RoHS Recast Compliant

Industrial microSD Card Series

Datasheet for SLC NAND-based Industrial microSD Card

August 15, 2017

Revision 1.1

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

1111 Triton Dr.
Suite 100
Foster City, CA 94404 USA
888-367-8588
www.fortasa.com

Features:

- **Fully compatible with microSD Card standard specification 3.0**
- **Low power consumption (typical)**
  - Supply voltage: 2.7 – 3.6V
  - Operating mode: 400 mA
  - Standby mode: <1 mA
- **Performance**
  - Sustained Read: up to 35 MB/sec
  - Sustained write: up to 20 MB/sec
- **Bus Speed Mode**
  - Support Class 10 with UHS-I
- **Capacity**
  - 256, 512MB
  - 1, 2, 4 32GB
- **NAND flash type: SLC**
- **Write Protect**
- **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 microSD card is a high reliability solid state storage solution designed specifically to address the rigorous requirements of OEM customers. The SLC-NAND based Industrial microSD cards offer the highest endurance, reliability and environmental agility.

The microSD card comes with an 8-pin interface, designed to operate at optimal performance. It can alternate communication protocol between the SD mode and SPI mode. It performs data error detection and correction with very low power consumption.

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.

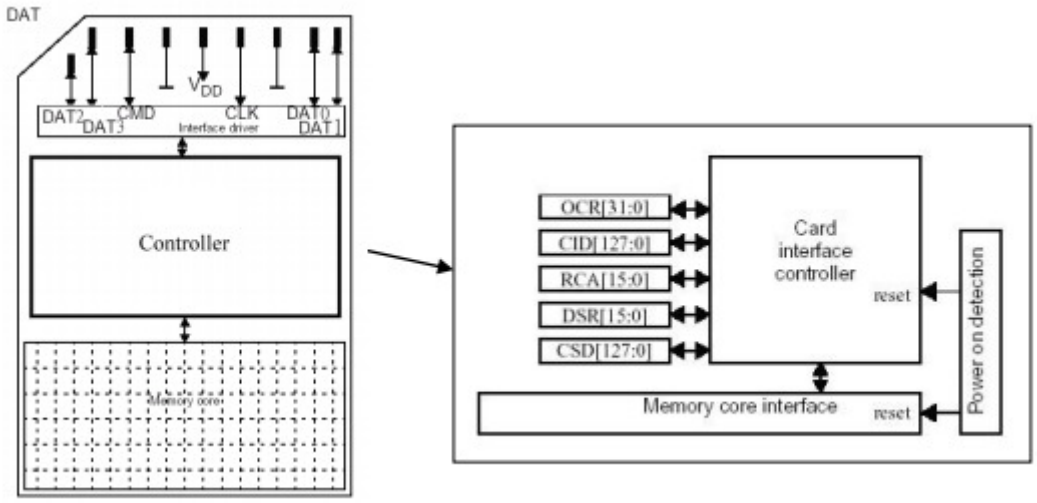


Figure 1-1: Functional block diagram

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.

1.4 Capacity Specification

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

Table 1-1: Capacity specifications

Capacity	User Data Bytes
256MB	255,721,472
512MB	504,102,912
1GB	1,024,065,536
2GB	2,052,718,592
4GB	4,097,835,006

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

1.5 Performance Specification

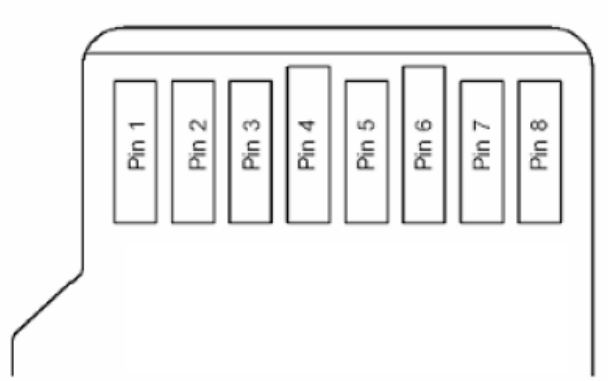
Performances of the Industrial microSD card are listed in Table 1-2.

Table 1-2: Standard Performance specifications

Performance \ Capacity	256MB	512MB	1GB	2GB	4GB
Sustained read (MB/s)	16	16	18	20	25
Sustained write (MB/s)	10	10	10	20	25

Note: Performances vary from flash configurations or host device settings

1.6 Card Architecture



1.7 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. Environmental 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)
Salt Spray	Non -Operating	3% NaCl Solution Temperature:35°C 24hr

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	-20°C to +70°C	2.7-3.6 V
Industrial	-40°C to 85°C	

3.2 Power Consumption

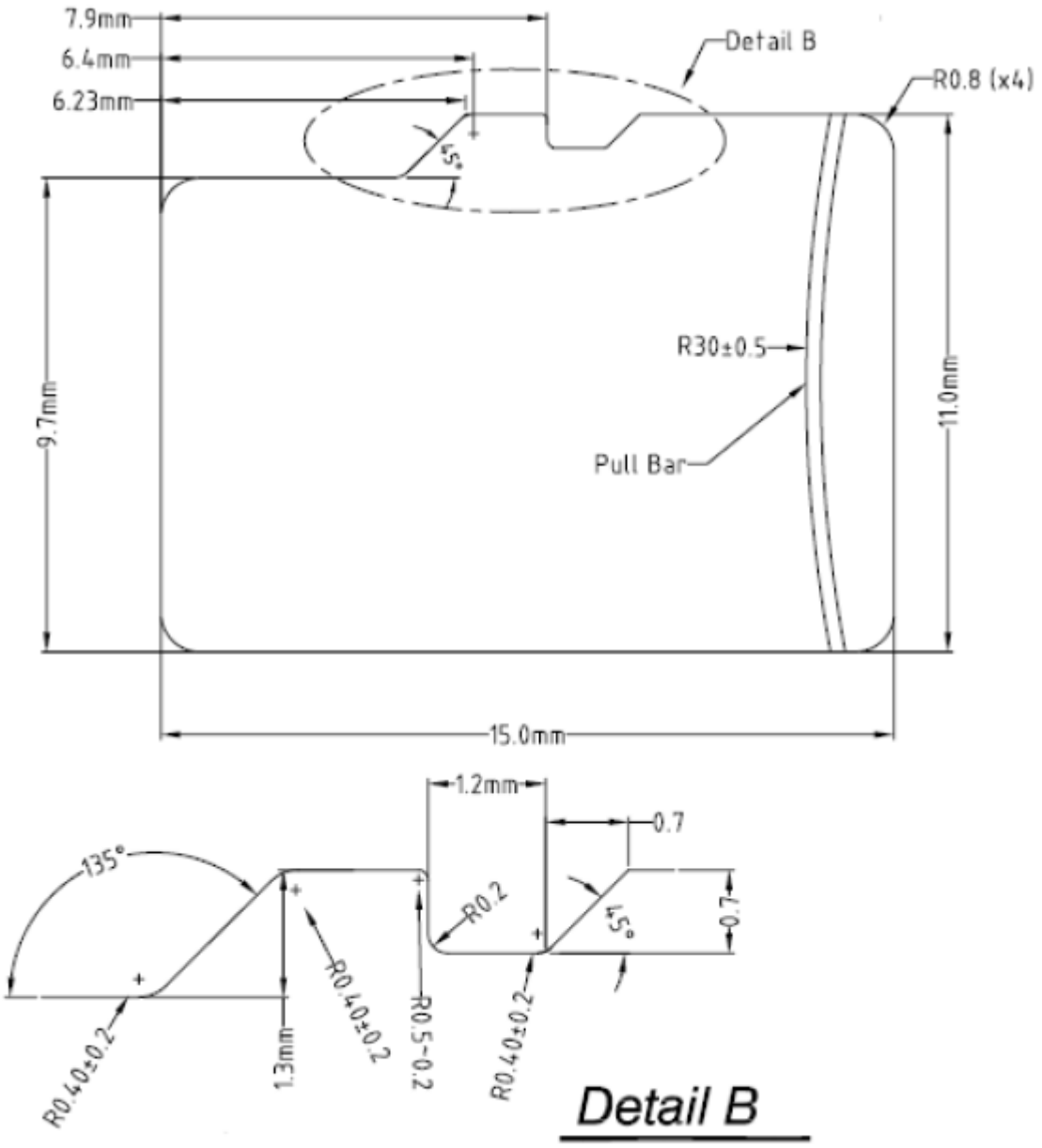
Table 3-2 lists the Industrial microSD power consumption.

Table 3-2 Industrial microSD power consumption

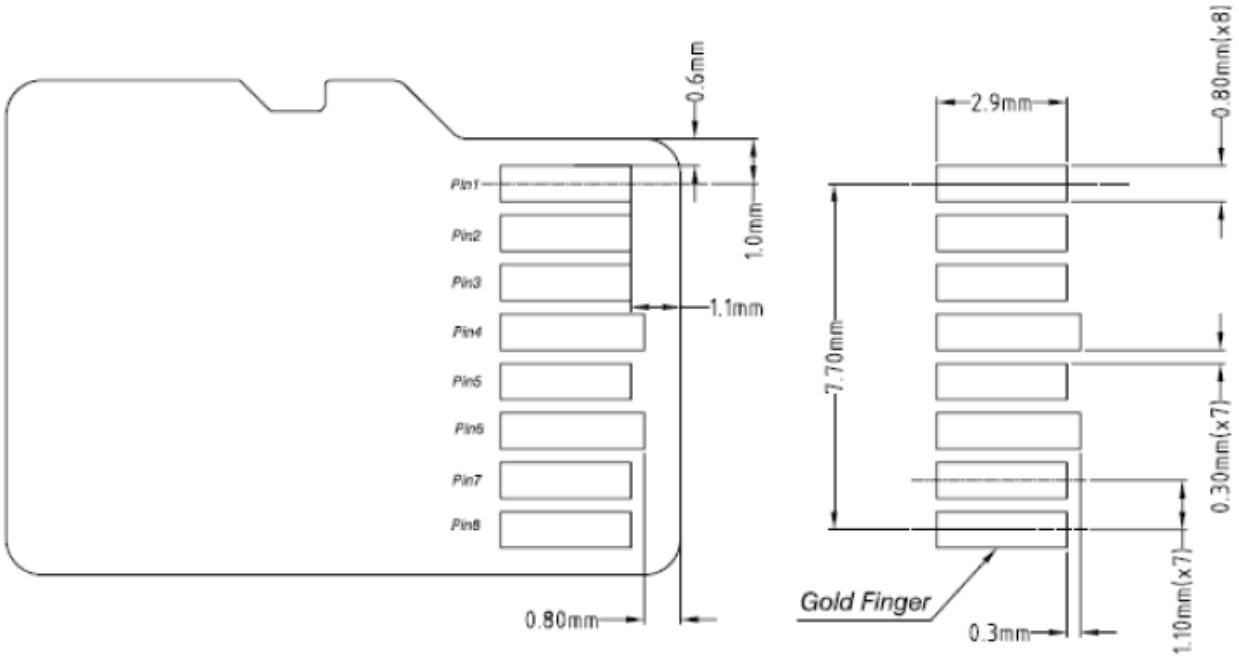
Capacity / Performance	256MB	512MB	1GB	2GB	4GB
Operating Mode (mA)	400	400	400	400	400
Standby Mode (mA)	1	1	1	1	1

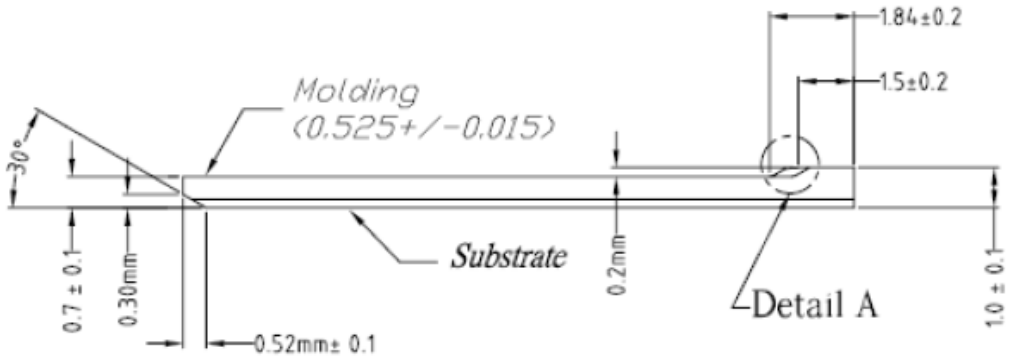
4. Physical Dimensions

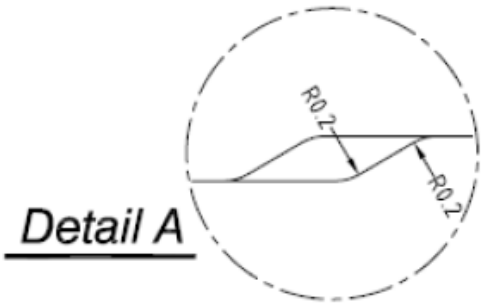
Top View



Bottom View

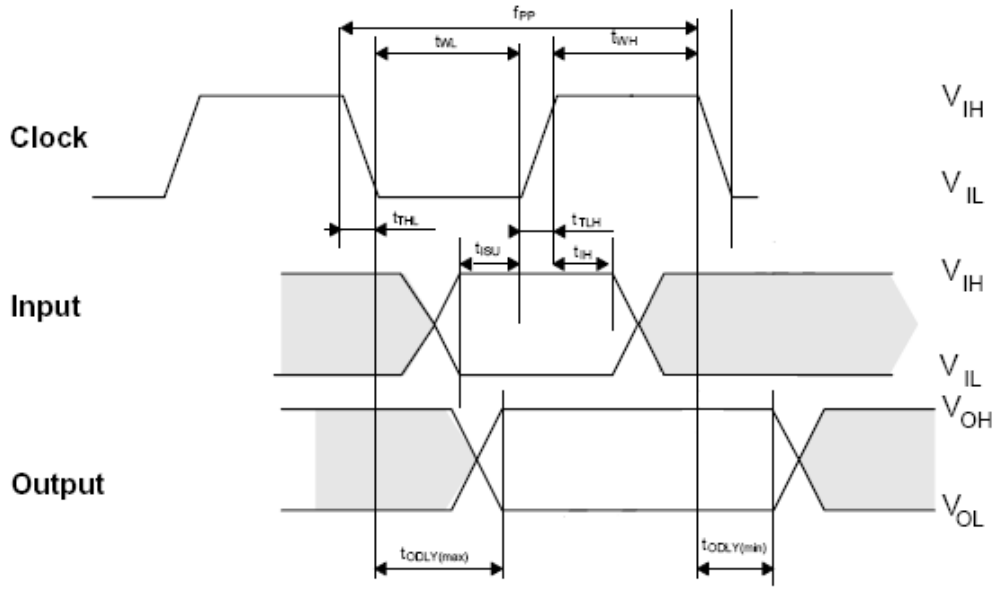

0.6mm
Pin1
Pin2
Pin3
Pin4
Pin5
Pin6
Pin7
Pin8
1.0mm
1.1mm
0.80mm
2.9mm
0.80mm(x8)
7.70mm
0.30mm(x7)
Gold Finger
0.3mm
1.10mm(x7)


1.84±0.2
1.5±0.2
Molding
(0.525+/-0.015)
30°
0.7 ± 0.1
0.30mm
0.52mm± 0.1
Substrate
0.2mm
Detail A
1.0 ± 0.1


R0.2
R0.2
Detail A

5. AC Characteristics

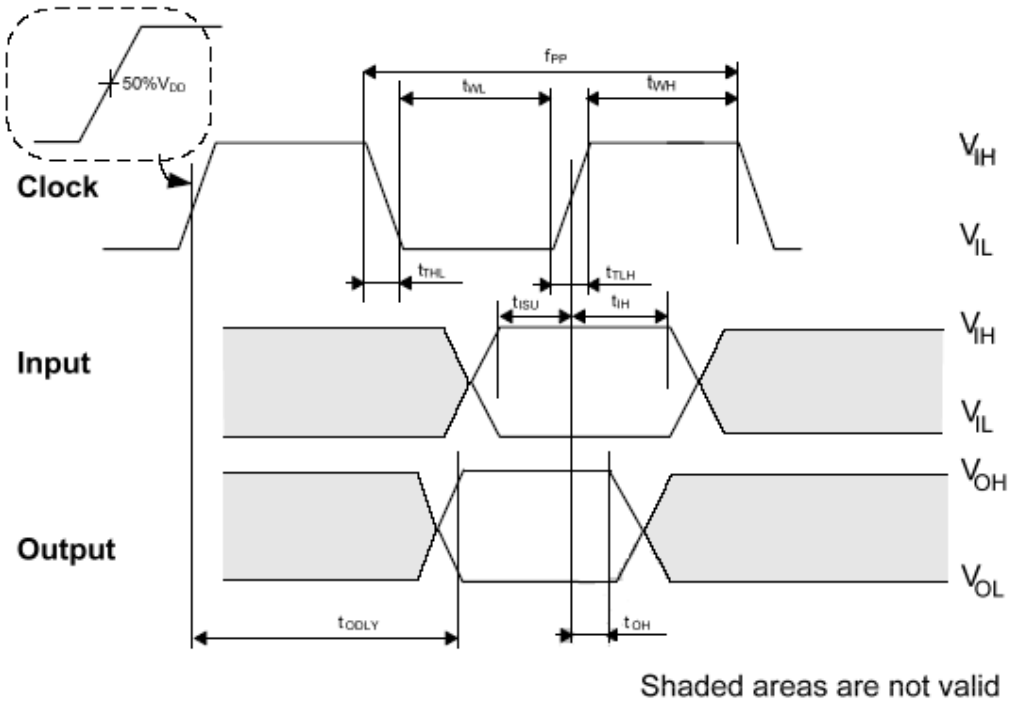
5.1 Bus Interface Timing (Standard)



SYMBOL	PARAMETER	MIN	MAX	UNIT	Note
Clock CLK (All values are referred to min(V_{IH}) and max(V_{IL})					
f_{PP}	Clock frequency Data Transfer Mode	0	25	MHz	C_{card}≤10 pF (1 card)
f_{OD}	Clock frequency Identification Mode	0(1)/100	400	kHz	C_{card}≤10 pF (1 card)
t_{WL}	Clock low time	10	-	ns	C_{card}≤10 pF (1 card)
t_{WH}	Clock high time	10	-	ns	C_{card}≤10 pF (1 card)
t_{TLH}	Clock rise time	-	10	ns	C_{card}≤10 pF (1 card)
t_{THL}	Clock fall time	-	10	ns	C_{card}≤10 pF (1 card)
t_{ISU}	Input setup time	5	-	ns	C_{card}≤10 pF (1 card)
t_{IH}	Input hold time	5	-	ns	C_{card}≤10 pF (1 card)
t_{ODLY}	Output delay time	0	14	ns	C_L≤40 pF (1 card)
t_{ODLY}	Output Delay time during Identification Mode	0	50	ns	C_L≤40 pF (1 card)

(1) 0Hz means to stop the clock. The given minimum frequency range is for cases that requires the clock to be continued.

5.2 Bus Interface Timing (High-speed)



SYMBOL	PARAMETER	MIN	MAX	UNIT	
f_{PP}	Clock frequency data transfer	0	50	MHz	Ccard≤10 pF (1 card)
t_{WL}	Clock low time	7	-	ns	Ccard≤10 pF (1 card)
t_{WH}	Clock high time	7	-	ns	Ccard≤10 pF (1 card)
t_{TLH}	Clock rise time	-	3	ns	Ccard≤10 pF (1 card)
t_{THL}	Clock fall time	-	3	ns	Ccard≤10 pF (1 card)
t_{ISU}	Input setup time	6	-	ns	Ccard≤10 pF (1 card)
t_{IH}	Input hold time	2	-	ns	Ccard≤10 pF (1 card)
t_{ODLY}	Output delay time		14	ns	CL≤40 pF (1 card)
t_{OH}	Output hold time	2.5	50	ns	CL≤15 pF (1 card)
c_L	System capacitance of each line*		40	pF	CL≤15 pF (1 card)

*In order to satisfy optimal timing, host shall interface with only one card

6. SMART Information

6.1 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)

6.2 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

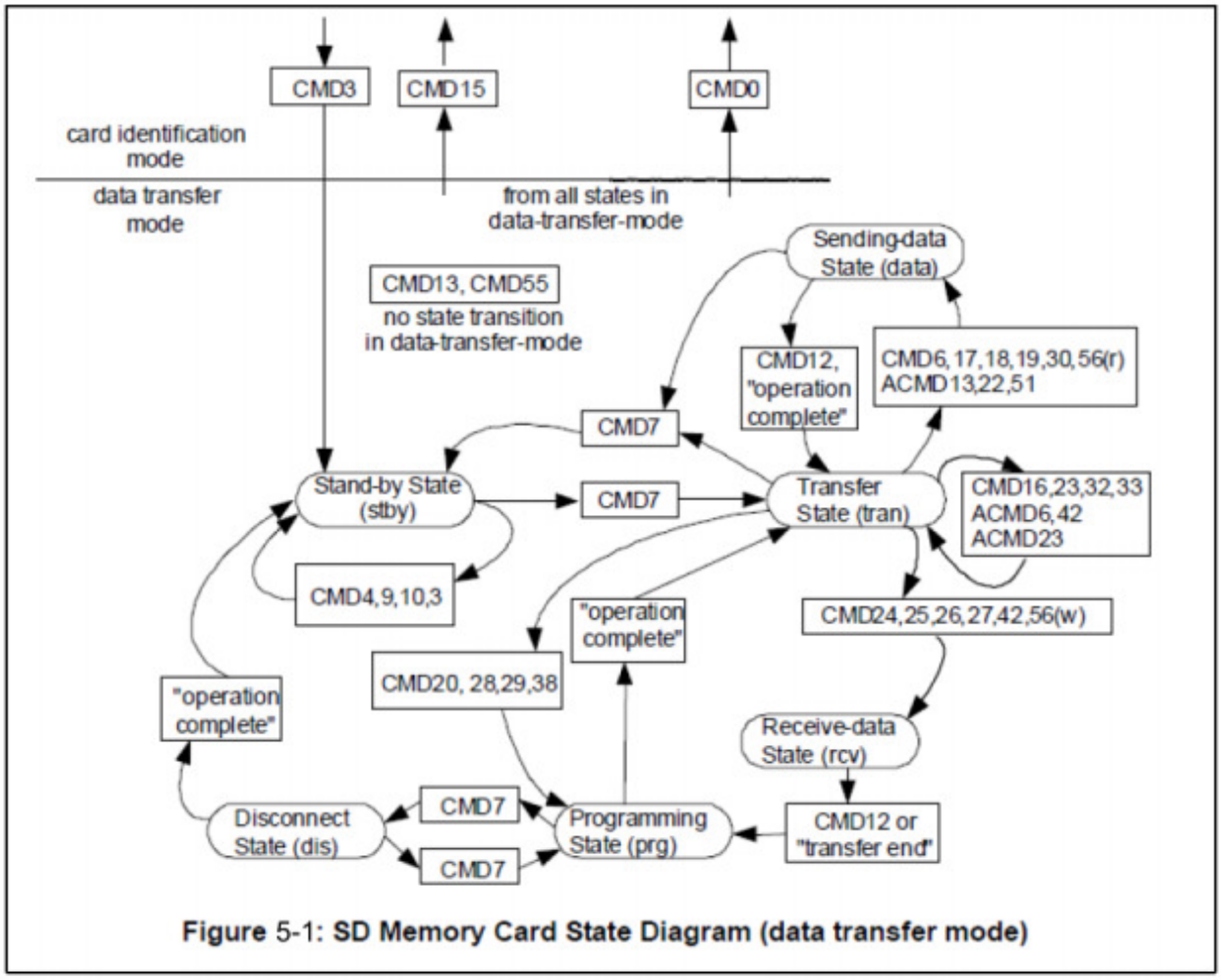
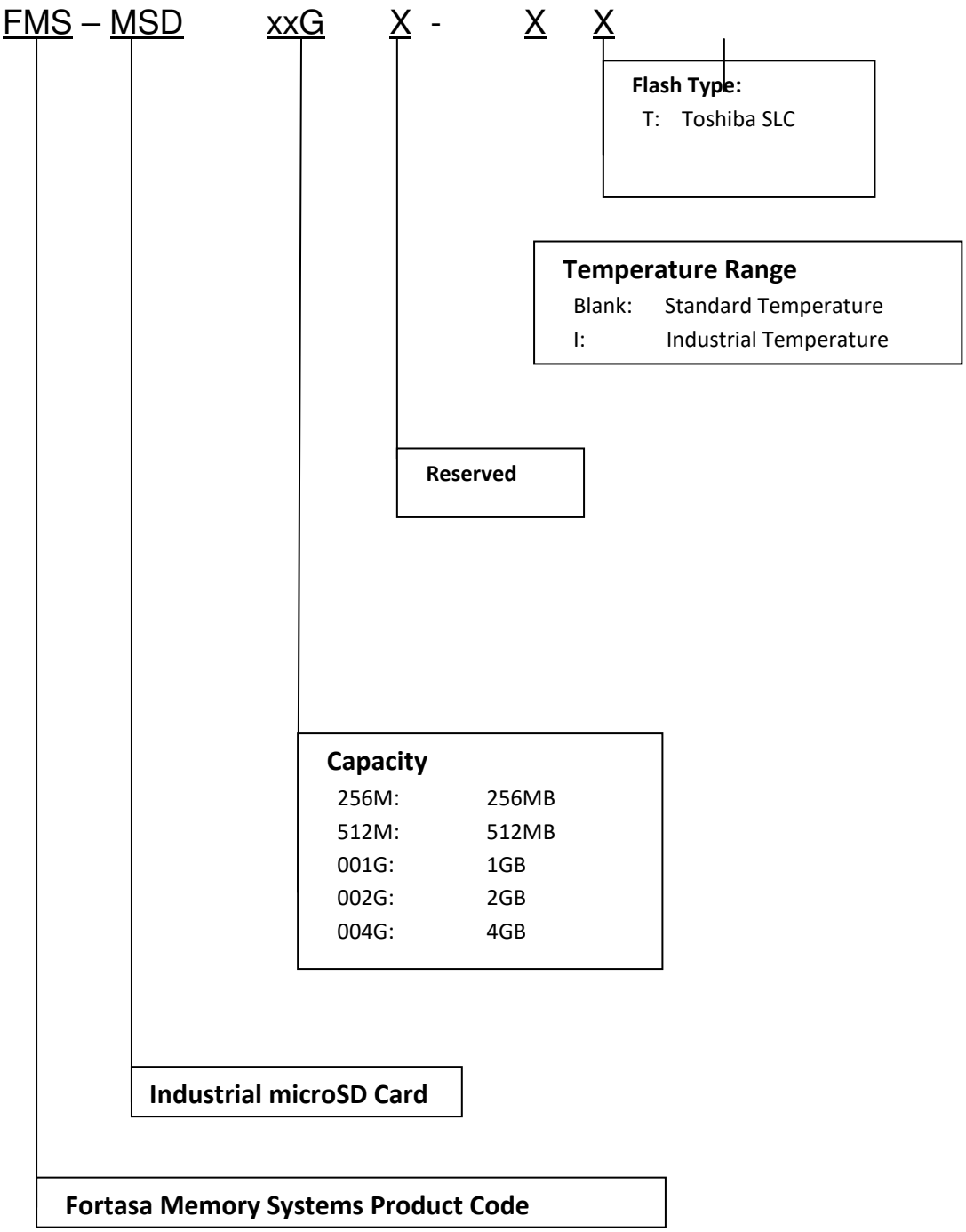


Figure 5-1: SD Memory Card State Diagram (data transfer mode)

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

7. Product Ordering Information

7.1 Product Code Designations



6.2 Valid Combinations

Capacity	Standard Temperature Model Numbers	Industrial Temperature Model Numbers
256MB	FMS-MSD256MA-T	FMS-MSD256MA-IT
512MB	FMS-MSD512MA-T	FMS-MSD512MA-IT
1GB	FMS-MSD001GA-T	FMS-MSD001GA-IT
2GB	FMS-MSD002GA-T	FMS-MSD002GA-IT
4GB	FMS-MSD004GA-T	FMS-MSD004GA-IT

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

8. Revision History

Revision	Date	Description	Comments
1.0	12/30/2015	Initial Release	
1.1	8/15/2017	Added 4GB Capacity	