RoHS Recast Compliant

Industrial microSD H2-M Card Series

Datasheet for MLC NAND-based Industrial microSD Card

June 1, 2018

Revision 1.0

This Specification Describes the Features and Capabilities of the Standard and Industrial Temperature Industrial microSD Cards

Please Contact Fortasa Memory Systems Sales for any Custom Features Required For Your Specific Application

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Features:

- **Fully compatible with microSD Card standard specification 5.1**
- **Low power consumption (typical)**
  - – Supply voltage: 2.7 – 3.6V
  - – Operating mode: 140 mA
  - – Standby mode: 240 µA
- **Performance**
  - – Sustained Read: up to 90 MB/sec
  - – Sustained write: up to 55 MB/sec
- **Bus Speed Mode -** Support Class 10 with UHS-I**
  - – DS: Default Speed up to 25MHz 3.3V signaling
  - – HS: High Speed up to 50MHz 3.3V signaling
  - – SDR12: SDR up to 25MHz 1.8V signaling
  - – SDR25: SDR up to 50MHz 1.8V signaling
  - – SDR50: SDR up to 100MHz 1.8V signaling
  - – SDR104: SDR up to 208MHz 1.8V signaling
  - – DDR50: DDR up to 50MHz 1.8V signaling
- **Support Video Speed Class – V10**
- **Support Application Performance Class – A10**
- **Capacity**
  - – 4, 8, 16, 32GB
- **NAND flash type: MLC**
- **Temperature ranges**
  - – Operation:
    - Standard Temperature: -25°C to 85°C
    - Industrial Temperature: -40°C to 85°C
  - – Storage: -40°C to 100°C
- **Intelligent endurance design**
  - – Built-in hardware BCH ECC
  - – Global wear-leveling scheme together with dynamical block allocation to significantly increase the lifetime of a flash device and optimize the disk performance
  - – Flash bad-block management
- **Physical Dimensions**
  - – 15.0 mm(L) x 11.0 mm(W) x 1.0 mm(H)
- **RoHS Recast compliant**

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1 Product Description

1.1 General Description

Fortasa's Industrial H2-M microSD card is a high reliability solid state storage solution designed specifically to address the rigorous requirements of OEM customers. MicroSD H2-M is compatible with the microSD card version 5.1. The command list supports [Physical Layer Specification Ver5] definitions. Card Capacity of Non-secure Area, Secure Area Supports [Security Specification Ver5] Specifications. Random performance of microSD H2-M is much more enhanced than before. The maximum transfer speed can be achieved along with UHS-I compliant devices. Besides, Video Speed Class is compliant with V10 and V30, which are mainly useful for camcorders, video recorders and other devices with video recording capabilities. With V10 and V30 speed mode, microSD card is recommended for high resolution and high quality 4K video recording. Fortasa microSD H2-M card is also compliant with Application Performance Class A1, optimized for 4K small file random read/write IOPS, delivering minimum read/write performance at 1500/500 IOPS.

The microSD 5.1 card comes with 8-pin interface, designed to operate at maximum operating frequency of 50MHz or 100MHz. It can alternate communication protocol between the SD mode and SPI mode and is backward compatible with SD 2.0 devices. It performs data error detection and correction with very low power consumption.

Fortasa Industrial microSD 5.1 card with high performance, reliability and compatibility is well adapted for hand-held applications, medical, surveillance systems and automotive markets.The MLC-NAND based Industrial microSD cards offer the highest endurance, reliability and environmental agility. **Manufactured using Industrial Temperature rated MLC NAND-flash, this microSD card can work in highly demanding environment and withstand wide range of operating temperature from -40°C to +85°C.**

1.2 Functional Block

The Industrial microSD card includes a single-chip SD Interface Flash Controller and the flash media. The controller integrates the flash management unit to support multi-channel, multi-bank flash arrays. Figure 1-1 shows the functional block diagram of the Industrial microSD card.

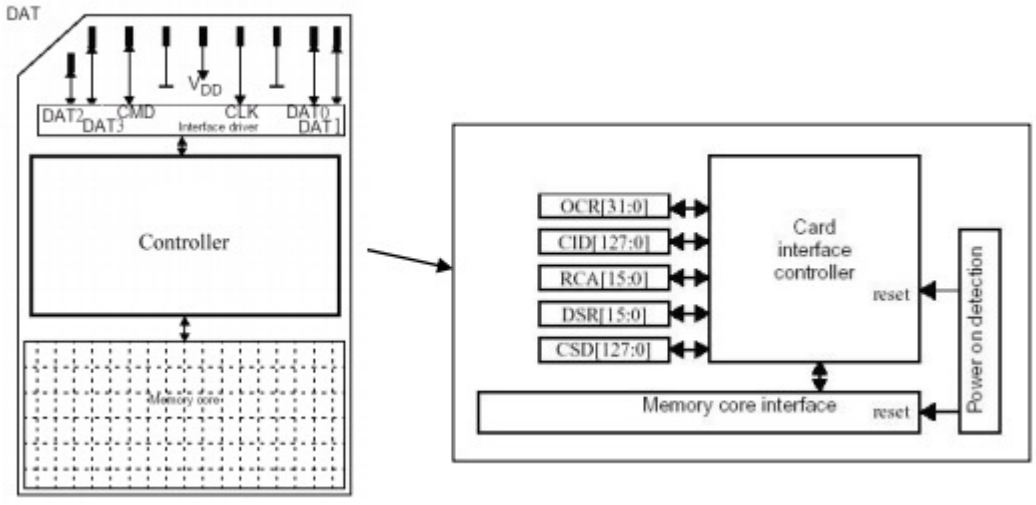


Figure 1-1: Functional block diagram

1.3 Functional Description

The Industrial microSD card contains an integrated logical subsystem that provides multiple management capabilities including:

- Powerful Error Correction Algorithm
- Global Wear Leveling Algorithm
- Critical Power Management for low power operation

1.3.1 Flash Management

The Industrial microSD Flash controller contains logic/physical flash block mapping and bad block management system. It manages all flash blocks including user data space, spare block space and system overhead blocks.

1.3.2 Powerful ECC Algorithm

The Industrial microSD card contains a sophisticated defect and error management system. In case that a bit is found to be defective, the Flash Controller on-the-fly ECC engine mathematically recalculates the missing bit to provide the requested with outmost integrity. This operation is completely transparent to the host and does not consume any user data space.

1.3.3 Power Management

A power saving feature of the Industrial microSD card is an automatic entrance and exit from sleep mode. Upon completion of an operation, the microSD card will enter sleep mode to conserve power if no additional commands are received within a set number of seconds. The host does not have to take any action for this to occur. The microSD card is always in the sleep mode except when the host is accessing it, thus conserving power.

Any command issued by the host to the Industrial microSD card will cause it to exit sleep mode and response to the host.

1.3.4 Power Failure Management

Fortasa Industrial MicroSD cards provide complete data protection mechanism in the event of any abnormal power shutdown situation, such as power failure during data programming, updating system tables, erasing blocks, etc.

Fortasa Power-Loss Protection mechanism includes:
- Maintaining data integrity and increasing the reliability of the data stored in the NAND Flash memory.
- Protecting F/W table and the data written to flash from data loss in the event of power disruption.

1.3.4 SMART Command

SMART, an acronym for Self-Monitoring, Analysis and Reporting Technology, is a manufacturer specific function that allows microSD card to automatically monitor its health. Please contact Fortasa for SMART Command information.

1.4 Capacity Specification

Standard capacity specification of the Industrial microSD product is shown in Table 1-1.

Table 1-1: Capacity specifications

Capacity	Total Bytes
4GB	3,967,811,584
8GB	7,944,011,776
16GB	15,896,412,160
32GB	31,797,018,624

Please contact factory for any non-listed microSD capacity or custom setting requirement.

1.5 Performance Specification

Performances of the Industrial microSD card are listed in Table 1-2.

Table 1-2: Standard Performance specifications

Performance \ Capacity	4GB	8GB	16GB	32GB
Sustained read (MB/s)	80	90	90	90
Sustained write (MB/s)	14	26	45	50

Note: Performances vary from flash configurations or host device settings

1.6 Endurance

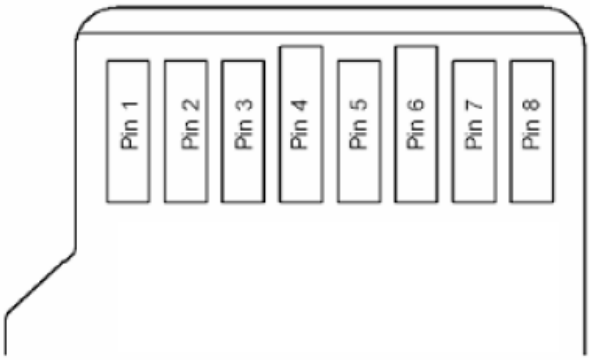
The endurance of a storage device is predicted by TeraBytes Written based on several factors related to usage, such as the amount of data written into the drive, block management conditions, and daily workload for the drive. Thus, key factors, such as Write Amplifications and the number of P/E cycles,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

Capacity	TeraBytesWritten (TBW)
4 GB	2
8 GB	4
16 GB	7
32 GB	17

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) = 1000 GB

1.7 Card Architecture



1.8 Pin Assignments

Pin	SD Mode		SPI Mode	
	Name	Description	Name	Description
1	DAT2	Data line[bit 2]	RSV	Reserved
2	CD/DAT3	Card Detect/Data line [bit 3]	CS	Chip select
3	CMD	Command/Response	DI	Data in
4	VDD	Supply voltage	VDD	Supply voltage
5	CLK	Clock	SCLK	Clock
6	VSS	Supply voltage ground	VSS	Supply voltage ground
7	DAT0	Data line[bit 0]	DO	Data out
8	DAT1	Data line[bit 1]	RSV	Reserved

2. Durability Specifications

2.1 Environments

Environmental specification of the Industrial microSD series follows the MIL-STD-810F standard as shown in Table 2-1.

Table 2-1: Environmental specifications

Environment		Specification
Temperature	Operation	-25°C to 85°C (standard); -40°C to 85°C (industrial)
	Storage	-40°C to 85°C
Humidity	Operation	40°C - 95% RH (Non-condensing)
	Storage	55°C - 93% RH (Non-condensing)
Shock	Operation	1,500G, 0.5ms
Vibration	Non -Operating	20Hz~80Hz/1.52mm (frequency/displacement) 80Hz~2000Hz/20G (frequency/displacement) X, Y, Z axis/60mins each
Drop	Non -Operating	150cm free fall, 6 face of each
Bending	Non -Operating	≧10N, hold 1min/5times
Torque	Non -Operating	0.1N-m or 2.5deg, hold 5min/5times
Salt Spray	Non -Operating	Concentration: 3% NaCl at 35°C (storage for 24 hours)
Waterproofing	Non -Operating	JIS IPX7 compliance Water temperature 25°C Water depth: the lowest point of unit is locating 1000mm below surface (storage for 30 mins)
X-Ray Exposure	Non -Operating	0.1 Gy of medium-energy radiation (70 KeV to 140 KeV, cumulative dose per year) to both sides of the card (storage for 30 mins)
Durability	Non -Operating	10,000 times mating cycle
ESD	Non -Operating	Pass

3. Electrical Specification

3.1 Operating Voltage

Caution: **Absolute Maximum Stress Ratings –** Applied conditions greater than those listed under "Absolute Maximum Stress Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these conditions or conditions greater than those defined in the operational sections of this data sheet is not implied. Exposure to absolute maximum stress rating conditions may affect device reliability.

Table 3-1: Operating range

Range	Ambient Temperature	Conditions
Standard	-25°C to +85°C	2.7-3.6 V
Industrial	-40°C to 85°C	

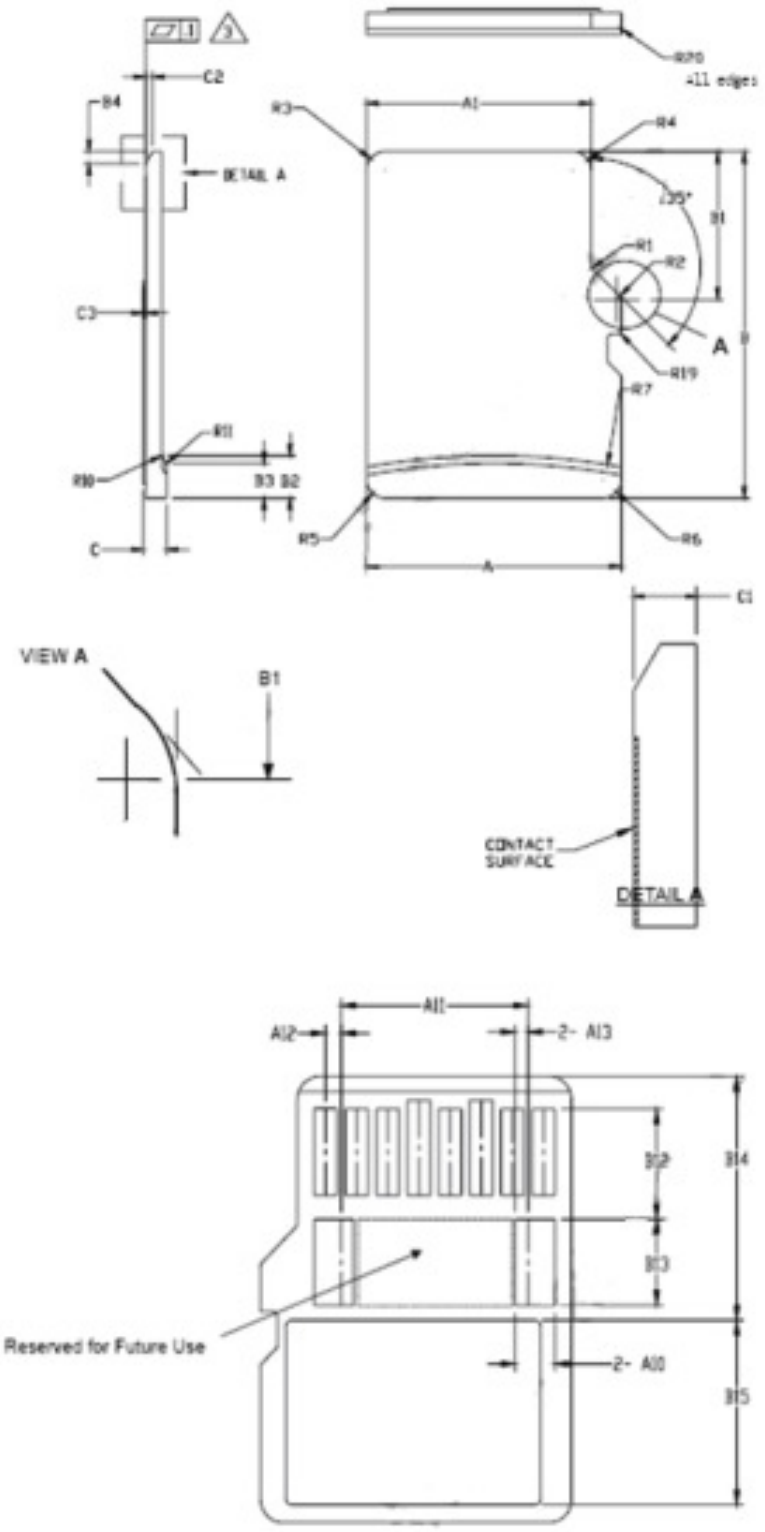
3.2 Power Consumption

Table 3-2 lists the Industrial microSD power consumption.

Table 3-2 Industrial microSD power consumption

Capacity / Performance	4GB	8GB	16GB	32GB
Operating Mode (mA)	60	75	105	140
Standby Mode (µA)	185	175	210	240

4. Physical Dimensions



5. SMART Information

5.1 Direct Host Access to SMART Data via SD General Command (CMD56)

CMD 56 is structured as a 32-bit argument. The implementation of the general purpose functions will arrange the CMD56 argument into the following format:

[31:24]	[23:16]	[18:15]	[7:1]	[0]
Argument #3	**Argument #2**	**Argument #1**	**Index**	**"1/0"**

- Bit [0]: Indicates Read Mode when bit is set to [1] or Write Mode when bit is cleared [0]. Depending on the function, either Read Mode or Write Mode can be used.
- Bit [7:1]: Indicates the index of the function to be executed:
- Read Mode: Index = 0x10 Get SMART Command Information
- Write Mode: Index = 0x08 Pre-Load SMART Command Information
- Bit [15:8]: Function argument #1 (1-byte)
- Bit [23:16]: Function argument #2 (1-byte)
- Bit [31:24]: Function argument #3 (1-byte)

5.2 Process for Retrieving SMART Data

Retrieving SMART data requires the following two commands executed in sequence and in accordance with the SD Association standard flowchart for CMD56 (see below).:

Step 1: Write Mode – [0x08] Pre-Load SMART Command Information

Sequence	Command	Argument	Expected Data
Pre-Load SMART Command Information	**CMD56**	**[0] "0" (Write Mode) [1:7] "0001 000" (Index = 0x08) [8:511] All '0' (Reserved)**	**No expected data**

Step 1: Write Mode – [0x08] Pre-Load SMART Command Information

Sequence	Command	Argument	Expected Data
Get SMART Command Information	CMD56	[0] "1" (Read Mode) [1:7] "0001 000" (Index = 0x10) [8:31] All '0' (Reserved)	1 sector (512 bytes) of response data byte[0-8] Flash ID byte[9-10] IC Version byte[11-12] FW Version byte[13] Reserved byte[14] CE Number byte[15] Reserved byte[16-17] Bad Block Replace Maximum byte[18] Reserved byte[32-63] Bad Block count per Die byte[64-65] Good Block Rate(%) byte[66-79] Reserved byte[80-83] Total Erase Count byte[84-95] Reserved byte[96-97] Endurance (Remain Life) (%) byte[98-99] Average Erase Count – L* byte[100-101] Minimum Erase Count – L* byte[102-103] Maximum Erase Count – L* byte[104-105] Average Erase Count – H* byte[106-107] Minimum Erase Count – H* byte[108-109] Maximum Erase Count – H* byte[110-111] Reserved byte[112-115] Power Up Count byte[116-127] Reserved byte[128-129] Abnormal Power Off Count byte[130-159] Reserved byte[160-161] Total Refresh Count byte[176-183] Product "Marker" byte[184-215] Bad Block count per Die byte[216-511] Reserved

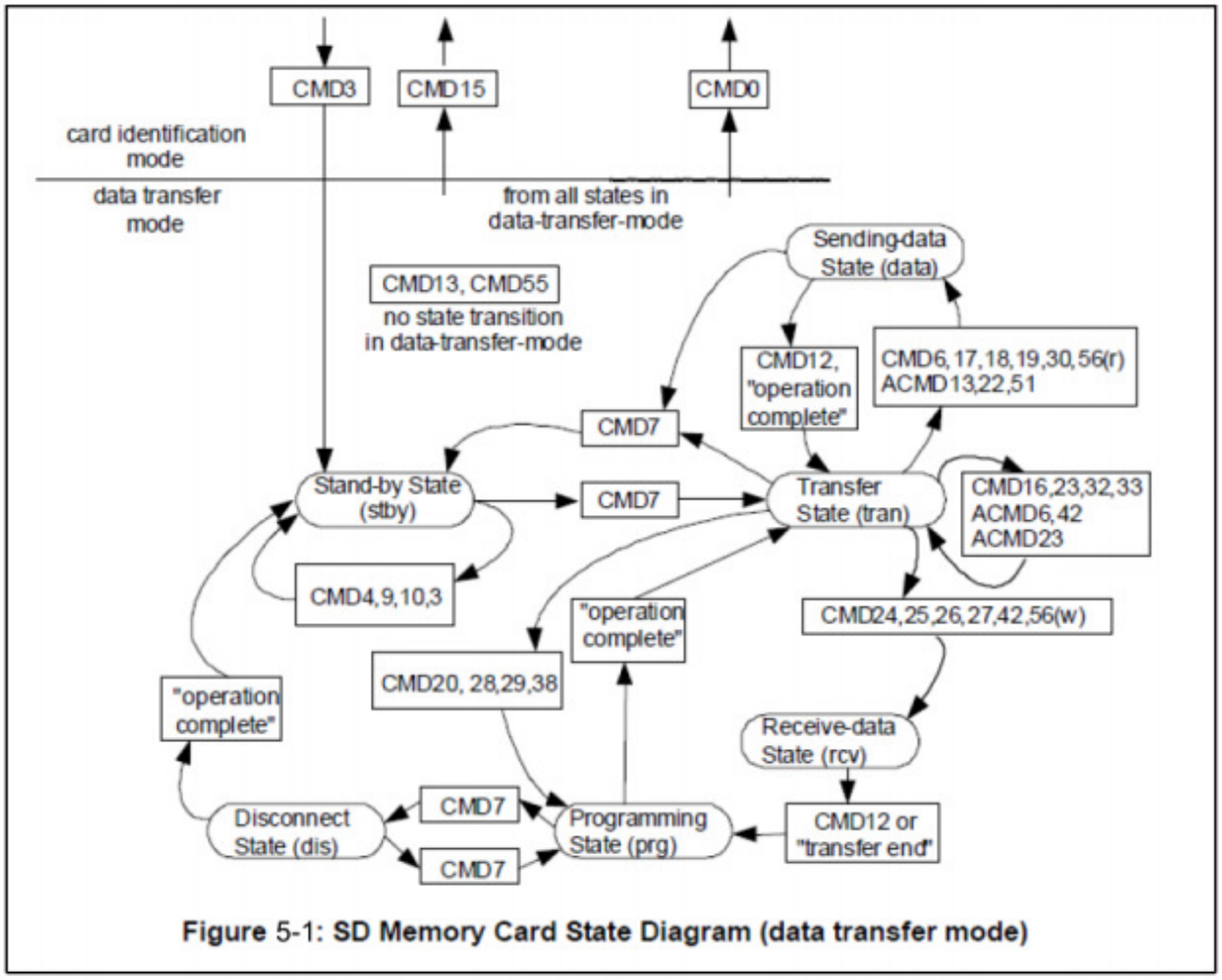
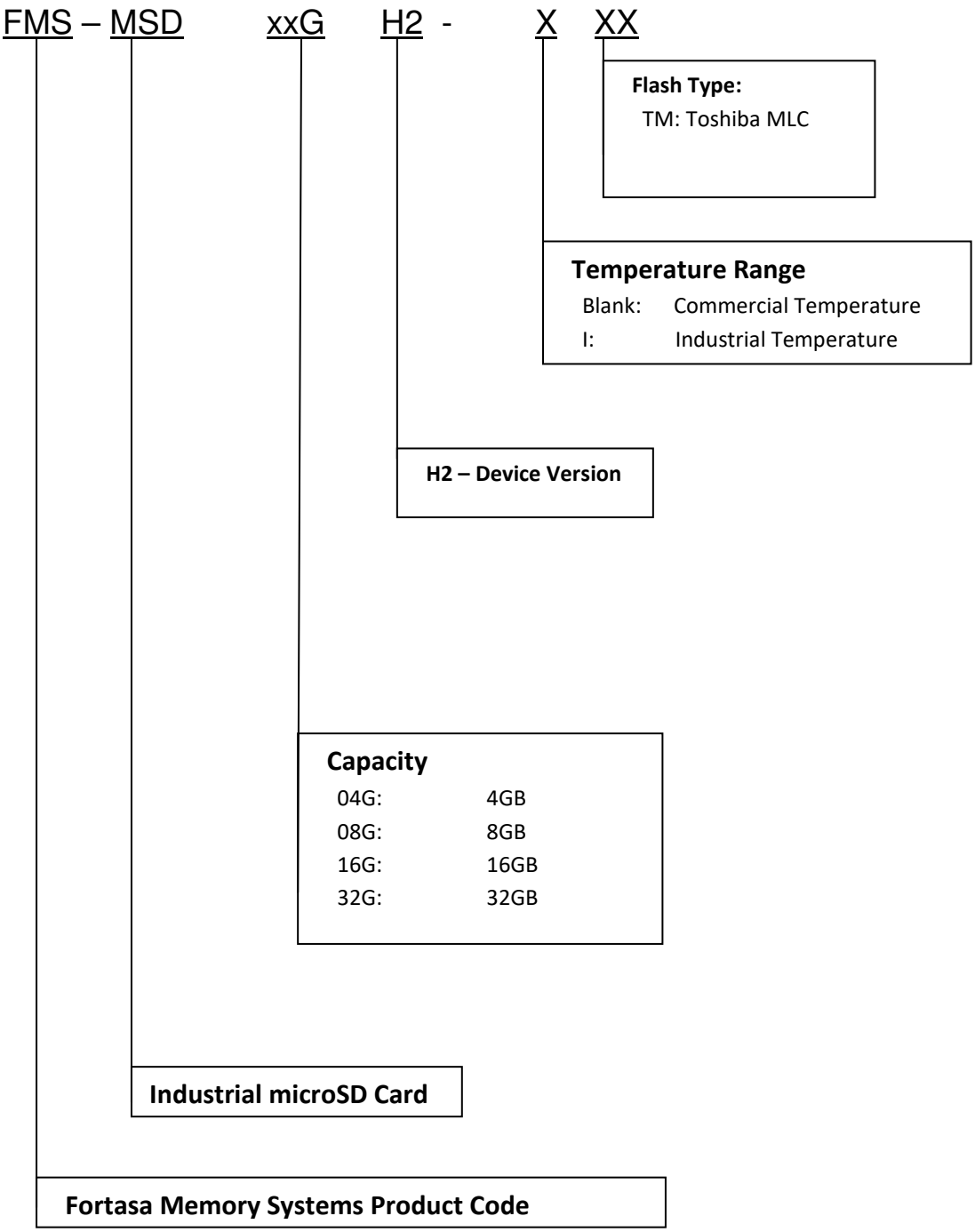


Figure 5-1: SD Memory Card State Diagram (data transfer mode)

Extracted from the SD Specifications Part 1 Physical Layer Simplified Specification Version 3.01.

6. Product Ordering Information

6.1 Product Code Designations



6.2 Valid Combinations

Capacity	Standard Temperature Model Numbers	Industrial Temperature Model Numbers
4GB	FMS-MSD04GH2-TM	FMS-MSD04GH2-ITM
8GB	FMS-MSD08GH2-TM	FMS-MSD08GH2-ITM
16GB	FMS-MSD16GH2-TM	FMS-MSD16GH2-ITM
32GB	FMS-MSD32GH2-TM	FMS-MSD32GH2-ITM

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

7. Revision History

Revision	Date	Description	Comments
1.0	6/1/2018	Initial Release	