

# DELKIN DEVICES®

## SLC Commercial and Industrial Secure Digital (SD/SDHC) Card Engineering Specification

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# 1.0 General Description

The Delkin Devices Secure Digital (SD) memory card is only the size of a postage stamp and the thickness of a credit card. Yet these solid state devices provide high speed performance and large storage capacity for many industrial applications. Delkin SD cards are a versatile storage solution for a wide variety of data. They feature built in write-protection to ensure data security.

## Features

- Functionally compliant with SD specification version 1.1 and 2.0 (High Capacity)
- Operating bus modes – SD & SPI
- SD capacities supported: 128MB, 256 MB, 512 MB, 1 GB and 2 GB
- SDHC capacities supported: 4GB and 8GB
- Write Protect Switch
- Solid State Memory
- Supports 2.7 Volt to 3.6 Volt operation
- Error Correction Code (ECC)
- Wear Leveling algorithms for extended card life
- RoHS Compliant (Conforms to European Union Directive 2002/95/EC)

## 1.1 Recommended Temperature Conditions

Parameter	Temperature Range
Storage Temperature	-50°C ~ 90°C
SLC Commercial Operating Temperature	-0°C ~ 70°C
SLC Industrial Operating Temperature	-40°C ~ 85°C

## 1.2 Performance

Parameter	Value
Data Transfer Rate*	Up to 25 MB/sec
Sustained Read*	Up to 20 MB/sec
Sustained Write*	Up to 10 MB/sec

## 1.3 Reliability

Parameter	Value
Endurance Cycle*	2,000,000 cycles minimum
MTBF**	2,000,000 hours
Data Retention	10 Years

\* Reference Delkin Reliability Test Report for Compact Flash, Secure Digital, USB and Embedded USB Drives (Document Number L5002).

\*\* Dependent on configuration and testing environment

## 1.4 Environmental Characteristics

Parameter	Value
Shock	40g's at 11ms
Vibration	15Hz to 2000Hz
Humidity	5% to 95% Non-condensing
Altitude	80,000 feet
Durability	10,000 mating cycles
WP switch Min. moving force	40gf
WP Switch cycles	1000 Cycles min. (@ Slide force 0.4N to 5N)

## 1.5 Part Numbers

### 1.5.1 SLC Commercial Grade (0 ~ 70°C) Delkin SD cards

Capacity	Part Number
128MB	SD12xxxxyy-C1000-D
256MB	SD25xxxxyy-C1000-D
512MB	SD51xxxxyy-C1000-D
1GB	SD0Gxxxxyy-C1000-D
2GB	SD02xxxxyy-C1000-D
4GB	SD04xxxxyy-C6000-D
8GB	SD08xxxxyy-C6000-D

### 1.5.2 SLC Industrial Grade (-40 ~ 85°C) Delkin SD cards

Capacity	Part Number
128MB	SE12xxxxyy-C1000-D
256MB	SE25xxxxyy-C1000-D
512MB	SE51xxxxyy-C1000-D
1GB	SE0Gxxxxyy-C1000-D
2GB	SE02xxxxyy-C1000-D
4GB	SE04xxxxyy-C6000-D
8GB	SE08xxxxyy-C6000-D
16GB	SE16xxxxyy-C6000-D

xxx = place holder for flash designation

yy = place holder for controller/firmware (H8 or HL)



## 2.0 SD Card Interface

### 2.1 SD Pin Assignment

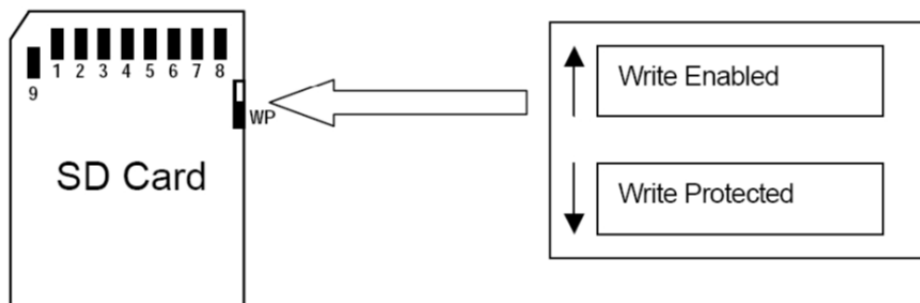


Figure 2. SD card pin designation

Table 1. SD card pin assignment

Pins	SD Mode			SPI Mode		
	Name	IO type <sup>1</sup>	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 <sub>SS1</sub>	S	Ground	V <sub>SS</sub>	S	Ground
4	V <sub>DD</sub>	S	Supply Voltage	V <sub>DD</sub>	S	Supply Voltage
5	CLK	I	Clock	SCLK	I	Clock
6	V <sub>SS2</sub>	S	Ground	V <sub>SS2</sub>	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 <sup>2</sup>
9	DAT2	I/O /PP	Data Line [Bit2]	RSV	-	Reserved <sup>2</sup>

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 SD Bus Topology

The SD Memory Card supports two alternative communication protocols—*SD* and *SPI Bus Mode*. The host system can choose either mode. The same SD Card data can be read and written by both modes. SD mode allows high performance, 4-bit data transfer. The SPI Bus mode provides a simple, common interface for the SPI channel, but exhibits lower performance relative to the SD Mode.

## 2.3 SD Bus Mode Protocol

The SD bus mode protocol allows the dynamic configuration of 1 to 4 data lines as bidirectional data signals. After power up, by default, the SD card will use only DAT0. After initialization, the host can change the bus width.

Multiple SD card connections are available to the host. Common Vdd, Vss and CLK signal connections are available in multiple connections. However, *Command*, *Respond* and *Data* lines from the host (DAT0-DAT3) are discrete for each. This feature allows for an easy trade-off between hardware cost and system performance. Communication over the SD bus is based on a command and data bit stream initiated by a start bit and terminated by a stop bit.

### Command:

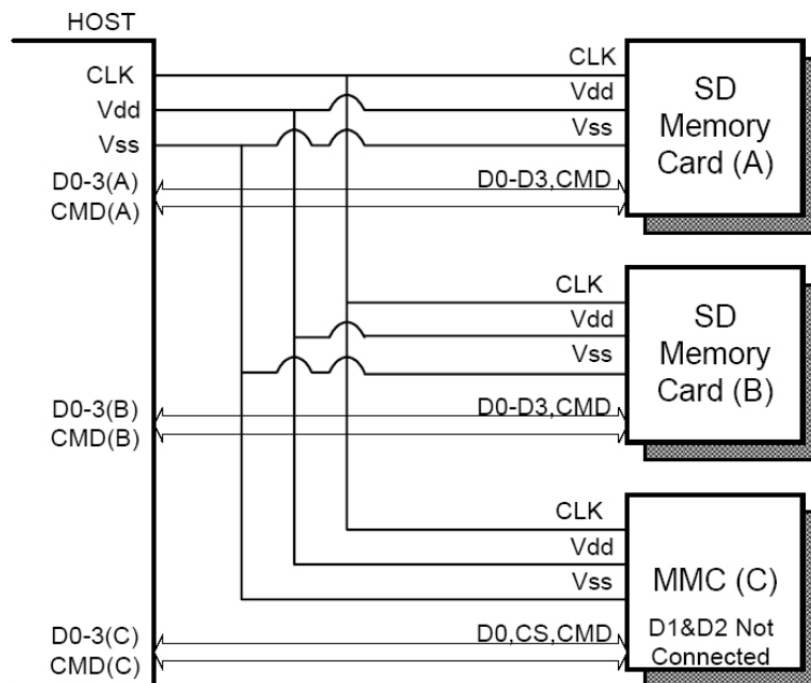
Commands are transferred serially on the CMD line. A command is a token to start an operation from host to the card. Commands are sent to an addressed single card (*addressed command*) or to all connected cards (*broadcast command*).

### Response:

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

### Data:

Data is transferred via the D0-3 data lines. Data can be transferred from the card to the host or vice versa.



**Figure 3. SD card (SD mode) connection diagram**

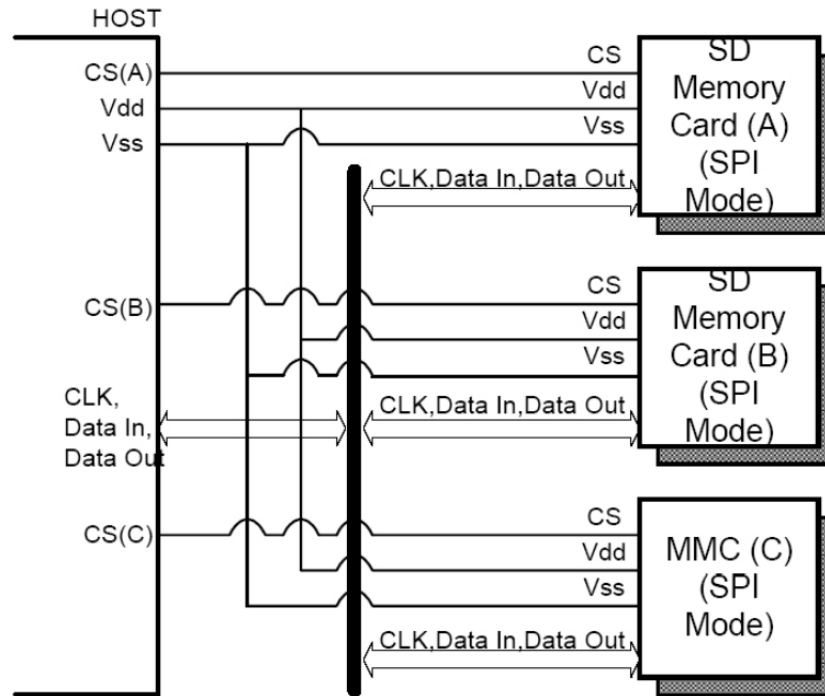
CLK: Host card Clock signal  
 CMD: Bi-directional Command/ Response Signal  
 DAT0 - DAT3: 4 Bi-directional data signal  
 Vdd: Power supply  
 Vss: GND

## 2.4 SPI Bus Mode Protocol

The SPI bus allows 1-bit data transfer via two channels (data in/out). The SPI-compatible mode allows *MultiMediaCard* (MMC) host systems to use the SD card with little change. The SPI bus mode protocol utilizes byte transfer. All of the data tokens are multiples of 8-bit bytes and always byte-aligned to the CS signal.

The advantage of the SPI mode is easier host configuration. In particular, an MMC host can be modified with little change. The disadvantage of the SPI mode is reduced performance relative to SD mode.

**CAUTION:** In host configuration, use ONLY the SD Card Specification. DO NOT use the MMC Specification. Initialization requires the SD-specific ACMD41 synchronization command. Also, take particular care regarding memory registers. Some registers are SD or MMC specific. Even compatible registers can require different definitions, in particular the *CSD* Register.



**Figure 4. 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
- Vdd: Power supply
- Vss: GND

## 3.0 SD Card Electrical Characteristics

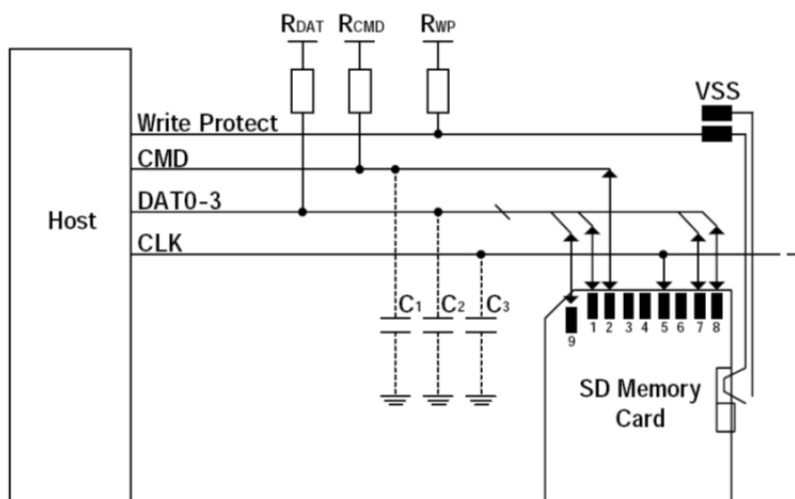


Figure 5. SD card connection diagram

### 3.1 Absolute Maximum Conditions

Card Type	Parameter	Symbol	Min	Max	Unit
SD	Supply Voltage	$V_{DD}$	-0.3	+5.0	V
	Input Voltage	$V_{IN}$	-0.3	$V_{DD}+0.3$	V
SDHC	Supply Voltage	$V_{DD}$	-0.3	+4.6	V
	Input Voltage	$V_{IN}$	-0.3	$V_{DD}+0.3$	V

### 3.2 DC Characteristics

This section includes data tables for the following:

- Standard Secure Digital (SD) DC characteristics
- Secure Digital High Capacity (SDHC) DC characteristics
- Signal capacitance

**Table 2. Standard Secure Digital (SD) DC characteristics**

Item	Symbol	Condition	MIN.	Typ	MAX.	Unit	Note	
Supply Voltage 1	VDD	-	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	VIH	-	VDD*0.625	-	-	V	
	Low Level	VIL	-	-	-	VDD*0.25	V	
Output Voltage	High Level	VOH	VDD = 2V IOH = - 100uA	VDD*0.75	-	-	V	
	Low Level	VOL	VDD = 2V IOL = 100uA	-	-	VDD*0.125	V	
Standby Current	ICC1	3.6V Clock 50MHz	-	-	30	mA		
		2.7V Clock Stop	-	-	0.2			
Operation Voltage	ICC2	3.6V/ 50MHz	-	-	80	mA	Write	
		2.7V/ 50MHz	-	-	80		Read	
Input Voltage Setup Time	Vrs	-	-	-	250	ms		

**Table 3. Secure Digital High Capacity (SDHC) DC characteristics**

Item	Symbol	Condition	MIN.	Typ.	MAX.	Unit	Note
Supply Voltage	VDD	-	2.7	-	3.6	V	
Input Voltage	High Level	VIH	-	VDD*0.625	-	-	V

Item	Symbol	Condition	MIN.	Typ.	MAX.	Unit	Note
	Low Level	VIL	-	-	VDD*0.25	V	
Output Voltage	High Level	VOH	VDD = 2V IOH = - 100uA	VDD*0.75	-	V	
	Low Level	VOL	VDD = 2V IOL = 100uA	-	VDD*0.125	V	
Standby Current	ICC1	3.6V Clock 25MHz	-	-	30	mA	@25 °C
		3.0V Clock Stop	-	-	0.55		
Operation Current <sup>1</sup>	ICC2	3.6V/ 25MHz, 50MHz	-	-	200	mA	Write
			-	-	200		Read
Input Voltage Setup Time	Vrs	-	-	-	250	ms	

1) Peak Current: RMS value over a 10usec period

**Table 4. Signal capacitance**

Item	Symbol	Min.	Max.	Unit	Note
Pull up Resistance	RCMD RDAT	10	100	K Ohm	
Bus Signal Line Capacitance	CL	-	100	pF	FPP<20MHz
Single Card Capacitance	CCARD	-	10	pF	
Pull up Resistance inside card(pin1)	RDAT3	10	90	K Ohm	

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

### 3.3 AC Characteristics

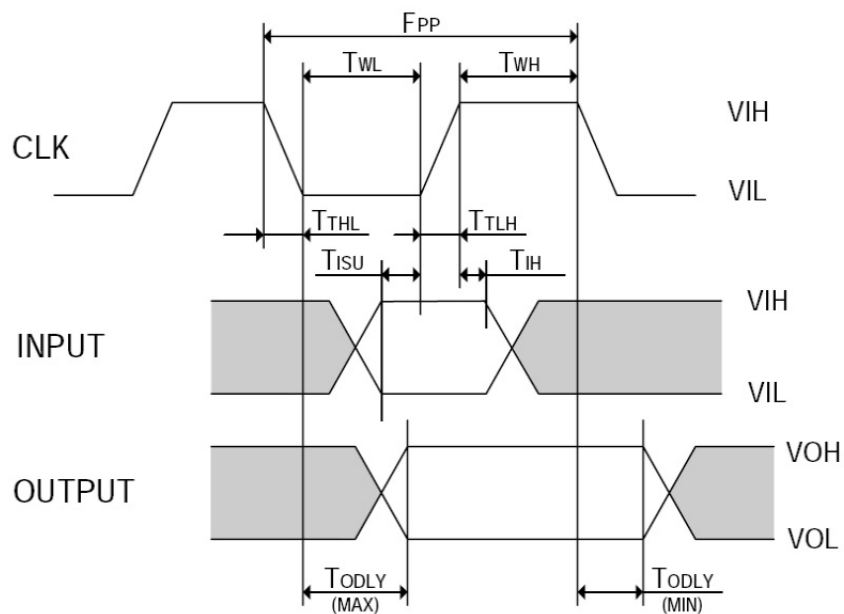


Figure 6. AC timing diagram

Table 5. AC characteristics

Item	Symbol	Min.	Max.	Unit	Note
Clock Frequency (In any State)	$F_{sty}$	0	50	MHz	$C_L < 100\text{pF}$
Clock Frequency (Data Transfer Mode)	$F_{PP}$	0	50	MHz	$C_L < 100\text{pF}$
Clock Frequency (Card Identification Mode)	$F_{OD}$	$0_{(1)}/100$	400	kHz	$C_L < 250\text{pF}$
Clock Low Time	$T_{WL}$	10	-	ns	$C_L < 100\text{pF}$
Clock High Time	$T_{WH}$	10	-	ns	
Clock Rise Time	$T_{TLH}$	-	10	ns	
Clock Fall Time	$T_{THL}$	-	10	ns	
Input Setup Time	$T_{ISU}$	5	-	ns	$C_L < 25\text{pF}$
Input Hold Time	$T_{IH}$	5	-	ns	
Output Delay Time	$T_{ODLY}$	0	14	ns	

## 4.0 Internal Card Information

### 4.1 Security Information

*Media Key Block (MKB)* and *Media ID* are Toshiba copy protection technologies that comply with the CPRM specification. This data security information is NOT development information available for evaluation. The Host System must be compliant with the CPRM specification to use these security functions. This information is kept confidential for security reasons.

### 4.2 SD Card Registers

The Delkin SD card supports six registers—OCR, CID, CSD, RCA, SCR, and SD Status. The registers OCR, CID, CSD, RCA, and SCR are MMC-compatible. The SD Status register is SD card-specific.

**Note:** The DSR register IS NOT SUPPORTED in this card.

**Table 6. SD card Registers**

Register Name	Bit Width	Description
OCR	32	Operation Condition (VDU Voltage Profile and Busy Status Information)
CID	128	Card Identification information
CSD	128	Card specific information
RCA	16	Relative Card Address
DSR	16	Not Implemented (Programmable Card Driver): Driver Stage Register
SCR	64	SD Memory Cards special features
SD Status	512	Status bits and Card features