SDカード　512MB-2GB

(ET1268+KIOXIA[Toshiba] 24/32nm SLC)

データシート

株式会社アドテック

Revision History

Revision	Description	Date
V1.1	First released	August 2015
V1.2	Updated Humidity information	April 2017
V1.3	Added Product Feature information	July 2017
V1.4	Added 512MB Capacity	August 2017
V1.5	Added ESD ability and humidity information	November 2017
V1.6	Added water proof information	April 2018
V1.7	Added 1.2 Product Features, 1.3 TBW and 3.8 Dust proof	July 2020
V1.8	Added 4.3 Bus Timing (Append Default Speed Mode)	September 2021

1. Product Introduction

1.1. Overview

The Industrial SD Card is designed for demanding industrial applications especially for portable devices. The SD Card is compatible with SD 2.0 and provides excellent performance. The built-in auto ECC function can also detect and correct errors during data transfer. Moreover, Industrial SD Card provides high write/read speed and high IOPS, it was designed to meet the security, high performance, and environmental requirements.

1.2. Product Features

- Interface: 9 pins SD standard interface
- Compliant SD Card Specification 2.0
- Capacity: 512MB, 1GB, 2GB
- Variable Clock Rate
  - Default Mode: 0-25 MHz, up to 12.5MB/s Interface Speed
  - High-Speed Mode: 0-50 MHz, up to 25MB/s Interface Speed
- Operating at -40°C to 85°C
- Flash: SLC NAND Flash (512MB: TC58NVG2S0HTAI0 ,1GB/2GB: TC58NVG3S0FTAI0)
- Controller: ET1268
- Program/Erase Cycle: 60,000 Cycles
- Built-in ECC corrects up to 30 bits/1 KB
- Read disturbance management (Auto-Refresh)
- Adaptive wear leveling
- Management of sudden power-fails
- SMART Function support (Dedicated software support)
- Support CPRM (Content Protection for Recordable Media) of SD Card
- Support Water & Dust proof IEC 60529 IP58

1.3. TBW (Tera Bytes Written)

Capacity	512MB	1GB	2GB
SLC	25.2TB	50.4TB	98.2TB

*The endurance of disk could be varying based on user behavior, NAND endurance cycles, and write amplification factor. It is not guaranteed by flash vendor.
*Client workload by JESD-219A

2. SD Card Interface Description

2.1 SD Pin Assignment

Table 1: SD Bus Mode Pin Definition

Pin #	Name	Type	SD Description
1	CD/DAT3	I/O	Card Detect / Data Line[Bit3]
2	CMD	PP	Command / Response
3	VS	S	Supply Voltage Ground
4	VDD	S	Supply Voltage
5	CLK	I	Clock
6	VS	S	Supply Voltage Ground
7	DAT0	I/O	Data Line [Bit 0]
8	DAT1	I/O	Data Line [Bit 1]
9	DAT2	I/O	Data Line [Bit 2]

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 command. The Host shall keep its own DAT1-DAT3 lines in input mode, as well, while they are not used. It is defined so, in order to keep compatibility to Multi-media Cards.

3) After power up this line (Pin1) is input with 50Kohm pull-up (can be used for card detection or SPI mode selection). The pull-up should be disconnected by user, during regular data transfer, with SET_CLR_CARD_DETECT (ACMD42) command.

Table 2: SPI Bus Mode Pin Definition

Pin #	Name	Type	SD Description
1	CS	I	Chip Select (neg true)
2	DI	I	Data In
3	VSS	S	Supply Voltage Ground
4	VDD	S	Supply Voltage
5	SCLK	I	Clock
6	VSS	S	Supply Voltage Ground
7	DO	O	Data Out
8	RSV		Reserved
9	RSV		Reserved

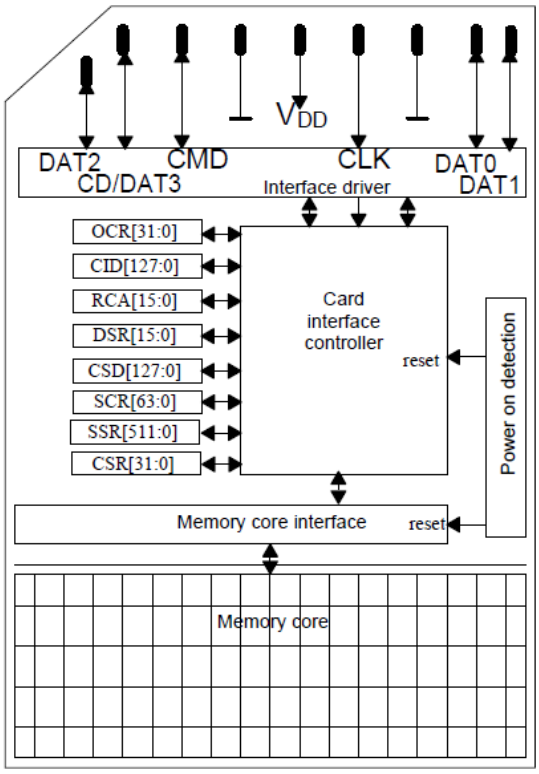

Figure 1: Functional Diagram

2.2 SD Bus Topology

The SD bus has six communication lines and three supply lines:

- 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.
- VSS: VSS is the power ground line.

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

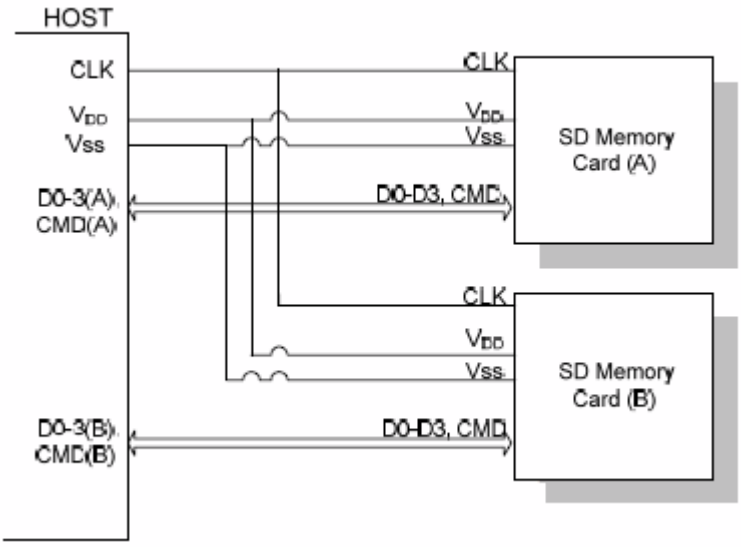

Figure 2: Memory Card System Bus Topology

2.3 SPI Bus Topology

The 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:

- CS: Host to card Chip Select signal.
- CLK: Host to card clock signal.
- Data In: Host to card data signal.
- 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 card identification and addressing methods are replaced by a hardware Chip Select (CS) signal. There are no broadcast commands, a card (slave) is selected by asserting (active low) the CS signal. The CS signal shall be continuously active for the duration of the SPI transaction (command, response and data). The only exception occurs during card programming, when the host can de-assert the CS signal without affecting the programming process.
The SPI interface uses the 7 out of the SD 9 signals (DAT1 and DAT2 are not used, DAT3 is the CS signal) of the SD bus.

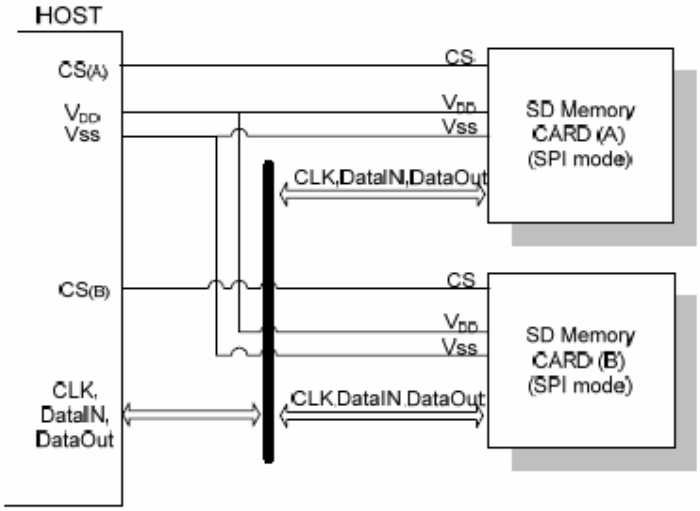

Figure 3: SPI mode SD Memory Card Bus System

3. Specifications

3.1. Performance

Max. Data Transfer Rate

- Read: 23MB/s; Write: 16MB/s

3.2. NAND Flash Memory

Industrial SD Card uses Single Level Cell (SLC) NAND Flash memory, which is non-volatility, high reliability, and high-speed memory storage. There are only two statuses 0 or 1 of one cell.

3.3. Power Requirement

3.3.1. DC Input Voltage

- 2.7V to 3.6V

3.4. Temperature Range

- -40°C to +85°C

3.5. Humidity

Relative Humidity: 5-95%, non-condensing

3.6. Water proof

Water proof level: IEC 60529 IPX8.

Test Condition	Referred standard
Depth of water 1.5m for 30 mins.	IEC 60529 IPX8

3.7. ESD Ability

Test Condition	Referred standard
● Contact discharge: ± 2KV, ± 4KV	SD Spec. Appendix D.1
● Air discharge: ± 4KV, ± 8KV, ± 15KV	SD Spec. Appendix D.2

3.8. Dust proof

Dust proof level: IEC 60529 IP5X.

Test Condition	Referred standard
Depression of 2 KPa, Talcum powder 2kg/m³, 8 hrs.	IEC 60529 IP5X

4. Electrical Specifications

4.1. General DC Characteristic

Table 3: Absolute Maximum Ratings

Symbol	Parameter	Min.	Max.	Unit	Note
$T_{storage}$	Storage Temperature	-50	95	°C	-
Ta	Ambient Operating Temperature	-40	85	°C	-
V_I	3.3V External Input Voltage	-0.3	3.6	V	-

Table 4: Power Consumption

Symbol	Parameter	Min.	Typ.	Max.	Unit
I_{Read}	Read Current at 3.3V	-	62	200	mA
I_{Write}	Write Current at 3.3V	-	73	200	mA
I_{STBY}	Standby Current	-	0.2	15	mA

4.2. Bus Signal Line Loading

Table 5: Bus Signal Line Loading

Symbol	Parameter	Min	Max	Unit	Remark
R_{CMD}	Pull-up resistance for SD_CMD Line	25	100	KΩ	To prevent bus floating
R_{DAT}	Pull-up resistance for SD_DATA Line	25	100	KΩ	To prevent bus floating
C_{CARD}	Card capacitance for each signal pin	-	10	pF	For single card
L_L	Signal Line Inductance	-	16	nH	

Table 6: DC Characteristics of I/O Interface

Symbol	Parameter	Min.	Max.	Unit
V_{IH}	Input High Voltage	0.625 x V_I	V_I +0.3	V
V_{IL}	Input Low Voltage	-0.3	0.25 x V_I	V
V_{OH}	Output High Voltage	0.75 x V_I	-	V
V_{OL}	Output Low Voltage	-	0.125 x V_I	V
I_{OH}	Output High Current	-16	-	mA
I_{OL}	Output Low Current	-	16	mA

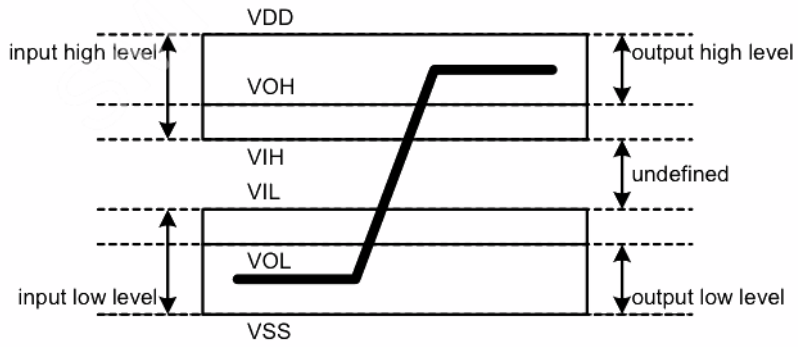

Figure 4: Bus Signal Level

4.3. Bus Timing

4.3.1 Bus Timing (Default Speed Mode)

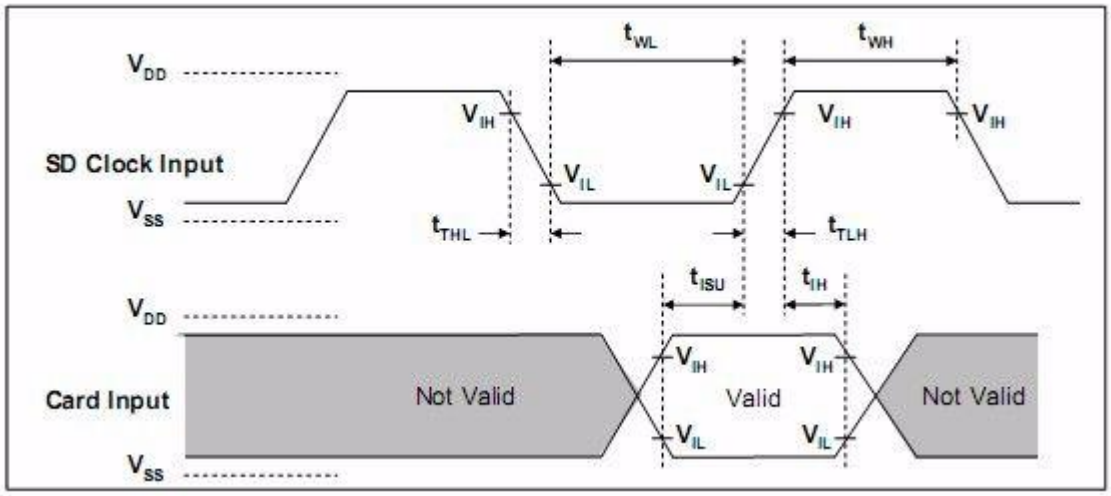

Figure 5: Card input Timing (Default Speed Card)

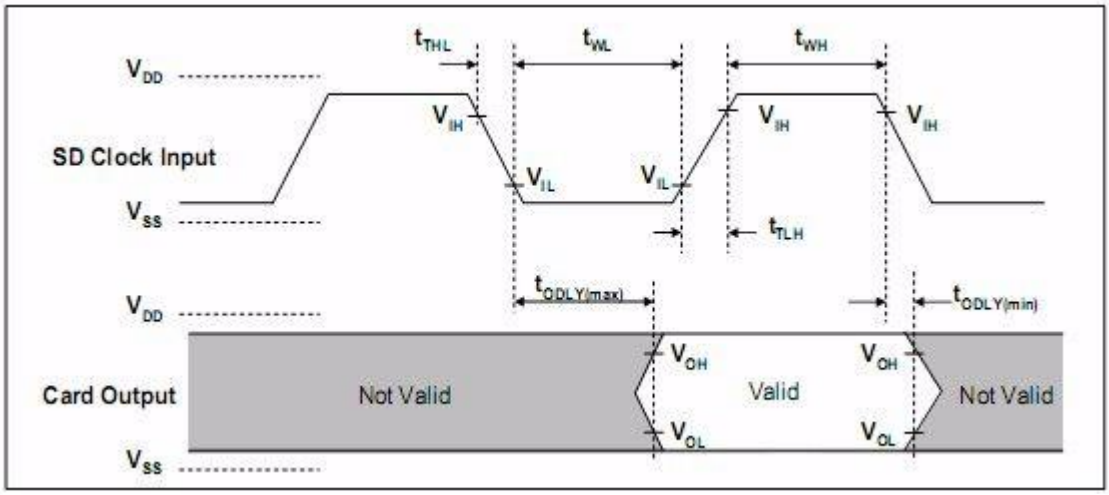

Figure 6: Card Output Timing (Default Speed Mode)

Table 7: Bus Timing-Parameters Values (Default Speed)

Parameter	Symbol	Min.	Max	Unit	Remark
Clock CLK (All values are referred to min (V_{IH}) and max (V_{IL})					
Clock frequency data transfer	f_{pp}	0	25	MHz	C_{CARD} ≤ 10pF (1 card)
Clock frequency Identification	f_{OD}	0(1)/100	400	KHz	C_{CARD} ≤ 10pF (1 card)
Clock low time	t_{WL}	10		ns	C_{CARD} ≤ 10pF (1 card)
Clock high time	t_{WH}	10		ns	C_{CARD} ≤ 10pF (1 card)
Clock rise time	t_{TLH}		10	ns	C_{CARD} ≤ 10pF (1 card)
Clock fall time	t_{THL}		10	ns	C_{CARD} ≤ 10pF (1 card)
Inputs CMD, DAT (referenced to CLK)					
Input set-up time	t_{ISU}	5		ns	C_{CARD}≤ 10pF (1 card)
Input hold time	t_{TH}	5		ns	C_{CARD}≤ 10pF (1 card)
Outputs CMD, DAT (referenced to CLK)					
Output Delay time during Data					
Transfer Mode	t_{ODLY}	0	14	ns	C_L ≤ 40pF (1 card)
Output Hold time	t_{OH}	0	50	ns	C_L ≤ 40pF (1 card)

(1) 0 Hz means to stop the clock. The given minimum frequency range is for cases were continues clock is required.

4.3.2 Bus Timing (High-Speed Mode)

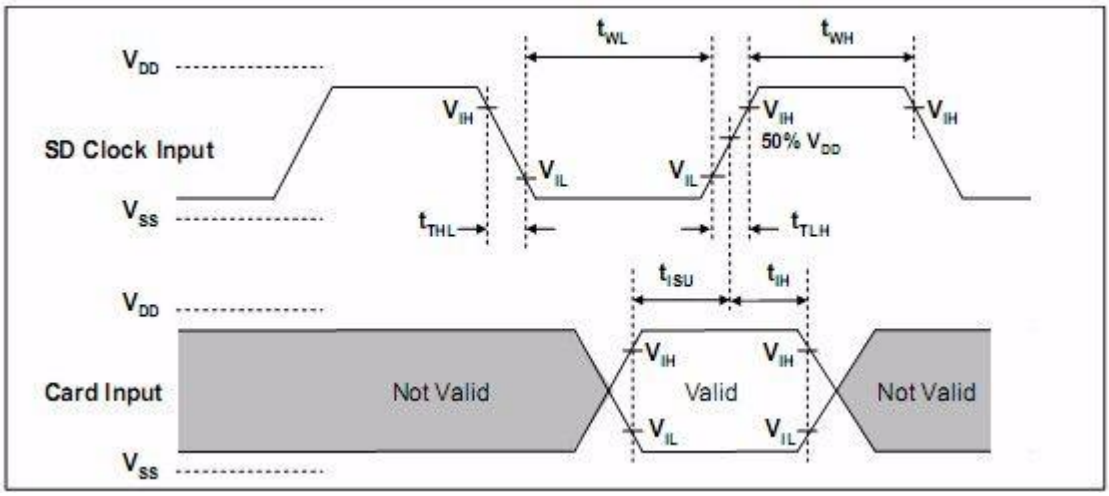

Figure 7: Card Input Timing (High Speed Card)

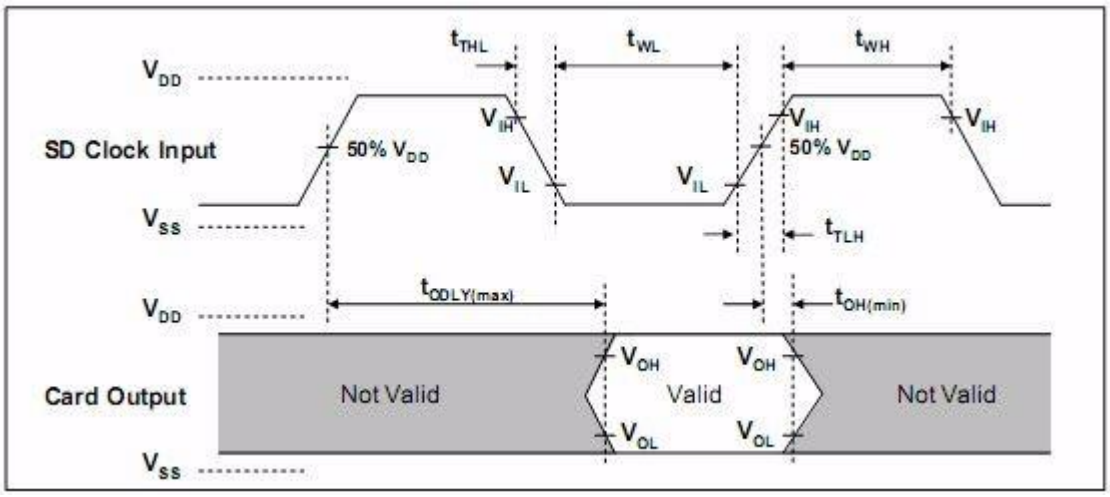

Figure8: Card Output Timing (High Speed Mode)

Table 8 : Bus Timing – Parameters Values(High Speed)

Parameter	Symbol	Min.	Max	Unit	Remark
Clock CLK (All values are referred to min (V_{IH}) and max (V_{IL})					
Clock frequency data transfer	f_{pp}	0	50	MHz	$C_{CARD}\leq$ 10pF (1 card)
Clock low time	t_{WL}	7		ns	$C_{CARD}\leq$ 10pF (1 card)
Clock high time	t_{WH}	7		ns	$C_{CARD}\leq$ 10pF (1 card)
Clock rise time	t_{TLH}		3	ns	$C_{CARD}\leq$ 10pF (1 card)
Clock fall time	t_{THL}		3	ns	$C_{CARD}\leq$ 10pF (1 card)
Inputs CMD, DAT (referenced to CLK)					
Input set-up time	t_{ISU}	6		ns	$C_{CARD}\leq$ 10pF (1 card)
Input hold time	t_{TH}	2		ns	$C_{CARD}\leq$ 10pF (1 card)
Outputs CMD, DAT (referenced to CLK)					
Output Delay time during Data Transfer Mode	t_{ODLY}		14	ns	$C_L \leq$ 40pF (1 card)
Output Hold time	t_{OH}	2.5		ns	$C_L \geq$ 15pF (1 card)
Total System capacitance for each line[1]	C_L		40	pF	1 card

1) In order to satisfy sever timing, host shall drive only one card.

5. Mechanical Dimensions

The mechanical dimensions of industrial SD card were basically followed the mechanical form factor definitions on SD-Memory card specifications which constructed by SD card association.

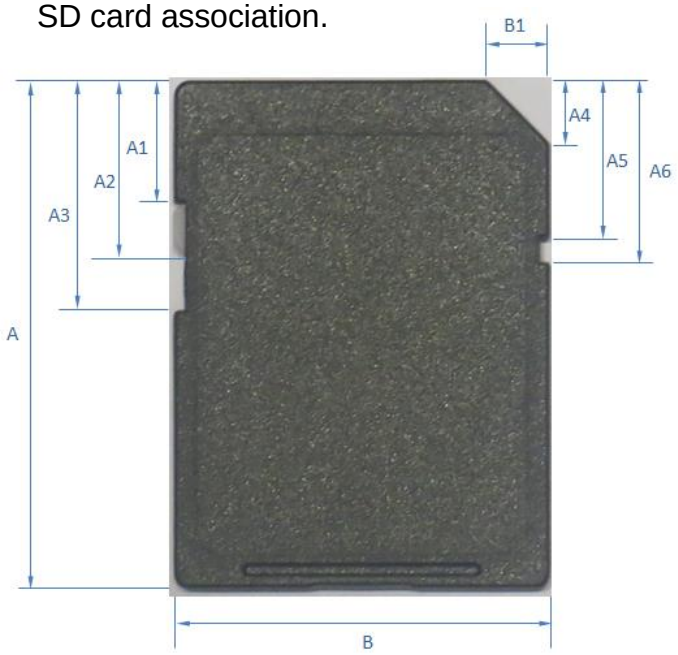

Figure 9: Top View

Criteria of SD — Unit: mm

Dimensions	Min	TYP	Max	Note
A	31.90	32.00	32.10	
B	23.90	24.00	24.10	
A1	7.65	7.80	7.95	
A2	10.70	10.85	11.00	
A3	14.35	14.50	14.65	
A4	3.85	4.00	4.15	
A5	9.85	10.00	10.15	
A6	11.35	11.50	11.65	
B1	3.85	4.00	4.15	
C1	7.00			
C2			4.00	
C3	2.20	2.30	2.40	
C4	0.20			
C5			1.60	
C6	5.00			
C7	5.95			
D1	1.40			
D2	1.10			
D3	0.90			
E	0.60	0.75	0.90	
P	2.35	2.50	2.65	
P1	5.475	5.625	5.775	
P2	7.90	8.05	8.20	
P3	9.60	9.75	9.90	
T	1.95	2.10	2.25	
T1	1.25	1.40	1.55	
T2	1.30	1.40	1.60	
W1	0.55	0.70	0.85	
W2	0.45	0.60	0.75	
R	0.15	0.30	0.45	

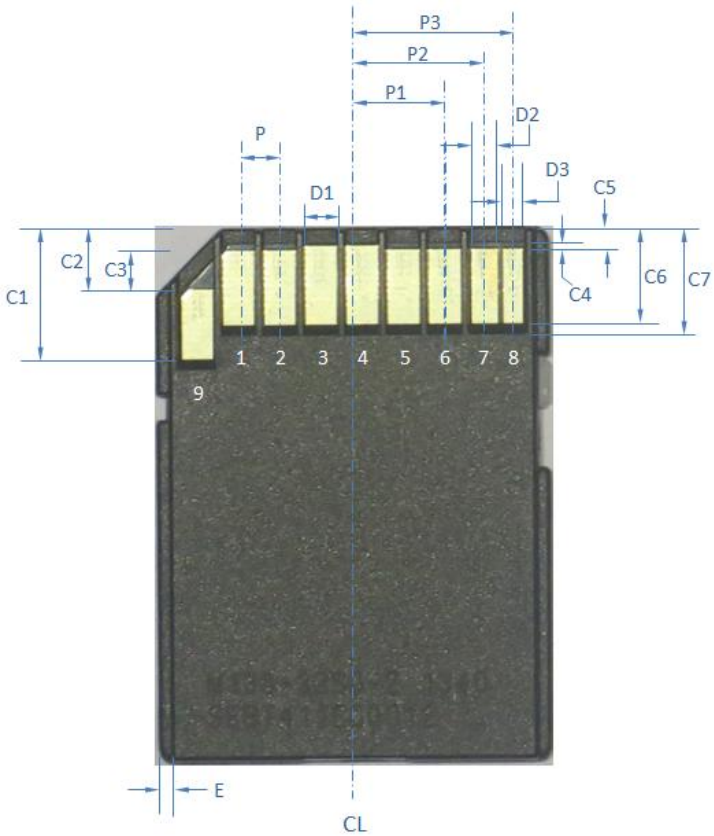

Figure 10: Bottom View

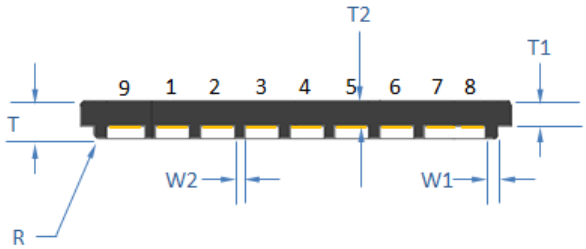

Figure 11: Side View

6. Ordering Information

Part Number	Capacity
ESD512SITCCEBF	512MB
ESD01GSITDBEBB	1GB
ESD02GSITDBEBB	2GB