Apacer

RoHS Recast Compliant

ATA Disk Module 5S

ADM5S 40P/180D Product Specifications (Pin 20 Block)

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Version 1.2

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Specifications Overview:

- **Standard ATA/IDE Bus Interface**
  - ATA command set compatible
  - Compliant with ATA/ATAPI-8
  - ATA operating mode supports up to:
    PIO Mode up to 4
    Multiword DMA Mode up to 2
    Ultra DMA Mode up to 6
- **Capacity**
  - 128, 256, 512 MB
  - 1, 2, 4, 8, 16, 32 GB
- **Performance**[1]
  - Sequential read: Up to 75 MB/sec
  - Sequential write: Up to 65 MB/sec
- **Flash Management**
  - Built-in hardware ECC
  - Global Wear Leveling
  - Flash bad-block management
  - S.M.A.R.T.
  - Power Failure Management
  - ATA Secure Erase
- **Endurance (in Terabytes Written: TBW)**
  - 128 MB: 7 TBW
  - 256 MB: 14 TBW
  - 512 MB: 29 TBW
  - 1 GB: 58 TBW
  - 2 GB: 116 TBW
  - 4 GB: 232 TBW
  - 8 GB: 464 TBW
  - 16 GB: 928 TBW
  - 32 GB: 1,856 TBW
- **Temperature Range**
  - Operating:
    Standard: 0°C to 70°C
    Wide: -40°C to 85°C
  - Storage: -40°C to 100°C
- **Power Consumption**[1]
  - Supply voltage: 3.3V / 5V
  - Active mode: 280 mA
  - Idle mode: 15 mA
- **Connector Type**
  - 40-pin female connector
- **Form Factor**
  - ATA Disk Module
  - Without Housing
    Dimensions: 50.93x25.95x6.00 (unit: ㎜)
  - With Housing
    Dimensions: 58.99x27.83x6.25 (unit: ㎜)
- **NAND Flash Type:** SLC
- **MTBF:** >2,000,000 hours
- **Master/Slave Switch**
- **RoHS Recast Compliant (Complies with 2011/65/EU Standard)**

Note:
1. Varies from capacities. The values for performances and power consumptions presented are typical and may vary depending on flash configurations or platform settings. The term idle refers to the standby state of the device.

Table of Contents

1. General Description

Apacer ATA Disk Module 5S (ADM5S) SSD delivers ultra smooth performance and extremely low power consumption. This device supports DMA mode up to UDMA 6 that offers advanced data transfer technology and internal memory efficiency, which effectively decreases the loading for the microprocessor. Compliant with ATA/ATAPI-8 standards, our ADM5S supports data transfer modes up to PIO 4, Multiword DMA 2, and Ultra DMA 6. Equipped with power Error Correction Coding (ECC) up to 72 bit/1KB, the ADM5S can provide high data integrity. Aside from data efficiency, the ADM5S also comes with power management. The device can work at 3.3V or 5V power supply, with the output voltage automatically adjusted by the voltage regulator in the core. In addition, the built-in ECC engine can support multi-mode correction capability up to 72 bits and perform effective decoding throughput with high reliability.

Well suited for embedded flash storage applications by offering new and expanded functionalities as well as more cost-effective designs, better performance and increased reliability, ADM is designed to work at either 5 or 3.3 Volts, and supports the standard ATA driver complying with all major operating systems such as Microsoft's Windows series, Apple's Mac OS family, and Unix variants. Featuring technologies as Advanced Wear-leveling algorithms, S.M.A.R.T, Intelligent Power Failure Recovery, and ATA Secure Erase, Apacer's ADM assures users of a versatile device on data storage.

1.1 Performance-optimized Controller

The heart of an ATA-Disk Module is the ATA controller, which translates standard ATA signals into the data and controls of the flash media. This proprietary ATA controller is specifically designed to attain high data throughput from the host to the flash.

1.1.1 Power Management

The controller unit of this ADM storage device is made for power efficiency. It comes with built-in 2.7V voltage detectors for power fail prevention. In addition, it also supports 1.2V power-on reset.

1.1.2 DATA Buffer

The ATA-Disk Module Controller is programmed with a 128KB data buffer to optimize the host's data transfer to and from the flash media.

2. Functional Block

The ATA-Disk Module (ADM) includes the ATA controller and flash media, as well as the ATA standard interface. Figure 2-1 shows the functional block diagram.

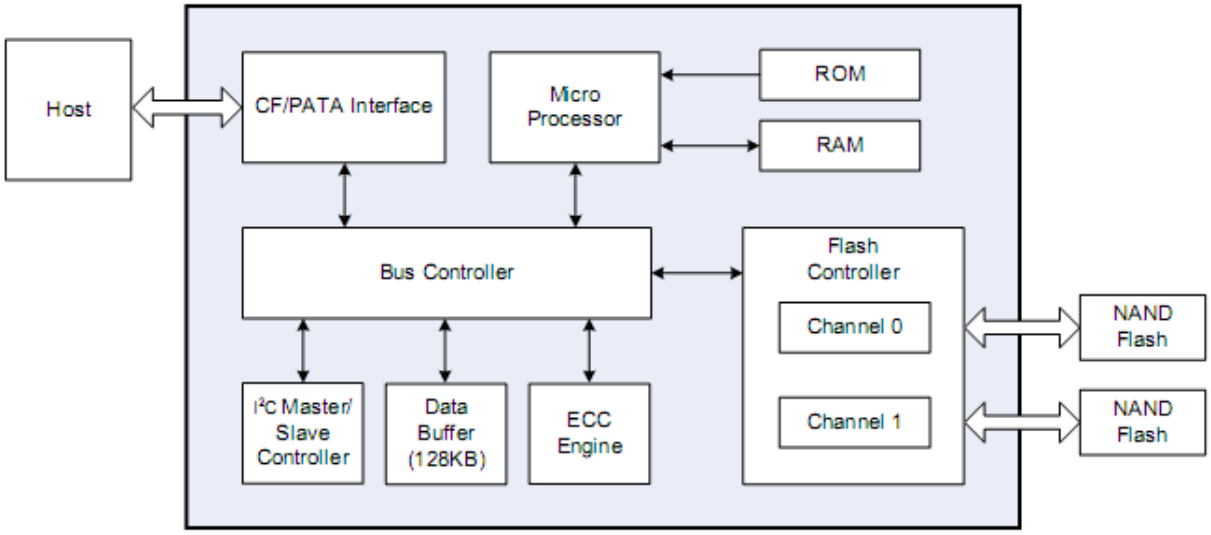


Figure 2-1 Functional Block Diagram

3. Pin Assignments

Table 3-1 lists the pin assignments with respective signal names for the 40-pin configuration. A "#" suffix indicates the active low signal. The pin type can be input, output or input/output.

Table 3-1 Pin Assignments for the 40-Pin Configuration

Pin No.	Signal Name	Pin Type	I/O Type	Pin No.	Signal Name	Pin Type	I/O Type
1	RESET#	I	I2U	2	GND	-	Ground
3	D7	I/O	I1Z, O2	4	D8	I/O	I1Z, O2
5	D6	I/O	I1Z, O2	6	D9	I/O	I1Z, O2
7	D5	I/O	I1Z, O2	8	D10	I/O	I1Z, O2
9	D4	I/O	I1Z, O2	10	D11	I/O	I1Z, O2
11	D3	I/O	I1Z, O2	12	D12	I/O	I1Z, O2
13	D2	I/O	I1Z, O2	14	D13	I/O	I1Z, O2
15	D1	I/O	I1Z, O2	16	D14	I/O	I1Z, O2
17	D0	I/O	I1Z, O2	18	D15	I/O	I1Z, O2
19	GND	-	Ground	20	NC	-	Power
21	DMARQ	O	O1	22	GND		Ground
23	IOWR# STOP	I	I2Z	24	GND	-	Ground
25	IORD# HDMARDY# HSTROBE#	I	I2Z	26	GND	-	Ground
27	IORDY DDMARDY# DSTROBE	O	O1	28	CSEL	I	I1U
29	DMACK#	I	I2U-	30	NC	-/I	-/I1U
31	INTRQ	O	O1	32	IOCS16#	O	O2
33	A1	I	I1Z	34	PDIAG#	I/O	I1U, O1
35	A0	I	I1Z	36	A2	I	I1Z
37	CS1FX#	I	I2Z	38	CS3FX#	I	I2Z
39	DASP#	I/O	I1U, O6	40	GND	-	Ground

4. Product Specifications

4.1 Capacity

Capacity specifications of the ATA-Disk Module (ADM) product family are available as shown in Table 4-1.

Table 4-1 Capacity Specifications

Capacity	Total bytes	Cylinders	Heads	Sectors	Total LBA
128 MB	128,057,344	977	8	32	250,112
256 MB	256,901,120	980	16	32	501,760
512 MB	512,483,368	993	16	63	1,000,944
1 GB	1,011,032,064	1,959	16	63	1,974,672
2 GB	2,011,226,112	3,897	16	63	3,928,176
4 GB	4,011,614,208	7,773	16	63	7,835,184
8 GB	8,012,390,400	15,525	16	63	15,649,200
16 GB	16,013,942,784	16,383	16	63	31,277,232
32 GB	32,017,047,552	16,383	16	63	62,533,296

Notes:
- Display of total bytes varies from operating systems.
- 1 GB = 1,000,000,000 bytes; 1 sector = 512 bytes.
- LBA count addressed in the table above indicates total user storage capacity and will remain the same throughout the lifespan of the device. However, the total usable capacity of the SSD is most likely to be less than the total physical capacity because a small portion of the capacity is reserved for device maintenance usages.

4.2 Performance

Performance of the ATA-Disk Module is listed in Table 4-2.

Table 4-2 Performance Specifications

Capacity / Performance	128 MB	256 GB	512 MB	1 GB	2 GB	4 GB	8 GB	16 GB	32 GB
Sequential Read (MB/s)	20	20	30	30	55	35	70	75	75
Sequential Write (MB/s)	11	11	20	20	40	30	60	65	65

Notes:
- Results may differ from various flash configurations or host system setting.
- Sequential read/write is based on CrystalDiskMark 5.2.1 with file size 1,000MB.

4.3 Environmental Specifications

Environmental specifications of the ATA-Disk Module (ADM) are shown in Table 4-3.

Table 4-3 Environmental Specifications

Environment		Specifications
Temperature	Operating	0°C to 70°C (Standard); -40°C to 85°C (Wide);
	Storage	-40°C to 100°C
Vibration (Non-Operating)		Sine wave: 10~2000Hz, 15G (X, Y, Z axes)
Shock (Non-Operating)		Half sine wave, 1500 G, 11 ms (X, Y, Z ; All 6 axes)

Note: This Environmental Specification table indicates the conditions for testing the device. Real world usages may affect the results.

4.4 Mean Time Between Failures (MTBF)

Mean Time Between Failures (MTBF) is predicted based on reliability data for the individual components in the drive. The prediction result for the drive 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.

4.5 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 4-4 Endurance Specifications

Capacity	TeraBytes Written
128 MB	7
256 MB	14
512 MB	29
1 GB	58
2 GB	116
4 GB	232
8 GB	464
16 GB	928
32 GB	1,856

Notes:

- 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.
- This estimation complies with JEDEC JESD-219, enterprise endurance workload of random data with payload size distribution.

5. Flash Management

5.1 Error Correction/Detection

The properties of NAND flash memory make it ideal for applications that require high integrity while operating in challenging environments. The integrity of data to NAND flash memory is generally maintained through ECC algorithms. This ATA-Flash Drive is programmed with a hardware ECC engine which correct up to 72 bits per 1KB.

5.2 Bad Block Management

Current production technology is unable to guarantee total reliability of NAND flash memory array. When a flash memory device leaves factory, it comes with a minimal number of initial bad blocks during production or out-of-factory as there is no currently known technology that produce flash chips free of bad blocks. In addition, bad blocks may develop during program/erase cycles. Since bad blocks are inevitable, the solution is to keep them in control. Apacer flash devices are programmed with ECC, block mapping technique and S.M.A.R.T to reduce invalidity or error. Once bad blocks are detected, data in those blocks will be transferred to free blocks and error will be corrected by designated algorithms.

5.3 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.

5.4 ATA Secure Erase

ATA Secure Erase is an ATA disk purging command currently embedded in most of the storage drives. Defined in ATA specifications, (ATA) Secure Erase is part of Security Feature Set that allows storage drives to erase all user data areas. The erase process usually runs on the firmware level as most of the ATA-based storage media currently in the market are built-in with this command. ATA Secure Erase can securely wipe out the user data in the drive and protects it from malicious attack.

5.5 Power Failure Management

Power Failure Management plays a crucial role when power supply becomes unstable. Power disruption may occur when users are storing data into the SSD, leading to instability in the drive. However, with Power Failure Management, a firmware protection mechanism will be activated to scan pages and blocks once power is resumed. Valid data will be transferred to new blocks for merging and the mapping table will be rebuilt. Therefore, data reliability can be reinforced, preventing damage to data stored in the NAND Flash.

6. Software Interface

6.1 Command Set

This section defines the software requirements and the format of the commands the host sends to the ATA-Disk Module (ADM). Commands are issued to the ADM by loading the required registers in the command block with the supplied parameters, and then writing the command code to the Command register. The manner in which a command is accepted varies.

Table 6-1 Command Set

Code	Command	Code	Command
E5H or 98H	Check-Power-Mode	F4H	Security-Erase-Unit
90H	Execute-Drive-Diagnostic	F5H	Security-Freeze-Lock
C0H	Erase Sector(s)	F1H	Security-Set-Password
E7H	Flush-Cache	F2H	Security-Unlock
50H	Format Track	7XH	Seek
ECH	Identify-Drive	EFH	Set-Features
E3H or 97H	Idle	B0H	SMART
E1H or 95H	Idle-Immediate	C6H	Set-Multiple-Mode
91H	Initialize-Drive-Parameters	E6H or 99H	Set-Sleep-Mode
00H	NOP	E2H or 96H	Standby
E4H	Read-Buffer	E0H or 94H	Standby-Immediate
C8H or C9H	Read-DMA	87H	Translate-Sector
C4H	Read-Multiple	E8H	Write-Buffer
20H or 21H	Read-Sector(s)	CAH or CBH	Write-DMA
40H or 41H	Read-Verify-Sector(s)	C5H	Write-Multiple
1XH	Recalibrate	CDH	Write-Multiple-Without-Erase
03H	Request-Sense	30H or 31H	Write-Sector(s)
F6H	Security-Disable-Password	38H	Write-Sector-Without-Erase
F3H	Security-Erase-Prepare	3CH	Write-Verify

6.2 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 SMART 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.

7. Electrical Specifications

7.1 Operating Voltage

Table 7-1 lists the supply voltage for the ATA-Disk Module.

Table 7-1 Operating Range

Item	Range
Supply Voltage	3.3V ± 5% (3.135-3.465) 5V ± 5% (4.75-5.25V)

7.2 Power Consumption

Table 7-2 lists the power consumption for the ATA-Disk Module.

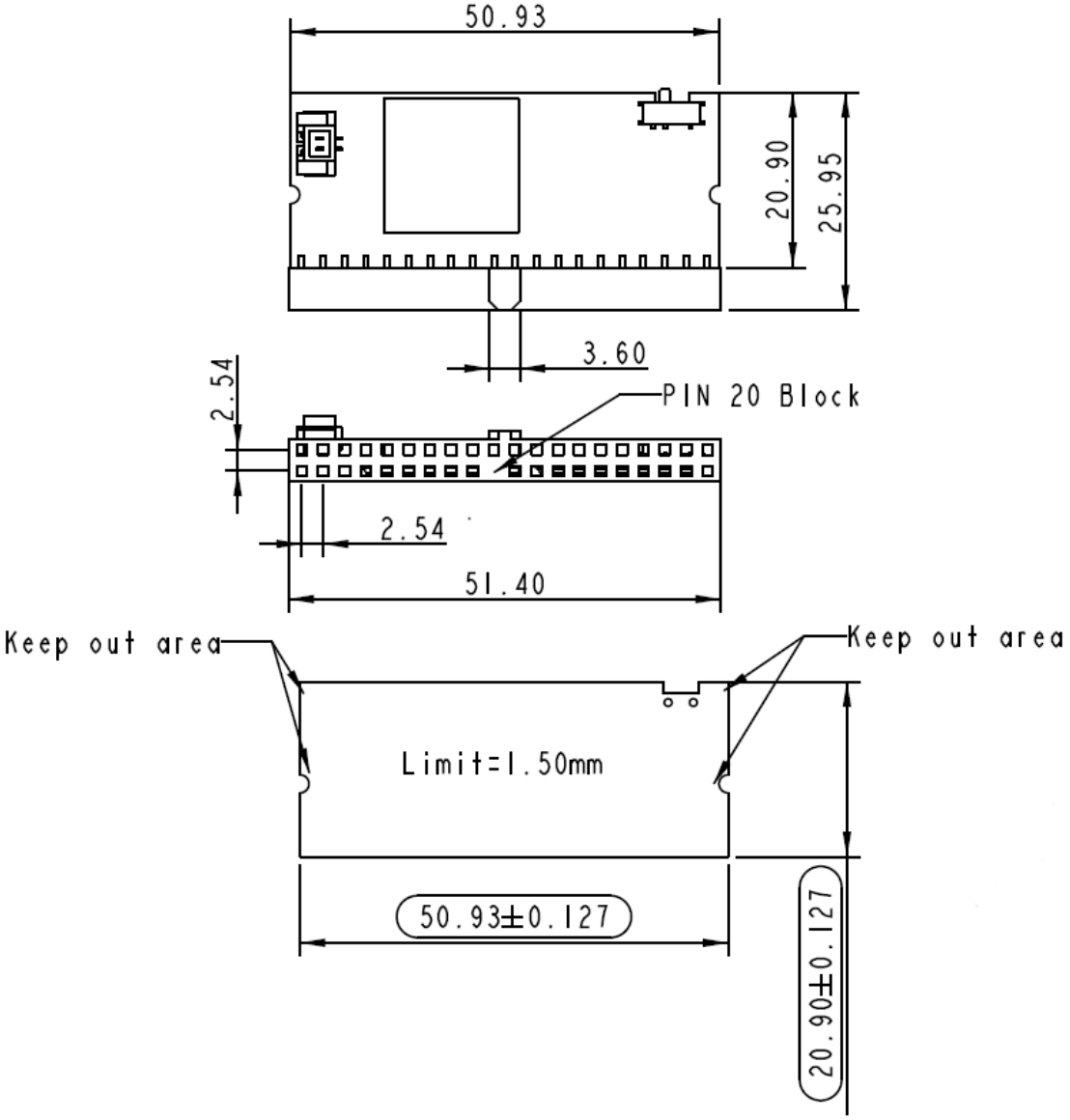
Table 7-2 Power Consumption

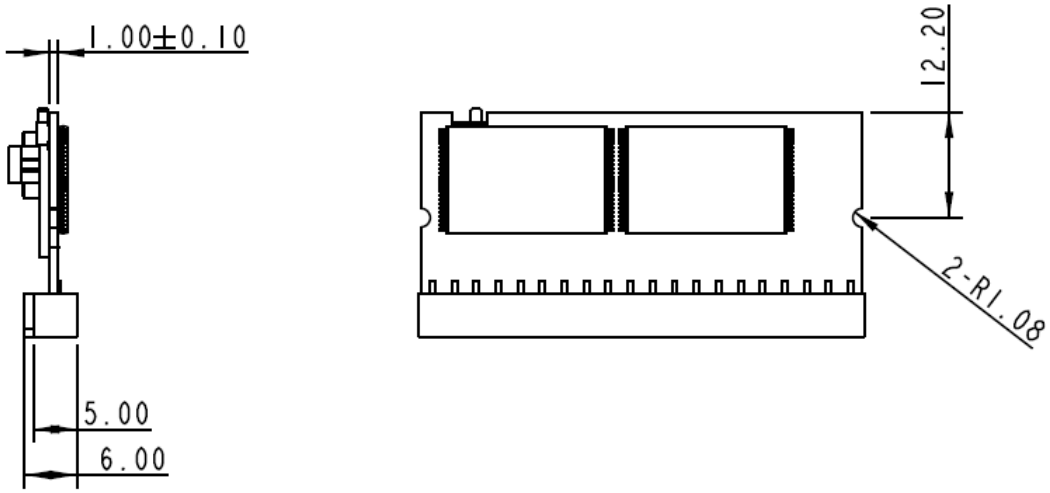
Capacity / Mode	128 MB	256 MB	512 MB	1 GB	2 GB	4 GB	8 GB	16 GB	32 GB
Active (mA)	125	125	135	135	195	160	230	250	280
Idle (mA)	15	15	15	15	15	15	15	15	15

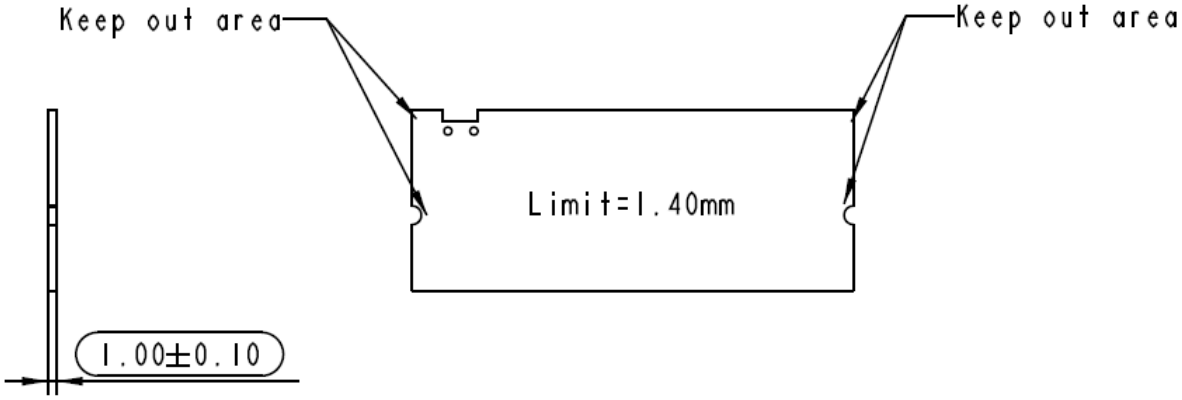
Notes:
- All values are typical and may vary depending on flash configurations or host system settings.
- Active power is an average power measurement performed using CrystalDiskMark with 128KB sequential read/write transfers.

8. Mechanical Specifications

8.1 Without Housing

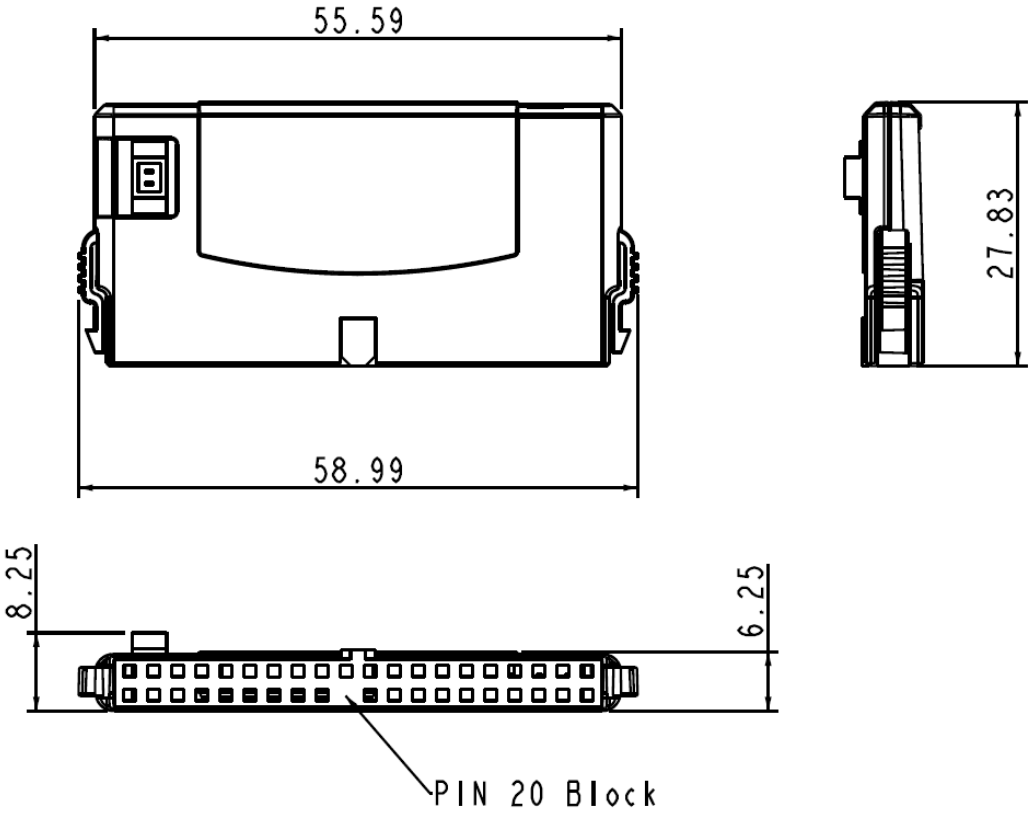






Unit: mm
Tolerance: ±0.2 mm

8.2 With Housing



Unit: mm
Tolerance: ±0.2 mm

9. Product Ordering Information

9.1 Product Code Designations

AP – FM xxxx D W 6 0 x S – X T X 1X

Model
1M: Middle Profile
1H: Middle Profile with Housing

Operating Temperature Range
Blank: Standard Temperature
W: Wide Temperature

Flash Type

FW Version
Blank: Std.

Environmental Spec

Voltage
3: 3.3V
5: 5.0V

Speed
0: Standard

PCB Version

Package Modifier
40 pin / 180D with Stu

Controller Version

Capacity

0128: 128MB	001G: 1GB	008G: 8GB
0256: 256MB	002G: 2GB	016G: 16GB
0512: 512MB	004G: 4GB	032G: 32GB

Model Name

Apacer Product Code

9.2 Valid Combinations

A. Standard Temperature

9.2.1 Middle Profile w/o housing

Capacity	3.3V	5V
128MB	AP-FM0128DW603S-T1M	AP-FM0128DW605S-T1M
256MB	AP-FM0256DW603S-T1M	AP-FM0256DW605S-T1M
512MB	AP-FM0512DW603S-T1M	AP-FM0512DW605S-T1M
1GB	AP-FM001GDW603S-T1M	AP-FM001GDW605S-T1M
2GB	AP-FM002GDW603S-T1M	AP-FM002GDW605S-T1M
4GB	AP-FM004GDW603S-T1M	AP-FM004GDW605S-T1M
8GB	AP-FM008GDW603S-T1M	AP-FM008GDW605S-T1M
16GB	AP-FM016GDW603S-T1M	AP-FM016GDW605S-T1M
32GB	AP-FM032GDW603S-T1M	AP-FM032GDW605S-T1M

9.2.2 Middle Profile w/ housing

Capacity	3.3V	5V
128MB	AP-FM0128DW603S-T1H	AP-FM0128DW605S-T1H
256MB	AP-FM0256DW603S-T1H	AP-FM0256DW605S-T1H
512MB	AP-FM0512DW603S-T1H	AP-FM0512DW605S-T1H
1GB	AP-FM001GDW603S-T1H	AP-FM001GDW605S-T1H
2GB	AP-FM002GDW603S-T1H	AP-FM002GDW605S-T1H
4GB	AP-FM004GDW603S-T1H	AP-FM004GDW605S-T1H
8GB	AP-FM008GDW603S-T1H	AP-FM008GDW605S-T1H
16GB	AP-FM016GDW603S-T1H	AP-FM016GDW605S-T1H
32GB	AP-FM032GDW603S-T1H	AP-FM032GDW605S-T1H

B. Wide Temperature

9.2.3 Middle Profile w/o housing

Capacity	3.3V	5V
128MB	AP-FM0128DW603S-TW1M	AP-FM0128DW605S-TW1M
256MB	AP-FM0256DW603S-TW1M	AP-FM0256DW605S-TW1M
512MB	AP-FM0512DW603S-TW1M	AP-FM0512DW605S-TW1M
1GB	AP-FM001GDW603S-TW1M	AP-FM001GDW605S-TW1M
2GB	AP-FM002GDW603S-TW1M	AP-FM002GDW605S-TW1M
4GB	AP-FM004GDW603S-TW1M	AP-FM004GDW605S-TW1M
8GB	AP-FM008GDW603S-TW1M	AP-FM008GDW605S-TW1M
16GB	AP-FM016GDW603S-TW1M	AP-FM016GDW605S-TW1M
32GB	AP-FM032GDW603S-TW1M	AP-FM032GDW605S-TW1M

9.2.4 Middle Profile w/ housing

Capacity	3.3V	5V
128MB	AP-FM0128DW603S-TW1H	AP-FM0128DW605S-TW1H
256MB	AP-FM0256DW603S-TW1H	AP-FM0256DW605S-TW1H
512MB	AP-FM0512DW603S-TW1H	AP-FM0512DW605S-TW1H
1GB	AP-FM001GDW603S-TW1H	AP-FM001GDW605S-TW1H
2GB	AP-FM002GDW603S-TW1H	AP-FM002GDW605S-TW1H
4GB	AP-FM004GDW603S-TW1H	AP-FM004GDW605S-TW1H
8GB	AP-FM008GDW603S-TW1H	AP-FM008GDW605S-TW1H
16GB	AP-FM016GDW603S-TW1H	AP-FM016GDW605S-TW1H
32GB	AP-FM032GDW603S-TW1H	AP-FM032GDW605S-TW1H

Note: Valid combinations are those products in mass production or will be in mass production. Consult your Apacer sales representative to confirm availability of valid combinations and to determine availability of new combinations.

Revision History

Revision	Description	Date
1.0	Official release	11/30/2015
1.1	- Added Endurance to Features page - Added 4.5 Endurance	3/30/2018
1.2	Removed WP support from pin 30 and the note from Table 3-1	4/14/2022

Global Presence

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