

1. PRODUCT OVERVIEW

1.1. Introduction of AMP Inc.'s MicroSD SLC

AMP Inc.'s MicroSD card solution with an integrated industrial controller, which is designed for embedded applications. With enhanced flash technologies and a powerful configurable BCH ECC engine, it can achieve high-speed data transfer rates.

AMP Inc.'s MicroSD provides a capacity of 4GB with SLC NAND Flash and is fully compliant with SD3.0 and SD2.0 specifications.

AMP Inc.'s MicroSD are specifically designed for industrial PC and embedded applications for high performance. With its low power consumption and the above-mentioned features, AMP Inc.'s MicroSD can be applied for industrial automation, SBC (single-board computer), medical equipment, infotainment, and mobile applications.

1.2. Product View and Models

AMP Inc.'s MicroSD is available in the 4GB capacity within SLC Flash IC.



Figure 1: AMP Inc.'s MicroSD

Part Number	Capacity
AMPMS004G8S-00WSMI-S2	4GB

1.3. SD 3.0 Interface

AMP Inc.'s MicroSD support SD 3.0 interface, and backward compliant to SD 2.0 interface.

2. PRODUCT SPECIFICATIONS

2.1. Capacity and Device Parameters

AMP Inc.'s MicroSD card device parameters are shown in Table 1.

Table 1: Device parameters

Capacity	LBA	User Capacity (MB)
4GB	7929856	3,872

2.2. Performance

Burst Transfer Rate: up to 104 MB/s in SD 3.0 SDR104

Table 2: Performance

Capacity	4GB
Class	10
Sequential Read (max.)	30 MB/sec
Sequential Write (max.)	23 MB/sec

Note: Base on CrystalDiskMark 5.1.2 with file size 1000MB

2.3. Electrical Specifications

2.3.1. Power Requirement

Table 3: AMP Inc.'s MicroSD card Power Requirement

Item	Symbol	Rating	Unit
Input voltage	VIN	2.7V~3.6V	V

2.3.2. Power Consumption

Table 4: Power Consumption

Mode	Power Consumption (mA)
Read	95.5 (max.)
Write	111.3 (max.)
Idle	0.1 (max.)

* *Target:* MicroSD SLC 4GB

2.4. Environmental Specifications

2.4.1. Temperature Ranges

Table 5: Temperature range for MicroSD card

Temperature	Range
Operating	Industrial Temp: -40°C to +85°C
Storage	-55°C to +95°C

2.4.2. Humidity

Relative Humidity: 10-95%, non-condensing

2.4.3. Shock and Vibration

Table 6: Shock/Vibration Testing for MicroSD card

Reliability	Test Conditions	Reference Standards
Vibration	7 Hz to 2K Hz, 20G, 3 axes	IEC 68-2-6
Mechanical Shock	Duration: 0.5ms, 1500 G, 3 axes	IEC 68-2-27

2.4.4. Mean Time between Failures (MTBF)

Table 7 summarizes the MTBF prediction results for various MicroSD card configurations.

The analysis was performed using a RAM Commander™ failure rate prediction.

Failure Rate: The total number of failures within an item population, divided by the total number of life units expended by that population, during a particular measurement interval under stated condition.

Mean Time between Failures (MTBF): A basic measure of reliability for repairable items: The mean number of life units during which all parts of the item perform within their specified limits, during a particular measurement interval under stated conditions.

Table 7: MicroSD card MTBF

Product	Condition	MTBF (Hours)
AMP Inc. MicroSD	Telcordia SR-332 GB, 25°C	>3,000,000

2.5. CE and FCC Compatibility

AMP Inc. MicroSD card conforms to CE and FCC requirements.

2.6. RoHS Compliance

AMP Inc. MicroSD card is fully compliant with RoHS directive.

2.7. Reliability

Parameter	Value
Read Cycles	Unlimited Read Cycles
Wear-Leveling Algorithm	Support
Bad Blocks Management	Support
Error Correct Code	Support
TBW (Sequential Write)	SLC
4GB	213

2.8. Transfer Mode

AMP Inc. MicroSD support following transfer mode: SD 3.0 / SD 2.0

2.9. Pin Assignment

AMP Inc. MicroSD is compliant with Standard SD SPEC., please refer to Table 8 for pin assignment.

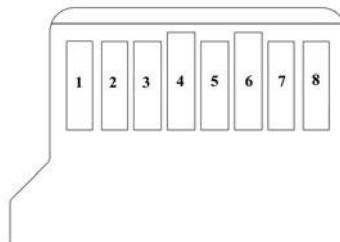
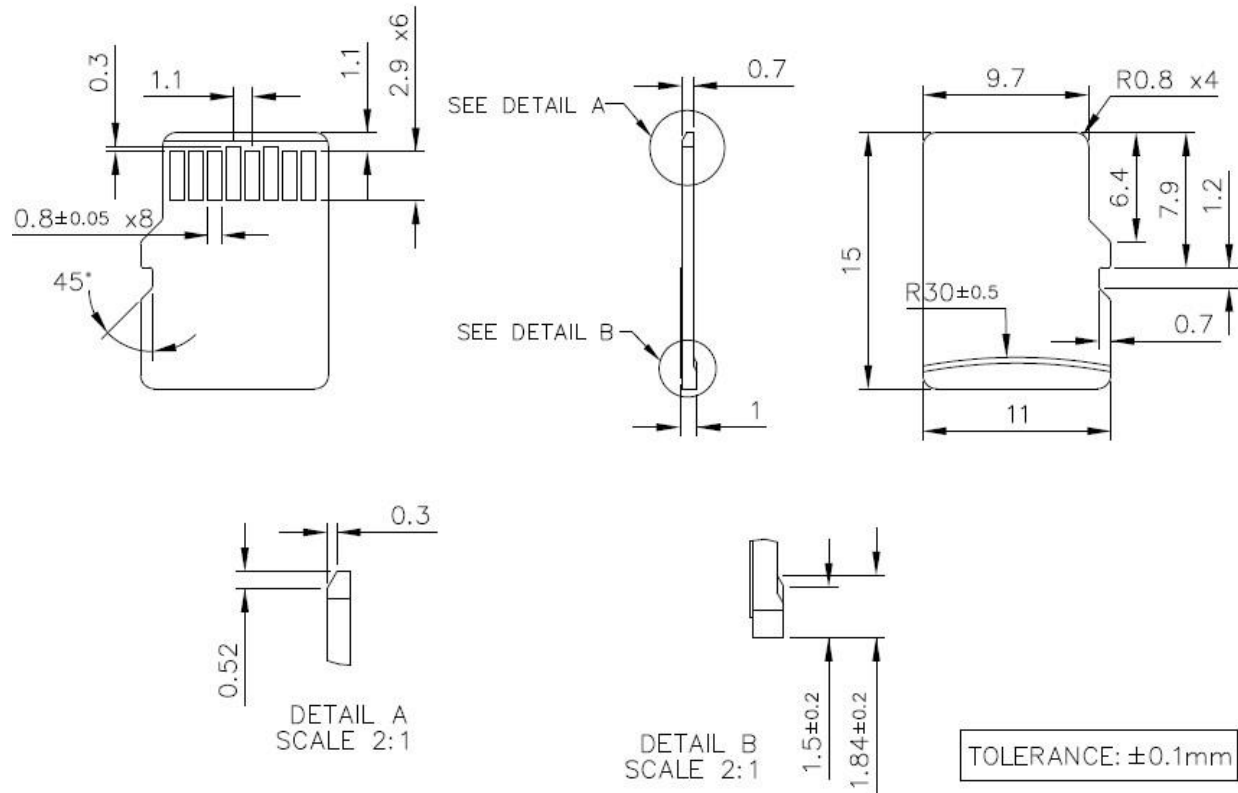


Table 8: AMP Inc. MicroSD Card Pin Assignment

Pin #	Name	Type	Description
1	DAT22,5	I/O	Data Line [Bit 2]
2	CD/DAT3	I/O3	Card Detect/Data Line [Bit 3]
3	CMD	I/O	Command/Response
4	V _{DD}	S	S Supply Voltage
5	CLK	I	Clock
6	V _{SS}	S	S Supply Voltage GND
7	DAT0	I/O	Data Line [Bit 0]
8	DAT1 ^{2,4}	I/O	Data Line [Bit 1]

2.10. Mechanical Dimensions



2.11. Assembly Weight

AMP Inc. MicroSD card 3.0 within SLC flash ICs, 4GB's weight is 0.25 grams approx.

2.12. Seek Time

AMP Inc. MicroSD card is not a magnetic rotating design. There is no seek or rotational latency required.

2.13. Hot Plug

The MicroSD card support hot plug function and can be removed or plugged-in during operation.

2.14. NAND Flash Memory

AMP Inc. MicroSD uses Single Level Cell (SLC) NAND flash memory, which is non-volatility, high reliability, and high-speed memory storage.

3. Theory of Operation

3.1. Overview

Figure 2 shows the operation of AMP Inc. MicroSD from the system level, including the major hardware blocks.

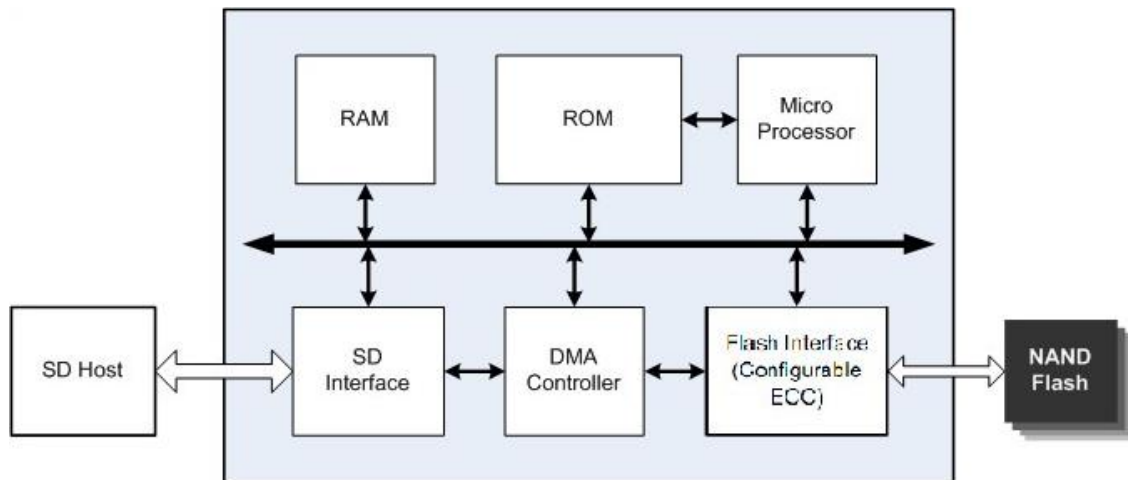


Figure 2: AMP Inc. MicroSD Block Diagram

AMP Inc. MicroSD integrates a SD 3.0 controller and NAND flash memories. Communication with the host occurs through the host interface, using the standard SD interface.

3.2. SD 3.0 Controller

AMP Inc. MicroSD is designed with a SD 3.0 controller, which has single channel for flash interface.

3.3. Error Detection and Correction

Highly sophisticated Error Correction Code algorithms are implemented. The ECC unit consists of the Parity Unit (parity-byte generation) and the Syndrome Unit (syndrome-byte computation). This unit implements an algorithm that can correct from 24 up to 72 bits per 1024 bytes in an ECC block. Code-byte generation during write operations, as well as error detection during read operation, is implemented on the fly without any speed penalties.

3.4. Wear-Leveling

Flash memory can be erased within a limited number of times. This number is called the **erase cycle limit** or **write endurance limit** and is defined by the flash array vendor. The erase cycle limit applies to each individual erase block in the flash device.

AMP Inc. MicroSD uses a global wear-leveling algorithm to ensure that consecutive writes of a specific sector are not written physically to the same page/block in the flash. This spreads flash media usage evenly across all pages, thereby extending flash lifetime.

3.5. Bad Blocks Management

Bad Blocks are blocks that contain one or more invalid bits whose reliability are not guaranteed. The Bad Blocks may be presented while the product is shipped or may develop during the life time of the MicroSD card. When the Bad Blocks is detected, it will be flagged, and not be used anymore. The MicroSD card implement Bad Blocks management, Bad Blocks replacement, Error Correct Code to avoid data error occurred. The functions will be enabled automatically to transfer data from Bad Blocks to spare blocks, and correct error bit.

3.6. Garbage Collection

Garbage collection is used to maintain data consistency and perform continual data cleansing on MicroSD card. It runs as a background process, freeing up valuable controller resources while sorting good data into available blocks, and deleting bad blocks. It also significantly reduces write operations to the drive, thereby increasing the SD's speed and lifespan.

3.7. Power cycling

AMP Inc. SD/MSDs provide the complete data protection mechanism during every abnormal power shutdown situation. Such as: power failure at programming data, updating system tables, erasing blocks, etc. The mechanism can maintain the data correctness and increase the reliability of the data stored in the NAND Flash memory.

4. Installation Requirements

4.1 MicroSD card Pin Directions

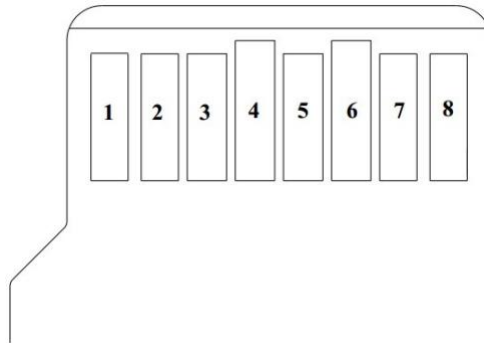


Figure 3: Signal Segment and Power Segment

4.2. Device Drives

No additional device drives are required.

REVISION HISTORY

Revision		Date	Description
Was	Is		
-	1.0	04/23/2024	Initial Release.
1.0	1.1	06/20/2024	Update Part Numbers and document formatting.