	B0h	S.M.A.R.T.
2Fh	Read Log EXT	E2h	Standby
C4h	Read Multiple	E0h	Standby Immediate
20 or 21h	Read Sector(s)	CAh	Write DMA
40 or 41h	Read Verify Sector(s)	35h	Write DMA EXT
10h	Recalibrate	61h	Write FPDMA Queued
57h	Write Log DMA EXT	3Fh	Write Log EXT
C5h	Write Multiple	30h or 31h	Write Sector(s)

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 SMART attribute structure

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

*Byte 5: LSB

SMART 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.
- Device Sleep (DevSleep or DEVSLP): PHY powered down; power consumption $\leqq$ 5 mW; host assertion time $\leqq$ 10 ms; exit timeout from this state $\leqq$ 20 ms (unless specified otherwise in SATA Identify Device Log).

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

4. Reliability Specifications

4.1 Environmental

Environmental specifications of Apacer AS33A SSD are shown in Table 5-1.

Table 5-1 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 AS33A. The prediction result for AS33A is more than 1,500,000 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 AS33A 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
32 GB	16.00
64 GB	42.00
128 GB	75.00
256 GB	180.00
512 GB	425.00
1024 GB	835.00

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 6-1 lists the supply voltage for AS33A.

Table 6-1 Operating Range

Item	Range
Supply Voltage	5V ± 5%

5.2 Power Consumption

Table 6-2 lists the power consumption for AS33A.

Table 6-2 Power Consumption

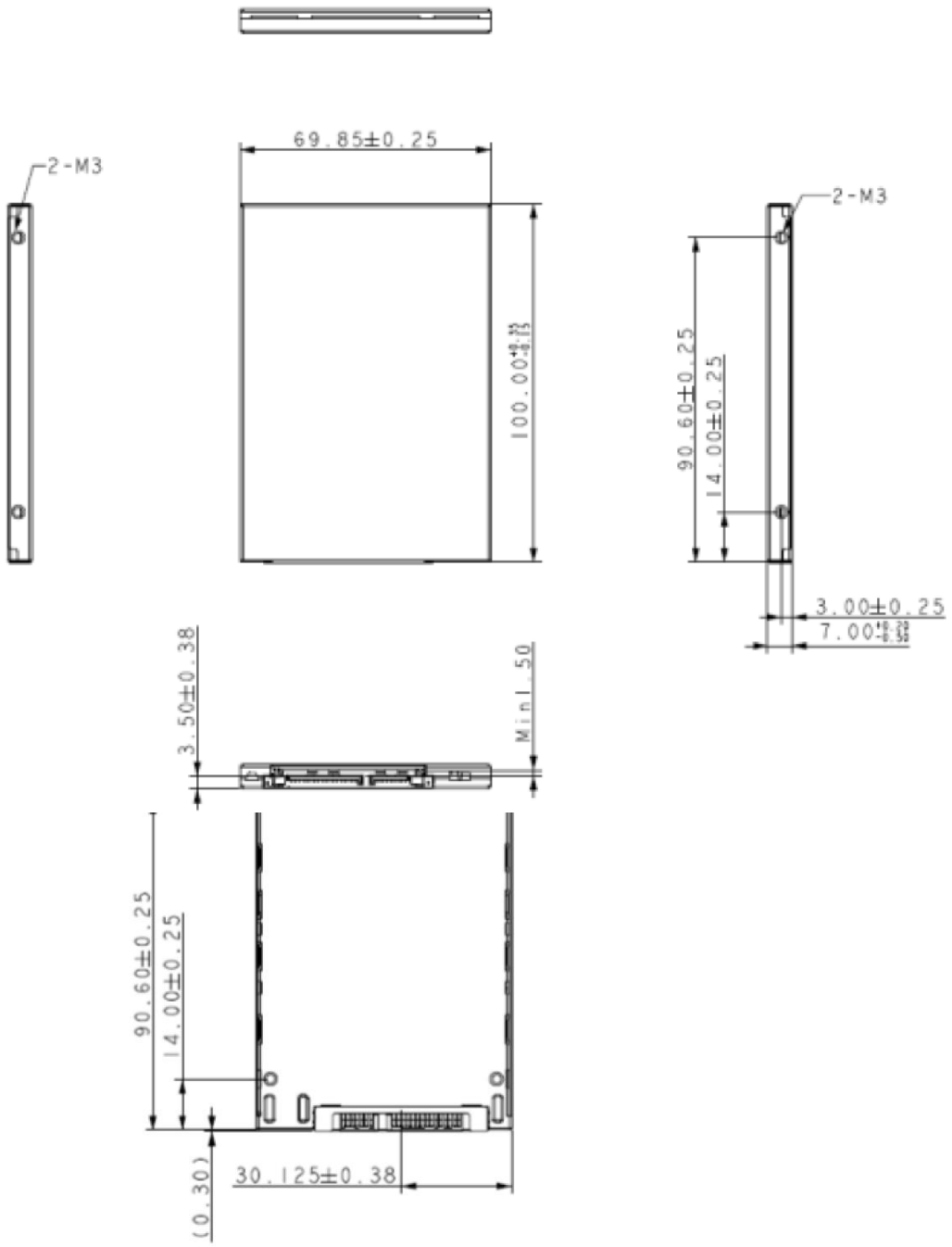
Mode	32GB	64GB	128GB	256GB	512GB	1024GB
Active (mW)	880	1000	1350	1600	1670	1750
Idle (mW)	325	320	320	315	320	320

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 7mm Type Dimensions

Figure 6-1 7mm Housing Physical Dimensions



6.2 Part Number Listing

Capacity	Bulk P/N
32GB	85.DC920.B010C
64GB	85.DC940.B010C
128GB	85.DC960.B010C
256GB	85.DC9A0.B010C
512GB	85.DC9E0.B010C
1024GB	85.DC9G0.B010C

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	10/20/2018
2.2	Add CDM Test data	2019/1/10

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