

HHW Industrial microSD Card

SD3.0 UHS-I

Datasheet

Rev. 1.0

REVISION HISTORY

Revision	Description	Date
V1.1	First released	August, 2015
V1.2	Updated humidity information	March, 2017
V1.3	Part number updated	September, 2018

1. Product Introduction

1.1. Overview

The Industrial microSD Card is designed for demanding industrial applications. The Industrial microSD Card is compatible with SD 3.0 and provides excellent performance. The built-in auto ECC function can detect and correct errors during data transfer. Moreover, the Industrial microSD Card supports Ultra High Speed (UHS) interface transfer mode, provides high write/read data transfer rate, high random IOPS, sudden Power-Fails protection, adaptive static wear-leveling, read/program disturb management, etc. It was designed to meet the high quality, high reliability, high performance, and versatile environmental requirements.

1.2. Product Features

- Interface: 8 pins microSD standard interface
- Compliant SD Card Specification 3.0
- Density support:
 - SLC: 4GB~8GB
 - MLC: 4GB~128GB
 - aSLC (Super MLC, single bit per cell MLC): 4GB~64GB
- Bus Speed Mode:
 - DS-Default Speed mode: 3.3V signaling, frequency up to 25MHz, up to 12.5MB/sec
 - HS-High Speed mode: 3.3V signaling, frequency up to 50MHz, up to 25MB/sec
 - SDR12: 1.8V signaling, frequency up to 25MHz, up to 12.5MB/sec

- SDR25: 1.8V signaling, frequency up to 50MHz, up to 25MB/sec
- SDR50: 1.8V signaling, frequency up to 100MHz, up to 50MB/sec
- SDR104: 1.8V signaling, frequency up to 208MHz, up to 104MB/sec
- DDR50: 1.8V signaling, frequency up to 50MHz, sampled on both clock edges, up to 50MB/s
- Operating Temperature: N-Temp: at 0°C to 70°C
W-Temp: at -40°C to 85°C
E-Temp: at -25°C to 85°C
- Flash: SLC and MLC NAND Flash
- aSLC (Super MLC, single bit per cell MLC) support, enhance the performance and product endurance.
- Read disturbance management
- Adaptive wear leveling
- Management of sudden power-fails
- SMART Function support

2. microSD Card Interface Description

2.1 microSD Pin Assignment

Table 1: microSD Bus Mode Pin Definition

Pin #	Name	Type	microSD Description
1	DAT2	I/O	Data Line [Bit 2]
2	CD/DAT3	I/O	Card Detect / Data Line[Bit3]
3	CMD	PP	Command / Response
4	VDD	S	Supply Voltage
5	CLK	I	Clock
6	VSS	S	Supply Voltage Ground
7	DAT0	I/O	Data Line [Bit 0]
8	DAT1	I/O	Data Line [Bit 1]

Notes:

- 1) S: power supply; I: input; O: output using push-pull drivers; PP: I/O 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 Multi-media Cards.
- 3) After power up this line (Pin2) is input with 50Kohm pull-up (can be used for card detection or SPI mode selection). The pull-up should be disconnected by user, during regular data transfer, with SET_CLR_CARD_DETECT

(ACMD42) command.

Table 2: SPI Bus Mode Pin Definition

Pin #	Name	Type	microSD Description
1	RSV		Reserved
2	CS	I	Chip Select (neg true)
3	DI	I	Data In
4	VDD	S	Supply Voltage
5	SCLK	I	Clock
6	VSS	S	Supply Voltage Ground
7	DO	O	Data Out
8	RSV		Reserved

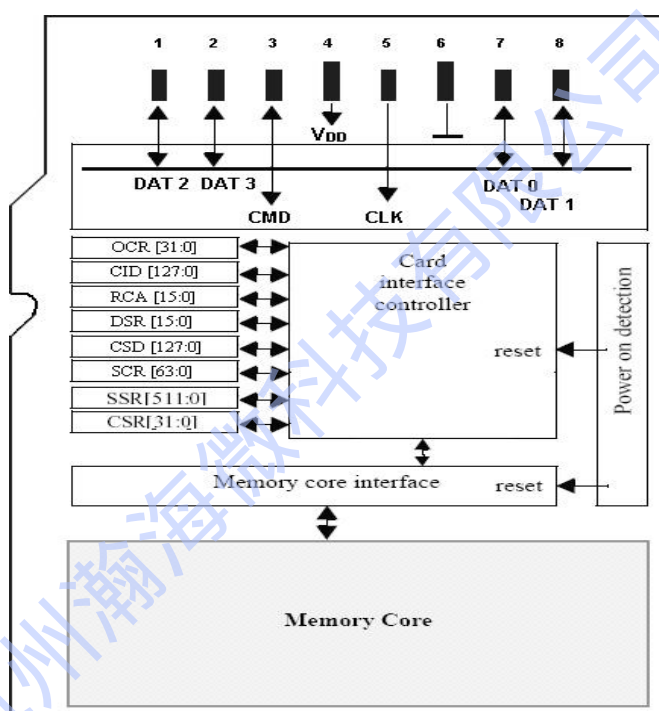


Figure 1: Functional Diagram

3. Specifications

3.1. Performance

Max. Data Transfer Rate

- Read: 90MB/s; Write: 70MB/s

3.2. NAND Flash Memory

Industrial microSD Card uses Single Level Cell (SLC) and Multi Level Cell (MLC) NAND Flash memory, which is non-volatility, high reliability and high speed memory storage.

3.3. Power Requirement

3.3.1. DC Input Voltage

- 2.7V to 3.6V

3.4. Temperature Range

- N-Temp: 0°C to 70°C
- W-Temp: -40°C to +85°C
- E-Temp: -25°C to +85°C

3.5. Humidity

Relative Humidity: 5-95%, non-condensing

4. Electrical Specifications

4.1. General DC Characteristic

W-Temp

Table 3: Absolute Maximum Ratings

Symbol	Parameter	Min.	Max.	Unit	Note
T _{storage}	Storage Temperature	-50	95	°C	-
T _a	Ambient Operating Temperature	-40	85	°C	-
V _I	3.3V External Input Voltage	-0.3	3.6	V	-

N-Temp

Symbol	Parameter	Min.	Max.	Unit	Note
T _{storage}	Storage Temperature	-40	85	°C	-

Ta	Ambient Operating Temperature	-25	85	°C	-
V _I	3.3V External Input Voltage	-0.3	3.6	V	-

Table 4: Power Consumption

Symbol	Parameter	Min.	Typ.	Max.	Unit
I _{Read}	Read Current at 3.3V	-	169	-	mA
I _{Write}	Write Current at 3.3V	-	89	-	mA
I _{STBY}	Standby Current at 3.3V	-	198	-	uA

4.2. Bus Operation Conditions for 3.3V Signaling

4.2.1 Threshold Level for High Voltage Range

Table 5: Threshold Level for High Voltage

Parameter	Symbol	Min	Max	Unit	Remark
Supply Voltage	V _{DD}	2.7	3.6	V	
Output High Voltage	V _{OH}	0.75* V _{DD}		V	I _{OH} =2mA V _{DD min}
Output Low Voltage	V _{OL}		0.125* V _{DD}	V	I _{OL} =2mA V _{DD min}
Input High Voltage	V _{IH}	0.625* V _{DD}	V _{DD} +0.3	V	
Input Low Voltage	V _{IL}	V _{ss} -0.3	0.25* V _{DD}	V	
Power Up Time			250	ms	From 0V to V _{DD min}

4.2.2 Peak Voltage and Leakage Current

Table 6: Peak Voltage and Leakage Current

Parameter	Symbol	Min	Max	Unit	Remark
Peak voltage on all lines		-0.3	V _{DD} +0.3	V	
All Inputs					
Input Leakage Current		-10	10	uA	
All Outputs					
Output Leakage Current		-10	10	uA	

4.2.3 Bus Signal Line Load

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

Parameter	Symbol	Min	Max	Unit	Remark
Pull-up resistance	R_{CMD} R_{DAT}	10	100	K Ω	To prevent bus floating
Total bus capacitance for each signal line	C_L		40	pF	1 card $C_{HOST}+C_{BUS}$ shall not exceed 30pF
Card capacitance for each signal pin	C_{CARD}		10	pF	
Maximum signal inductance			16	nH	
Pull-up resistance inside card(pin1)	R_{DAT3}	10	90	K Ω	May be used for card detection
Capacity Connected to Power Line	C_C		5	μ F	To prevent inrush current

4.2.4 Bus Signal Levels

As the bus can be supplied with a variable supply voltage, all signal levels are related to the supply voltage.

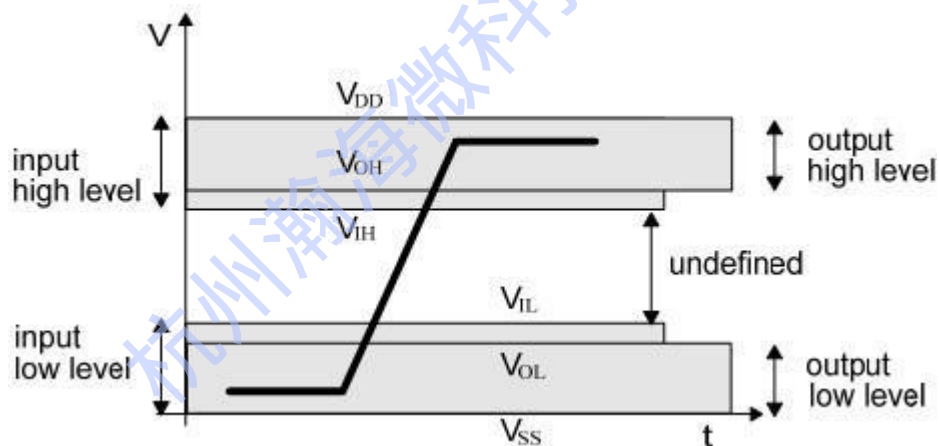


Figure 2: Bus Signal Levels

To meet the requirements of the JEDEC specification JESD8-1A and JESD8-7, the card input and output voltages shall be within the specified ranges shown in Table 6 for any VDD of the allowed voltage range.

4.2.5 Bus Timing (Default)

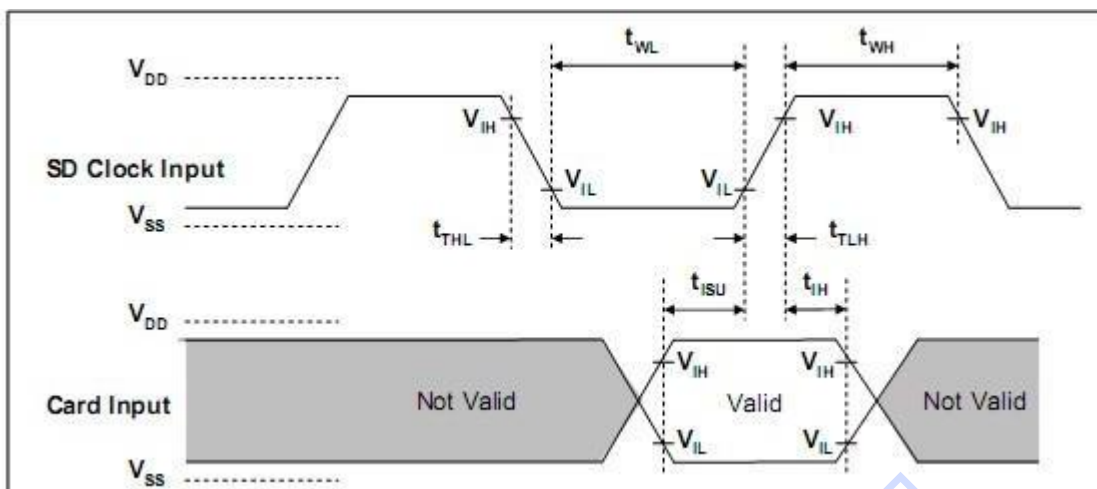


Figure 3: Card input Timing (Default Speed Card)

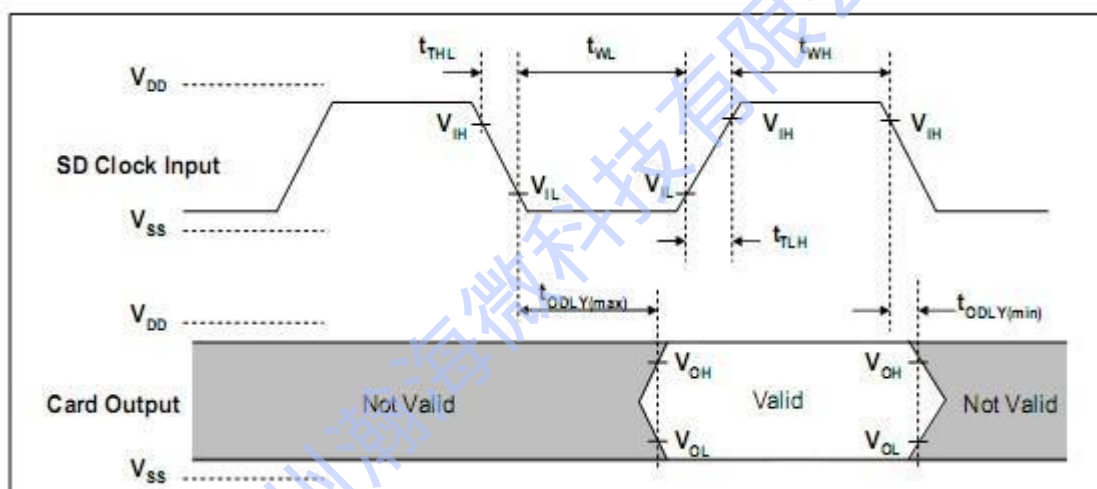


Figure 4: Card Output Timing (Default Speed

Mode) Table 8: Bus Timing-Parameters Values

Parameter	(Default Speed)	Symbol	Min.	Max	Unit	Remark
Clock CLK (All values are referred to min (V_{IH}) and max (V_{IL}))						
Clock frequency data transfer		fpp	0	25	MHz	$C_{CARD} \leq 10pF$ (1 card)
Clock frequency Identification		f_{OD}	0 ⁽¹⁾ /100	400	KHz	$C_{CARD} \leq 10pF$ (1 card)
Clock low time		t_{WL}	10		ns	$C_{CARD} \leq 10pF$ (1 card)
Clock high time		t_{WH}	10		ns	$C_{CARD} \leq 10pF$ (1 card)
Clock rise time		t_{TLH}		10	ns	$C_{CARD} \leq 10pF$ (1 card)
Clock fall time		t_{THL}		10	ns	$C_{CARD} \leq 10pF$ (1 card)
Inputs CMD, DAT (referenced to CLK)						
Input set-up time		t_{ISU}	5		ns	$C_{CARD} \leq 10pF$ (1 card)

Input hold time	t_{TH}	5		ns	$C_{CARD} \leq 10pF$ (1 card)
Outputs CMD, DAT (referenced to CLK)					
Output Delay time during Data Transfer Mode	t_{ODLY}	0	14	ns	$C_L \leq 40pF$ (1 card)
Output Hold time	t_{OH}	0	50	ns	$C_L \leq 40pF$ (1 card)

(1) 0 Hz means to stop the clock. The given minimum frequency range is for cases where continuous clock is required (refer to Chapter 4.4-Clock Control)

4.2.6 Bus Timing (High-Speed Mode)

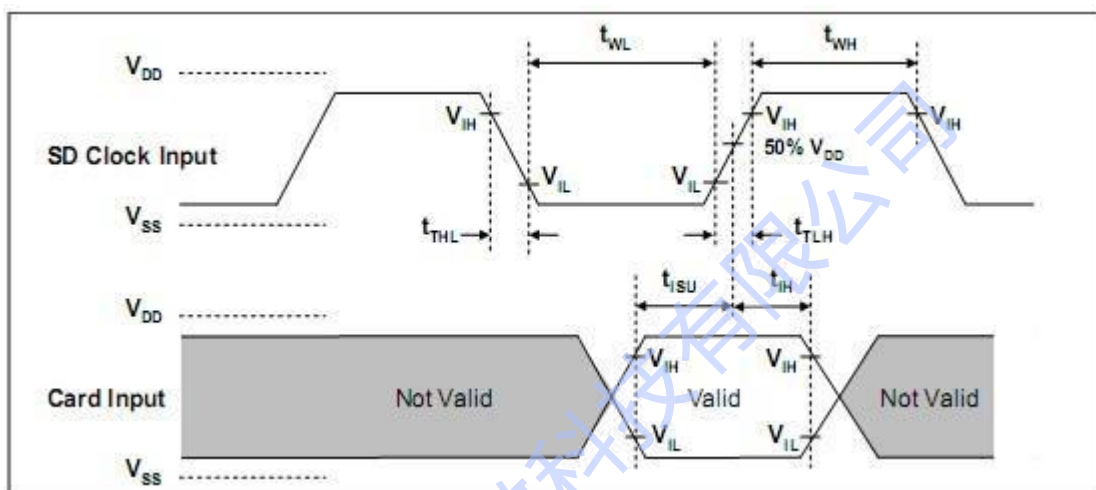


Figure 5: Card Input Timing (High Speed Card)

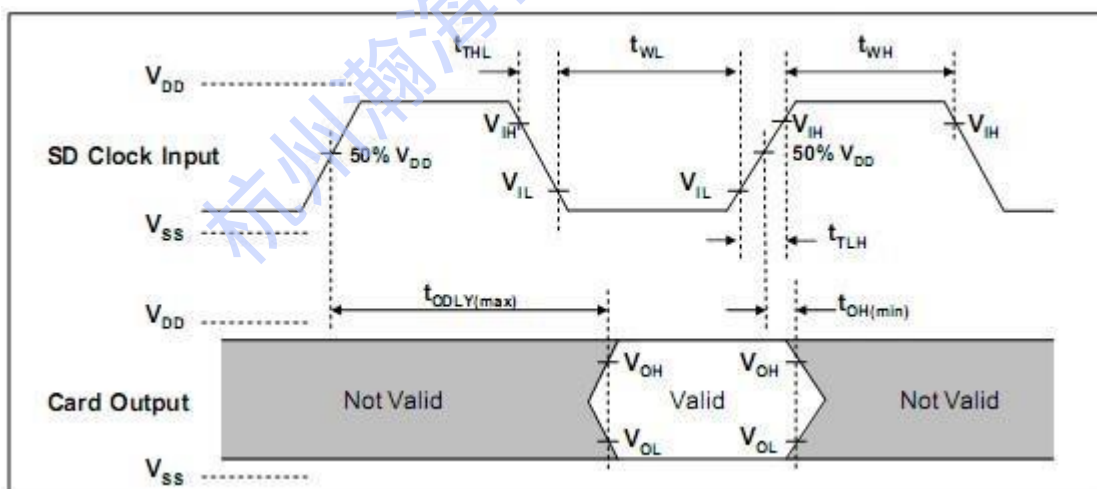


Figure 6: Card Output Timing (High Speed Mode)

Table 9 : Bus Timing – Parameters Values(High Speed)

Parameter	Symbol	Min.	Max	Unit	Remark
Clock CLK (All values are referred to min (V_{IH}) and max (V_{IL}))					
Clock frequency data transfer	fpp	0	50	MHz	$C_{CARD} \leq 10pF$ (1 card)
Clock low time	t_{WL}	7		ns	$C_{CARD} \leq 10pF$ (1 card)
Clock high time	t_{WH}	7		ns	$C_{CARD} \leq 10pF$ (1 card)
Clock rise time	t_{TLH}		3	ns	$C_{CARD} \leq 10pF$ (1 card)
Clock fall time	t_{THL}		3	ns	$C_{CARD} \leq 10pF$ (1 card)
Inputs CMD, DAT (referenced to CLK)					
Input set-up time	t_{ISU}	6		ns	$C_{CARD} \leq 10pF$ (1 card)
Input hold time	t_{TH}	2		ns	$C_{CARD} \leq 10pF$ (1 card)
Outputs CMD, DAT (referenced to CLK)					
Output Delay time during Data Transfer Mode	t_{ODLY}		14	ns	$C_L \leq 40pF$ (1 card)
Output Hold time	t_{OH}	2.5		ns	$C_L \geq 15pF$ (1 card)
Total System capacitance for each line ¹	C_L		40	pF	1 card

1) In order to satisfy sever timing, host shall drive only one card.

4.3 Bus Operation Conditions for 1.8V Signaling

4.3.1 Threshold Level for High Voltage Range

Table 10: Threshold Level for High Voltage

Parameter	Symbol	Min	Max	Unit	Remark
Supply Voltage	V_{DD}	2.7	3.6	V	
Regulator Voltage	V_{DDIO}	1.7	1.95	V	Generated by V_{DD}
Output High Voltage	V_{OH}	1.4		V	$I_{OH}=2mA$ V_{DD} min
Output Low Voltage	V_{OL}		0.45	V	$I_{OL}=2mA$ V_{DD} min
Input High Voltage	V_{IH}	1.27	2.0	V	
Input Low Voltage	V_{IL}	$V_{ss}-0.3$	0.58	V	

4.3.2 Peak Voltage and Leakage Current

Table 11: Peak Voltage and Leakage Current

Parameter	Symbol	Min	Max	Unit	Remark
Input Leakage Current		-2	2	uA	DAT3 pull-up is disconnected

4.3.3 Bus Timing Specification in SDR12, SDR25, SDR50 and SDR104 Modes

4.3.3.1 Clock Timing

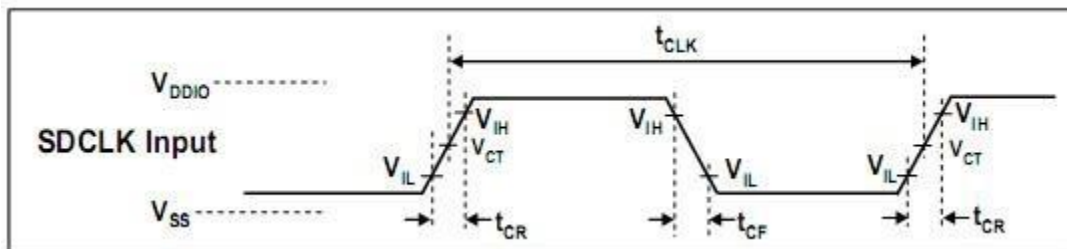


Figure 7: Clock Signal

Timing Table 12: Clock

Symbol	Min	Max	Unit	Remark
t_{CLK}	4.8	-	ns	Signal Timing 208MHz (Max.), Between rising edge, $V_{CT}=0.975V$
t_{CR}, t_{CF}	-	$0.2 * t_{CLK}$	ns	$t_{CR}, t_{CF} < 2.00ns$ (max.) at 208MHz, $C_{CARD}=10pF$ $t_{CR}, t_{CF} < 2.00ns$ (max.) at 100MHz, $C_{CARD}=10pF$ The absolute maximum value of t_{CR}, t_{CF} is 10ns regardless of clock frequency
Clock Duty	30	70	%	

4.3.3.2 Card Input Timing

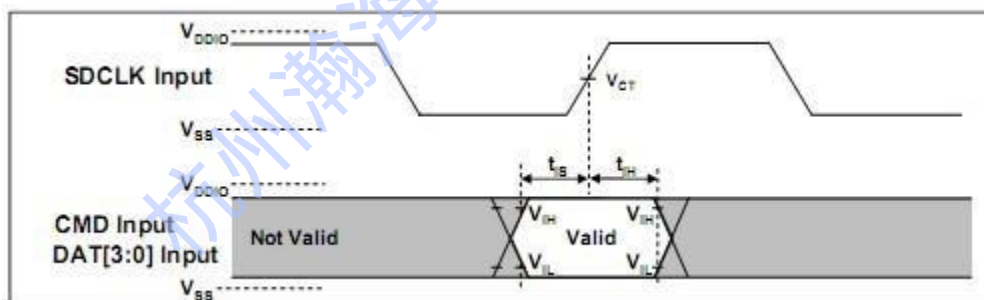


Figure 8: Card Input Timing

Table 13: SDR50 and SDR104 Input Timing

Symbol	Min	Max	Unit	SDR104 mode
t_{IS}	1.40	-	ns	$C_{CARD} = 10pF, V_{CT} = 0.975V$
t_{IH}	0.80		ns	$C_{CARD} = 5pF, V_{CT} = 0.975V$
Symbol	Min	Max	Unit	SDR12, SDR25 and SDR50 modes
t_{IS}	3.00	-	ns	$C_{CARD} = 10pF, V_{CT} = 0.975V$
t_{IH}	0.80	-	ns	$C_{CARD} = 5pF, V_{CT} = 0.975V$

4.3.3.3 Card Output Timing

4.3.3.3.1 Output Timing of Fixed Data Window (SDR12, SDR25 and SDR50)

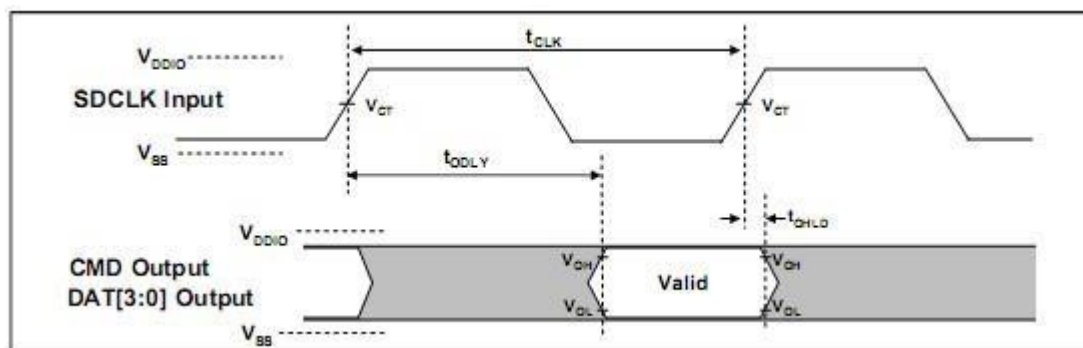


Figure 9: Output Timing of Fixed Date

Window Table 14: Output Timing of Fixed

Data Window

Symbol	Min	Max	Unit	Remark
t_{ODLY}	-	7.5	ns	$t_{CLK} \geq 10.0ns$, $CL=30pF$, using driver Type B, for SDR50.
t_{ODLY}		14	ns	$t_{CLK} \geq 20.0ns$, $CL=40pF$, using driver Type B, for SDR25 and SDR12.
t_{OH}	1.5	-	ns	Hold time at the t_{ODLY} (min.). $CL=15pF$

4.3.3.3.2 Output Timing of Variable Window (SDR104)

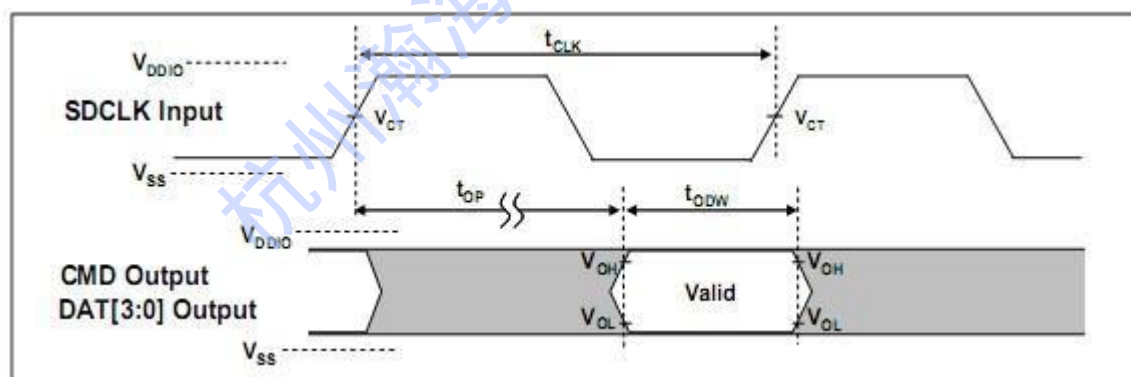


Figure 10: Output Timing of Variable Data

Symbol	Min	Max	Unit	Remark
t_{OP}	-	2	UI	Card Output Phase
Δt_{OP}	-350	+750	ps	Delay variation due to temperature change after tuning
t_{ODW}	0.60	-	UI	$t_{ODW} = 2.88ns$ at 208MHz

5. Mechanical Dimensions

The mechanical dimensions of Agrade Industrial microSD Card were basically followed the mechanical form factor definitions on microSD card specifications which constructed by SD card association.

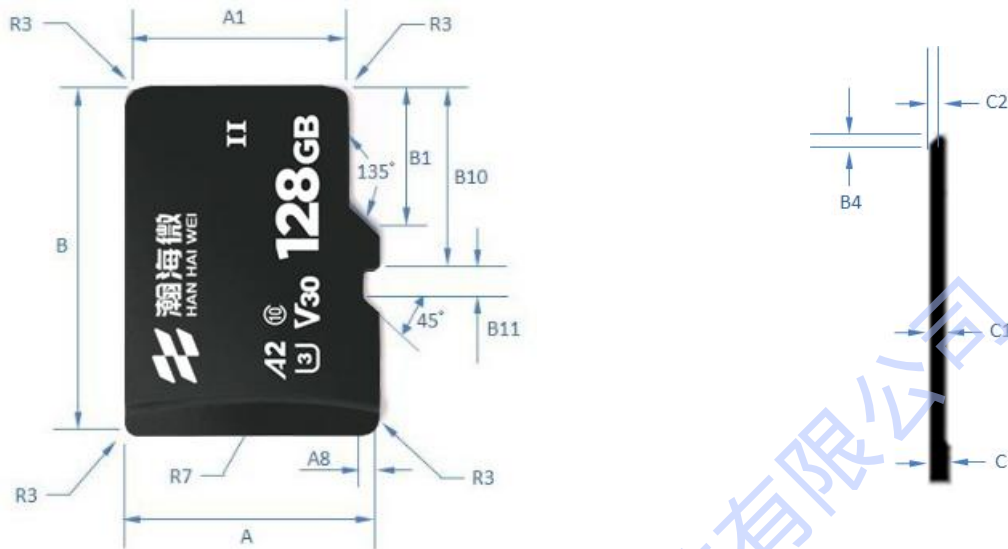


Figure 11: Top View
Figure 12: Side View

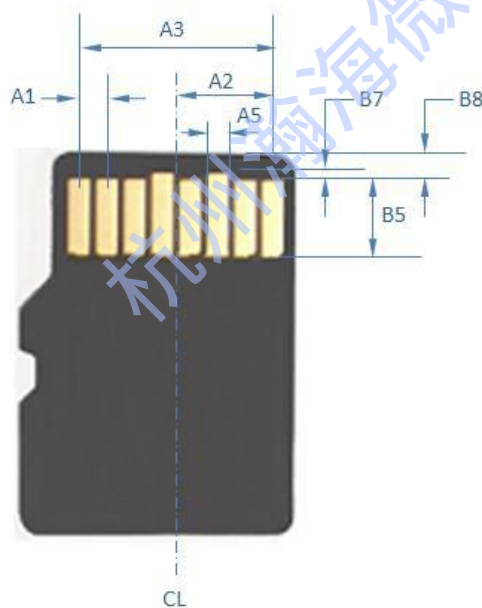


Figure 13: Bottom View

Criteria of microSD				Unit: mm
Dimensions	Min	TYP	Max	Note
A	10.90	11.00	11.10	
A1	9.60	9.70	9.80	
A2		3.85		BASIC
A3	7.60	7.70	7.80	
A4		1.10		BASIC
A5	0.75	0.80	0.85	
A8	0.60	0.70	0.80	
B	14.90	15.00	15.10	
B1	6.13	6.23	6.33	
B4	0.42	0.52	0.62	
B5	2.80	2.90	3.00	
B7	0.20	0.30	0.40	
B8	1.00	1.10	1.20	
B10	7.80	7.90	8.00	
B11	1.10	1.20	1.30	
R3	0.70	0.80	0.90	
R7	29.50	30.00	30.50	
C	0.90	1.00	1.10	
C1	0.60	0.70	0.80	
C2	0.20	0.30	0.40	

6. Ordering Information

	microSD Card(SLC)	microSD Card(aSLC)
Capacity	Wide-temperature	Wide-temperature
1GB	HHW2GTFS-33	
2GB	HHW4GTFS-33	
4GB	HHW4GTFS-33	
32GB		
64 GB		

microSD Card(MLC)			
Capacity	Normal-Temperature	Extended-Temperature	Wide-temperature
4GB			HHW4GTFM-33
8GB			HHW8GTFM-33
16GB			HHW16GTFM-33
32GB			HHW32GTFM-33
64GB			HHW64GTFM-33
128GB			HHW128GTFM-33