Industrial microSD/SDHC Memory Card

Product Specification

Version 1.2

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Document Version

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1.0	New Issue	13, Sep., 2010	Amos Chung	Kent Liu
1.1	Modify	30, Dec., 2010	Amos Chung	Kent Liu
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Contents

1. Introduction

1.1 General Description

Pretec Wide Temperature Industrial Grade microSD (Secure Digital) Memory Cards are specifically designed, and manufactured to perform consistently under extreme environmental conditions, such as wide temperature, shock, vibration, and humidity. The manufacturing process encapsulates all exposed components to ensure the products are fully waterproof, shockproof, ESD proof and withstand an operating temperature range from -40 to +85°C.

Industrial microSD/SDHC Memory Cards are consist of SLC (Single Level Cell) Flash IC with enhanced 12 bit ECC (Error Correction Code) function and wear-leveling algorithm. This results in MTBF ratings over 2 million hours and the highest write cycle lifetimes. The sequential performance can reach up to 19MB/sec read and 17MB/sec write speed. Each card is extensively tested at Pretec manufacturing facility to guarantee perfect functionality in extreme industrial conditions, such as automotive, medical, enterprise, and military application. Pretec provides rigorous bill of material control as an additional guarantee for customers, ensuring long term product stability and support.

1.2 Features

- Fully compliant with SD 1.1/2.0 standard. (only 4GB and above support SDHC standard)
- Built in 12 bit BCH ECC function and wear-leveling algorithm
- Voltage range: 2.7V ~ 3.6V
- Qualified temperature range: -40ºC to +85ºC
- CE and FCC certificates

1.3 Ordering Information

Part Number	Capacity	Description
UDI001GMAHP	1GB	Industrial microSD 1GB Wild Temp. series
UDI002GMAHP	2GB	Industrial microSD 2GB Wide Temp. series
UHI004GMAHP	4GB	Industrial microSDHC 4GB Wide Temp. series

2. Product Specification

2.1 Reliability and Durability Specifications

Temperature	Operating: -40°C to +85°C Storage: -50°C to +90°C
moisture and corrosion	Operating: 25°C / 95% rel. humidity Non-Operating: 40°C / 93% rel. hum./500h salt water spray: 3% NaCl/35C; 24h acc. MIL STD Method 1009
Durability	Waterproof; Dirt Proof; ESD Proof
Bending	10N
Torque	0.10N*m. ±2.5° max
Drop Test	1.5m free fall
Visual Inspection/Shape and Form	No warp age; no mold slim; complete form; no cavities; surfacesmoothness≦-0.1mm/ cm2 within contour; no cracks; no pollution (oil, dust, etc.)

2.2 System Reliability and Maintenance

MTBF	Over 2,000,000 hours
Data Reliability	10 years
Endurance	100,000 read/write/erase cycles

2.3 Electrical Static Discharge (ESD) requirement

ESD Protection	Contact Discharge	±4KV, Human body model according to IEC61000-4-2.EN55024
	Air Discharge	±8KV, Human body model according to IEC61000-4-2.EN55024

2.4 Performance

Capacity	Benchmark	Read	Write
1GB	ATTO BENCH	19 MB/s	17 MB/s
2GB		19 MB/s	17 MB/s
4GB		19 MB/s	17 MB/s

Note:

1. Speed performance may vary depending on different testing environment.

3. Interface Description

3.1 General Description of Pins and Registers

The host is connected to the microSD/SDHC Memory Card using an eight pin connector.

Table 1: Pin Assignment in SD Bus Mode Pad Definition

Pin #	Name	Type*1	microSD/SDHC Description
1	DAT*2	I/O	Card Detect/ Data Lin [Bit 3]
2	CD/DAT*3	I/O	Card Detect / Data Line
3	CMD	PP	Command / Response
4	VDD	S	Supply voltage
5	CLK	I	Clock
6	Vss	S	Supply voltage ground
7	DAT0	I/O	Data Line [Bit 0]
8	DAT1	I/O	Data Line [Bit 1]

Note:

*1 S=power supply; I=input; O=output using push-pull drivers.

*2 The extended DAT lines (DAT1-DAT3) are input on power up; they start to operate as DAT lines after the SET_BUS_WIDTH command.

*3 After power up, this line is input with 50Kohm pull-up (can be used for card detection or SPI mode selection). The pull-up should be disconnected by the user, during regular data transfer, with SET_CLR_CARD_DETECT (ACMD42) command.

Table 2: Pin Assignment in SPI Bus Mode Pad Definition

Pin #	Name	Type	microSD/SDHC Description
1	RSV	-	Reserved
2	CS	I	Chip Select
3	DI	S	Data In
4	VDD	S	Supply Voltage
5	SCLK	I	Clock
6	VSS	S	Supply Voltage Ground
7	DO	O	Data Out
8	RSV	I	Reserved

Each card has a set of information registers

Table 3: microSD/SDHC Memory Card Registers

Name	Width	Description
CID	128	Card identification number: individual card number for identification
RCA	16	Relative card address: local system address of a card dynamically suggested by the card and approved by the host during initialization
CSD	128	Card specific data: information about the card operation conditions
SCR	64	SD Configuration Register: information about the microSD Card's special feature capabilities
OCR	32	Operation Condition Register

The host may reset the cards by switching the power supply off and on again. The card has its own power-on detection circuitry which puts the card into an idle state after the power-on. The card can also be reset by sending the GO_IDLE (CMD0) command.

3.2 microSD/SDHC Memory Card Pin Assignment

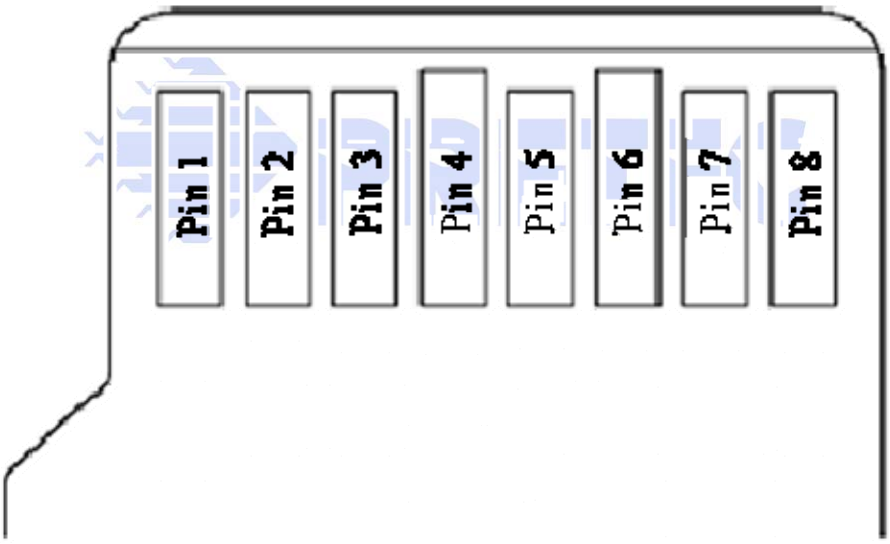

Figure 1: microSD/SDHC Memory Card Contact Area

3.3 SD Bus Topology

Name	Description
CMD	Command is bi-directional signal. (Host and card drivers are operating in push pull mode)
DAT0-3	Data lines are bi-directional signals. (Host and card drivers are operating in push pull mode)
CLK	Clock is a host to cards signal. (CLK operates in push pull mode)
VDD	VDD is the power supply line for all cards.
VSS1-2	VSS are two ground lines.

The following figure shows the bus topology of several cards with one host in SD Bus mode.

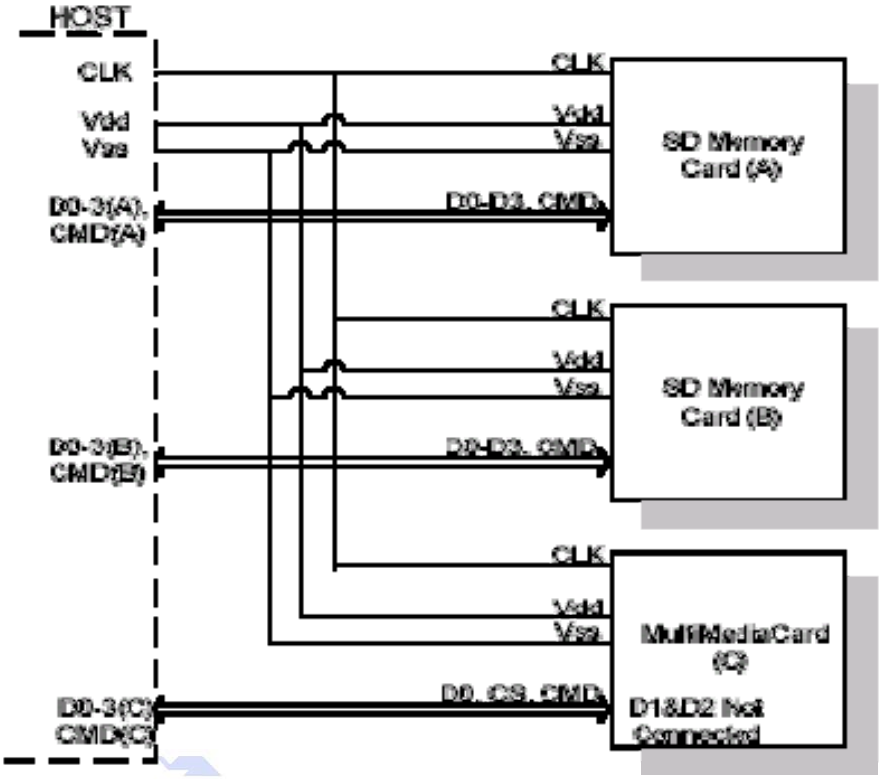

Figure 2: SD Memory Card System Bus Topology

During the initialization process, commands are sent to each card individually, allowing the application to detect the cards and assign logical addresses to the physical slots. Data is always sent to each card individually. However, to simplify the handling of the card stack, after initialization, all commands may be sent concurrently to all cards.
Addressing information is provided in the command packet.
The SD Bus allows dynamic configuration of the number of data lines. After power-up, by default, the SD Memory Card will use only DAT0 for data transfer. After initialization, the host can change the bus width (number of active data lines). This feature allows easy trade off between hardware cost and system performance.

3.3.1 Power Protection

The SD Memory Card can be inserted into or removed from the Bus without damage. If one of the supply pins (VDD or Vss) is not connected properly, then the current is drawn through a data line to supply the card.
Data transfer operations are protected by CRC codes; therefore, any bit changes induced by card insertion and removal can be detected by the SD Bus master. The inserted card must be properly reset also when CLK carries a clock frequency fpp.
If the hot insertion feature is implemented in the host, the host has to withstand a shortcut between VDD and Vss without damage.

3.4 SPI Bus Topology

The SD Memory Card SPI interface is compatible with SPI hosts available on the market. As any other SPI device the SD Memory Card SPI channel consists of the following 4 signals:

1. CS: Host to card Chip Select signal.
2. SCLK: Host to card clock signal.
3. Data In: Host to card data signal.
4. Data Out: Card to host data signal.

Another SPI common characteristic, which is implemented in the Memory Card as well, is byte transfers. All data tokens are multiples of 8 bit bytes and always byte aligned to the CS signal.

The SPI standard defines the physical link only and not the complete data transfer protocol. In SPI Bus mode, the SD Memory Card uses a subset of the SD Memory Card protocol and command set.
The SD Memory Card identification and addressing algorithms are replaced by a hardware Chip Select (CS) signal.
A card (slave) is selected, for every command, by asserting (active low) the CS signal.
The CS signal must be continuously active for the duration of the SPI transaction (command, response and data). The only exception is card programming time. At this time the host can de-assert the CS signal without affecting the programming process.

The bi-directional CMD and DAT lines are replaced by uni-directional data In and data Out signals. This eliminates the ability of executing commands while data is being read or written. An exception is the multi read/write operations. The Stop Transmission command can be sent during data read. In the multi block write operation a Stop Transmission token is sent as the first byte of the data block.

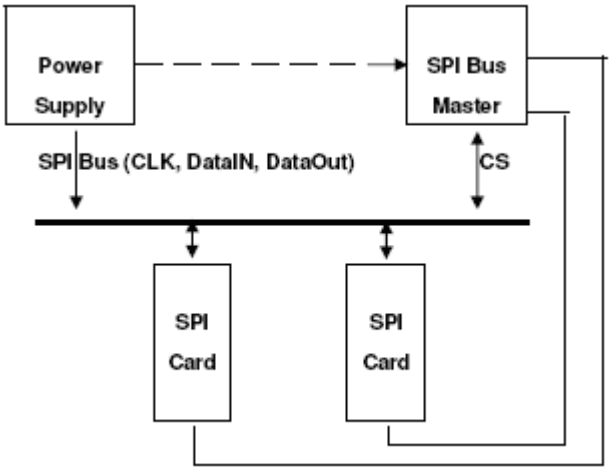

Figure 3: SD Memory Card Bus System

3.5 Electrical Interface

3.5.1 Absolute Maximum Ratings

Symbol	Parameter	Min.	Max.	Unit
VI	3.3V External Input Voltage	2.7	3.6	V
VI8	1.8V Supply Voltage	1.6	2	V

3.5.2 DC Characteristics

Symbol	Parameter	Min.	Max.	Unit
V_{IL}	Input LOW Voltage	-0.3	0.25*VI	V
V_{IH}	Input HIGH Voltage	0.625*VI	VI+0.3	V
V_{OL}	Output LOW Voltage	-	0.125*VI	V
V_{OH}	Output HIGH Voltage	0.75*VI	-	V
I_{OH}	Output High Current	-12	-	mA
I_{OL}	Output Low Current	-	12	mA
I_{STBY}	Standby Current	50	150	μA

Note:

1. Measurements are at recommended operating conditions unless otherwise specified.

3.5.3 AC Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit
Input Rising Delay	TP_{ILH}	0.61 (0.8pF)	0.72 (2.4pF)	0.92 (4.8pF)	ns
Input falling Delay	TP_{IHL}	0.88 (0.8pF)	1.03 (2.4pF)	1.24 (4.8pF)	ns
Output Rising Delay	TP_{OLH}	1.937 (10pF)	2.768 (30pF)	3.594 (50pF)	ns
Output falling Delay	TP_{OHL}	1.905 (10pF)	2.614 (30pF)	3.282 (50pF)	ns
Output Rising Time	TR	1.052 (10pF)	2.761 (30pF)	4.493 (50pF)	ns
Output falling Time	TF	0.932 (10pF)	2.133 (30pF)	3.372 (50pF)	ns

3.6 microSD/SDHC Memory Card Registers

There is a set of seven registers within the card interface. The OCR, CID, CSD and SCR registers carry the card configuration information. The RCA register holds the card relative communication address for the current session. The card status and SD status registers hold the communication protocol related status of the card.

3.6.1 Operating Conditions Register (OCR)

The 32-bit operation conditions register stores the VDD voltage profile of the card. The microSD/SDHC Memory Card is capable of executing the voltage recognition procedure (CMD1) with any standard microSD/SDHC Memory Card host using operating voltages form 2 to 3.6 Volts.

Accessing the data in the memory array, however, requires 2.7 to 3.6 Volts. The OCR shows the voltage range in which the card data can be accessed. The structure of the OCR register is described in under table.

Table 4: OCR Register Definition

OCR Bit	VDD Voltage Window
0-3	Reserved
4	Reserved
5	Reserved
6	Reserved
7	Reserved
8	Reserved
9	Reserved
10	Reserved
11	Reserved
12	Reserved
13	Reserved
14	Reserved
15	2.7-2.8
16	2.8-2.9
17	2.9-3.0
18	3.0-3.1
19	3.1-3.2
20	3.2-3.3
21	3.3-3.4
22	3.4-3.5
23	3.5-3.6
24-29	Reserved
30	Card Capacity Status (CCS)
31	Card power up status bit (busy)

3.6.2 Card Identification (CID) Register

The CID register is 16 bytes long and contains a unique card identification number as shown in the table below. It is programmed during card manufacturing and can not be changed by microSD/SDHC Memory Card hosts. Note that the CID register in the microSD/SDHC Memory Card has a different structure than the CID register in the Multimedia Card.

Table 5: CID Fields

Name	Type	Width	CID - Slice	Comments
Manufacturer ID(MID)	Binary	8	[127:120]	The manufacturer IDs are controlled and assigned by the SD Memory Card Association.
OEM/Application ID(OID)	ASC II	16	[119:104]	Identifies the card OEM and/or the card contents. The OID is assigned by the 3C.
Product Name(PNM)	ASC II	40	[103:64]	5ASC II characters long
Product Revision (PRV)	BCD	8	[63:56]	Two binary coded decimal digits
Serial Number (PSN)	Binary	32	[55:24]	32 Bits unsigned integer
Reserved		4	[23:20]	
Manufacturing Data Code(MDT)	BCD	12	[19:8]	Manufacturing date-yym(offset from 2000)
CRC7 checksum(CRC)	Binary	7	[7:1]	Calculated
Not used, always '1'		1	[0:0]	

4. Mechanical Form Factor

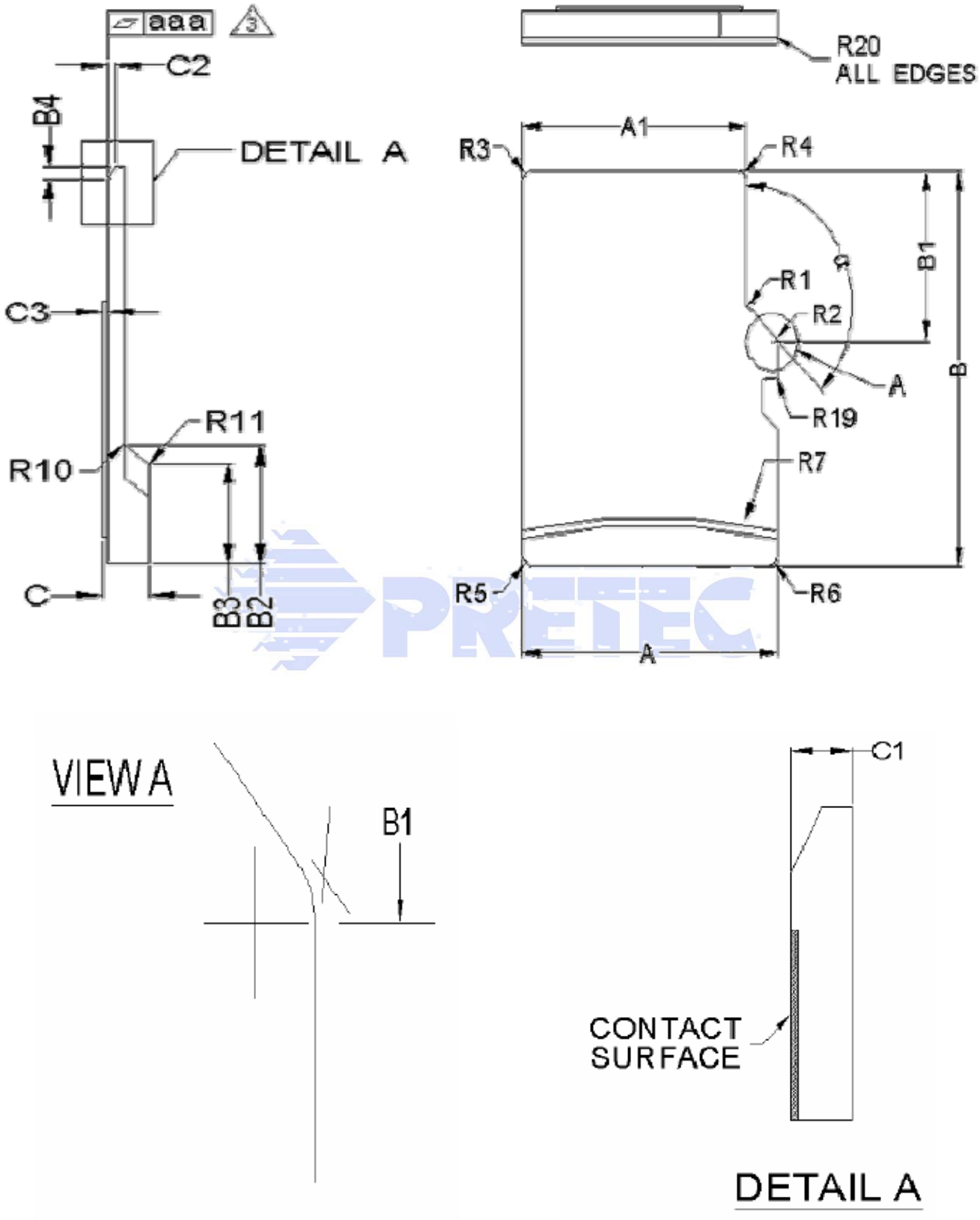

Figure 4: Mechanical Description: Top View

	COMMON DIMENSIONS			
SYMBOL	MIN	NOM	MAX	NOTE
A	10.90	11.00	11.10	
A1	9.60	9.70	9.80	
A2	-	3.85	-	BASIC
A3	7.60	7.70	7.80	
A4	-	1.10	-	BASIC
A5	0.75	0.80	0.85	
A6	-	-	8.50	
A7	0.90	-	-	
A8	0.60	0.70	0.80	
A9	0.80	-	-	
A10	1.35	1.40	1.45	
A11	6.50	6.60	6.70	
A12	0.50	0.55	0.60	
A13	0.40	0.45	0.50	
B	14.90	15.00	15.10	
B1	6.30	6.40	6.50	
B2	1.64	1.84	2.04	
B3	1.30	1.50	1.70	
B4	0.42	0.52	0.62	
B5	2.80	2.90	3.00	
B6	5.50	-	-	
B7	0.20	0.30	0.40	
B8	1.00	1.10	1.20	
B9	-	-	9.00	
B10	7.80	7.90	8.00	
B11	1.10	1.20	1.30	
B12	3.60	3.70	3.80	
B13	2.80	2.90	3.00	
B14	8.20	-	-	
B15	-	-	6.20	
C	0.90	1.00	1.10	
C1	0.60	0.70	0.80	
C2	0.20	0.30	0.40	
C3	0.00	-	0.15	
D1	1.00	-	-	
D2	1.00	-	-	
D3	1.00	-	-	
R1	0.20	0.40	0.60	
R2	0.20	0.40	0.60	
R3	0.70	0.80	0.90	
R4	0.70	0.80	0.90	
R5	0.60	0.80	0.90	
R6	0.60	0.80	0.90	
R7	29.50	30.00	30.50	
R10	-	0.20	-	
R11	-	0.20	-	
R17	0.10	0.20	0.30	
R18	0.20	0.40	0.60	
R19	0.05	-	0.20	
R20	4	-	0.15	
α	133°	135°	137°	
aaa			0.10	

Notes :

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M - 1994.
2. DIMENSIONS ARE IN MILLIMETERS.
3. COPLANARITY IS ADDITIVE TO C1 MAX THICKNESS.
4. ALL EDGES SHALL NOT BE SHARP AS TESTED PER UL1439 "Test for Sharpness of Edges on Equipment."
5. Refer to Appendix E about test method of warpage.

Figure 5: microSD/SDHC Memory Card Package: Dimensions