SD - Mxxx Series
SD Memory Card

DESCRIPTION

The SD-Mxxx series SD Memory card is a very small removable flash storage device.
It is constructed with single chip controller chip and NAND-type（Toshiba）flash memory device.

The SD Memory card provides 16MB, 32MB, 64MB, and up to 128MB of memory. The controller manages interface protocols and data storage and retrieval, as well as Error Correction Code (ECC) algorithms, defect handling and diagnostics, power management and clock control.

The SD memory card is designed to cover a wide area of applications as smart phones, PDAs, cameras etc.

FEATURES

- Card capacity of 16MB,32MB,64MB and up to 128MB available.
- Supports SD and SPI Mode.
- Targeted for portable and stationary applications.
- Voltage range
  - Communication: 2.0-3.6V
  - Memory Access : 2.7-3.6V
- Correction of memory field errors.
- Built-in write protection features.(permanent and temporary)
- Variable clock rate 0-25MHz

Application

This document describes the specifications of the Toshiba standard SD Card .
To commence the design of the host system for SD Card, please confirm the latest information and refer the 9.Host Interface design notes.

1.Production Code

Toshiba Standard SD Card:

Capacity		Production Code
SD Card	16MB	SD-M16
SD Card	32MB	SD-M32
SD Card	64MB	SD-M64
SD Card	128MB	SD-M128

Fig1. : Toshiba Standard SD Card Design

2. Product Overview

The SD Card is a Memory Card of Small and Thin with SDMI compliant Security method.
(SDMI: Secure Digital Music Initiative)
Contents in the Card can be protected by CPRM based security. This contents security can be accomplished by SD Card ,host , and security application software combinations.

3.SD Card Features

Table.1: Model Name

Product	SD-M16	SD-M32	SD-M64	SD-M128	Others
Memory Capacity	16MB	32 MB	64 MB	128MB	
Production Standard	Japan (Applicable to other country Standards for OEM requirement bases)				
Label Design, Contents, Media Format					
Design	Toshiba Standard (Fig .1)				
Contents	None (OEM Design Available)				ID, MKB Programmed (Toshiba Specific)
Security Functions	SD Security Specification Ver.1.0 Compliant (CPRM Based) *CPRM: Contents Protection for Recording Media Specification				
Logical Format	SD File System Specification Ver.1.0 Compliant (DOS-FAT Based formatted)				
Physical , Electrical					
Electrical	Operating Voltage: 2.7V to 3.6 V (Memory Operation) Interfaces: SD Card Interface, (SD : 4 or 1bit) SPI Mode Compatible (if you use this mode, please contact us) SD Physical Layer Specification Ver.1.0 Compliant				
Physical	L: 32, W: 24 , T: 2.1 (mm), Weight: 3g (Max) 2g (typ.) SD Physical Layer Specification Ver.1.0 Compliant (Detailed Dimensions attached : sheet . 1)				
Durability	SD Physical Layer Specification Ver.1.0 Compliant				
Accessories					
Guarantee	Not Applied (Available with OEM requirement)				
Description	Not Applied (Available with OEM requirement)				
Card Case	Not Applied (Available with OEM requirement)				
Card Label	Not Applied (Available with OEM requirement)				
Packaging	Not Applied (Available with OEM requirement)				

4.Compatibility

Compliant Specifications

- SD Memory Card Specifications
  - Compliant with PHYSICAL LAYER SPECIFICATION Ver.1.0. (Part1)
  - Compliant with FILE SYSTEM SPECIFICATION Ver.1.0. (Part2)
  - Compliant with SECURITY SPECIFICATION Ver.1.0. (Part3)

Supplementary Explanation are described in " 8.Others: Limited Conditions , SD Specification Compliance" in this document.

5.Physical Characteristics

5.1.Environmental Characteristics

1) Standard Operation Conditions

Absolute Maximum Temperature Range: Ta = -25 to +85 degrees centigrade
(Humidity less than RH = 95 % , Non condensed)

Recommended Operating Conditions: Ta = 0 to +55 degrees centigrade
(Humidity RH = 20% to 85 % Non condensed)

Note:
Absolute maximum temperature range shows the maximum range which can operate in some condition, and DOES NOT mean a guaranteed operation in any conditions.
For the Stable operations, the recommended operating conditions is suggested or please ask for the customized conditions to Toshiba sales representatives.

2) Storage Temperature

Absolute Maximum Temperature Range: Tstg = -40 to +85 degrees centigrade
(Humidity less than RH = 95% Non condensed)

Recommended Storage Conditions: Tstg = -20 to +65 degrees centigrade
(Humidity RH = 5% to 85% Non condensed)

Note:
Absolute maximum temperature range shows the maximum range to store.
However, DOES NOT mean a guaranteed conditions for long term.
There are some impacts on the SD card if stored in this temperature rage for long term.
For the long term storage period, the recommended storage conditions is suggested or please ask for the customized conditions to Toshiba sales representatives.

5.2.Physical Characteristics

1) Hot Insertion or Removal

Toshiba SD Card can remove or insert without power off the host system described in the SD Physical Layer Specification 8.3.1.
The connector to realize the Hot Insertion or Removal is defined in the 9.2.2. of the PHYSICAL LAYER SPECIFICATION.

2) Mechanical Write Protect Switch

A mechanical sliding tablet on the side of the card can use for write protect switch.
The host system shall be responsible for this function .

The card is in a “Write Protected” status when the tablet is located on the “Lock “ position.
The host system shall not write nor format the card in this status.

The card is in “Write Enabled” status when the tablet is moved to the opposite position (Un-Lock).
(Please refer the figures below for the tablet polarity.)

Please slide the tablet till the dead end (stopped position).
The tablet is set on the “Write Enabled” position when it is shipped.

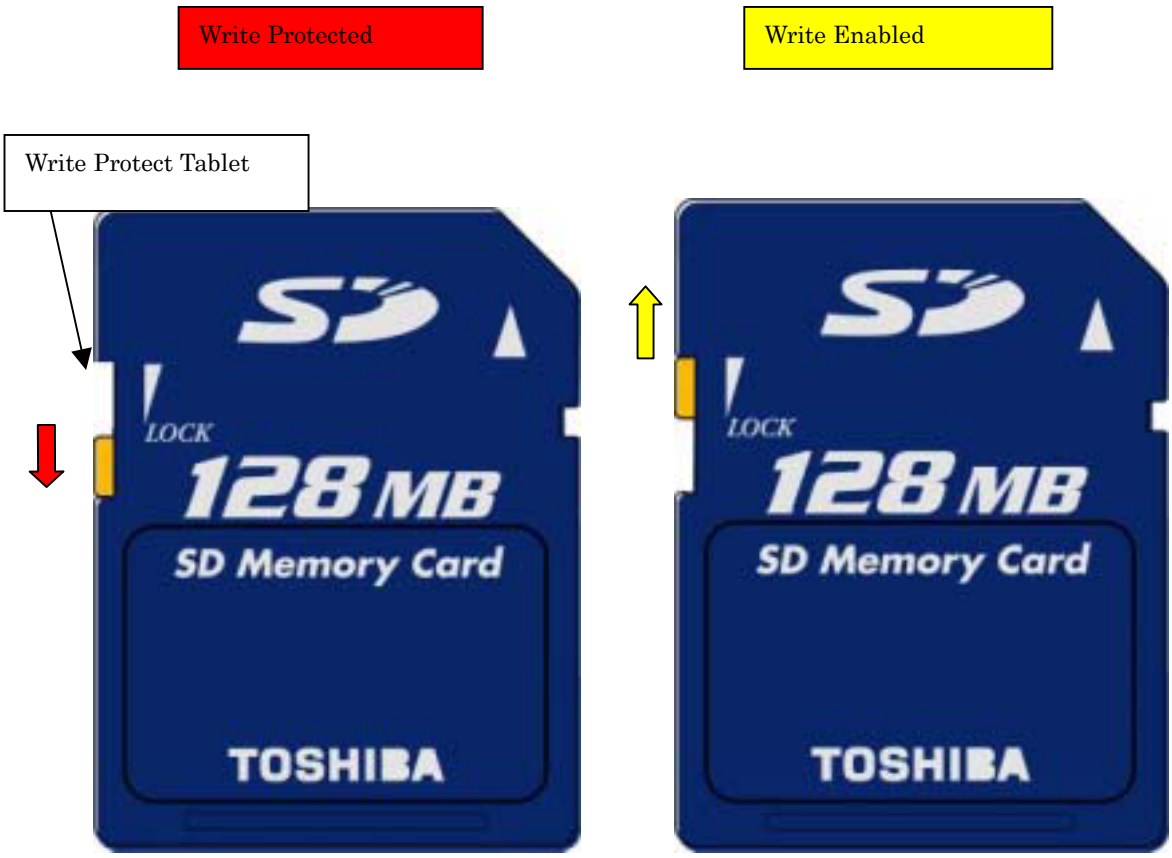


Fig 2: Write Protect Tablet Polarity (Front View)

6.Electrical Interface outlines

6.1. SD card pins

Table 2 describes the pin assignment of the SD card.
Fig.3 describes the pin assignment of the SD card.

Please refer the detail descriptions by SD Card Physical Layer Specification.

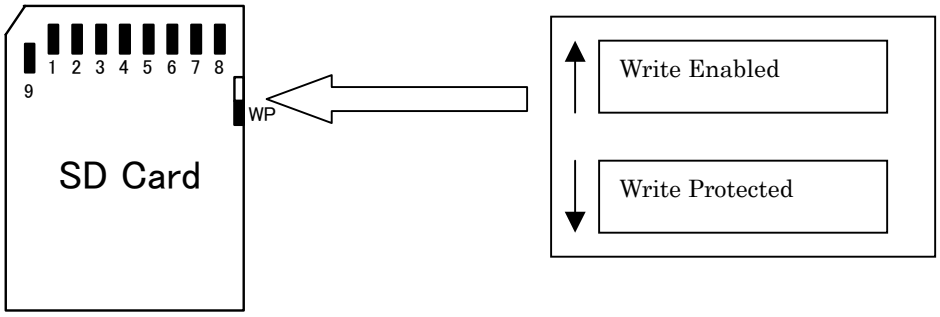


Fig3: SD Card Pin assignment (Back view of the Card)

Table 2:SD card pin assignment

Pins	SD Mode			SPI Mode		
	Name	IO type [1]	Description	Name	IO Type	Description
1	CD/ DAT3	I/O /PP	Card Detect/ Data Line[Bit3]	CS	I	Chip Select (Negative True)
2	CMD	PP	Command/Response	DI	I	Data In
3	V_{SS1}	S	Ground	V_{SS}	S	Ground
4	V_{dd}	S	Supply Voltage	V_{dd}	S	Supply Voltage
5	CLK	I	Clock	SCLK	I	Clock
6	V_{SS2}	S	Ground	V_{SS2}	S	Ground
7	DAT0	I/O /PP	Data Line[Bit0]	DO	O/PP	Data Out
8	DAT1	I/O /PP	Data Line[Bit1]	RSV	-	Reserved (*)
9	DAT2	I/O /PP	Data Line[Bit2]	RSV	-	Reserved (*)

1) S: Power Supply, I: Input, O: Output, I/O: Bi-directionally ,'PP' - IO using push-pull drivers
(*) These signals should be pulled up by host side with 10-100k ohm resistance in the SPI Mode.

6.2 SD Card Bus Topology

The SD Memory Card supports two alternative communication protocols: SD and SPI Bus Mode.

Host System can choose either one of modes. Same Data of the SD Card can read and write by both modes.

SD Mode allows the 4-bit high performance data transfer. SPI Mode allows easy and common interface for SPI channel. The disadvantage of this mode is loss of performance, relatively to the SD mode.

6.2.1 SD Bus Mode protocol

The SD bus allows the dynamic configuration of the number of data line from 1 to 4 Bi-directional data signal.
After power up by default, the SD card will use only DAT0. After initialization, host can change the bus width.

Multiplied SD cards connections are available to the host. Common V_{dd}, V_{ss} and CLK signal connections are available in the multiple connection. However, Command, Respond and Data lined (DAT0-DAT3) shall be divided for each card from host.
This feature allows easy trade off between hardware cost and system performance. Communication over the SD bus is based on command and data bit stream initiated by a start bit and terminated by stop bit.

Command:
Commands are transferred serially on the CMD line. A command is a token to starts an operation from host to the card. Commands are sent to a addressed single card(addressed Command) or to all connected cards (Broad cast command).

Response:
Responses are transferred serially on the CMD line.
A response is a token to answer to a previous received command. Responses are sent from a addressed single card or from all connected cards.

Data:
Data can be transfer from the card to the host or vice versa.
Data is transferred via the data lines.

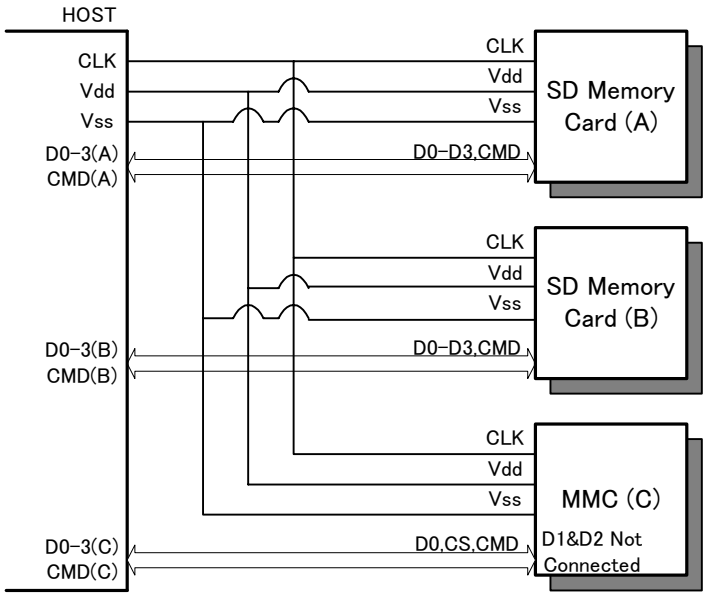


Fig 4: SD Card (SD Mode) connection Diagram

CLK: Host card Clock signal
CMD: Bi-directional Command/ Response Signal
DAT0 - DAT3: 4 Bi-directional data signal
V_{dd}: Power supply
V_{ss}: GND

6.2.2 SPI Bus mode Protocol

The SPI bus allows 1 bit Data line by 2-chanel (Data In and Out).

The SPI compatible mode allows the MMC Host systems to use SD card with little change.
The SPI bus mode protocol is byte transfers.

All the data token are multiples of the bytes (8-bit) and always byte aligned to the CS signal.

The advantage of the SPI mode is reducing the host design in effort.

Especially, MMC host can be modified with little change.

The disadvantage of the SPI mode is the loss of performance versus SD mode.

Caution: Please use SD Card Specification. DO NOT use MMC Specification.

For example, initialization is achieved by ACMD41, and be careful to Register. Register definition is different, especially CSD Register.

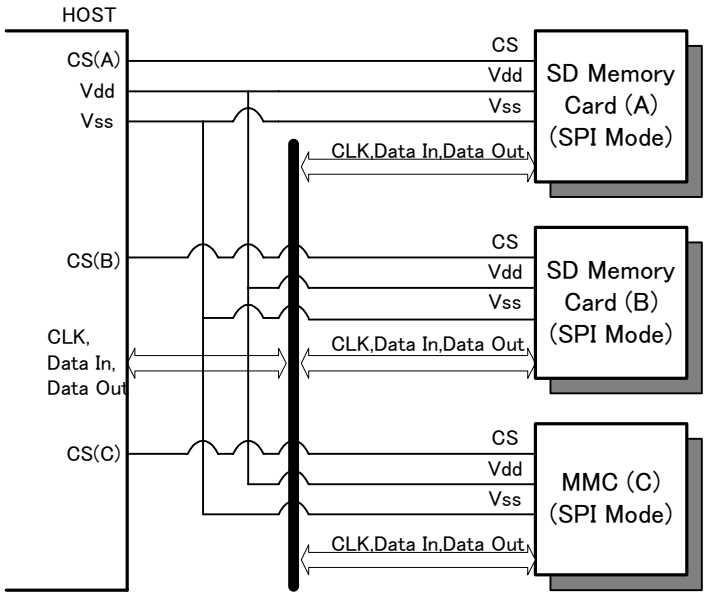


Fig 5: SD card (SPI mode) connection diagram
CS: Card Select Signal
CLK: Host card Clock signal
Data in: Host to card data line
Data out: card to host data line
V_{dd}: Power supply
V_{ss}: GND

6.3. SD card Electrical Characteristics

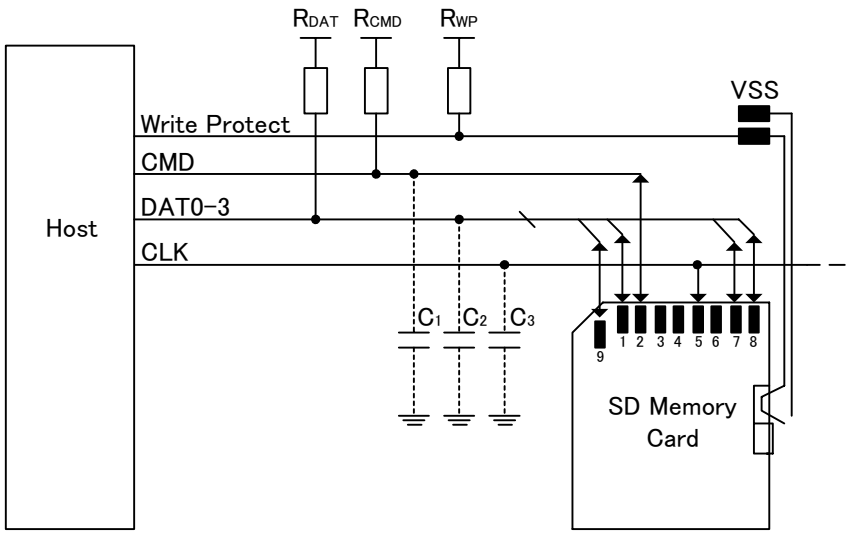


Fig7: SD card Connection diagram

6.3.1 Absolute Maximum Conditions

Table 5: Absolute Maximum Conditions

Item	Symbol	Value	Unit
Supply Voltage	V_{DD}	-0.3 to 5.0	V
Input Voltage	V_{IN}	-0.3 to VDD+0.3	V

6.3.2 DC Characteristics

Table 6: DC Characteristics

Item		Symbol	Condition	MIN.	Typ.	MAX.	Unit	Note
Supply Voltage 1		V_{DD}	-	2.0	-	3.6	V	For CMD0,15,55, ACMD41 Only
Supply Voltage 2			-	2.7	-	3.6	V	For All commands
Input Voltage	High Level	V_{IH}	-	VDD*0.625	-	-	V	
	Low Level	V_{IL}	-	-	-	VDD*0.25	V	
Output Voltage	High Level	V_{OH}	VDD = 2V IOH = -100uA	VDD*0.75	-	-	V	
	Low Level	V_{OL}	VDD = 2V IOL = 100uA	-	-	VDD*0.125	V	
Standby Current		I_{CC1}	3.6V Clock 25MHz	-	-	30	mA	
			2.7V Clock Stop	-	-	0.2		
Operation Voltage		I_{CC2}	3.6V/25MHz	-	-	80	mA	Write
			2.7V/25MHz	-	-	80		Read
Input Voltage Setup Time		Vrs	-	-	-	250	ms	

Table 7: Signal Capacitance

Item	Symbol	Min.	Max.	Unit	Note
Pull up Resistance	R_{CMD} R_{DAT}	10	100	K Ohm	
Bus Signal Line Capacitance	C_L	-	250	pF	F_{PP}<5MHz (21Cards)
Bus Signal Line Capacitance	C_L	-	100	pF	F_{PP}<20MHz (7Cards)
Single Card Capacitance	C_{CARD}	-	10	pF	
Pull up Resistance inside card(pin1)	R_{DAT3}	10	90	K Ohm	

Note: WP pull-up (R_{wp}) Value is depend on the Host Interface drive circuit.

6.3.3 AC Characteristics

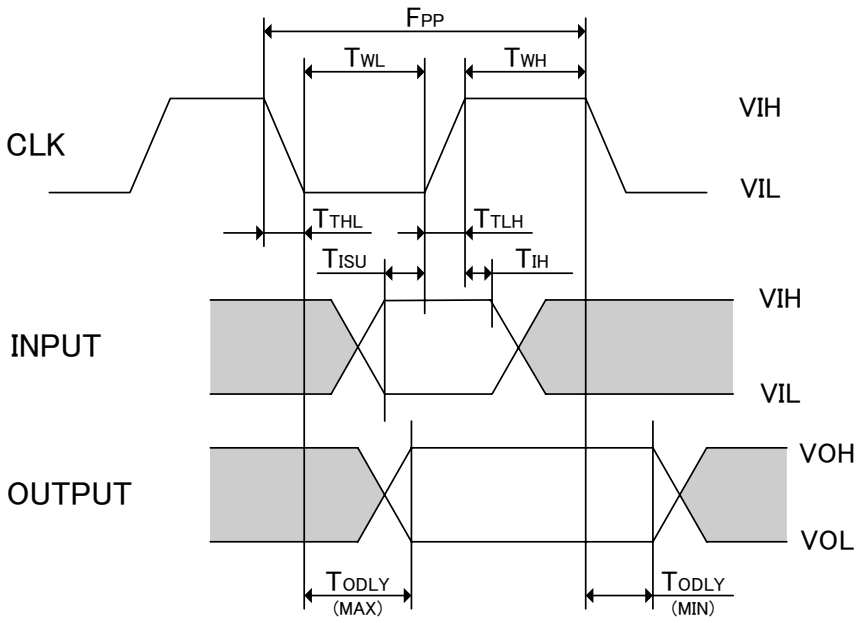
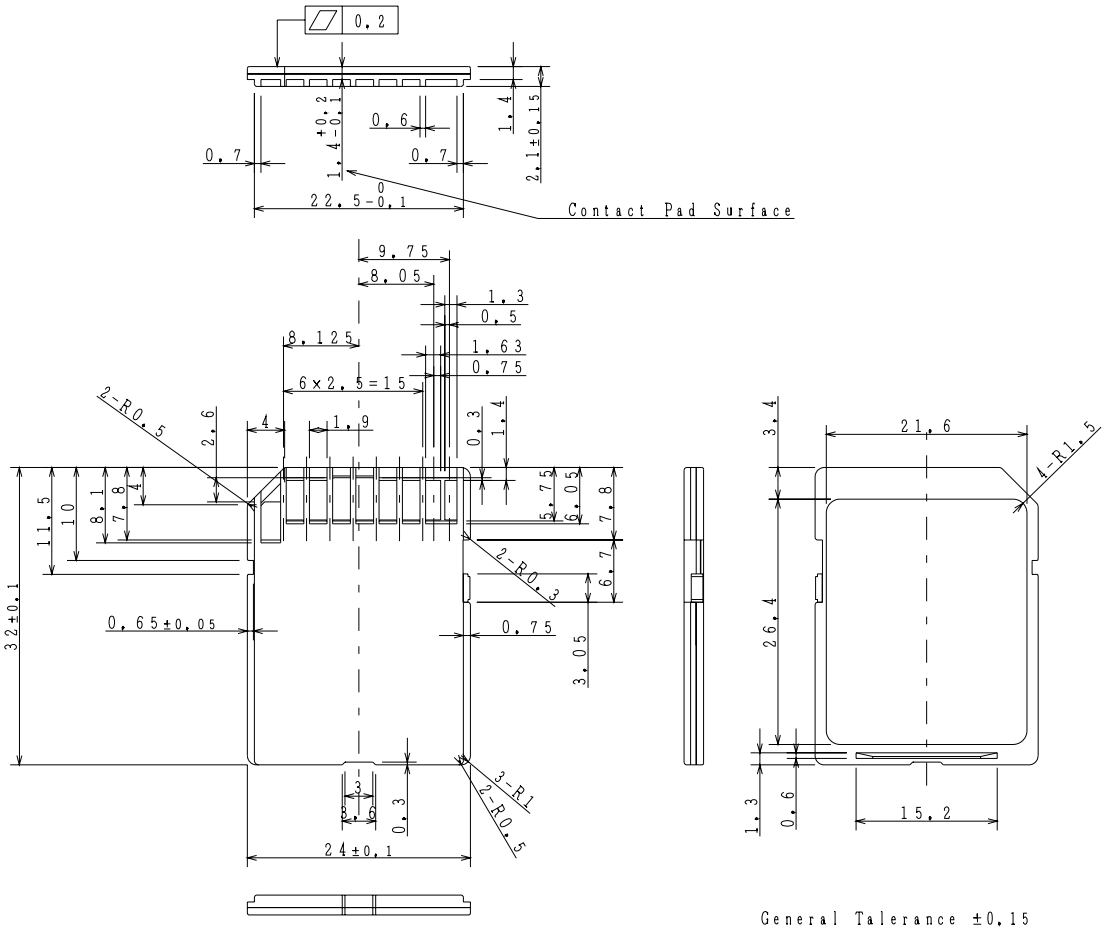


Fig 8: AC Timing Diagram

Table 8: AC Characteristics

Item	Symbol	Min.	Max.	Unit	Note
Clock Frequency (In any Sates)	F_{sty}	0	25	MHz	C_L<100pF (7Cards)
Clock Frequency (Data transfer Mode)	F_{PP}	0.1	25	MHz	C_L<100pF (7Cards)
Clock Frequency (Card identification Mode)	F_{OD}	100	400	kHz	C_L<250pF (21Cards)
Clock Low Time	T_{WL}	10	-	ns	C_L<100pF (7Cards)
Clock High Time	T_{WH}	10	-	ns	
Clock Rise Time	T_{TLH}	-	10	ns	
Clock Fall Time	T_{THL}	-	10	ns	
Clock Low Time	T_{WL}	50	-	ns	C_L < 250pF (21Cards)
Clock High Time	T_{WH}	50	-	ns	
Clock Rise Time	T_{TLH}	-	50	ns	
Clock Fall Time	T_{THL}	-	50	ns	
Input Setup Time	T_{ISU}	5	-	ns	C_L < 25pF (1Cards)
Input Hold Time	T_{IH}	5	-	ns	
Output Delay Time	T_{ODLY}	0	14	ns	

Appendix 1. SD Card Mechanical Dimensions (Unit : mm)



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