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**Datasheet for:**

**SDHC/SDXC UHS104**

**microSD Cards**

PSFUSDxxxxCxxxxx\_W

*microSD Cards*

## Legal Information

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## Revision History

Date	Revision	Description	Checked by
4/15/19	A	Revised from PSUSDxxxxCxxxxxC_A Remove references to tos, change performance. Change to TLC	
10/2/19	B	Add new PN's per PSG 9/25/19. Add VWFUSD016GCEDWW PN per agile	
10/14/19	C	Add VWFUSD016GCEDWW PN per agile	
11/1/19	D	Add specs for 256GB	
11/15/19	E	Revise VWFUSD8192CEWWW to (-25to+85°C)	
1/21/20	F	Add VWUSD128GCEHWW3C VWUSD064GCE5WW3C	

## Ordering Information for the SDHC/SDXC UHS104 microSD Cards

VikingPart#	Interface	Temp	GB	Client/Ent	NAND
VWFUSD8192CEWWW	microSD Card	(-25 to +85°C)	8	Client	TSB BiCS 3D
VWFUSD016GCEDWW	microSD Card	(-25 to +85°C)	16	Client	TSB BiCS 3D
VWUSD032GCE1WW3C	microSD Card	(-25 to +85°C)	32	Client	TSB BiCS 3D TLC
VWUSD064GCE5WW3C	microSD Card	(-25 to +85°C)	64	Client	TSB BiCS 3D TLC
VWUSD128GCEHWW3C	microSD Card	(-25 to +85°C)	128	Client	TSB BiCS 3D TLC
VWFUSD064GCEAMWL	microSD Card	(-25 to +85°C)	64	Client	SanDisk MLC
VWFUSD128GCEZMWL	microSD Card	(-25 to +85°C)	128	Client	SanDisk MLC
VWFUSD256GCECMWL	microSD Card	(-25 to +85°C)	256	Client	SanDisk MLC

**Notes:**

1. Contact Viking for availability date
2. The lowercase letters x,y and z are wildcard characters that indicate product or customer specific information
3. Refer to the Viking part number coversheet or PN decoder for details.

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# 1 Introduction

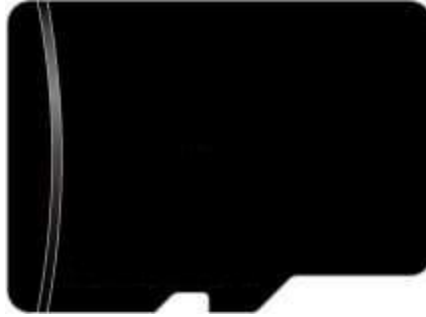
This data sheet describes the specifications of the SDHC/SDXC Standard microSD Card with UHS104 SD Bus mode. The SDHC/SDXC microSD Cards are a Memory Card of Small and Thin with SDMI compliant Security method. (SDMI: Secure Digital Music Initiative) Contents in the Card can be protected by CPRM based security. This contents security can be accomplished by SDHC/SDXC Card, host, and security application software combinations.

## 1.1 FEATURES

**Table 1-1: Features**

Media Format	
microSD Memory Card Standard	Compliant with the SD Memory Card Standard Ver. 4.20, UHS104
Security Functions	SD Security Specification Ver.2.00 Compliant (CPRM Based) *CPRM: Contents Protection for Recording Media Specification
Logical Format	SD File System Specification Ver.2.00 Compliant SDHC Card = FAT32, SDXC Card = exFAT
Electrical Features	
Operating Voltage	VDD = 2.7V(min), 3.3V(Typ), 3.6V(max)
Operating Current	SDR104 Write : 140mA(max) SDR104 Read : 150mA(max)
SD Interface	DS : Signaling Voltage = 3.3V(Typ), SDCLK = 25MHz HS : Signaling Voltage = 3.3V(Typ), SDCLK = 50MHz
UHS-I Interface	Ultra High Speed: UHS104 : Signaling Voltage = 1.8V(Typ), SDCLK = 208MHz UHS50 : Signaling Voltage = 1.8V(Typ), SDCLK = 100MHz@SDR100 / 50MHz@DDR50 Supported UHS-I bus modes are SDR104, SDR50, DDR50, SDR25, SDR12.
Physical Features	
Physical Package size /Mass	L: 15, W: 11, T: 1 (mm), Weight: 0.3g (typ.) SD Physical Layer Specification Ver.3.01 Compliant
Durability	Compliant with SD Physical Layer Specification Ver.3.01 and microSD Memory Card specification 2.01 Compliant
RoHS	Compliant with RoHS regulations (DIRECTIVE 2011/65/EU)
Performance Features	
Maximum access speed	Bus mode Sequential Write = 50 MB/s Sequential Read = 80 MB/s
Speed Class	UHS Speed Class = U3 SD Speed Class = C10, Class 4





**Figure 1-1: Top View**

## 2 microSD Card Standards Compatibility

This microSD Memory Card Specification is compliant with:

- PHYSICAL LAYER SPECIFICATION Ver.3.01 (Part1)  
(Except for Mechanical Specification)
- FILE SYSTEM SPECIFICATION Ver.2.00. (Part2)
- SECURITY SPECIFICATION Ver.2.00. (Part3)
- microSD Card Memory Card Specification Version 2.01

## 3 Physical Characteristics

### 3.1 Package Characteristics

1. Mold Material: Epoxy Resin+Silicon Dioxide
2. Flameproof Grade: V-0(UL94)
3. Heatproof Temperature: approx.400 degrees

### 3.2 Environmental Characteristics

The standard Operation Conditions are:

- Absolute Maximum Temperature Range
- Humidity less than RH = 95 %, Non condensed

Ta = -25 to +85°C

Ta = 25°C

The standard Storage Conditions are:

- Maximum Temperature Range:
- Humidity less than RH = 93%, Non condensed

Tstg = -40 to +85°C

Ta = 40°C

### 3.3 Physical Characteristics

#### 1) Hot Insertion or Removal

The microSD Card can be removed or inserted without power off from the host system as described in the SD Physical Layer Specification 6.1

The connector will recognize the Hot Insertion or Removal is defined in the 6.2 of the PHYSICAL LAYER SPECIFICATION.

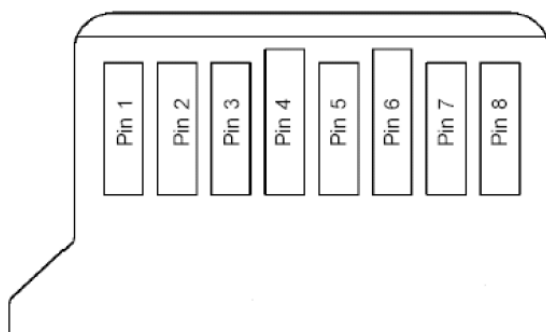
#### 2) Mechanical Write Protect Switch

The microSD memory Card has no mechanical write protect switch.

## 4 Electrical Interface

### 4.1 Pin Assignment

The table below describes the pin assignment of the microSD card. The following figure describes the pin assignment of the microSD card. Please refer to the detail descriptions by SD Card Physical Layer Specification.



**Figure 4-1: microSD Card Pin Assignment (Back view of the Card)**

**Table 4-1: microSD Card Pin Assignment**

Pin	SD Mode			SPI Mode		
	Name	IO Type	Description	Name	IO Type	Description
1	DAT2	I/O/PP	Data Line[Bit2]	RSV		
2	CD/ DAT3	I/O/ PP	Card Detect/ Data Line[Bit3]	CS	I	Chip Select (Negative True)
3	CMD	PP	Command/Response	DI	I	Data In
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>SS</sub>	S	Ground	V <sub>SS</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(*)

**Notes:**

S: Power Supply

I: Input

O: Output using push-pull drivers

PP: I/O using push-pull drivers

(\*) These signals should be pulled up by host side with 10-100k ohm resistance in the SPI Mode.

## 4.2 microSD Card Bus Topology

The device supports two alternative communication protocols: SD and SPI Bus Mode. It is as same as standard microSD memory cards. Host System can choose either one of modes. Same Data of the device 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.

### 4.2.1 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 Device will use only DAT0. After initialization, host can change the bus width. Multiplied microSD 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 tradeoff 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:**

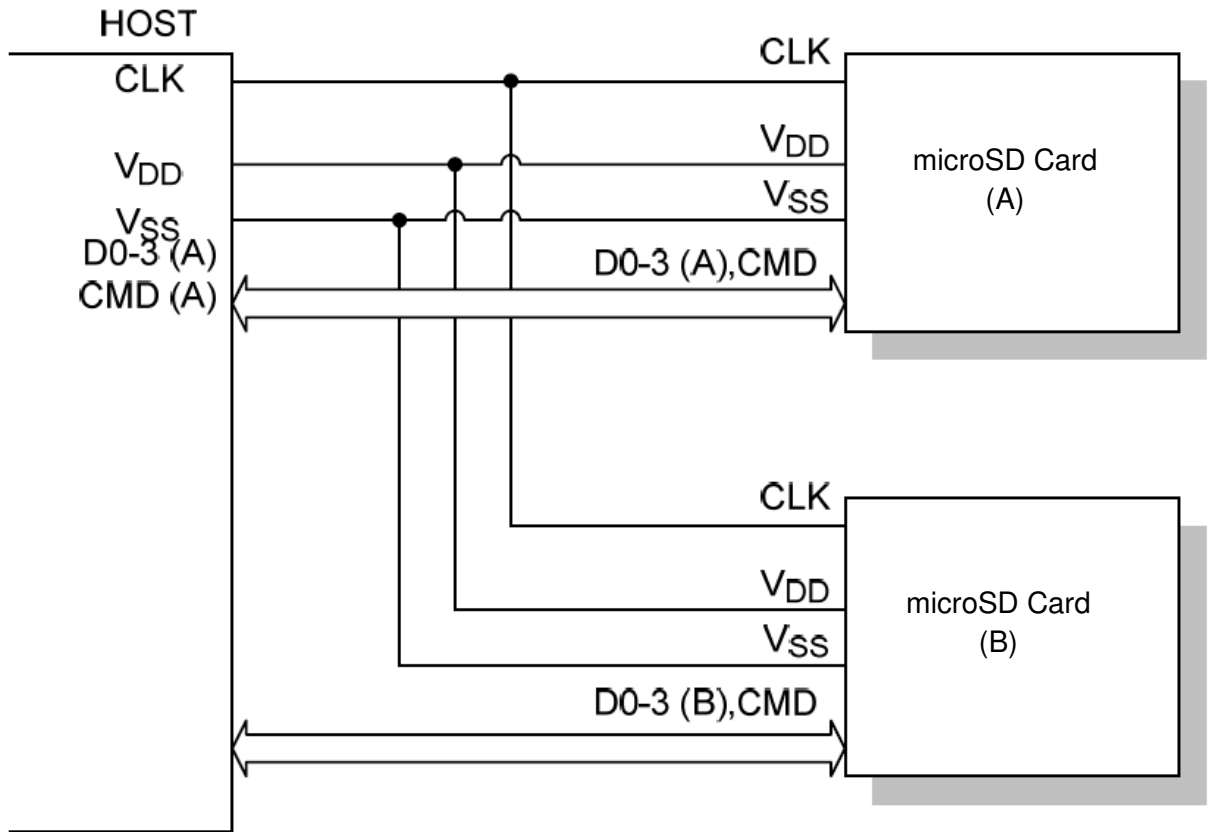
Commands are transferred serially on the CMD line. A command is a token to starts an operation from host to the card. Commands are sent to an addressed single card (addressed Command) or to all connected cards (Broad cast command).

**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.



**Figure 4-2: Bus Connection Diagram (SD Mode)**

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

**Table 4-2: SD Mode Command Set ( + = Implemented, - = Not Implemented)**

CMD Index	Abbreviation	Implementation	Note
CMD0	GO_IDLE_STATE	+	
CMD2	ALL_SEND_CID	+	
CMD3	SEND_RELATIVE_ADDR	+	
CMD4	SET_DSR	-	DSR Register is not implemented.
CMD6	SWITCH_FUNC	+	
CMD7	SELECT/DESELECT_CARD	+	
CMD8	SEND_IF_COND	+	
CMD9	SEND_CSD	+	
CMD10	SEND_CID	+	
CMD11	VOLTAGE_SWITCH	+	UHS-I mode

CMD Index	Abbreviation	Implementation	Note
CMD12	STOP_TRANSMISSION	+	
CMD13	SEND_STATUS	+	
CMD15	GO_INACTIVE_STATE	+	
CMD16	SET_BLOCKLEN	+	
CMD17	READ_SINGLE_BLOCK	+	
CMD18	READ_MULTIPLE_BLOCK	+	
CMD19	SEND_TUNING_PATTERN	+	UHS-I mode
CMD20	SPEED_CLASS_CONTROL	+	For SDHC/SDXC
CMD23	SET_BLOCK_COUNT	+	
CMD24	WRITE_BLOCK	+	
CMD25	WRITE_MULTIPLE_BLOCK	+	
CMD26	Reserved for Manufacturer	+	
CMD27	PROGRAM_CSD	+	
CMD28	SET_WRITE_PROT	-	Internal Write Protection is not implemented.
CMD29	CLR_WRITE_PROT	-	
CMD30	SEND_WRITE_PROT	-	
CMD32	ERASE_WR_BLK_START	+	
CMD33	ERASE_WR_BLK_END	+	
CMD38	ERASE	+	
CMD42	LOCK_UNLOCK	+	
CMD55	APP_CMD	+	
CMD56	GEN_CMD	+	This command is not specified.
CMD60	Reserved for Manufacturer	+	
CMD61	Reserved for Manufacturer	+	
CMD62	Reserved for Manufacturer	+	
ACMD6	SET_BUS_WIDTH	+	
ACMD13	SD_STATUS	+	
ACMD22	SEND_NUM_WR_BLOCKS	+	
ACMD23	SET_WR_BLK_ERASE_COUNT	+	
ACMD41	SD_SEND_OP_COND	+	1.8V Signaling and XPC (SDXC Power Control) support
ACMD42	SET_CLR_CARD_DETECT	+	
ACMD51	SEND_SCR	+	
ACMD18	SECURE_READ_MULTI_BLOCK	+	
ACMD25	SECURE_WRITE_MULTI_BLOCK	+	
ACMD26	SECURE_WRITE_MKB	+	
ACMD38	SECURE_ERASE	+	
ACMD43	GET_MKB	+	
ACMD44	GET_MID	+	
ACMD45	SET_CER_RN1	+	
ACMD46	GET_CER_RN2	+	
ACMD47	SET_CER_RES2	+	
ACMD48	GET_CER_RES1	+	
ACMD49	CHANGE_SECURE_AREA	-	

**Notes:**

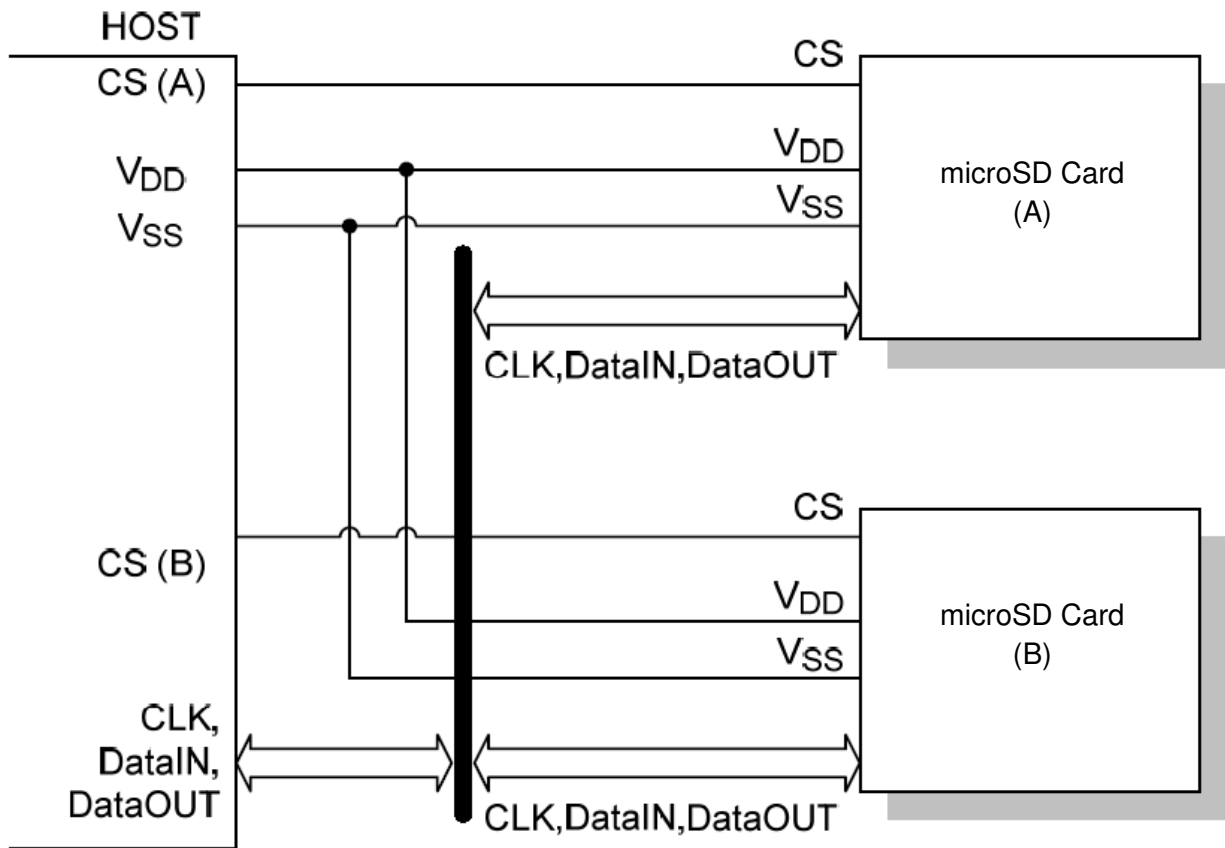
- CMD28, 29 and CMD30 are optional commands.
- CMD4 is not implemented because DSR register (Optional Register) is not implemented.
- CMD56 is a vender specific command which is not defined in the standard card.

### 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 microSD 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 effort. Especially, the 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.)



**Figure 4-3: Bus Connection Diagram (SPI Mode)**

CS	Card Select Signal
CLK	Host card Clock signal
CMD	Bi-directional Command/ Response Signal
DataIN	Host to card data line
DataOUT	Host to card data line
VDD	Power supply
VSS	GND

**Table 4-3: SPI Mode Command Set ( + = Implemented, - = Not Implemented)**

CMD Index	Abbreviation	Implementation	Note
CMD0	GO_IDLE_STATE	+	
CMD1	SEND_OP_COND	+	NOTICE: DO NOT USE
CMD6	SWITCH_FUNC	+	
CMD8	SEND_IF_COND	+	
CMD9	SEND_CSD	+	
CMD10	SEND_CID	+	
CMD12	STOP_TRANSMISSION	+	
CMD13	SEND_STATUS	+	
CMD16	SET_BLOCKLEN	+	

CMD Index	Abbreviation	Implementation	Note
CMD17	READ_SINGLE_BLOCK	+	
CMD18	READ_MULTIPLE_BLOCK	+	
CMD24	WRITE_BLOCK	+	
CMD25	WRITE_MULTIPLE_BLOCK	+	
CMD26	Reserved for Manufacturer	+	
CMD27	PROGRAM_CSD	+	
CMD28	SET_WRITE_PROT	-	Internal Write Protection is not implemented.
CMD29	CLR_WRITE_PROT	-	
CMD30	SEND_WRITE_PROT	-	
CMD32	ERASE_WR_BLK_START	+	
CMD33	ERASE_WR_BLK_END	+	
CMD38	ERASE	+	
CMD42	LOCK_UNLOCK	+	
CMD55	APP_CMD	+	
CMD56	GEN_CMD	+	This command is not specified.
CMD58	READ_OCR	+	
CMD59	CRC_ON_OFF	+	
CMD60	Reserved for Manufacturer	+	
ACMD13	SD_STATUS	+	
ACMD22	SEND_NUM_WR_BLOCKS	+	
ACMD23	SET_WR_BLK_ERASE_COUNT	+	
ACMD41	SD_SEND_OP_COND	+	
ACMD42	SET_CLR_CARD_DETECT	+	
ACMD51	SEND_SCR	+	
ACMD18	SECURE_READ_MULTI_BLOCK	+	
ACMD25	SECURE_WRITE_MULTI_BLOCK	+	
ACMD26	SECURE_WRITE_MKB	+	
ACMD38	SECURE_ERASE	+	
ACMD43	GET_MKB	+	
ACMD44	GET_MID	+	
ACMD45	SET_CER_RN1	+	
ACMD46	GET_CER_RN2	+	
ACMD47	SET_CER_RES2	+	
ACMD48	GET_CER_RES1	+	

**Notes:**

- CMD28, 29 and CMD30 are optional commands.
- CMD56 is a vendor specific command which is not defined in the standard card.



### 4.3 Initialization

The flow chart for UHS-I hosts and the sequence of commands to perform a signal voltage switch is shown below. Red and yellow boxes are new procedures to initialize the UHS-I card.

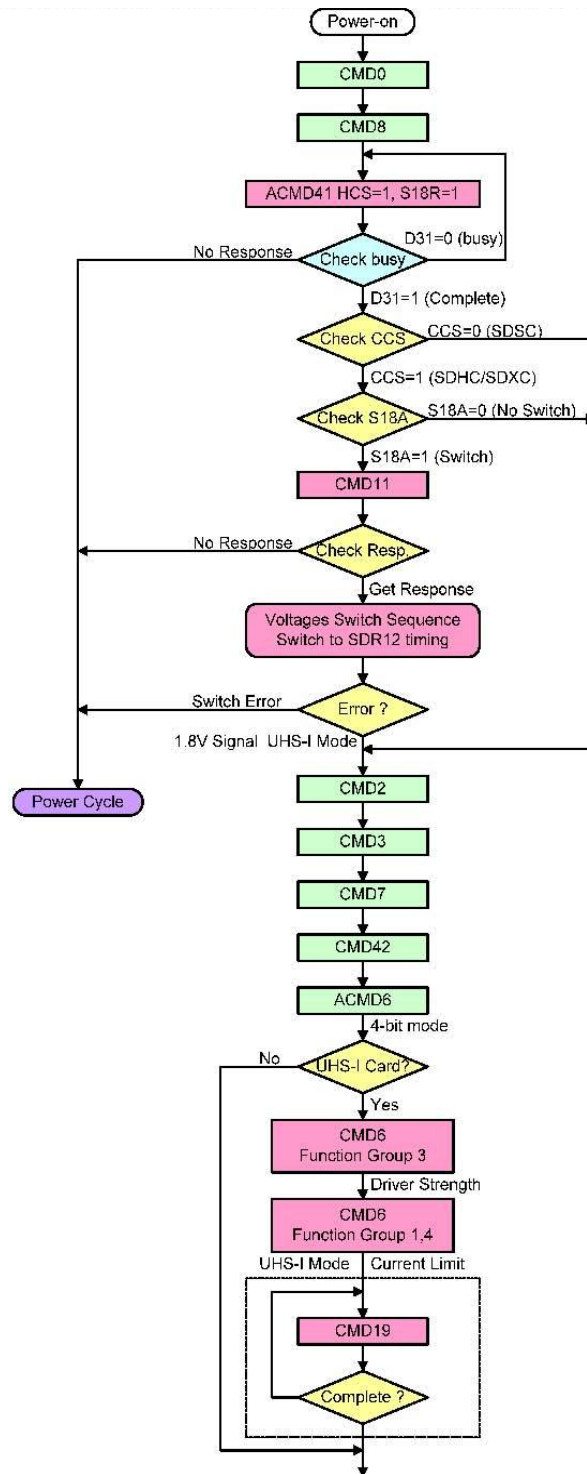
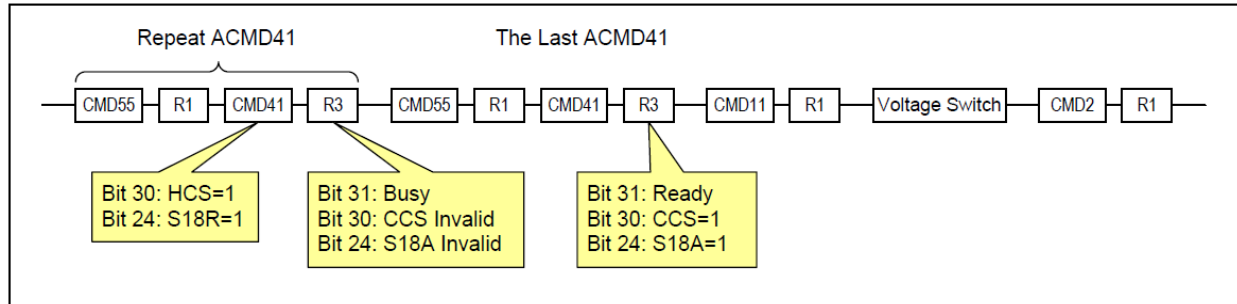


Figure 4-4: UHS-I Host Initialization Flow Chart



**Figure 4-5: ACMD41 Timing Followed by Signal Voltage Switch Sequence**

1) POWER ON: Supply Voltage for initialization.

Host System applies the operating Voltage to the card. Apply more than 74 cycles of Dummy-clock to the microSD card.

2) Select operation mode (SD mode or SPI mode)

In the case of SPI mode operation, the host should drive pin 1 (CD/DAT3) of the microSD Card I/F to a “Low” level. Then, issue CMD0. In the case of SD mode operation, the host should drive or detect pin 1 of the microSD Card I/F (Pull up register of pin 1 is pull up to “High” normally). The card maintains selected operation mode except re-issue of CMD0 or power on below is SD mode initialization procedure.

3) Send Interface condition command (CMD8).

When the card is in the Idle state, the host shall issue CMD8 before ACMD41. In the argument, 'voltage supplied' is set to the host supply voltage and 'check pattern' is set to any 8-bit pattern. The card that accepted the supplied voltage returns R7 response. In the response, the card echoes back both the voltage range and check pattern set in the argument. If the card does not support the host supply voltage, it shall not return response and stays in the Idle state.

4) Send initialization command (ACMD41).

When the signaling level is 3.3V, the host repeats an issue ACMD41 with HCS=1 and S18R=1 until the response indicates ready. The argument (HCS and S18R) of the first ACMD41 is effective but the all the following ACMD41 should be issued with the same argument. If Bit 31 indicates ready, the host needs to check CCS and S18A. The card indicates S18A=0, which means that the voltage switch is not allowed and the host needs to use the current signaling level.

**Table 4-4:S18R and S18A Combinations**

Current Signaling Level	18R	S18A	Comment
3.3V	0	0	1.8V signaling is not requested
	1	0	The card does not support 1.8V signaling
	1	1	Start signal voltage switch sequence
1.8V	X	0	Already switched to 1.8V

**5) Send voltage switch command (CMD11)**

S18A=1 means that the voltage switch is allowed and host issues CMD11 to invoke voltage switch sequence. By receiving CMD11, the card returns R1 response and start voltage switch sequence. No response of CMD11 means that S18A was 0 and therefore the host should not have sent CMD11. Completion of voltage switch sequence is checked by high level of DAT[3:0]. Any bit of DAT[3:0] can be checked depends on ability of the host. The card enters UHS-I mode and card input and output timings are changed (**SDR12 in default**) when the voltage switch sequence is completed successfully.

**6) Send ALL SEND CID command (CMD2) and get the Card ID (CID)****7) Send SEND RELATIVE ADDR (CMD3) and get the RCA.**

RCA value is randomly changed by access, not equal zero.

**8) Send SELECT / DESELECT CARD command (CMD7) and move to the transfer state.**

When entering tran state, **CARD\_IS\_LOCKED** status in the R1 response should be checked (it is indicated in the response of CMD7). If the **CARD\_IS\_LOCKED** status is set to 1 in the response of CMD7, CMD42 is required before ACMD6 to unlock the card. ( If the card is locked, CMD42 is required to unlock the card. ) If the card is unlocked, CMD42 can be skipped.

**9) Send SET BUS WIDTH command (ACMD6).**

**UHS-I supports only 4-bit mode.** Host shall select 4-bit mode by ACMD6. If the card is locked, host needs to unlock the card by CMD42 in 1-bit mode and then needs to issue ACMD6 to change 4-bit bus mode. Operating in 1-bit mode is not assured.

**10) Set driver strength.**

CMD6 mode 0 is used to query which functions the card supports, and to identify the maximum current consumption of the card under the selected functions. In case of UHS-I card, appropriate **driver strength (default is Type-B buffer)** is selected by **CMD6 Function Group 3**.

**11) Set UHS-I mode current limit.**

**UHS-I modes ( Bus Speed Mode )** is selected by **CMD6 Function Group**

- Current limit** is selected by **CMD6 Function Group 4**.

Maximum access settings:

SDR104 = (CMD6 Function Group 1 = 3-h, CMD6 Function Group 4 = 0-h(\*))

SDR50 = (CMD6 Function Group 1 = 2-h, CMD6 Function Group 4 = 0-h(\*))

DDR50 = (CMD6 Function Group 1 = 4-h, CMD6 Function Group 4 = 0-h(\*))

(\* The Current Limit is default value (200mA).

**Note:**

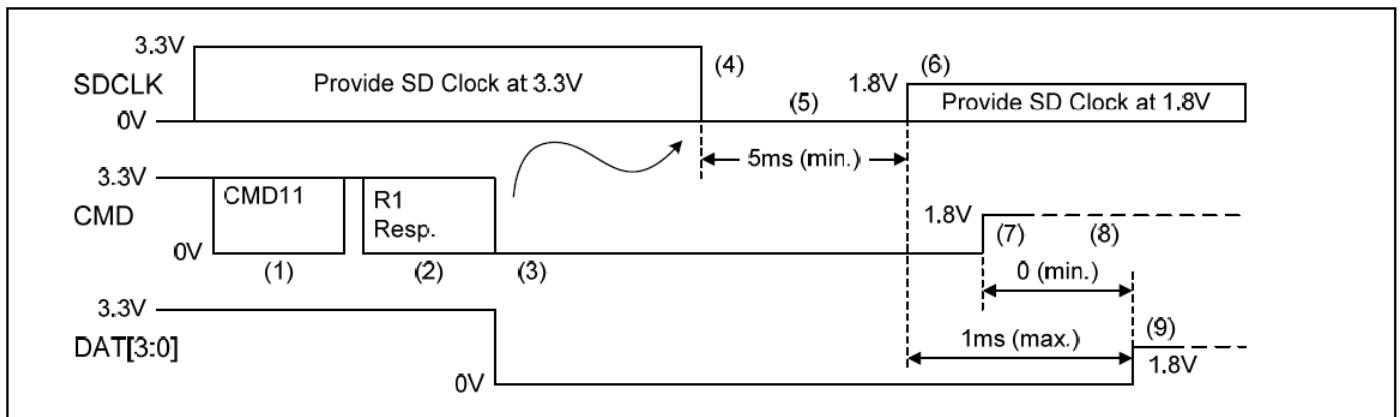
Function Group 4 is defined as Current Limit switch for SDR50, SDR104. The Current Limit does not act on the card in SDR12 and SDR25. The default value of the Current Limit is 200mA (minimum setting). Then after selecting one of SDR50, SDR104 mode by Function Group 1, host needs to change the Current Limit to enable the card to operate in higher performance. This value is determined by a host power supply capability to the card, heat release method taken by a host and the maximum current of a connector.

**12) Tuning of sampling point**

CMD19 sends a tuning block to the host to determine sampling point. In SDR50 and SDR104 modes, if tuning of sampling point is required, CMD19 is repeatedly issued until tuning is completed. Then the Host can access the Data between the microSD card as a storage device.

**Application Notes:**

- 1.The host shall set ACMD41 timeout to more than 1 second to abort repeat of issuing ACMD41 when the card does not indicate ready. The timeout count starts from the first ACMD41 which is set voltage window in the argument.
- 2.Once the signal voltage is switched to 1.8V, the card continues 1.8V signaling regardless of CMD0. Power cycle resets the signal voltage to 3.3V. After switching 1.8V signaling, the card cannot be changed to SPI mode.
- 3.Timing to Switch Signal Voltage To change signaling level at the same time between host and card, signal voltage switch sequence is invoked by CMD11 as shown in the figure below. CMD11 is issued only when S18A=1 in the response of ACMD41.



**Figure 4-6: Signal Voltage Switch Sequence**

**Steps that the host takes to start a voltage switch sequence.**

1. The host issues CMD11 to start voltage switch sequence.
2. The card returns R1 response.
3. The card drives CMD and DAT[3:0] to "low" immediately after the response.
4. The host stops supplying SDCLK. The card shall start switching voltage after host stops SDCLK. The

- time to stop SDCLK is not specified. The host can detect whether the sequence starts by checking signal level of either one of CMD, DAT[3:0]. What signal should be checked will depend on the ability of the host. If low level is not detected, the host should abort the sequence and execute power cycle.
- 1.8V output of voltage regulator in card shall be stable within 5ms. The Host keeps SDCLK low at least 5ms. This means that 5ms is the maximum for the card and the minimum for the host.
  - After 5ms from (step 4) and host voltage regulator is stable, the host starts providing SDCLK at 1.8V. The card can check whether SDCLK voltage is 1.8V.
  - By detecting SDCLK, the card drives CMD to high at 1.8V for at least one clock and then stops driving (tri-state). CMD is triggered by rising edge of SDCLK (SDR timing).
  - The card can check whether host drives CMD to 1.8V through the host pull-up resistor.
  - If switching to 1.8V signaling is completed successfully, the card drives DAT[3:0] to high at 1.8V at least one clock and then stop driving (tri-state). DAT[3:0] is triggered by rising edge of SDCLK (SDR timing). DAT[3:0] shall be high within 1ms from start of providing SDCLK. Host check whether DAT[3:0] is high after 1ms from supplying SDCLK. This means that 1ms is the maximum for the card and the minimum for the host.

#### 4.4 Electrical Characteristics

(SD Bus Mode)

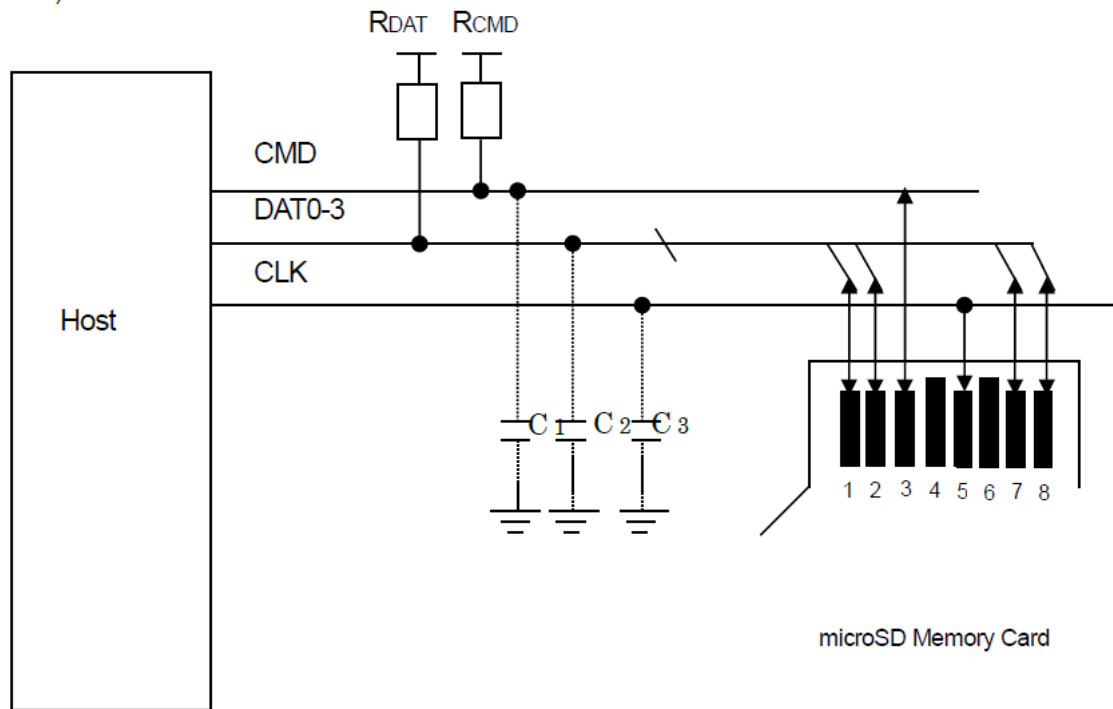


Figure 4-7: microSD Card Connection Diagram

##### 4.4.1 Absolute Maximum Conditions

Table 4-5: Absolute Maximum Conditions

Item	Symbol	Value	Unit
Supply Voltage	V <sub>DD</sub>	-0.3 to 3.9	V
Input Voltage	V <sub>IN</sub>	-0.3 to V <sub>DD</sub> +0.3 (≤3.9)	V

## 4.4.2 DC Characteristics

**Table 4-6: DC Characteristics**

Item		Symbol	Condition	MIN.	Typ.	MAX.	Unit		
Supply Voltage		V <sub>DD</sub>	-	2.7	-	3.6	V		
3.3V Signaling	Input Voltage	High Level		V <sub>DD</sub> *0.625	-	-	V		
		Low Level		-	-	V <sub>DD</sub> *0.25	V		
	Output Voltage	High Level	I <sub>OH</sub> = -2mA	V <sub>DD</sub> *0.75	-	-	V		
		Low Level	I <sub>OL</sub> = 2mA	-	-	V <sub>DD</sub> *0.125	V		
1.8V Signaling	Input Voltage	High Level	-	1.27	-	2	V		
		Low Level		-	-	0.58	V		
	Output Voltage	High Level	I <sub>OH</sub> = -2mA	1.4	-	-	V		
		Low Level	I <sub>OL</sub> = 2mA	-	-	0.45	V		
Standby Current		I <sub>CCS</sub>	V <sub>DD</sub> = 3.6V Clock Stop	-	-	400	uA		
32GB				-	-	450			
64GB 128GB 256GB				-	-	650			
Operation Read Current (peak)		I <sub>CCOP1</sub>	SDR104 Current Limit = 200mA, 400mA V <sub>DD</sub> = 3.6V	-	-	170	mA		
32GB 64GB 128GB 256GB				SDR50 Current Limit = 200mA, 400mA V <sub>DD</sub> = 3.6V	-	-		155	
					DDR50 Current Limit = 200mA, 400mA V <sub>DD</sub> = 3.6V	-		-	155
						SDR25, HS V <sub>DD</sub> = 3.6V		-	-

Item	Symbol	Condition	MIN.	Typ.	MAX.	Unit	
		SDR12, DS V <sub>DD</sub> = 3.6V	-	-	125		
Operation Write Current (peak)	32GB 64GB 128GB 256GB	I <sub>CCOP1</sub> 1	SDR104 Current Limit = 200mA, 400mA V <sub>DD</sub> = 3.6V	-	-	220	mA
			SDR50 Current Limit = 200mA, 400mA V <sub>DD</sub> = 3.6V	-	-	205	
			DDR50 Current Limit = 200mA, 400mA V <sub>DD</sub> = 3.6V	-	-	205	
Operation Read Current (average)	32GB 64GB 128GB 256GB	I <sub>CCOP2</sub> 2	SDR104 Current Limit = 200mA, 400mA V <sub>DD</sub> = 3.6V	-	-	130	mA
			SDR50 Current Limit = 200mA, 400mA V <sub>DD</sub> = 3.6V	-	-	100	
			DDR50 Current Limit = 200mA, 400mA V <sub>DD</sub> = 3.6V	-	-	95	
			SDR25, HS V <sub>DD</sub> = 3.6V	-	-	80	
			SDR12, DS V <sub>DD</sub> = 3.6V	-	-	70	

Item	Symbol	Condition	MIN.	Typ.	MAX.	Unit	
Operation Write Current (average)	32GB 64GB 128GB 256GB	I <sub>CCOP2.2</sub>	SDR104 Current Limit = 200mA, 400mA V <sub>DD</sub> = 3.6V	-	-	145	mA
			SDR50 Current Limit = 200mA, 400mA V <sub>DD</sub> = 3.6V	-	-	115	
			DDR50 Current Limit = 200mA, 400mA V <sub>DD</sub> = 3.6V	-	-	110	
			SDR25, HS V <sub>DD</sub> = 3.6V	-	-	90	
			SDR12, DS V <sub>DD</sub> = 3.6V	-	-	75	

**Notes:** Peak Current RMS value over a 10usec period. 2) Average Current value over 1second period.

**Table 4-7: Bus Operating Conditions - Signal Line's Load**

Parameter	Symbol	Min.	Max.	Unit	Remark
Pull-up resistance	R <sub>CMD</sub> R <sub>DAT</sub>	10	100	kΩ	To prevent bus floating
Total bus capacitance for each signal line	C <sub>L</sub>		40	pF	1 card C <sub>HOST</sub> +C <sub>BUS</sub> shall not exceed 30 pF
Card capacitance for each signal pin	C <sub>CARD</sub>		10	pF	
Maximum signal line inductance			16	nH	
Pull-up resistance inside card (pin1)	R <sub>DAT3</sub>	10	90	kΩ	May be used for card detection
Capacity Connected to Power Line	C <sub>C</sub>		5	uF	To prevent inrush current

**Table 4-8: Threshold Level 1.8V Signaling**

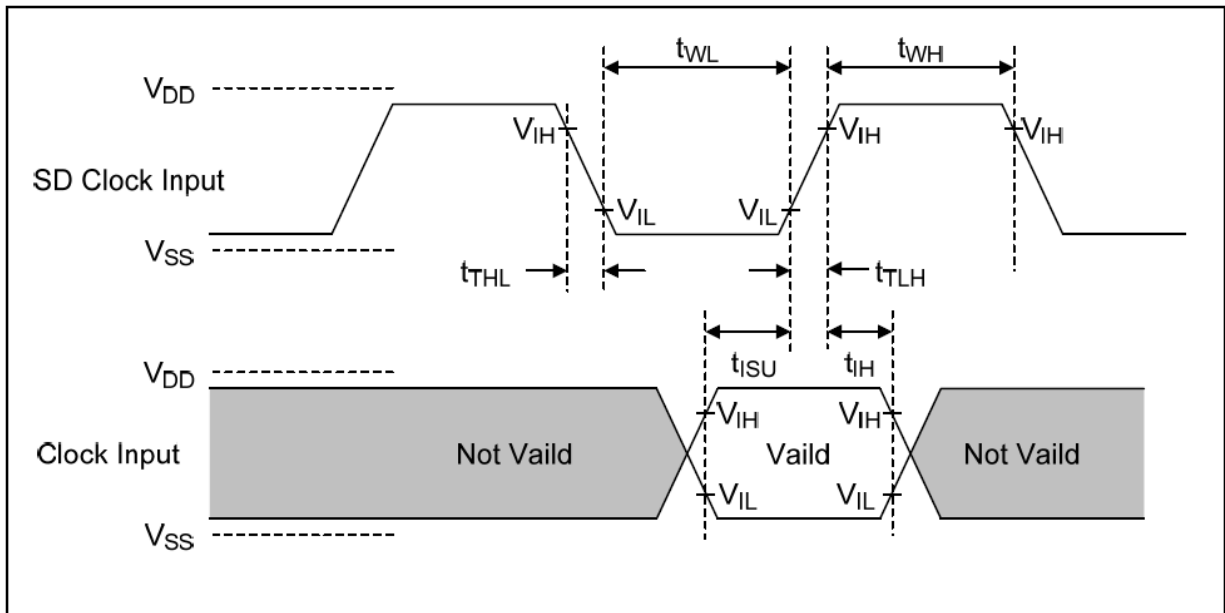


Parameter	Symbol	Min.	Max.	Unit	Remark
Supply Voltage	$V_{DD}$	2.70	3.60	V	
Regulator Voltage	$V_{DDIO}$	1.70	1.95	V	Generated by $V_{DD}$
Output High Voltage	$V_{OH}$	1.40	-	V	$I_{OH} = -2mA$
Output Low Voltage	$V_{OL}$		0.45	V	$I_{OL} = 2mA$
Input High Voltage	$V_{IH}$	1.27	2.00	V	
Input Low Voltage	$V_{IL}$	$V_{SS}-0.30$	0.58	V	

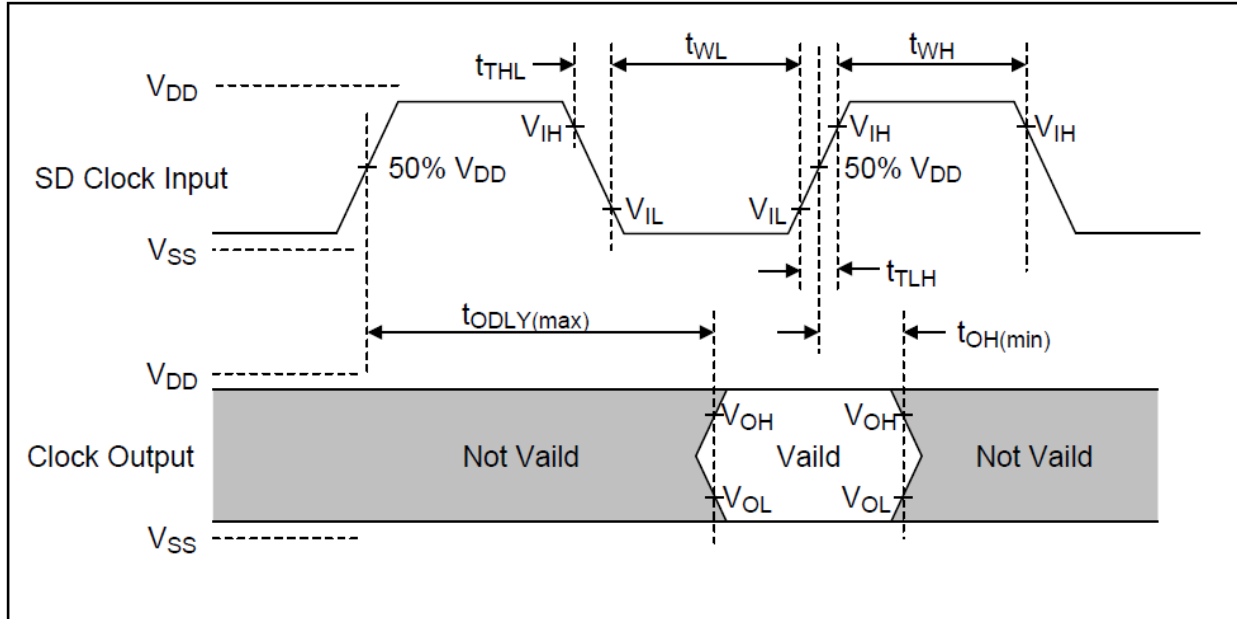
**Table 4-9: Threshold Level 1.8V Signaling**

Parameter	Symbol	Min.	Max.	Unit	Remark
Input Leakage Current		-2	2	$\mu A$	DAT3 pull-up is disconnected.

### 4.4.3 AC Characteristics (Default Speed)



**Figure 4-8: Card Input Timing (Default Speed Mode)**



**Figure 4-9: Card Output Timing (Default Speed Mode)**

**Table 4-10: Bus Timing - Parameters Values (Default Speed)**

Parameter	Symbol	Min.	Max.	Unit	Remark
<b>Clock CLK</b> (All values are referred to min ( $V_{IH}$ ) and max ( $V_{IL}$ ))					
Clock frequency Data Transfer Mode	f <sub>pp</sub>	0	25	MHz	C <sub>CARD</sub> ≤ 10 pF (1 card)
Clock frequency Identification Mode	f <sub>OD</sub>	0(1)/100	400	kHz	C <sub>CARD</sub> ≤ 10 pF (1 card)
Clock low time	t <sub>WL</sub>	10		ns	C <sub>CARD</sub> ≤ 10 pF (1 card)
Clock high time	t <sub>WH</sub>	10		ns	C <sub>CARD</sub> ≤ 10 pF (1 card)
Clock rise time	t <sub>TLH</sub>		10	ns	C <sub>CARD</sub> ≤ 10 pF (1 card)
Clock fall time	t <sub>THL</sub>		10	ns	C <sub>CARD</sub> ≤ 10 pF (1 card)
Parameter	Symbol	Min.	Max.	Unit	Remark
<b>Inputs CMD, DAT</b> (referenced to CLK)					
Input set-up time	t <sub>ISU</sub>	5		ns	C <sub>CARD</sub> ≤ 10 pF (1 card)
Input hold time	t <sub>IH</sub>	5		ns	C <sub>CARD</sub> ≤ 10 pF (1 card)
Parameter	Symbol	Min.	Max.	Unit	Remark
<b>Outputs CMD, DAT</b> (referenced to CLK)					
Output Delay time during Data Transfer Mode	t <sub>ODLY</sub>	0	14	ns	CL ≤ 40 pF (1 card)
Output Delay time during Identification Mode	t <sub>ODLY</sub>	0	50	ns	CL ≤ 40 pF (1 card)

**Note:**

1. 0 Hz means to stop the clock. The given minimum frequency range is for cases where continuous clock is required

#### 4.4.4 AC Characteristics (High Speed)

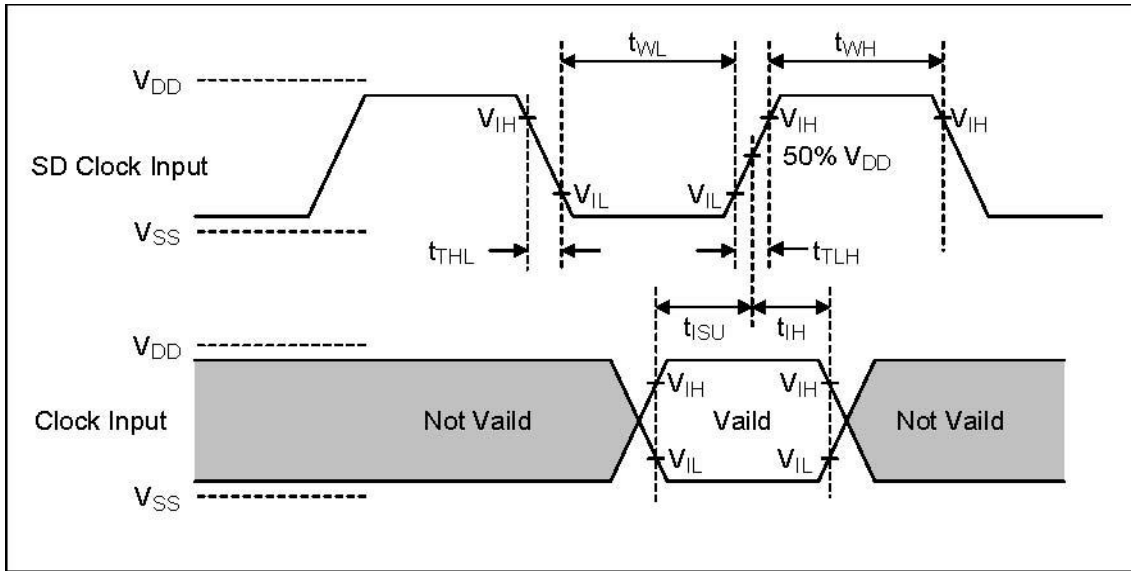


Figure 4-10: Card Input Timing (High Speed Card)

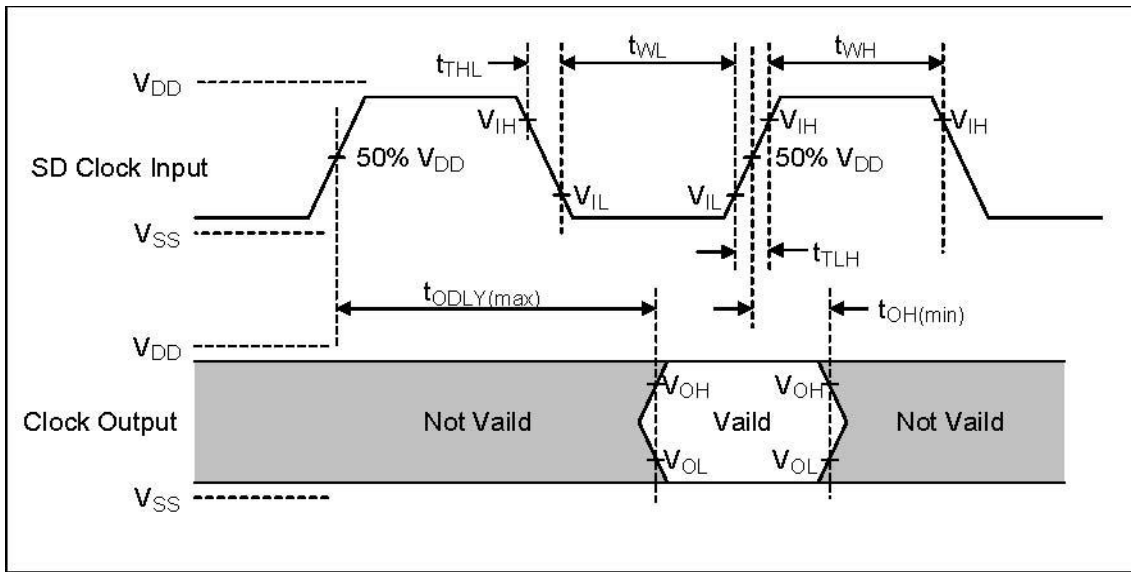


Figure 4-11: Card Output Timing (High Speed Card)

Table 4-11: Bus Timing - Parameters Values (High Speed)

Parameter	Symbol	Min.	Max.	Unit	Remark
Clock <b>CLK</b> (All values are referred to min (VIH) and max (VIL))					
Clock frequency Data Transfer Mode	f <sub>PP</sub>	0	50	MHz	C <sub>CARD</sub> ≤ 10 pF (1 card)

Parameter	Symbol	Min.	Max.	Unit	Remark
Clock low time	tWL	7		ns	C <sub>CARD</sub> ≤ 10 pF (1 card)
Clock high time	tWH	7		ns	C <sub>CARD</sub> ≤ 10 pF (1 card)
Clock rise time	tTLH		3	ns	C <sub>CARD</sub> ≤ 10 pF (1 card)
Clock fall time	tTHL		3	ns	C <sub>CARD</sub> ≤ 10 pF (1 card)
Parameter	Symbol	Min.	Max.	Unit	Remark
Inputs <b>CMD, DAT</b> (referenced to CLK)					
Input set-up time	tISU	6		ns	C <sub>CARD</sub> ≤ 10 pF (1 card)
Input hold time	tIH	2		ns	C <sub>CARD</sub> ≤ 10 pF (1 card)
Parameter	Symbol	Min.	Max.	Unit	Remark
Outputs <b>CMD, DAT</b> (referenced to CLK)					
Output Delay time during Data Transfer Mode	tODLY		14	ns	C <sub>L</sub> ≤ 40 pF (1 card)
Output Hold time	tOH	2.5		ns	C <sub>L</sub> > 15pF (1 card)
Output Delay time during Identification Mode	tODLY	0	50	ns	C <sub>L</sub> ≤ 40 pF (1 card)

#### 4.4.5 AC Characteristics (Ultra High Speed; UHS104)

##### 6.4.5.1 Bus Timing Specification <SDR104, SDR50,SDR25,SDR12>

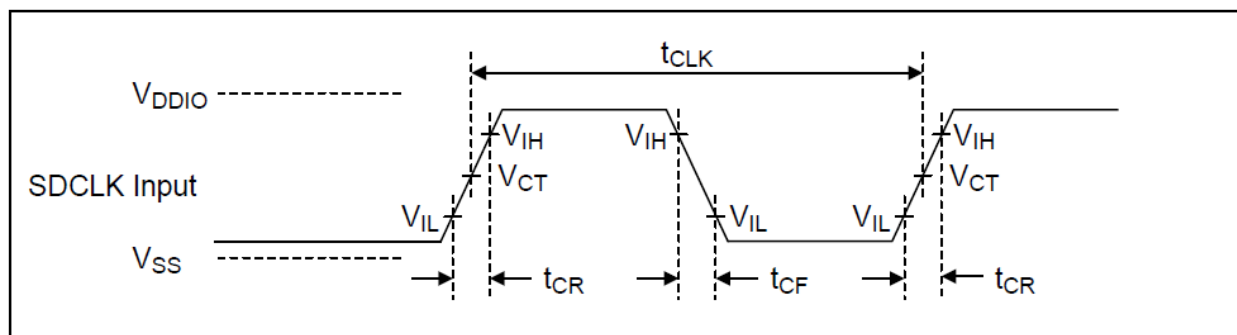
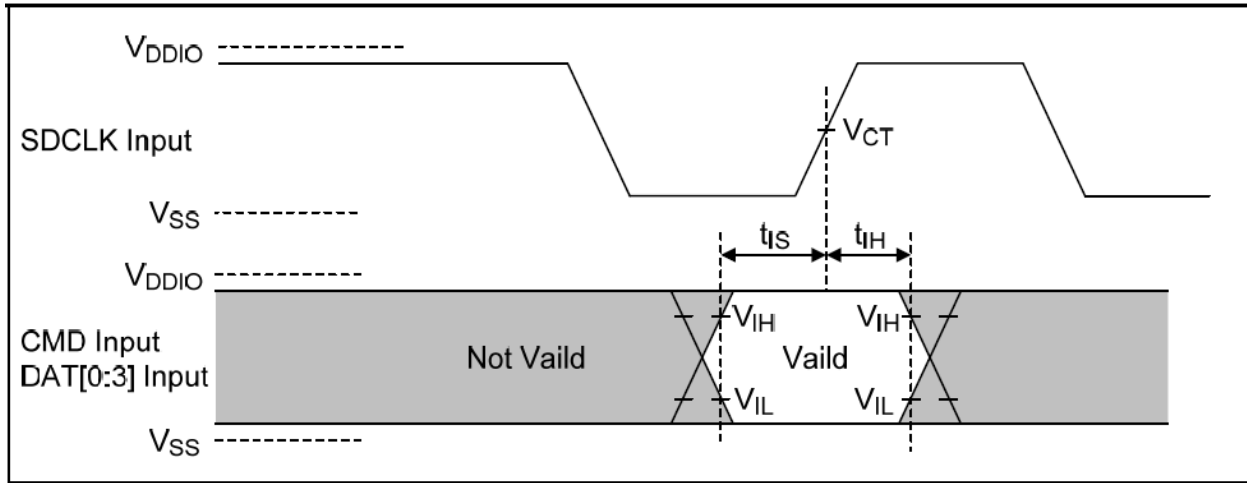


Figure 4-12: Clock Signal Timing

**Table 4-12: Clock Signal Timing of SDR104, SDR50, SDR25, SDR12**

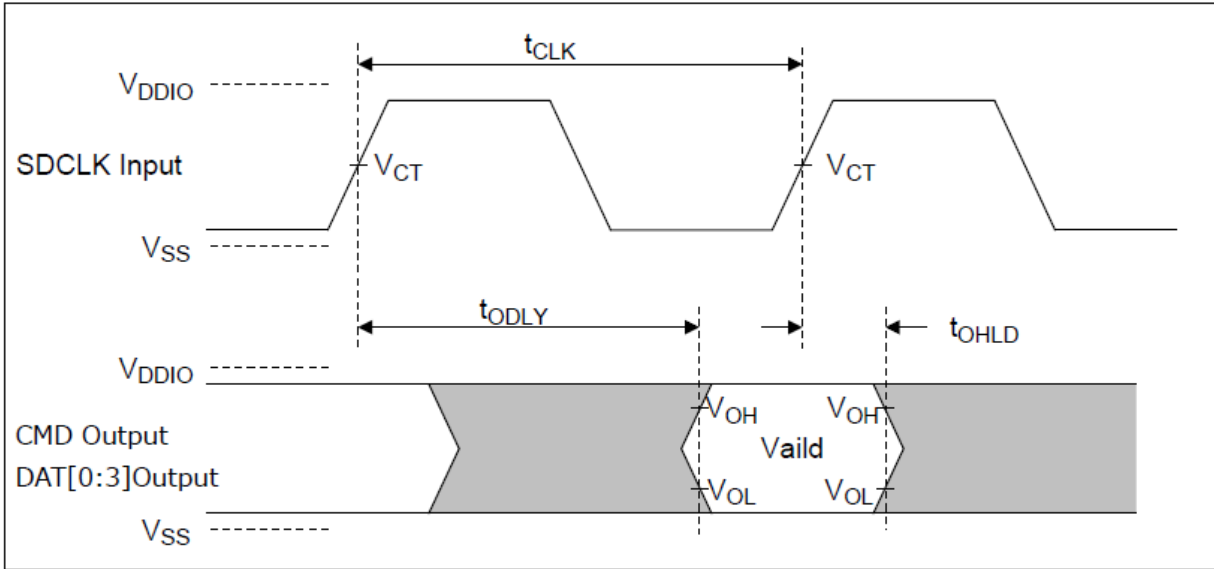
Symbol	Min.	Max.	Unit	Remark
t <sub>CLK</sub>	4.80	-	ns	208MHz (Max.), Between rising edge, V <sub>CT</sub> = 0.975V
t <sub>CR</sub> , t <sub>CF</sub>	-	0.2* t <sub>CLK</sub>	ns	t <sub>CR</sub> , t <sub>CF</sub> < 0.96ns (max.) at 208MHz, C <sub>CARD</sub> =10pF t <sub>CR</sub> , t <sub>CF</sub> , < 2.00ns (max.) at 100MHz, C <sub>CARD</sub> =10pF
Clock Duty	30	70	%	



**Figure 4-13: Clock Input Timing**

**Table 4-13: Clock input Timing of SDR104, SDR50, SDR25, SDR12**

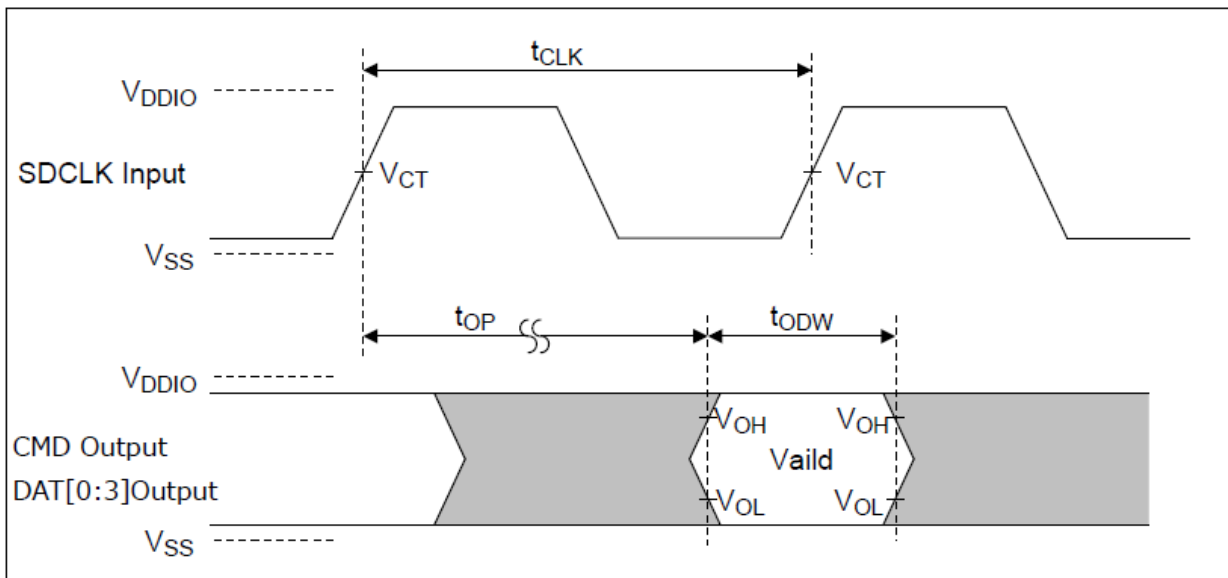
Symbol	Min.	Max.	Unit	SDR104 mode
t <sub>IS</sub>	1.40	-	ns	C <sub>CARD</sub> =10pF, V <sub>CT</sub> = 0.975V
t <sub>IH</sub>	0.80	-	ns	C <sub>CARD</sub> =5pF, V <sub>CT</sub> = 0.975V
Symbol	Min.	Max.	Unit	SDR12, SDR25 and SDR50 mode
t <sub>IS</sub>	3.00	-	ns	C <sub>CARD</sub> =10pF, V <sub>CT</sub> = 0.975V
t <sub>IH</sub>	0.80	-	ns	C <sub>CARD</sub> =5pF, V <sub>CT</sub> = 0.975V



**Figure 4-14: Output Timing of Fixed Window**

**Table 4-14: Output Timing of Fixed Data Window ( SDR50, SDR25, SDR12 )**

Symbol	Min.	Max.	Unit	Remark
t <sub>ODLY</sub>		7.5	ns	t <sub>CLK</sub> ≥ 10.0ns, C <sub>L</sub> = 30pF, using driver Type B, for SDR50
t <sub>ODLY</sub>		14	ns	t <sub>CLK</sub> ≥ 20.0ns, C <sub>L</sub> = 40pF, using driver Type B, for SDR25 and SDR12
t <sub>OH</sub>	1.5	-	ns	Hold time at the t <sub>ODLY</sub> (min.), C <sub>L</sub> = 15pF



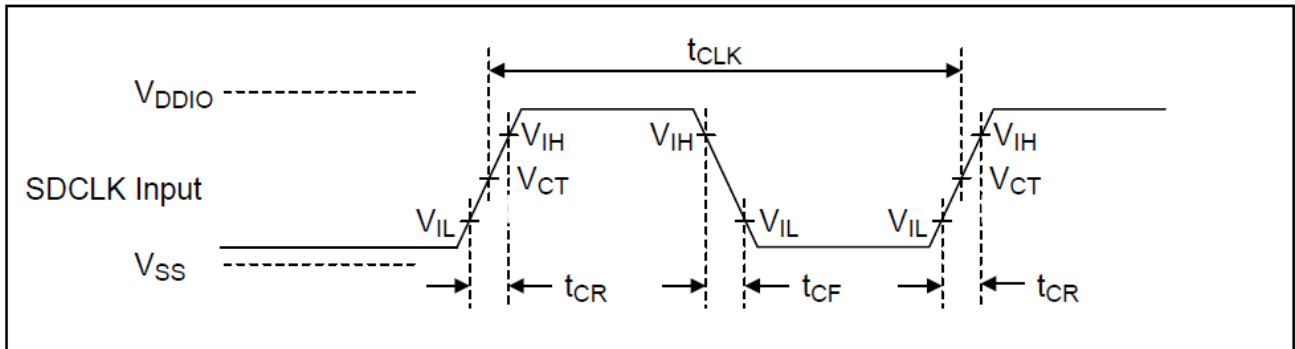
**Figure 4-15: Output Timing of Variable Window**

**Table 4-15: Output Timing of Variable Data Window ( SDR104 )**

Symbol	Min.	Max.	Unit	Remark
$t_{OP}$	0	2	UI	Card Output Phase
$\Delta t_{OP}$	-350	+1550	ps	Delay variation due to temperature change after tuning
$t_{ODW}$	0.60	-	UI	$t_{ODW}=2.88ns$ at 208MHz

Card  $\Delta t_{OP}$  is the total allowable shift of output valid window ( $t_{ODW}$ ) from last system Tuning procedure. Card  $\Delta t_{OP} = 1550ps$  for junction temperature of  $\Delta T = 90^{\circ}C$  during operation. Card  $\Delta t_{OP} = -350ps$  for junction temperature of  $\Delta T = -20^{\circ}C$  during operation.

**6.4.5.2 Bus Timing Specification <DDR50>**

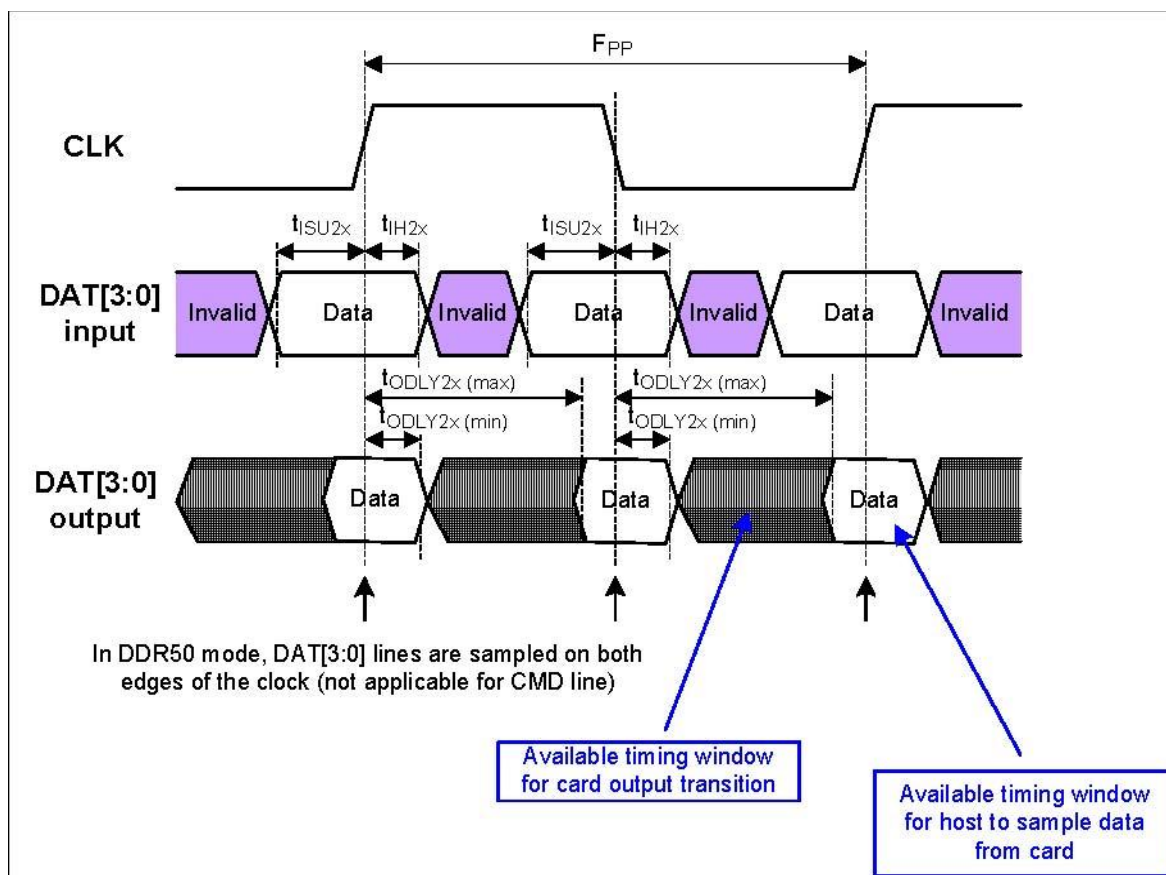


**Figure 4-16: Clock Signal Timing**

**Table 4-16: Clock Signal Timing of DDR50**

Symbol	Min.	Max.	Unit	Remark
$t_{CLK}$	20	-	ns	50MHz (Max.), Between rising edge
$t_{CR}, t_{CF}$	-	$0.2 * t_{CLK}$	ns	$t_{CR}, t_{CF}, < 4.00ns$ (max.) at 50MHz, $C_{CARD}=10pF$
Clock Duty	45	55	%	

CMD signal timings are not shown in the figure below but For CMD signal timing refers to Figure 4-13 (Card Input Timing) and Figure 4-14 (Output Timing of Fixed Data Window) for Timing Diagram of SDR mode).



**Figure 4-17: Timing Diagram DAT Inputs/Outputs Referenced to CLK in DDR50 Mode**

**Table 4-17: BUS Timings – Parameters Values (DDR50 mode)**

Parameter	Symbol	Min	Max	Unit	Remark
<b>Input CMD (referenced to CLK rising edge)</b>					
Input set-up time (*)	t <sub>ISU</sub>	3	-	ns	C <sub>CARD</sub> ≤ 10 pF (1 card)
Input hold time	t <sub>IH</sub>	0.8	-	ns	C <sub>CARD</sub> ≤ 10 pF (1 card)
<b>Output CMD (referenced to CLK rising edge)</b>					
Output Delay time during Data Transfer Mode	t <sub>ODLY</sub>	-	13.7	ns	C <sub>L</sub> ≤ 30 pF (1 card)
Output hold time	t <sub>OH</sub>	1.5	-	ns	C <sub>L</sub> ≥ 15pF (1 card)
<b>Inputs DAT (referenced to CLK rising and falling edges)</b>					
Input set-up time	t <sub>ISU2x</sub>	3	-	ns	C <sub>CARD</sub> ≤ 10 pF (1 card)
Input hold time	t <sub>IH2x</sub>	0.8	-	ns	C <sub>CARD</sub> ≤ 10 pF (1 card)
<b>Outputs DAT (referenced to CLK rising and falling edges)</b>					
Output Delay time during Data Transfer Mode	t <sub>ODLY2x</sub>		7.0	ns	C <sub>L</sub> ≤ 25 pF (1 card)
Output hold time	t <sub>ODLY2x</sub>	1.5	-	ns	C <sub>L</sub> ≥ 15pF (1 card)

(\*) Input set-up time : t<sub>ISU</sub>(min) is 6ns in PHYSICAL LAYER SPECIFICATION Ver.3.01



## 5 Card Internal Information

### 5.1 Security Information

MKB (Media Key Block) and Media ID are Standard Information. This information is in compliance with the CPRM.

**Note:** The security information is NOT Development information for evaluation. The Host System shall be compliance with the CPRM to use the security function. This information is kept as confidential because of security reasons.

### 5.2 microSD Card Registers

The device has six Registers and two Status information: OCR, CID, CSD, RCA, DSR, SCR and Card Status, SD Status as same as SD card.

DSR IS NOT SUPPORTED in this card.

There are two types of register groups.

- MMC compatible registers: OCR, CID, CSD, RCA, DSR, and
- SCR SD card Specific: SD Status and Card Status

**Table 5-1: microSD Card Registers**

Register Name	Bit Width	Description
CID	128	Card Identification number
RCA	16	Relative Card Address
DSR	16	Optional : Driver Stage
CSD	128	Card Specific Data
SCR	64	SD Configuration
OCR	32	Operation conditions
SSR	512	SD Status
CSR	32	Card Status
CMD6	512	Switch Function Status

### 5.2.1 OCR Register

This 32-bit register describes operating voltage range and status bit in the power supply.

**Table 5-2: OCR register definition**

OCR bit position	OCR Fields Definition	Response Value						
		8GB	16GB	32GB	64GB	128GB	256GB	
0-3	VDD voltage Window	reserved	TBD	TBD	0	0	0	0
6-Apr		reserved	TBD	TBD	0	0	0	0
7		Reserved for Low Voltage Range	TBD	TBD	0	0	0	0
14-Aug		reserved	TBD	TBD	0	0	0	0
15		2.7 - 2.8	TBD	TBD	1	1	1	1
16		2.8 - 2.9	TBD	TBD	1	1	1	1
17		2.9 - 3.0	TBD	TBD	1	1	1	1
18		3.0 - 3.1	TBD	TBD	1	1	1	1
19		3.1 - 3.2	TBD	TBD	1	1	1	1
20		3.2 - 3.3	TBD	TBD	1	1	1	1
21		3.3 - 3.4	TBD	TBD	1	1	1	1
22		3.4 - 3.5	TBD	TBD	1	1	1	1
23		3.5 - 3.6	TBD	TBD	1	1	1	1
24 <sup>(1)</sup>		Switching to 1.8V Accepted (S18A)	TBD	TBD	1	1	1	1
25-29	reserved	TBD	TBD	0	0	0	0	
30	Card Capacity Status (CCS) <sup>(2)</sup>	TBD	TBD	1 (SDHC)	1 (SDXC)	1 (SDXC)	1 (SDXC)	
31	Card power up status bit (busy) <sup>(3)</sup>	TBD	TBD	"0" = busy "1" = ready	"0" = busy "1" = ready	"0" = busy "1" = ready	"0" = busy "1" = ready	

**Notes:**

1. bit24: Only UHS-I card supports this bit.
2. bit30 : This bit is valid only when the card power up status bit is set.
3. bit31: This bit is set to LOW if the card has not finished the power up routine.  
bit 23-4: Describes the micro SD Card Voltage bit 31 indicates the card power up status. Value "1" is set after power up and initialization procedure has been completed.

### 5.2.2 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.

**Table 5-3: CID register**

Field	Width	CID-slice	Initial Value		Initial Value			Comment
			8GB	16GB	32GB	64GB	128GB 256GB	
MID	8	[127:120]	TBD	TBD	TBD			Manufacture ID( WDC)
OID	16	[119:104]	TBD	TBD	TBD	TBD		OEM/Application ID (WDC)
PNM	40	[103:64]	TBD	TBD	0x5543304435	0x5543304535	0x5543304635	32GB:"UC0D5"
			TBD	TBD				64GB:"UC0E5"
			TBD	TBD				128GB:"UC0F5"
PRV	8	[63:56]	TBD	TBD	TBD	0x52		Product Revision
PSN	32	[55:24]	TBD	TBD	TBD	0xn timer		Product serial number
-	4	[23:20]	TBD	TBD	TBD	0x0		reserved
MDT	12	[19:8]	TBD	TBD	TBD	0xm timer		Manufacturing data
GRC	7	[7:1]	TBD	TBD	TBD	CRC		CRC 7 Checksum
-	1	[0:0]	TBD	TBD	TBD	0x1		not used, always 1

### 5.2.3 CSD Register

CSD is Card-Specific Data register provides information on 128bit width. Some field of this register can writable by PROGRAM\_CSD (CMD27).

**Table 5-4: CSD register**

Field	Width	Cell Type	CSD-slice	Initial Value			Comment
				32GB	64GB	128GB 256GB	
CSD_STRUCTURE	2	R	[127:126]		01b		CSD version 2.0(High Capacity and Extended Capacity)
-	6	R	[125:120]		00_0000b		reserved
TAAC	8	R	[119:112]		0000_1110b		1ms(time unit) * 1.0(time value) = 1ms
NSAC	8	R	[111:104]		0000_0000b		0 clock Cycle
	SDR104				0010_1011b		200Mbit/s
	SDR50				0000_1011b		100Mbit/s

Field	Width	Cell Type	CSD-slice	Initial Value			Comment	
				32GB	64GB	128GB 256GB		
	DDR50				0000_1011b		100Mbit/s	
TRAN_SPEED	SDR25	8	R	[103:96]	0101_1010b		50Mbit/s	
	SDR12				0011_0010b		25Mbit/s	
	HS				0101_1010b		50Mbit/s	
	DS				0011_0010b		25Mbit/s	
CCC	12	R		[95:84]	0101_1011_0101b		Class 0,2,4,5,7,8,10 are supported	
READ_BL_LEN	4	R		[83:80]	1001b		512Bytes	
READ_BL_PARTIAL	1	R		[79:79]	0		"0": Partial block read is inhibited and only unit of block access is allowed.	
WRITE_BLK_MISALIGN	1	R		[78:78]	0		"0": Not allowed on this card	
READ_BLK_MISALIGN	1	R		[77:77]	0		"0": Invalid on this card	
DSR_IMP	1	R		[76:76]	0		"0": DSR NOT implemented	
-	6	R		[75:70]	00_0000b		reserved	
C_SIZE	22	R		[69:48]	EE87h	1DD17h	3B9EFh	memory capacity = (C_SIZE+1) * 512K byte
-	1	R		[47:47]	0		reserved	
ERASE_BLK_EN	1	R		[46:46]	1		"1": Can erase by WRITE_BL_LEN unit (512 Bytes)	
SECTOR_SIZE	7	R		[45:39]	111_1111b		This size of an erasable sector. This field is fixed to 7F-h. Sector size = 64KBytes.	
WP_GRP_SIZE	7	R		[38:32]	000_0000b		This size of a write protected group. This field is fixed to 00-h. 1 Write Protect Group = 1sector.	
WP_GRP_ENABLE	1	R		[31:31]	0		value of 0 means no group write protection possible.	
-	2	R		[30:29]	00b		reserved	
R2W_FACTOR	3	R		[28:26]	010b		This field is fixed to "2-h", which indicates 4 multiples. However, host should not use this factor and should use 250ms for write timeout.	
WRITE_BL_LEN	4	R		[25:22]	1001b		"9": 512Bytes on this card.	
WRITE_BL_PARTIAL	1	R		[21:21]	0		"0": Only the WRITE_BL_LEN size or 512Bytes are available	
-	5	R		[20:16]	0_0000b		reserved	
FILE_FORMAT_GRP	1	R		[15:15]	0		This field is set to "0". Host should not use this field.	
COPY	1	R/W		[14:14]	0		"0": Original on this card	
PERM_WRITE_PROTECT	1	R/W		[13:13]	0		"0": Not protected / Writable on this card	

Field	Width	Cell Type	CSD-slice	Initial Value			Comment
				32GB	64GB	128GB 256GB	
TMP_WRITE_PROTECT	1	R/W	[12:12]	0			"0": Not protected / Writable on this card
FILE_FORMAT	2	R	[11:10]	00b			"0": Hard disk-like file system with partition table on this card.
-	2	R	[9:8]	00b			reserved
CRC	7	R/W	[7:1]	CRC			CRC 7 Checksum
-	1	-	[0:0]	1			not used, always 1

**Notes:**

1. Cell Types: R: Read Only, R/W: Writable and Readable, R/W(1): One-time Writable / Readable
2. Erase of one data block is not allowed in this card. This information is indicated by "ERASE\_BLK\_EN". Host System should refer this value before one data block size erase.

## 5.2.4 RCA Register

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

## 5.2.5 DSR Register

This register is not used

## 5.2.6 SCR Register

CR(microSD Card Configuration Register) provides information on the microSD Memory Card's special features. The size of SCR Register is 64 bit.

**Table 5-5: The SCR Fields**

Field	Width	SCR-slice	Initial Value		Initial Value			Comment
			8GB	16GB	32GB	64GB	128GB 256GB	
SCR_STRUCTURE	4	[63:60]	TBD	TBD	0x0			SCR version 1.0 (Version 1.01-3.00)
SD_SPEC	4	[59:56]	TBD	TBD	0x2			"2": Version 2.00 or Version 3.0X, Version 4.xx ( Refer to SD_SPEC3 and SD_SPEC4 )
DATA_STAT_AFTER_ERASE	1	[55:55]	TBD	TBD	0x1			"1": on this card
SD_SECURITY	3	[54:52]	TBD	TBD	0x3	0x4		"3": Security Version 2.00 "4": Security Version 3.00
SD_BUS_WIDTHS	4	[51:48]	TBD	TBD	0x5			"0101": 1 and 4 bit supported
SD_SPEC3	1	[47:47]	TBD	TBD	0x1			"1": Version 3.0X, Version 4.xx ( Refer to SD_SPEC4 )

EX_SECURITY	4	[46:43]	TBD	TBD	0x0	Extended Security is not supported.
SD_SPEC4	1	[42:42]	TBD	TBD	0x1	" 1 " : Version 4.xx
-	6	[41:36]	TBD	TBD	0x0	reserved
CMD_SUPPORT	4	[35:32]	TBD	TBD	0x3	" 11 " : CMD23 and CMD20 support
-	32	[31:0]	TBD	TBD	0x3202nnnn	reserved for manufacture usage

## 5.2.7 Card Status

This field is intended to transmit the card's status information to the host.

**Table 5-6: Card Status**

Identifier	Bits	Type	Value
OUT_OF_RANGE	31	ERX	" 0 " = no error , " 1 " = error
ADDRESS_ERROR	30	ERX	" 0 " = no error , " 1 " = error
BLOCK_LEN_ERROR	29	ERX	" 0 " = no error , " 1 " = error
ERASE_SEQ_ERROR	28	ER	" 0 " = no error , " 1 " = error
ERASE_PARAM	27	ERX	" 0 " = no error , " 1 " = error
WP_VIOLATION	26	ERX	" 0 " = not protected , " 1 " = protected
CARD_IS_LOCKED	25	SX	" 0 " = card unlocked , " 1 " = card locked
LOCK_UNLOCK_FAILED	24	ERX	" 0 " = no error , " 1 " = error
COM_CRC_ERROR	23	ER	" 0 " = no error , " 1 " = error
ILLEGAL_COMMAND	22	ER	" 0 " = no error , " 1 " = error
CARD_ECC_FAILED	21	ERX	" 0 " = success , " 1 " = failure
CC_ERROR	20	ERX	" 0 " = no error , " 1 " = error
ERROE	19	ERX	" 0 " = no error , " 1 " = error
-	18		reserved
-	17		reserved for DEFERRED_RESPONSE
CSD_OVERWRITE	16	ERX	" 0 " = no error , " 1 " = error
WE_ERASE_SKIP	15	ERX	" 0 " = not protected , " 1 " = protected
CARD_ECC_DISABLED	14	SX	" 0 " = enabled , " 1 " = disabled
ERASE_STATE	13	SR	" 0 " = cleared , " 1 " = set
CURRENT_STATE	12 – 9	SX	" 0 " = idle , " 1 " = ready , " 2 " = ident , " 3 " = stanby " 4 " = tran , " 5 " = data , " 6 " = rcv , " 7 " = prg " 8 " = dis , " 9 – 14 " = reserved " 15 " = reserved for I/O mode

Identifier	Bits	Type	Value
READY_FOR_DATA	8	S X	" 0 " = not ready , " 1 " = ready
-	7 , 6		-
APP_CMD	5	S R	" 0 " = Disabled , " 1 " = Enabled
-	4		reserved for SD I/O Card
AKE_SEQ_ERROR	3	E R	" 0 " = no error , " 1 " = error
-	2		reserved
-	1 , 0		reserved

**Notes:**

E: Error bit , S: Status bit , R: Detected and set for actual command response.

X: Detected and set during command execution.

## 5.2.8 SD Status

Table 5-7: SD Status

Field	Width	Type	SD Status -slice	Initial Value		Comment
				32GB	64GB 128GB 256GB	
				00b		1bit: HS1bit, SD1bit, HSSPI, SPI
DAT_BUS_WIDTH	2	SR	[511:510]	10b		4bit: SDR104, DDR50, SDR50, SDR25, SDR12, HS4bit, SD4bit
SECURED_MODE	1	SR	[509]	1		Secured Mode
reserved	8		[508:502]	0x00		reserved
reserved	6		[501:496]	0x00		reserved
SD_CARD_TYPE	16	SR	[495:480]	0x0000		Regular SD RD/WR card
SIZE_OF_PROTECTED_AREA	32	SR	[479:448]	0x05000000	0x08000000	32GB:81,920KB 64GB:131,072KB 128GB:131,072KB
SPEED_CLASS	8	SR	[447:440]	0x04		Class10
PERFORMANCE_MOVE	8	SR	[439:432]	0x02	0x00	0x02:2MB/s, 0x00:0MB/s
AU_SIZE	4	SR	[431:428]	0x9		0x9:4MB
reserved	4		[427:424]	0x0		reserved
ERASE_SIZE	16	SR	[423:408]	0x0020		32AU
ERASE_TIMEOUT	6	SR	[407:402]	0x01		1sec
ERASE_OFFSET	2	SR	[401:400]	11b		3sec
UHS_SPEED_GRADE	4	SR	[399:396]	0x3		0x3:30MB/sec and above
UHS_AU_SIZE	4	SR	[395:392]	0xC		0xC:16MB
-	80		[391:312]	ALL 0		reserved
-	312		[311:0]	ALL 0		reserved for manufacture

S : Status bit , R : Set based on Command Response



## 5.2.9 Switch Function Status

Switch function command (CMD6) is used to switch or expand memory card functions. Currently four function groups are defined:

- (1) Access Mode: Selection of SD bus interface speed modes.
- (2) Command System: A specific function can be extended and controlled by a set of shared commands.
- (3) Driver Strength Selection of suitable output driver strength in UHS-I modes depends on host environment.
- (4) Power Limit Selection to limit the maximum power depends on host power supply capability and heat release capability.

**Table 5-8: Switch Function Status**

Description	Width	Bits	Bus Speed Mode	Set Value of Gr4	Value
					32GB to 256GB
				0x0	0x00C8 (0.72W/200mA)
				0x1	0x00FA (0.90W/250mA)
			SDR104/ SDR50/ DDR50	0x2	0x00FA (0.90W/250mA)
Maximum Current Consumption	16	[511:496]		0x3	0x00FA (0.90W/250mA)
				0x4	0x00FA (0.90W/250mA)
			SDR25	0x0~0x4	0x00C8 (0.72W/200mA)
			SDR12	0x0~0x4	0x0064 (0.36W/100mA)
			HS	0x0	0x00C8 (0.72W/200mA)
			DS	0x0	0x0064 (0.36W/100mA)
Function Gr 6, information.	16	[495:480]	-	-	0x8001
Function Gr 5, information.	16	[479:464]	-	-	0x8001
Function Gr4, information.	16	[463:448]	SDR104-12 DDR50	-	0x801F
			HS,DS	-	0x8001
Function Gr3, information.	16	[447:432]	SDR104-12 DDR50	-	0x800F
			HS,DS	-	0x8001
Function Gr 2, information.	16	[431:416]	-	-	0x8001
Function	16	[415:400]	SDR104-	-	0x801F

Description	Width	Bits	Bus Speed Mode	Set Value of Gr4	Value
					32GB to 256GB
Gr1, information.			12 DDR50		
			HS,DS	-	0x8003
Function Gr6, information.	4	[399:396]	-	-	Set Response Value
Function Gr5, information.	4	[395:392]	-	-	Set Response Value
Function Gr4, information.	4	[391:388]	-	-	Set Response Value
Function Gr3, information.	4	[387:384]	-	-	Set Response Value
Function Gr2, information.	4	[383:380]	-	-	Set Response Value
Function Gr1, information.	4	[379:376]	-	-	Set Response Value
Data Structure Version	8	[375:368]	-	-	0x00
Busy Status of functions in Gr6	16	[367:352]	-	-	0x0000
Busy Status of functions in Gr5	16	[351:336]	-	-	0x0000
Busy Status of functions in Gr4	16	[335:320]	-	-	0x0000
Busy Status of functions in Gr3	16	[319:304]	-	-	0x0000
Busy Status of functions in Gr2	16	[303:288]	-	-	0x0000
Busy Status of functions in Gr1	16	[287:272]	-	-	0x0000
Reserved	272	[271:0]	-	-	ALL 0

### 5.3 Logical Format

The microSD card is formatted before shipping to be compliant to the SD Card FILE SYSTEM SPECIFICATION. The following parameters may be changed if the host system is not compliant with the SD Card Format Specification. The data of the logical format is described in section 5.3.3 to 5.3.6.

### 5.3.1 microSD card Capacities

Item	microSD Card Capacities			
Total Capacity	32GB	64GB	128GB	256GB
User Data Bytes	31,902,400,512	63,831,015,424	127,831,375,872	255,802,212,352
LBAs	62,333,952	124,735,488	249,736,192	499,744,768
# Partition System Area Sectors	8,192	32,768	32,768	65,536
Total Partition Sectors	62,325,760	124,702,720	249,703,424	499,769,232
User Data Sectors	62,309,376	124,669,952	249,670,656	499,613,696

## 6 SD Specification Compliance

### 1) Non Supported Registers:

DSR Register (Optional register: PHYSICAL LAYER SPECIFICATION 5.5)

### 2) Non Supported Functions:

Programmable Card Output Driver (Optional in PHYSICAL LAYER SPECIFICATION 6.5) Card 's Internal Write Protect (Optional in PHYSICAL LAYER SPECIFICATION 4.3.6.)

### 3) Non Specified Command:

CMD4 SET\_DSR CMD28 SET\_WRITE\_PROT CMD29 CLR\_WRITE\_PROT CMD30 SEND\_WRITE\_PROT CMD56 GEN\_CMD

## 7 Reliability Guidance

This reliability guidance is intended to provide some guidance related to using raw NAND flash. Although random bit errors may occur during use, it does not necessarily mean that a block is bad. Generally, a block should be marked as bad when a program status failure or erase status failure is detected. The other failure modes may be recovered by a block erase.

ECC treatment for read data is mandatory due to the following Data Retention and Read Disturb failures.

### Write/Erase Endurance

Write/Erase endurance failures may occur in a cell, page, or block, and are detected by doing a status read after either an auto program or auto block erase operation. The cumulative bad block count will increase along with the number of write/erase cycles.

#### Data Retention

The data in memory may change after a certain amount of storage time. This is due to an electrical charge loss or charge gain. After block erasure and reprogramming, the block may become usable again. Also write/erase endurance deteriorates data retention capability. The figure below shows a generic trend of relationship between write/erase endurance and data retention.

#### Read Disturb

A read operation may disturb the data in memory. The data may change due to charge gain. Usually, bit errors occur on other pages in the block, not the page being read. After a large number of read cycles (between block erases), a tiny charge may build up and can cause a cell to be soft programmed to another state. After block erasure and reprogramming, the block may become usable again.

Considering the above failure modes, Viking recommends following usage model:  
Avoid any excessive iteration of resets and initialization sequences (card identification mode) as far much as possible after power-on, which may result in read disturb failure. The resets include hardware resets and software resets. i.e.

1) The iteration of the following command sequence: CMD0 -ACMD41  
(The assertion of ACMD41 implies a count of internal read operation in Raw NAND.

- CMD0: Go idle state command,
- ACMD41 : SD send operation command

2) Iteration of the following command: ACMD43

- ACMD43 : Get MKB command

## 8 microSD Card Mechanical Dimensions

