i400 microSDXC Card

MTSD064AMC8MS-1WT, MTSD128ANC8MS-1WT, MTSD256ANC8MS-1WT, MTSD512ANC8MS-1WT, MTSD1T0ANC8MS-1WT, MTSD1T5ANC8MS-1WT

Features

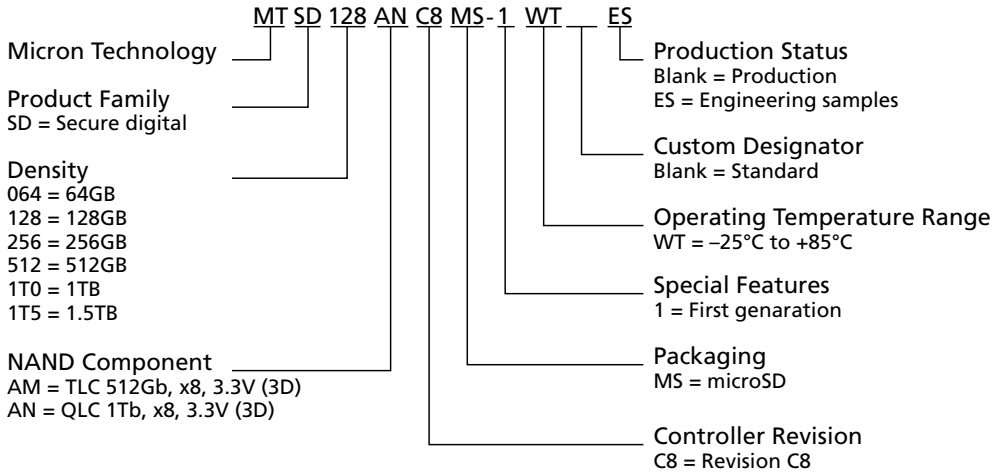
- Micron® 176-layer 3D NAND Flash
- Form factor: 8-pad microSD memory card (11mm × 15mm)
- Density[1]: 64GB to 1.5TB
- SD Physical Layer Specification version 6.10 compliant[2]
  - microSD Card Specification version 4.20[3]
  - SD memory card file system specification
  - Password protection of cards
  - Supports secure digital interface (SD) and serial peripheral interface (SPI)
- Mean time to failure (MTTF): 2 million hours
- Endurance: Total bytes written (TBW)
  - 64GB: up to 140TB
  - 128GB: up to 175TB
  - 256GB: up to 300TB
  - 512GB: up to 600TB
  - 1TB: up to 1200TB
  - 1.5TB: up to 1800TB
- Surveillance recording capability
  - 24/7 recording for 5 years
- Health monitoring: Available[4]
- Performance
  - Refer to Performance and Capacity (page 9) for read and write speed
- Bus speed mode (theoretical transfer rate @x4 bits)
  - Default: 3.3V signaling up to 12.5 MB/s @25 MHz
  - High-speed: 3.3V signaling up to 25 MB/s @50 MHz
  - SDR12: UHS-I 1.8V signaling up to 12.5 MB/s @25 MHz
  - SDR25: UHS-I 1.8V signaling up to 25 MB/s @50 MHz
  - SDR50: UHS-I 1.8V signaling up to 50 MB/s @100 MHz
  - SDR104: UHS-I 1.8V signaling up to 104 MB/s @208 MHz
  - DDR50: UHS-I 1.8V signaling up to 50 MB/s @50 MHz (sampled on both clock edges)
- 1.8V low voltage signaling (LVS) interface support[5]
  - LV50: LV cards supporting UHS50
  - LV104: LV cards supporting UHS104
- Integrated power-on reset, oscillator, voltage regulation, and voltage detection circuits
- Built-in features for defect and error management
  - LDPC error correction code implemented
  - Global wear leveling
  - Bad block management
  - Refresh mechanism for UECC prevention
  - Sudden power-off (SPO) protection
- Operating voltage: 2.7–3.6V
- Temperature
  - Operating: –25°C to +85°C
  - Storage: –40°C to +85°C
- Standards compliance
  - RoHS
  - FCC
  - CE
  - BSMI
  - KC RRA
  - W.E.E.E.
  - VCCI
  - IC
- Halogen-free

Notes: 1. Actual usable capacity may vary. 1GB = 1 billion bytes. 1TB = 1 trillion bytes.
2. SD Specifications, Part 1, Physical Layer Specification, version 6.10.
3. SD Specifications, Part 1, microSD Card Specification, version 4.20.
4. Contact Micron factory for details.
5. SD Specifications, Part 1, Low Voltage Interface Addendum, version 1.00.

Part Number Ordering Information

Micron microSD memory cards are available in different configurations and densities. Verify valid part numbers by using Micron's part catalog search at www.micron.com. To compare features and specifications by device type, visit www.micron.com/products. Contact the factory for cards not found.

Figure 1: Marketing Part Number Chart



Note: 1. Not all combinations are necessarily available. For a list of available devices or for further information on any aspect of these products, please contact your nearest Micron sales office.

Table 1: Ordering Information

Part Number	Capacity
MTSD064AMC8MS-1WT	64GB
MTSD128ANC8MS-1WT	128GB
MTSD256ANC8MS-1WT	256GB
MTSD512ANC8MS-1WT	512GB
MTSD1T0ANC8MS-1WT	1TB
MTSD1T5ANC8MS-1WT	1.5TB

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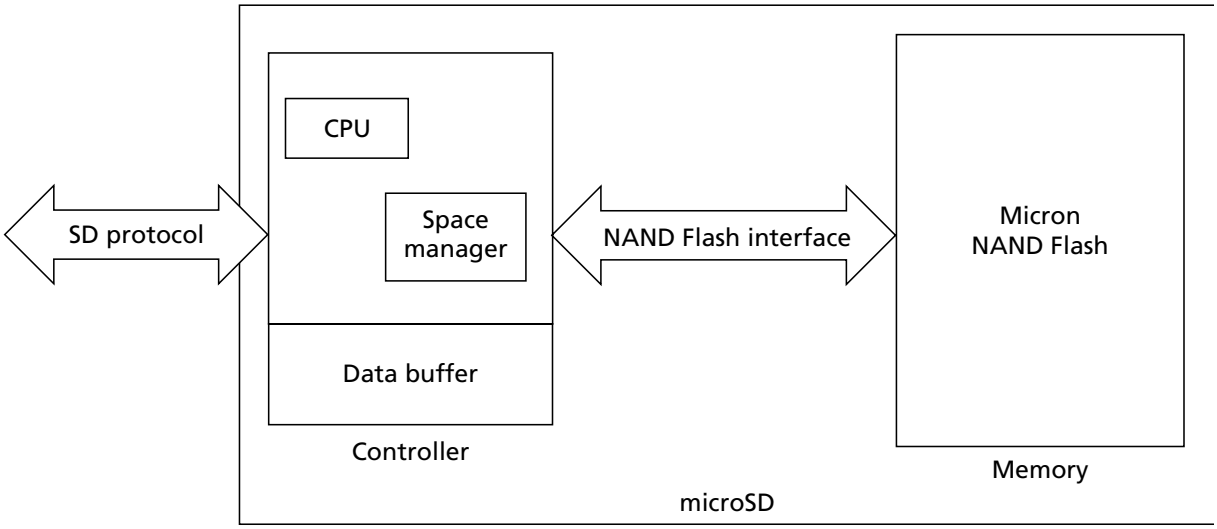
General Description

The microSD card is an advanced Micron® 3D NAND Flash memory technology based removable storage device specifically designed to meet the performance, capacity, and quality required for industrial devices or systems. In addition to mass storage-specific Flash memory, the microSD card includes an on-board intelligent controller which manages interface protocols, security algorithms for content protection, data storage and retrieval, as well as error correction code (ECC) algorithms, defect handling, sudden power-off safeguard and wear leveling.

The microSD card includes one or more NAND Flash memory components and a microSD card controller. The density of a card depends on the number of die within the package and the density of each die.

Figure 2: Functional Block Diagram



Note: 1. Not drawn to scale.

Pad Assignment and Descriptions

Figure 3: microSD Card Pad Assignment (Bottom View)

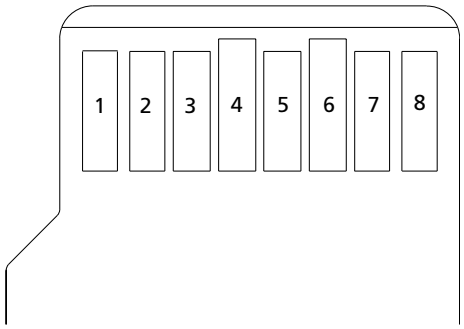


Table 2: MicroSD Contact Pad Description

Pad Number	SD Mode			SPI Mode		
	Symbol	Type[1]	Description	Symbol	Type[1]	Description
1	DAT2[2]	I/O/PP	Data line [Bit 2]	RSV	–	Reserved
2	CD/DAT3[2]	I/O/PP[3]	Card detect/data line [Bit 3]	CS	I[3]	Chip select (active low)
3	CMD	PP	Command/response	DI	I	Data in
4	V_{DD}	S	Supply voltage	V_{DD}	S	Supply voltage
5	CLK	I	Clock	SCLK	I	Clock
6	V_{SS}	S	Supply voltage ground	V_{SS}	S	Supply voltage ground
7	DAT0	I/O/PP	Data line [Bit 0]	DO	O/PP	Data out
8	DAT1[2]	I/O/PP	Data line [Bit 1]	RSV	–	Reserved

Notes: 1. S: Power supply; I: Input; O: Output using push-pull drivers; PP: I/O using push-pull drivers.
2. The extended DAT lines (DAT1-DAT3) are input on power-up. They start to operate as DAT lines after SET_BUS_WIDTH (ACMD6) command. The host should keep its own DAT1-DAT3 lines in input mode, as well, while they are not used.
3. After power-up, pad 2 is configured as an input with an internal 50kΩ pull-up (for card detection and SPI mode selection). The pull-up should be disconnected prior to regular data transfer by issuing the SET_CLR_CARD_DETECT (ACMD42) command.

Performance and Capacity

Performance

Using a striping method across multiple NAND Flash devices the card read and write performance is optimized.

The Industrial microSD cards also use performance features of the underlying NAND Flash to increase speed in streaming applications. By sending larger packets of sequential data, the Industrial microSD card can better utilize NAND Flash features to enhance performance.

Table 3: Measured Performance (25°C, V_{DD} = 3.3V)

Density[1]	Sequential Read[2]	Sequential Write[2]
64GB	100 MB/s	45 MB/s
128GB	100 MB/s	25 MB/s
256GB	100 MB/s	37 MB/s
512GB	100 MB/s	52 MB/s
1TB	100 MB/s	45 MB/s
1.5TB	100 MB/s	35 MB/s

Notes: 1. 1GB = 1 billion bytes. 1TB = 1 trillion bytes.
2. Measurements are based on a 100MB file size in UHS-I mode and depend on the host configuration used to run the test.

Capacity

When quoting device capacity, Micron uses the formatted capacity, not the raw number of bytes available.

Table 4: Bytes Available After Factory Formatting (exFAT for SDXC Card)

Density	Usable Bytes	Speed Class	Application Performance Class[4]
64GB	64,055,410,688	Class10, U3	A2
128GB	124,980,822,016	Class10, U1	A2
256GB	249,961,644,032	Class10, U3	A2
512GB	503,010,295,808	Class10, U3	A2
1TB	1,000,018,542,592	Class10, U3	A2
1.5TB	1,503,209,193,472	Class10, U3	A2

Notes: 1. 1GB = 1 billion bytes. 1TB = 1 trillion bytes.
2. Actual user usable capacity. When cloning disk partitions, the master disk should always be formatted to no more than the minimum guaranteed usable bytes available for that card capacity.
3. Class is determined by Testmetrix VTE4100 Compliance Test.
4. Enable users to run their smartphone apps from the installed memory card.

OCR Register

The 32-bit operation conditions register defines the supported operating voltage ranges for the power supply and supported access modes of the microSD card. Additionally, this register includes status information bits.

Table 5: OCR Field Parameters

OCR-Slice	OCR Value	Description
[31]	1b (ready)/0b (busy)	Card power-up status bit (busy)
[30]	1b	Card Capacity Status (CCS)
[29]	0b	Card doesn't support UHS-II interface
[28:25]	0000b	Reserved
[24]	1b (switching)/0b (maintained)	Switching to 1.8V Accepted (S18A)
[23:15]	1 1111 1111b	V_{DD}: 2.7–3.6V range
[14:0]	000 0000 0000 0000b	Reserved

Notes: 1. This bit is set to LOW if the card has not finished the power-up routine.
2. This bit is valid only when the card power-up status bit is set.

CID Register

The card identification (CID) register is 128 bits wide. It contains the device identification information used during the card identification phase as required by SD protocol. Each card is created with a unique identification number.

Table 6: CID Register Field Parameters

Name	Field	Width	CID-Slice	CID Value
Manufacturer ID	MID	8	[127:120]	09h
OEM/Application ID	OID	16	[119:104]	41 50h
Product name	PNM	40	[103:64]	64GB: MB4AC 128GB: MB5BC 256GB: MB6BC 512GB: MB7BC 1TB: MB9BC 1.5TB: MBABC
Product revision	PRV	8	[63:56]	16h
Product serial number	PSN	32	[55:24]	–
Reserved	–	4	[23:20]	–
Manufacturing date	MDT	12	[19:8]	–
CRC7 checksum	CRC	7	[7:1]	–
Not used, always 1	–	1	[0]	1

CSD Register

The card-specific data (CSD) register provides information about accessing the card contents. The CSD register defines the data format, error correction type, maximum data access time, as well as whether the DSR register can be used, and so forth. The programmable part of the register (entries marked with W in the following table) can be changed by the PROGRAM_CSD (CMD27) command. The types of the entries in the table below are coded as follows: R = readable, W(1) = writable once, W = multiple writable.

Table 7: CSD Register Field Parameters

Name	Field	Width	Cell Type	CSD-Slice	CSD Value
CSD structure	CSD_STRUCTURE	2	R	[127:126]	01b
Reserved	–	6	R	[125:120]	00 0000b
Data read access time	TAAC	8	R	[119:112]	0Eh
Data read access time in CLK cycles (NSAC × 100)	NSAC	8	R	[111:104]	00h
Maximum data transfer rate	TRAN_SPEED	8	R	[103:96]	-
Card command classes	CCC	12	R	[95:84]	010110110101b
Maximum read data block length	READ_BL_LEN	4	R	[83:80]	9
Partial blocks for read allowed	READ_BL_PARTIAL	1	R	[79:79]	0
Write block misalignment	WRITE_BLK_MISALIGN	1	R	[78:78]	0
Read block misalignment	READ_BLK_MISALIGN	1	R	[77:77]	0
DSR implemented	DSR_IMP	1	R	[76:76]	0
Reserved	–	6	R	[75:70]	00 0000b
Device size	C_SIZE	22	R	[69:48]	64GB: 01DD7Fh 128GB: 03A36D 256GB: 0746DB 512GB: 0EA437 1TB: 1D1BB7 1.5TB: 2BC0C7
Reserved	–	1	R	[47:47]	0
Erase single block enable	ERASE_BLK_EN	1	R	[46:46]	1
Erase sector size	SECTOR_SIZE	7	R	[45:39]	7Fh
Write protect group size	WP_GRP_SIZE	7	R	[38:32]	000 0000b
Write protect group enable	WP_GRP_ENABLE	1	R	[31:31]	0
Reserved	–	2	R	[30:29]	00b
Write speed factor	R2W_FACTOR	3	R	[28:26]	010b
Maximum write data block length	WRITE_BL_LEN	4	R	[25:22]	9
Partial blocks for write allowed	WRITE_BL_PARTIAL	1	R	[21:21]	0
Reserved	–	5	R	[20:16]	0 0000b
File format group	FILE_FORMAT_GRP	1	R	[15:15]	0
Copy flag	COPY	1	R/W(1)	[14:14]	0

Table 7: CSD Register Field Parameters (Continued)

Name	Field	Width	Cell Type	CSD-Slice	CSD Value
Permanent write protection	PERM_WRITE_PROTECT	1	R/W(1)	[13:13]	0
Temporary write protection	TMP_WRITE_PROTECT	1	R/W	[12:12]	0
File format	FILE_FORMAT	2	R	[11:10]	0
Reserved	–	2	R	[9:8]	00b
CRC	CRC	7	R/W	[7:1]	xxxxxxxb
Not used, always 1	–	1	–	[0:0]	1

Notes: 1. All register table values reflect their expected state after card initialization and prior to host issuing CMD6.

SCR Register

In addition to the CSD register, there is another configuration register named SD card configuration register (SCR). SCR provides information on the SD Memory Card's special features that were configured into the given card. The size of SCR register is 64 bits. The types of all bits of SCR are R = readable.

Table 8: CSD Register Field Parameters

Description	Field	Width	Cell Type	CSD-Slice	CSD Value
SCR structure	SCR_STRUCTURE	4	R	[63:60]	0000b
SD memory card – Specification version	SD_SPEC	4	R	[59:56]	0010b
Data status after erases	DATA_STAT_AFTER_ERASE	1	R	[55:55]	0
CPRM security support	SD_SECURITY	3	R	[54:52]	000b
DAT bus widths supported	SD_BUS_WIDTHS	4	R	[51:48]	0101b
Specification version 3.00 or later	SD_SPEC3	1	R	[47:47]	1b
Extended security support	EX_SECURITY	4	R	[46:43]	0000b
Specification version 4.00 or later	SD_SPEC4	1	R	[42:42]	1b
Specification version 5.00 or later	SD_SPECX	4	R	[41:38]	0010b
Reserved	–	2	R	[37:36]	00b
Command support bits	CMD_SUPPORT	4	R	[35:32]	0111b
Reserved for manufacturer usage	–	32	R	[31:0]	01 00 00 00h

Command Set

The SD specification categorizes commands into classes. shows commands supported by the microSD card.

Table 9: Supported Commands

Command Type	Card Command Class (CCC)	Supported Commands
Basic commands	Class 0	CMD0, CMD2, CMD3, CMD7, CMD8, CMD9, CMD10, CMD11, CMD12, CMD13, CMD15
Command Queue function commands	Class 1	CMD43, CMD44, CMD45, CMD46, CMD47
Block-oriented READ commands	Class 2	CMD16, CMD17, CMD18, CMD19, CMD20, CMD23
Block-oriented WRITE commands	Class 4	CMD16, CMD20, CMD23, CMD24, CMD25, CMD27
ERASE commands	Class 5	CMD32, CMD33, CMD38
Lock card	Class 7	CMD16, CMD42
Application-specific commands	Class 8	CMD55, CMD56, ACMD6, ACMD13, ACMD22, ACMD23, ACMD41, ACMD42, ACMD51
SWITCH commands	Class 10	CMD6
Function extension commands	Class 11	CMD48, CMD49

Notes: 1. Each application-specific (ACMD) command is a 2-sequence command. First, a CMD55 is sent, followed by a CMDx, where x is the ACMDx value.

Electrical Specifications

Absolute Ratings and Operating Conditions

Stresses greater than those listed in may cause permanent damage to the device. This is a stress rating only, and functional operation of the device at these or any other conditions outside those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may adversely affect reliability.

Table 10: Absolute Maximum Ratings

Parameter/Condition	Min	Max	Unit
V_{DD} supply voltage	2.7	3.6	V
Storage temperature	–40	+85	°C

Table 11: Recommended Operating Conditions

Parameter/Condition	Symbol	Min	Typ	Max	Unit
Operating temperature	T_A	–25	–	+85	°C
Supply voltage	V_{DD}	2.7	3.3	3.6	V
Regulator supply voltage for 1.8V signaling	V_{DDIO}	1.7	1.8	1.95	V
Ground supply voltage	V_{SS}	0	0	0	V

DC Characteristics

Table 12: DC Voltage Characteristics for 3.3V Signalling

Parameter	Symbol	Min	Max	Unit	Comments
Input low voltage	V_{IL}	V_{SS} - 0.30	0.25 × V_{DD}	V	
Input high voltage	V_{IH}	0.625 × V_{DD}	V_{DD} + 0.30	V	
Output low voltage	V_{OL}	–	0.125 × V_{DD}	V	I_{OL} = 2mA @ V_{DD} (MIN)
Output high voltage	V_{OH}	0.75 × V_{DD}	–	V	I_{OH} = –2mA @ V_{DD} (MIN)

Table 13: DC Voltage Characteristics for 1.8V Signalling

Parameter	Symbol	Min	Max	Unit	Comments
Input low voltage	V_{IL}	V_{SS} - 0.30	0.58	V	
Input high voltage	V_{IH}	1.27	2.00	V	
Output low voltage	V_{OL}	–	0.45	V	I_{OL} = 2mA
Output high voltage	V_{OH}	1.40	–	V	I_{OH} = –2mA

Notes: 1. As signaling level is generated by regulator in host and card, some of the values are defined by fixed value rather than based on V_{DD}.

Table 14: DC Current Characteristics

Parameter	Density	Symbol	Min	Max	Unit
Operating current (read)	64GB	I_{CC1}	–	315	mA
	128GB		–	339	
	256GB		–	340	
	512GB		–	345	
	1TB		–	345	
	1.5TB		–	345	
Operating current (write)	64GB	I_{CC2}	–	315	mA
	128GB		–	328	
	256GB		–	411	
	512GB		–	522	
	1TB		–	540	
	1.5TB		–	540	

Notes: 1. Peak current: SDR104 mode with Testmetrix VTE4100 at 25C.

AC Characteristics

Timing specifications including clock timing, input and output timings for all bus modes are defined in SD Specifications. Refer to Section 6.6 and 6.7 of Part 1, Physical Layer Specification, version 5.10 for detail information.

Electrostatic Discharge (ESD)

Contacts pads:

- Human body model of ±4kV according to IEC61000-4-2.

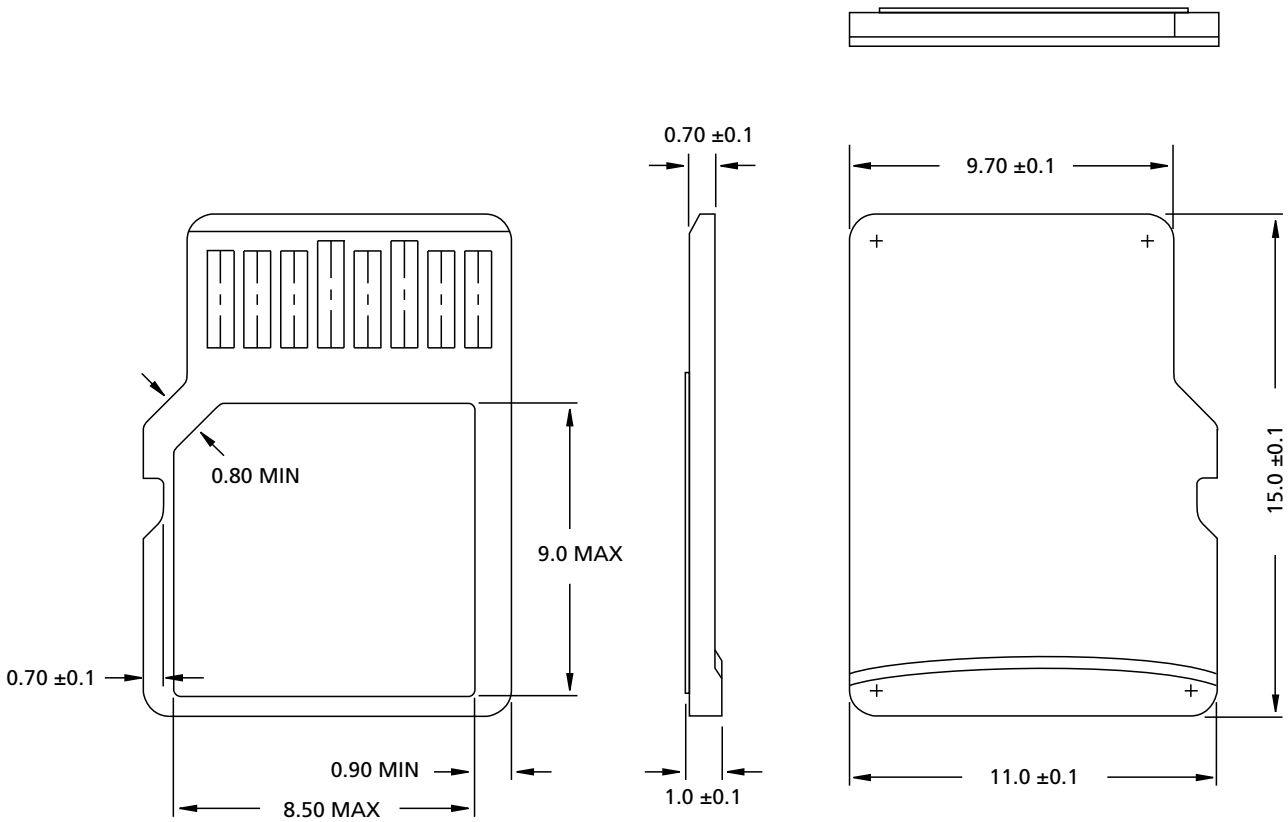
Non contacts pad area:

- Coupling plane discharge of ±8kV.
- Air discharge of ±15kV.
- Human body model according to IEC61000-4-2.

Package Dimensions

microSD Card – 11mm × 15mm provides the physical dimensions of Micron microSD card. For detail dimensions and tolerances, refer to SDA microSD Card Addendum, Section 3.0 Mechanical Specification for microSD Memory Card.

Figure 4: microSD Card – 11mm × 15mm



Note: 1. Dimensions are in millimeters.

Table 15: Package Specifications

Parameter	Descriptions
Surface	Plain (except contact area)
Edges	Smooth edges
Weight	0.25gm

Compliance

Micron microSD card comply with the following:

- Micron Green Standard
- CE (Europe): EN 55032 Class B, RoHS
- UKCA (UK): SI 2016/1091 Class B and SI 2012/3032 RoHS
- FCC: CFR Title 47, Part 15 Class B
- BSMI (Taiwan): approval to CNS 13438 Class B and CNS 15663

- KC RRA (Korea): approval to KN32 Class B, KN 35 Class B

B 급 기기	이 기기는 가정용으로 전자파적합등록을한 기기로서 주거
(가정용 정보통신기기)	지역에서는 물론 모든지역에서 사용할 수 있습니다.

R-R-MU2-MTSDXXXAMC8MS, R-R-MU2-MTSDXXXANC8MS

- W.E.E.E.: compliance with EU WEEE directive 2012/19/EC. Additional obligations may apply to customers who place these products in the markets where WEEE is enforced.
- VCCI (Japan): 2015-04 Class B

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VCCIーB

- IC (Canada): ICES-003 Class B
  - This Class B digital apparatus complies with Canadian ICES-003.
  - Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada.
  - CAN ICES-3 (B)/NMB-3(B).

FCC Rules

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Revision History

Rev. B – 4/22

- Updated part numbers

Rev. A – 12/21

- initial release

8000 S. Federal Way, P.O. Box 6, Boise, ID 83707-0006
208-368-4000, micron.com/support

This data sheet contains minimum and maximum limits specified over the power supply and temperature range set forth herein.
Although considered final, these specifications are subject to change, as further product development and data characterization sometimes occur.