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RoHS Industrial & Industrial Extended Temperature SD & miniSD Memory Cards
Engineering Specification

Revision	Change Description	Date
A	Preliminary Release	03/13/06
B	Remove Part Numbers	9/8/06
1.2	Added 30 µ inches of gold on the contacts in features	7/9/08

General Description

Delkin Devices Inc., Secure Digital Card (SD Card) dimensions are 24mm x 32mm x 2.1mm. (W x L x T) The size is relative to a postage stamp and as thick as a credit card. This solid state storage solution is high speed with a compact form factor and is ideal for industrial and enterprise applications.

SD and miniSD™ is based on Single Level Cell (SLC) NAND Flash. NAND Flash is non-volatile and retains the data without the need of a continuous power source. The miniSD™ Card dimensions are 20mm x 21.5mm x 1.4mm (W x L x T), and shares all the same benefits of the larger SD Cards.

Applications

- Industrial Computer
- Embedded Systems
- Data Acquisition
- Automotive
- Flight Systems
- Agriculture
- Manufacturing
- Military
- Gaming
- Telecommunications
- Also, hundreds of other industries looking for a more robust and rugged digital storage option.

Features

Compliant with *SD Spec. – Part 1 Physical Layer Specification Version 1.10* and *miniSD Spec. – Addendum to Part 1, Version 1.02*

Compliant with European Union Directive 2002/95/EC (RoHS)

Operating bus modes – SD & SPI

SD capacities supported: 64 MB, 128 MB, 256 MB, 512 MB, 1 GB, and 2 GB

miniSD capacities supported: 128 MB, 256 MB, 512 MB, and 1 GB

Card removal during read operation will never harm the content

Write Protect Switch, SD card only

SD card available in Industrial and Industrial Extended Temperature operating ranges

Solid State Memory

Supports 2.7Volt to 3.6Volt operation

ECC and Wear Leveling

Available upon request – Custom programming, serial numbers, labels, packaging and 30 µ inches of gold on the contacts

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1.0 General SD & miniSD Card Specifications

1.1 Recommended Temperature Conditions

Parameter	Min.	Max.
Storage Temp.	-40°C	85°C
Commercial Operating Temp.	0°C	55°C
Industrial Operating Temp.	-10°C	85°C
Industrial Extended Operating Temp.	-25°C	85°C

1.2 Performance

Parameter	Value
*Data Transfer Rate	up to 25 MB/sec
*Sustained Read	up to 7 MB/sec
*Sustained Write	up to 5 MB/sec

1.3 Reliability

Parameter	Value
**Cycle Endurance	1,000,000 cycles min.
*MTBF	1,000,000 hrs
Data Retention	10 Yrs

1.4 Environmental Characteristics

Parameter	Value
Shock	40g's at 11ms, MIL-STD-810, Method 516.5
Vibration	15Hz to 2000Hz, MIL-STD-810, Method 514.5
Humidity	95% R-H, MIL-STD-810, Method 507.4
Altitude	80,000 ft
Durability	10,000 mating cycles
***Minimum moving force of WP switch	40gf
***WP Switch cycles	1000 Cycles min. (@ Slide force 0.4N to 5N)

* Dependant on configuration and testing environment
** Reference DDEndurance.doc
*** SD Card only

1.5 Restriction of Hazardous Substances (RoHS)

These devices comply with all requirements of the European Union Directive 2002/95/EC (RoHS) and have been maintained in the manufacturing of this assembly. This assembly meets the following requirements:

1. Cadmium and Cadmium compounds — threshold 0.01% of weight
2. PBB and PBDE (halogenated flame retardant) — threshold 0.1% of weight
3. Mercury — threshold 0.1% of weight
4. Chromium (VI) — threshold 0.1% of weight
5. Lead and Lead compounds — threshold 0.1% of weight

This assembly meets the recommended maximum reflow temperature in accordance with IPC/JEDEC J-STD-020C.

1.6 Card Dimensions

Table 1 - SD Card Dimensions

Length:	32 ± 0.10 mm (1.260 ±.004 in.)
Width:	24 ± 0.10 mm (0.945 ±.004 in.)
Thickness Including Label Area:	2.1 mm ± 0.15 mm (0.083 ± .006 in.)
Weight:	2.0 g typical

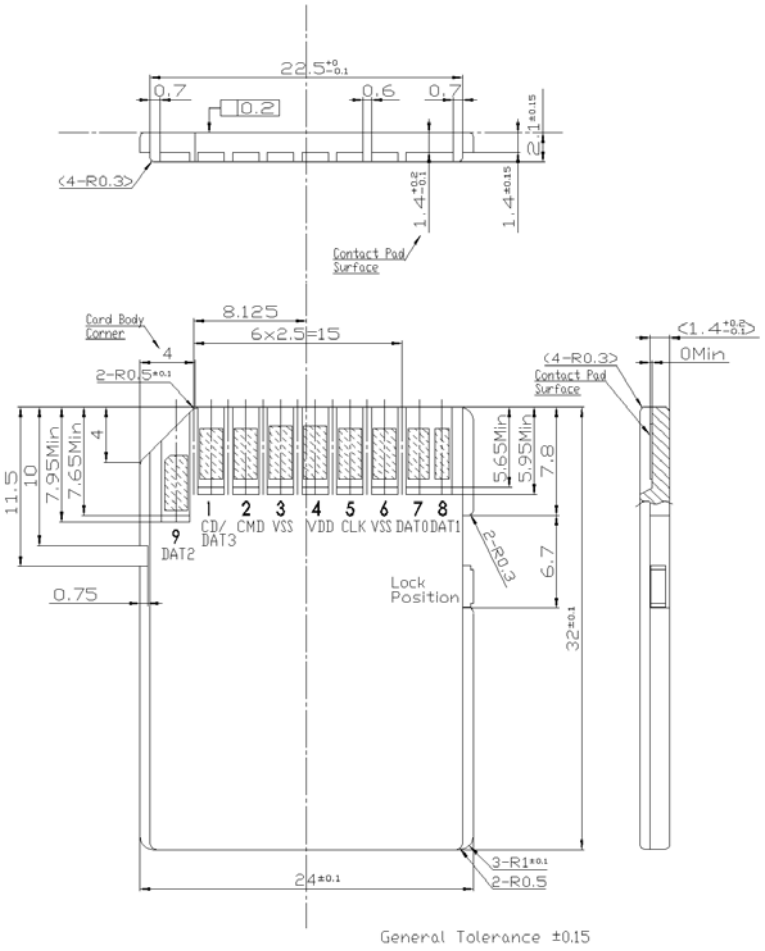

Fig 1 - SD Card Dimensions

Table 2 - miniSD Card Dimensions

Length:	21.5 ± 0.10 mm (0.846 ±.004 in.)
Width:	20 ± 0.10 mm (0.787 ±.004 in.)
Thickness Including Label Area:	1.40 mm ± 0.10 mm (0.055 ± .004 in.)
Weight:	1.0 g typical

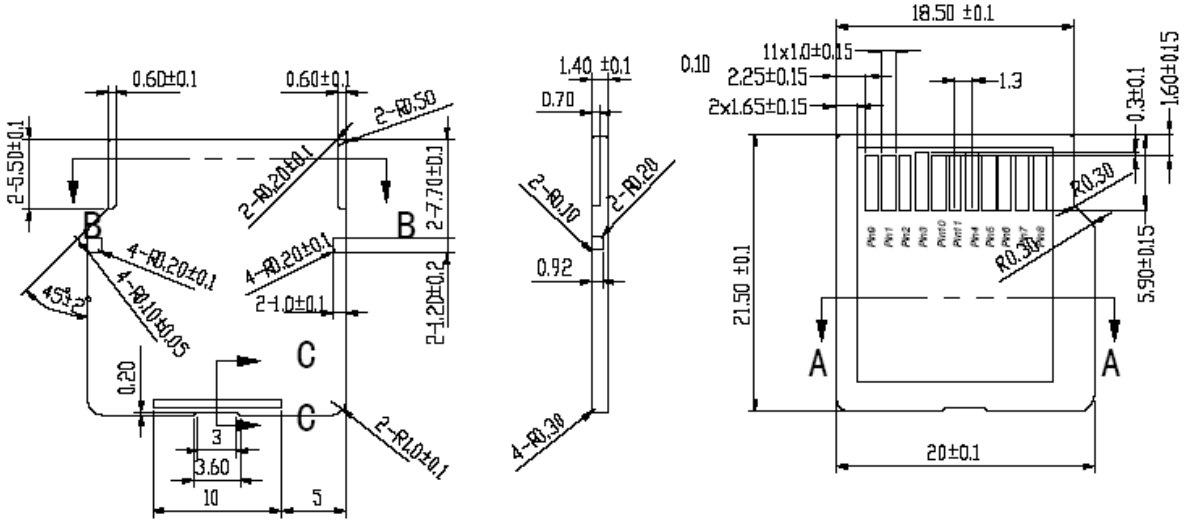

Fig 2 – miniSD Card Dimensions

******* Please reference the SD Spec. – Part 1 Physical Layer Specification Version 1.10 and miniSD Spec. – Addendum to Part 1, Version 1.02 at sdcard.org for any questions regarding the SD standard and host design. *******

2.0 SD & miniSD Card Interface

2.1 SD Pin Assignment

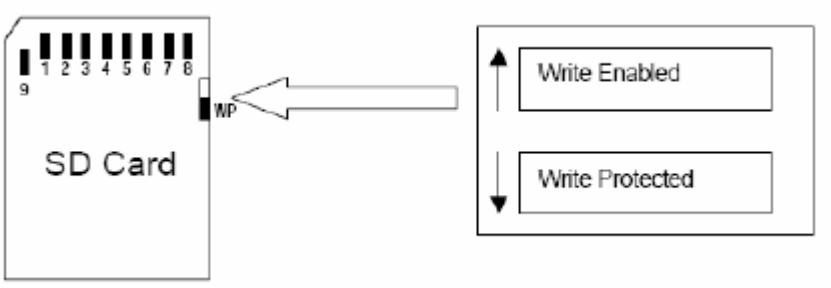

Fig 3 - SD Card Pin Designation

Table 3 - 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 [2]
9	DAT2	I/O /PP	Data Line [Bit2]	RSV	-	Reserved [2]

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

2.2 miniSD Pin Assignment

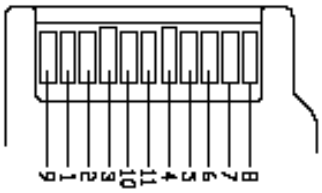

Fig 4 – miniSD Card Pin Designation

Table 3 - miniSD Card Pin Assignment

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

1) S: Power Supply, I: Input, O: Output, I/O: Bi-directionally, 'PP' - IO 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 MultiMedia Cards.
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
4) NC pins should be left open.

2.3 SD 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.

2.4 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 Vdd, Vss and CLK signal connections are available in the multiple connections. 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 an 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 an 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.

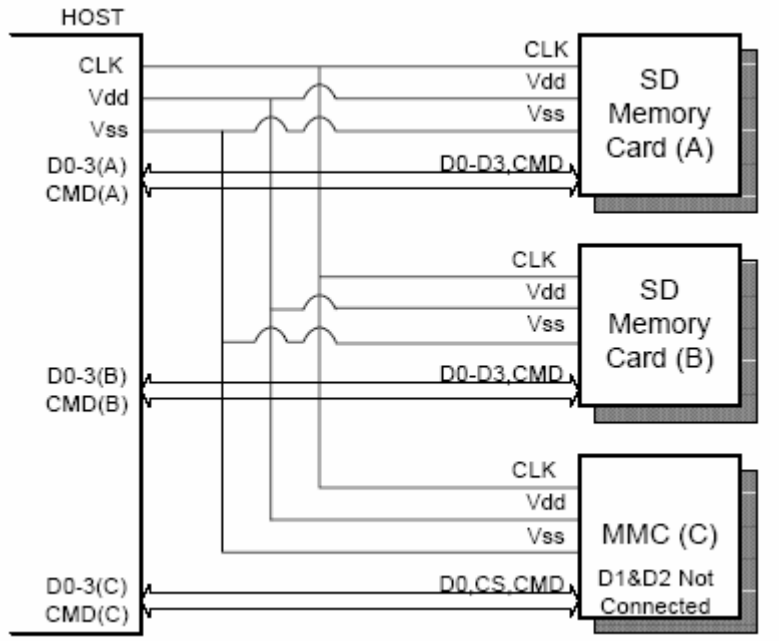

Fig 5 - SD Card (SD Mode) Connection Diagram

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

For more information on the SD Mode Command Set *SD Spec. – Part 1 Physical Layer Specification Version 1.10* .

2.5 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 of 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.

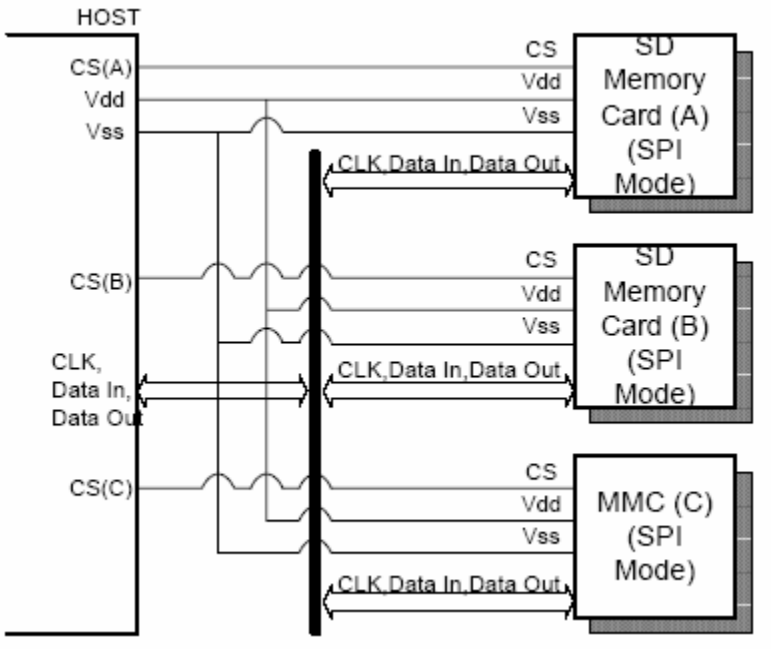

Fig 6 - SD Card (SPI Mode) Connection Diagram

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

For more information on the SPI Mode Command Set refer to *SD Spec. – Part 1 Physical Layer Specification Version 1.10* .

3.0 SD & miniSD Card Electrical Characteristics

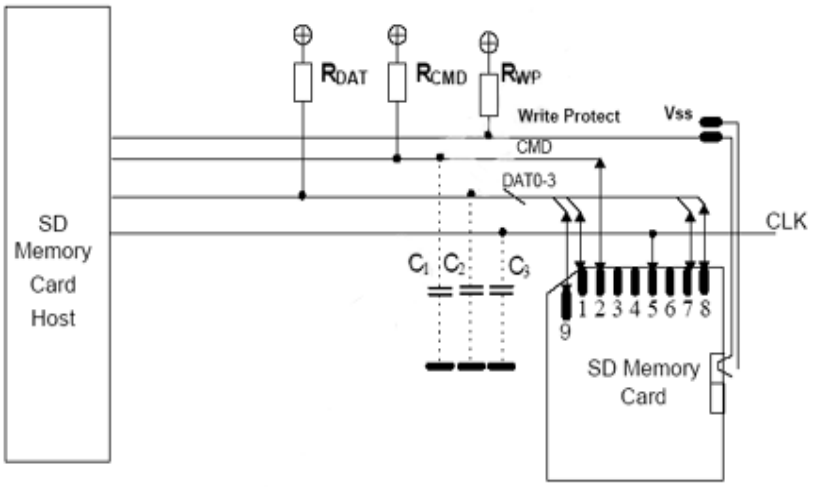

Fig 7 - SD Card Connection Diagram

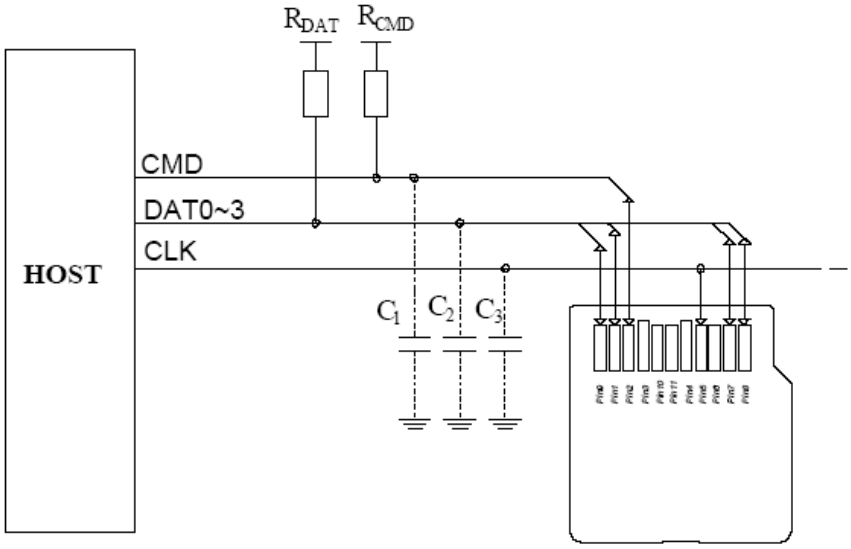

Fig 8 – miniSD Card Connection Diagram

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

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 dependant on the Host Interface drive circuit.

3.3 AC Characteristics

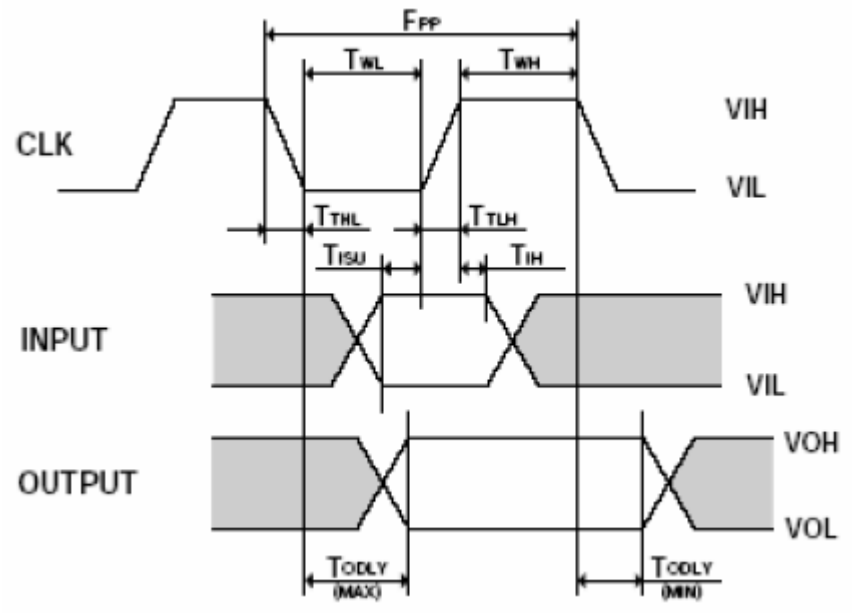

Fig 9 - AC Timing Diagram

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}	$0_{(1)}$/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	

4.0 Internal Card Information

4.1 Security Information

MKB (Media Key Block) and Media ID are Toshiba Standard Information. This information is compliant with the CPRM. Note: The security information is NOT Development information for evaluation. Host System shall be compliance with the CPRM to use the security function. This information is kept as confidential because of security reasons.

4.2 SD Card Registers

The SD card has six registers and SD Status information: OCR, CID, CSD, RCA, DSR, SCR and SD Status. DSR IS NOT SUPPORTED in this card. There are two types of register groups.
1) MMC compatible registers: OCR, CID, CSD, RCA, DSR, and SCR
2) SD card Specific: SD Status
(Refer to *SD Spec. – Part 1 Physical Layer Specification Version 1.10* for more detail)

4.3 OCR Register

This 32-bit register describes operating voltage range and status bit in the power supply.
(Refer to *SD Spec. – Part 1 Physical Layer Specification Version 1.10* for more detail)

4.4 CID Register

The CID (Card Identification) register is 128-bit width. It contains the card identification information. The Value of CID Register is vender specific. (Refer to *SD Spec. – Part 1 Physical Layer Specification Version 1.10* for more detail)

4.5 CSD Register

CSD is Card-Specific Data register provides information on 128bit width.
(Refer to *SD Spec. – Part 1 Physical Layer Specification Version 1.10* for more detail)

4.6 RCA Register

The writable 16bit relative card address register carries the card address in SD Card mode.

4.7 DSR Register

This register is not implemented on this card

4.8 SCR Register

SCR (SD Card Configuration Register) provides information on SD Memory Card's special features. The size of SCR Register is 64 bit. (Refer to *SD Spec. – Part 1 Physical Layer Specification Version 1.10* for more detail)

4.9 Logical Format

The Delkin SDPRO card is formatted before shipping compliant to the SD Card FILE SYSTEM SPECIFICATION.