DELKIN DEVICES®

SLC Industrial Secure Digital (SD/SDHC) Card

Engineering Specification

Including

ELC
Extended Life Cycle

Products

Document Number L5ENG00432 Rev. B

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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, 8GB and 16GB
- 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 Industrial Operating Temperature	-40°C ~ 85°C

1.2 Performance

Parameter	Value
Data Transfer Rate*	Up to 25 MB/sec
Sustained Read*	Up to 24 MB/sec
Sustained Write*	Up to 21 MB/sec

*Dependent on card configuration and test equipment / software.

1.3 Reliability

Parameter	Value
Endurance Cycle*	Raw flash rated for 60,000 P/E cycles Actual cycles will depend on usage model
MTBF**	2,000,000 hours at 0°C
Data Retention	10 Years

** Dependent on configuration and testing environment

1.4 Environmental Characteristics

Parameter	Value
Shock	10g'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 Industrial Grade (-40 ~ 85°C) Delkin SD cards

Capacity*	Part Number
128MB	SE12TFJHL-C1000-D
256MB	SE25TFKHL-C1000-D
512MB	SE51TFLHL-C1000-D
1GB	SE0GTFHHL-C1000-D
2GB	SE02TFNHL-C1000-D or SE02TFHHL-C1000-D
4GB	SE04TFPHL-C6000-D or SE04TFNHL-C6000-D or SE04TGPYB-C6000-D
8GB	SE08TFPHL-C6000-D
16GB	SE16MGFHL-C6000-D

1.6 Extended Life Cycle (ELC) Family

Delkin Devices' Extended Life Cycle (ELC) product line is aimed at applications requiring product stability for three, five or even up to ten years, utilizing long-life cycle flash and controller components. As opposed to consumer-grade solutions that can change every 3 – 6 months, Delkin will deliver the same controlled storage solution for the life of your project, eliminating costly re-qualifications. ELC products are ideal for medical, military, automotive & other industrial applications with extended product life cycles and stringent change management protocols.

1.6.1 ELC Capacities and Part Numbers

Capacity *	Product Grade	Part Number
512MB	ELC Industrial (-40 to 85°C)	SE51MHVHL-C1000-5
1GB	ELC Industrial (-40 to 85°C)	SE0GMHWHL-C1000-5
2GB	ELC Industrial (-40 to 85°C)	SE02MHWHL-C1000-5

*Note: Usable capacities are within 10% of the gross capacity figures shown above, which is typical with all NAND flash devices, as a small portion of the total is needed for controller firmware and spare block reserves.

1.7 Card Dimensions

Dimension	Measurement
Length:	32 ± 0.10 mm (1.260 ±.004 in.)
Width:	24 ± 0.10 mm (0.945 ±.004 in.)
Thickness (with label area)	2.1 mm ± 0.15 mm (0.083 ± .006 in.)
Weight:	2.0 g typical

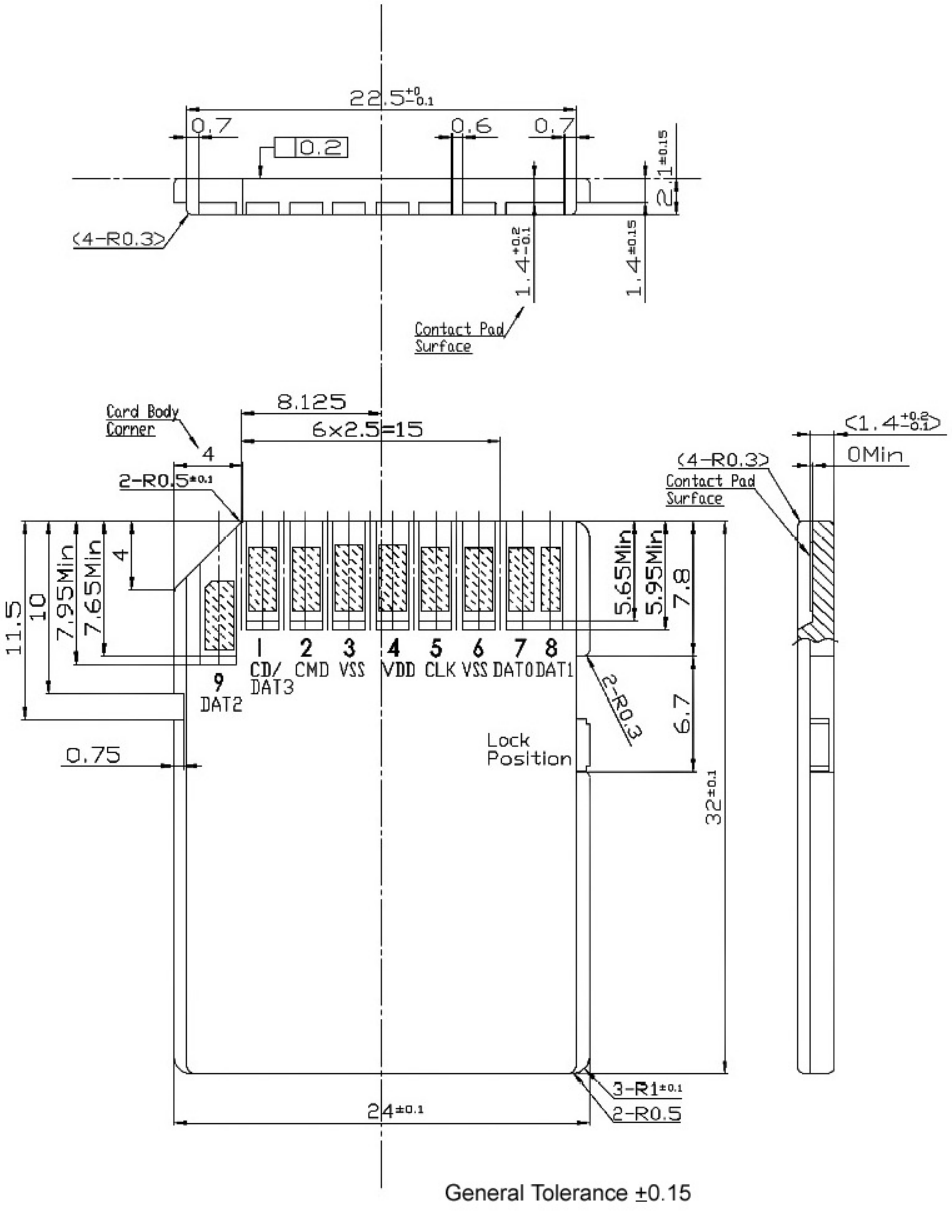

Figure 1. SD card dimensions

2.0 SD Card Interface

2.1 SD Pin Assignment

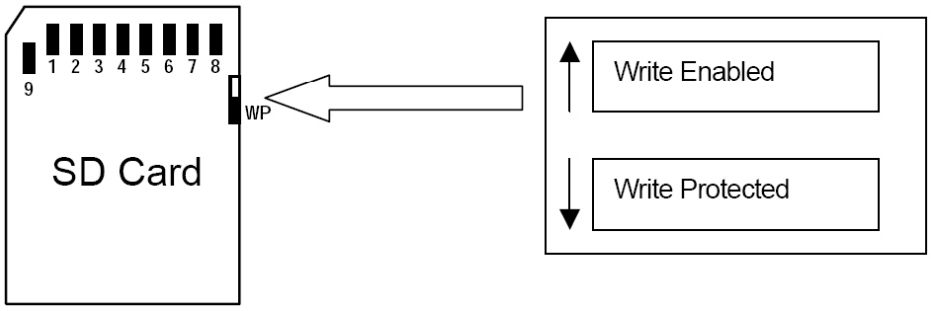

Figure 2. SD card pin designation

Table 1. SD card pin assignment

Pins	SD Mode			SPI Mode		
	Name	IO type [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 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.

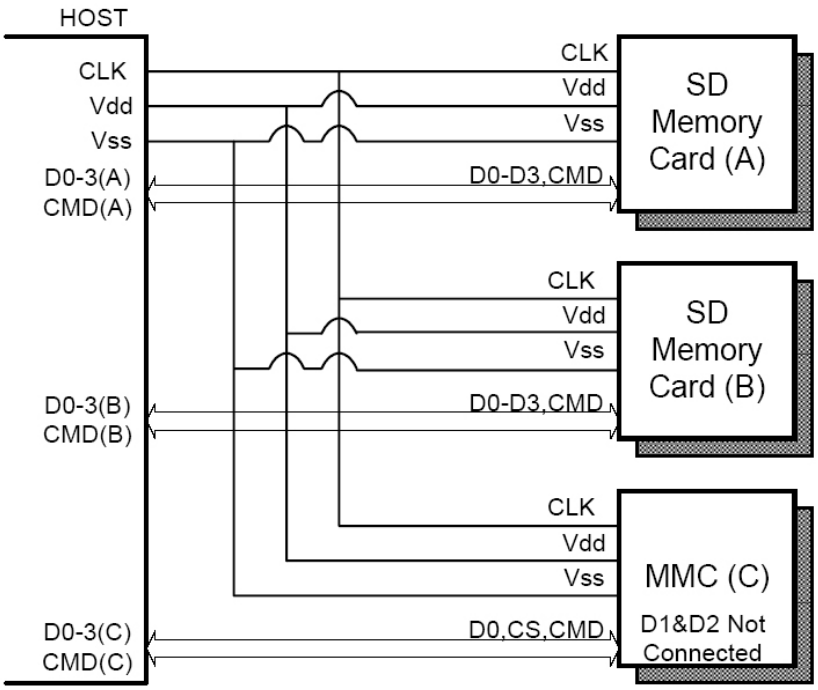

Figure 3. SD card (SD mode) connection diagram

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.

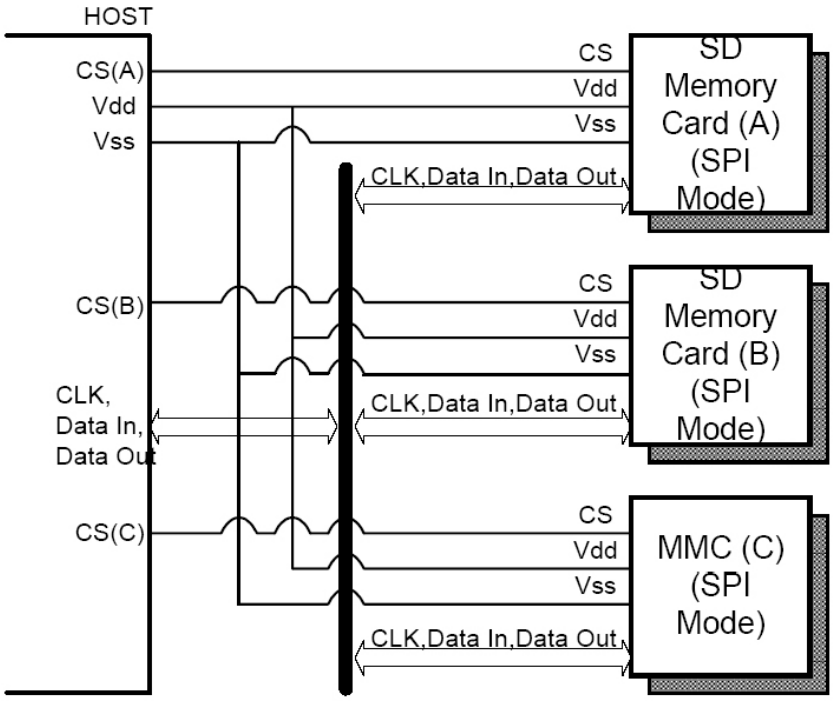

Figure 4. SD card (SPI mode) connection diagram

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

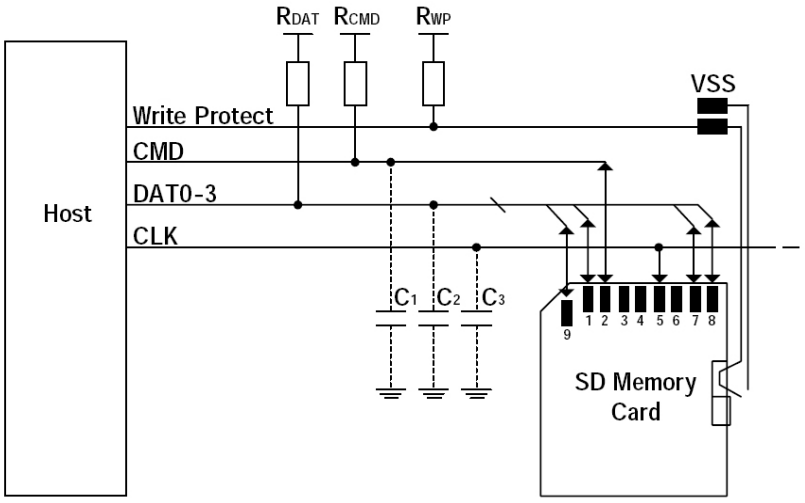

Figure 5. SD card connection diagram

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	
	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	
			3.0V Clock Stop	-	-	0.55		@25 °C
Operation Current[1]		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

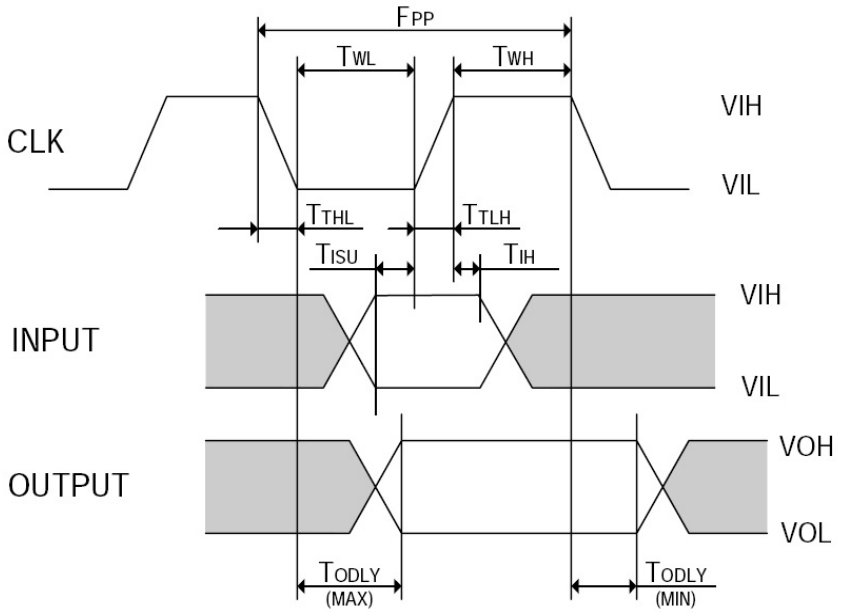

Figure 6. AC timing diagram

Table 5. AC characteristics

Item	Symbol	Min.	Max.	Unit	Note
Clock Frequency (In any State)	F_{sty}	0	50	MHz	C_L<100pF
Clock Frequency (Data Transfer Mode)	F_{PP}	0	50	MHz	C_L<100pF
Clock Frequency (Card Identification Mode)	F_{OD}	$0_{(1)}$/100	400	kHz	C_L<250pF
Clock Low Time	T_{WL}	10	-	ns	C_L<100pF
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< 25pF
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

Resister 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