

RoHS Compliant

Industrial Secure Digital Card

Specifications

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Version 1.3



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FEATURES:

- **Fully compatible with SD card standard specification**
 - SD Memory Card Specifications, Part 1, Physical Layer Specification, Version 2.00
 - SD Memory Card Specifications, Part 2, File System Specification, Version 2.00
 - SD Memory Card Specifications, Part 3, Security Specification, Version 2.00
- **Capacity**
 - Standard: 256, 512 MB
1, 2 GB
 - SDHC: 4, 8, 16, 32 GB
- **Performance**
 - Sustained read: Up to 19 MB/sec
 - Sustained write: Up to 14 MB/sec
- **SD-protocol compatible**
- **Support SPI mode**
- **NAND Flash Type: SLC**
- **Variable clock rate 0-50MHz**
- **Intelligent endurance design**
 - Built-in BCH-ECC supports correction up to 24 bits data error per 1K bytes data automatically
 - Implements global wear-leveling algorithms to substantially increase longevity of flash media
 - Flash bad-block management
 - S.M.A.R.T utility
- **Temperature ranges**

Standard	0°C ~ 70°C
Extended	-40°C ~ 85°C

 - Operating temperature
 - Storage temperature: -40°C ~ 85°C
- **Power consumption**
 - Standby: 110 μ A
 - Read: 45 mA
 - Write: 55 mA
- **Operation voltage: 2.7V ~ 3.6V**
- **Physical dimension: 24mm x 32mm x 2.1mm**
- **RoHS Compliant**

Note: The performance and the power consumption addressed here are typical and may vary from capacities, flash configurations or host system settings.

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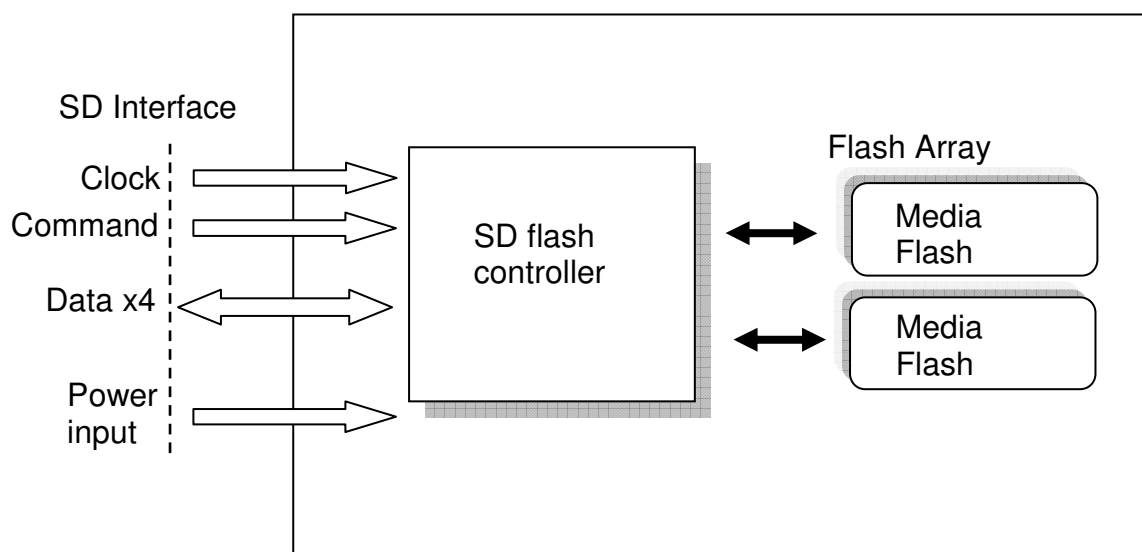
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1. General Description

As the demand of reliable and high-performance data storage in a small form factor increases, Apacer's embedded SD card is designed specifically for rigorous applications by offering maximum endurance, reliability, and agility, where extreme traceability, enhanced data integrity, and exceptionally velocity are required.

1.1 Product Function Block

The embedded SD contains a flash controller and flash media with SD standard interface.



1.2 Functional description

The embedded SD device contains a high level, intelligent subsystem that provides many capabilities including:

- Powerful ECC algorithms
- Global wear-leveling algorithms
- Power management

1.2.1 Flash Management

The SD controller contains logic/physical flash block mapping and bad block management system. It will manage all flash block include user data space and spare block.

The embedded SD also contains a sophisticated defect and error management system. It does a read after write under margin conditions to verify that the data is written correctly (except in the case of write pre-erased sectors). In case that a bit is found to be defective, the embedded SD replaces this bad bit with a spare bit within the sector header. If necessary, the embedded SD will even replace the entire sector with a spare sector. This is completely transparent to the master (host device) and does not consume any user data space.

1.2.2 Powerful ECC Algorithms

The powerful ECC algorithms will enhance flash block use rate and whole device life. The SD controller has an innovative algorithm to recover the data. Built-in BCH-ECC supports correction up to 24 bits data error per 1K bytes data automatically

1.2.3 Power Management

A power saving feature of the embedded SD is automatic entrance and exit from sleep mode. Upon completion of an operation, the embedded SD will enter the sleep mode to conserve power if no further commands are received within X seconds, where X is programmable by software. The master does not have to take any action for this to occur. The embedded SD is in sleep mode except when the host is accessing it, thus conserving power.

Any command issued by the master to the embedded SD will cause it to exit sleep mode and response to the master.

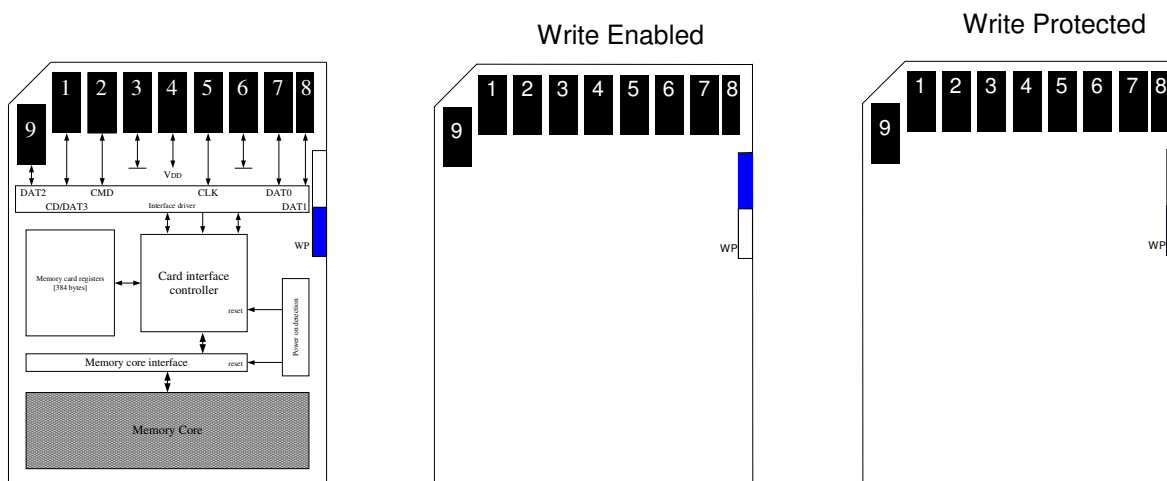
1.2.4 S.M.A.R.T

S.M.A.R.T. (SMART), an acronym stands for Self-Monitoring, Analysis and Reporting Technology, is an open standard allowing an individual disk drive in the ATA/IDE or SCSI interface to automatically monitor its own health and report potential problems in order to prevent data loss. This failure warning technology provides predictions from unscheduled downtime by observing and storing critical drive performance and calibration parameters. Ideally, this should allow taking hands-on actions to keep from impending drive failure.

Failures are divided into two categories: those that can be predicted and those that cannot. Predictable failures occur gradually over time, and the decline in performance can be detected; on the other hand, unpredictable failures happen very sudden without any warning. These failures may be caused by power surges or related to electronic components. The purpose of the SMART implementation is to predict near-term failures of each individual disk drive and generate a warning to prevent unfortunate loss.

2. Electrical characteristics

2.1 Card Architecture



2.2 Pin Assignment

Pin	SD Mode		SPI Mode	
	Name	Description	Name	Description
1	CD/DAT3	Card detect/Data line[Bit 3]	CS	Chip select
2	CMD	Command/Response	DI	Data in
3	VSS1	Supply voltage ground	VSS	Supply voltage ground
4	VDD	Supply voltage	VDD	Supply voltage
5	CLK	Clock	SCLK	Clock
6	VSS2	Supply voltage ground	VSS2	Supply voltage ground
7	DAT0	Data line[Bit 0]	DO	Data out
8	DAT1	Data line[Bit 1]	Reserved	
9	DAT2	Data line[Bit 2]	Reserved	

2.3 Capacity Specification

The following table shows the out-of-box capacity. (Follow SDA rule to do format)

Capacity	Total (LBA) Sectors	Total Partition Sectors	User Data Sectors	User Data Bytes
256 MB	499,712	499,611	499,456	255,721,472
512 MB	985,088	984,851	984,576	504,102,912
1 GB	2,000,896	2,000,651	2,000,128	1,024,065,536
2 GB	4,009,984	4,009,739	4,009,216	2,052,718,592
4 GB	8,019,968	8,011,776	8,003,584	4,097,835,008
8 GB	16,039,936	16,031,744	16,023,552	8,204,025,856
16 GB	31,719,424	31,711,232	31,703,040	16,231,923,712
32 GB	63,438,848	63,430,656	63,414,272	32,468,074,496

Note: the statistics may vary depending on file systems of various OS. User data bytes do not indicate total useable bytes. LBA count addressed in the table above indicates total user storage capacity and will remain the same throughout the lifespan of the device. However, the total usable capacity of the SD is most likely to be less than the total physical capacity because a small portion of the capacity is reserved for device maintenance usages.

2.4 Performance

Performances of Embedded SD are shown in the table below.

Capacity	256 MB	512 MB	1 GB	2 GB	4 GB	8 GB	16 GB	32 GB
Performance								
Sustained Read (MB/s)	18	19	19	19	19	19	19	19
Sustained Write (MB/s)	7	13	11	12	14	14	11	12

Note: Performances vary from flash configurations or host device settings.

2.5 DC Power Supply

Symbol	Parameter	Min.	Typ.	Max.	Unit
V _{DD}	Power Supply Voltage	2.7	3.3	3.6	V

2.6 Power consumption

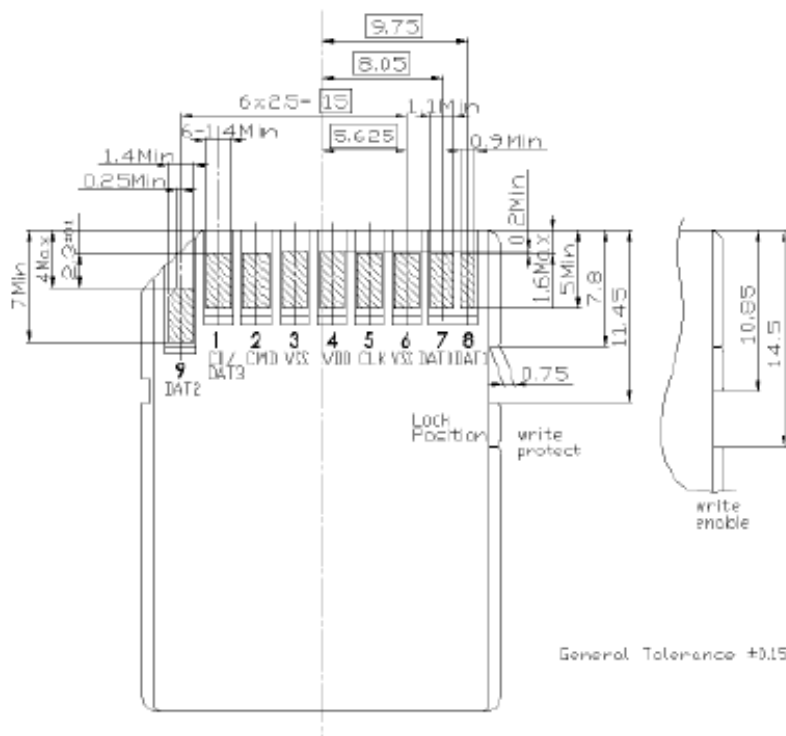
Mode	Value	Unit	Condition
Standby	110	μ A	Typical
Read	45	mA	Typical
Write	55	mA	Typical

Note: results are measured under 3.3V

3. Physical Characteristics

3.1 Physical Dimension

Dimensions Card Package	24 mm x 32 mm Min. 23.9 mm x 31.9 mm Max. 24.1 mm x 32.1 mm
Thickness	2.1 mm ± 0.15 mm
Surface	Plain (except contact area)
Edges	Smooth edges



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3.2 Environmental Specifications

Climatic Testing		
Test Item	DUT State	Test Condition (Gold Series)
		Temperature
High Temperature	Storage	85°C
	Operation	70°C
Low Temperature	Storage	- 40°C
	Operation	0°C
Moisture and Corrosion	Storage	40°C 93%
	Operation	25°C 95%
Junction temperature		Max. 95°C

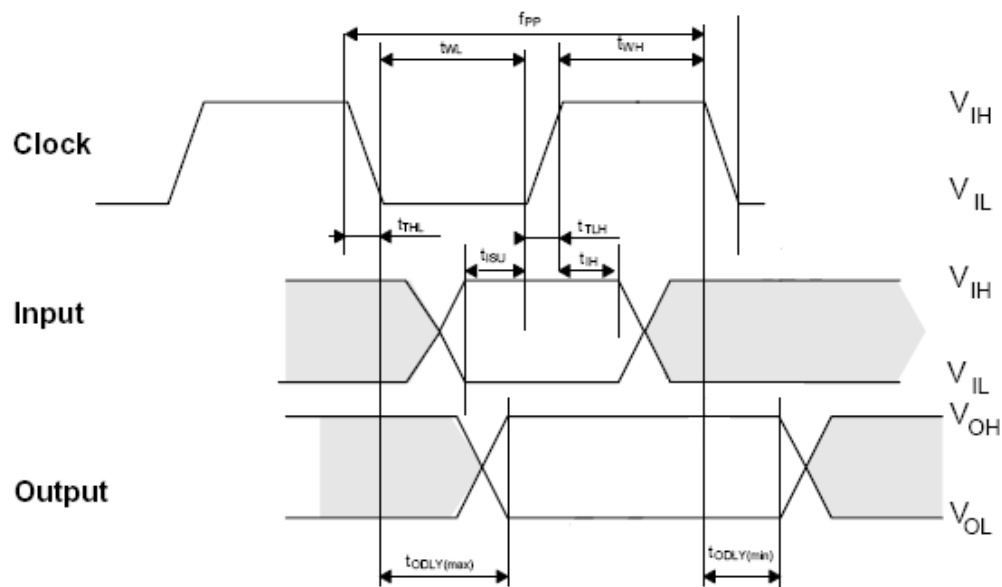
Reliability & Durability Testing	
Test Item	Descriptions
Durability	10,000 mating cycles

Industrial Secure Digital Card
AP-ISDxxxXXXX-3X

Bending	10 N
UV light exposure	UV:254 nm, 15 Ws/cm ² according to ISO 7816-1
Visual inspection shape and form	No warpage; no mold skin; complete form; no cavities surface smoothness ≤ -0.1 mm/cm ² within contour; no cracks; no pollution (fat, oil dust, etc)
Drop	1.5 m free fall
Salt Water Spray	3 $\pm$ 1%NaCl; 35°C; 24hrs accumulated (MIL STD Method 1009)
Torque	0.15N.m or +/- 2.5 degree
WP (Write Protect) switch cycles	Minimum 1000 cycles (@ slide force 0.4 N to 5N)

4. AC Characteristics

4.1 SD Interface Timing (Default)



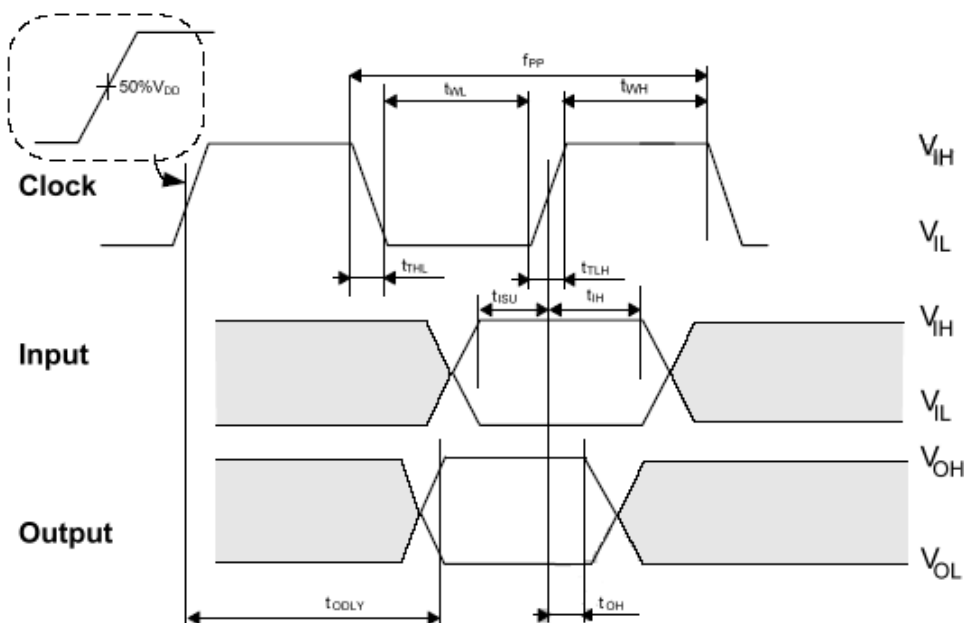
Shaded areas are not valid

SYMBOL	PARAMETER	MIN	MAX	UNIT	Note
Clock CLK (All values are referred to min(V_{IH}) and max(V_{IL}))					
f_{PP}	Clock frequency Data Transfer Mode	0	25	MHz	$C_{card} \leq 10$ pF (1 card)
f_{OD}	Clock frequency Identification Mode	0 ₍₁₎ /100	400	kHz	$C_{card} \leq 10$ pF (1 card)
t_{WL}	Clock low time	10	-	ns	$C_{card} \leq 10$ pF (1 card)
t_{WH}	Clock high time	10	-	ns	$C_{card} \leq 10$ pF (1 card)
t_{TLH}	Clock rise time	-	10	ns	$C_{card} \leq 10$ pF (1 card)
t_{THL}	Clock fall time	-	10	ns	$C_{card} \leq 10$ pF (1 card)
t_{ISU}	Input setup time	5	-	ns	$C_{card} \leq 10$ pF (1 card)
t_{IH}	Input hold time	5	-	ns	$C_{card} \leq 10$ pF (1 card)
t_{ODLY}	Output delay time	0	14	ns	$C_L \leq 40$ pF (1 card)

t_{ODLY}	Output Delay time during Identification Mode	0	50	ns	$C_L \leq 40$ pF (1 card)
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(1) 0Hz means to stop the clock. The given minimum frequency range is for cases that requires the clock to be continued.

4.2 SD Interface Timing (High Speed Mode)



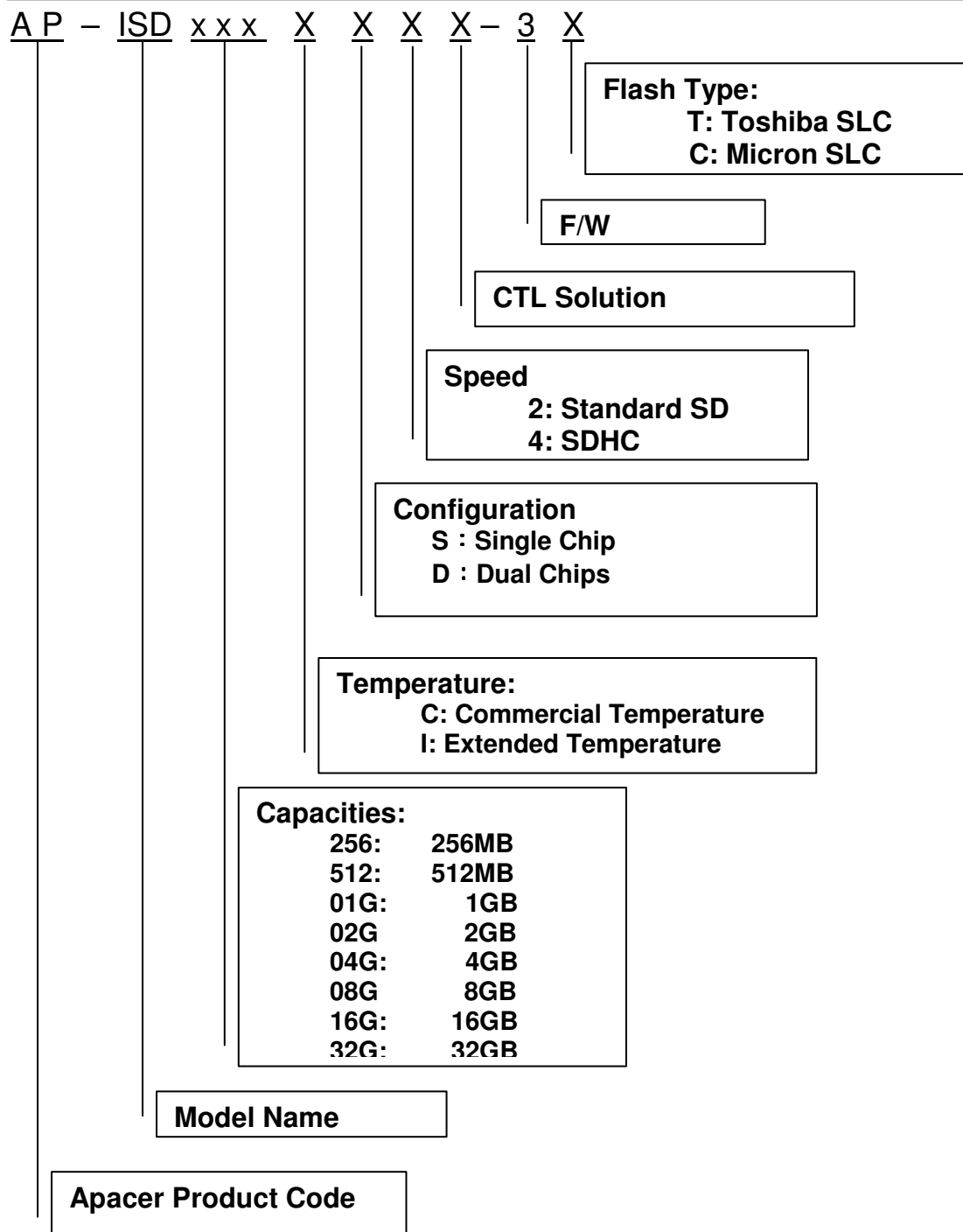
Shaded areas are not valid

SYMBOL	PARAMETER	MIN	MAX	UNIT	Note
f_{PP}	Clock frequency data transfer mode	0	50	MHz	$C_{card} \leq 10$ pF (1 card)
t_{WL}	Clock low time	7	-	ns	$C_{card} \leq 10$ pF (1 card)
t_{WH}	Clock high time	7	-	ns	$C_{card} \leq 10$ pF (1 card)
t_{TLH}	Clock rise time	-	3	ns	$C_{card} \leq 10$ pF (1 card)
t_{THL}	Clock fall time	-	3	ns	$C_{card} \leq 10$ pF (1 card)
t_{ISU}	Input setup time	6	-	ns	$C_{card} \leq 10$ pF (1 card)
t_{IH}	Input hold time	2	-	ns	$C_{card} \leq 10$ pF (1 card)
t_{ODLY}	Output delay time		14	ns	$C_L \leq 40$ pF (1 card)
T_{OH}	Output hold time	2.5		ns	$C_L \leq 15$ pF (1 card)
C_L	System capacitance of each line*		40	pF	$C_L \leq 15$ pF (1 card)

*In order to satisfy severe timing, host shall run on only one card

5. Product Ordering Information

5.1 Product Code Designations



5.2 Valid Combinations

5.2.1 Standard Temperature

Capacity	AP/N
256MB	AP-ISD256CS2A-3T
512MB	AP-ISD512CS2A-3T
1GB	AP-ISD01GCS2A-3T
2GB	AP-ISD02GCS2A-3T
4GB	AP-ISD04GCS4A-3T
8GB	AP-ISD08GCD4A-3T
16GB	AP-ISD16GCD4A-3C
32GB	AP-ISD32GCD4A-3C

5.2.2 Extended Temperature

Capacity	AP/N
256MB	AP-ISD256IS2B-3T
512MB	AP-ISD512IS2B-3T
1GB	AP-ISD01GIS2B-3T
2GB	AP-ISD02GIS2B-3T
4GB	AP-ISD04GIS4B-3T
8GB	AP-ISD08GID4B-3T
16GB	AP-ISD16GID4B-3C
32GB	AP-ISD32GID4B-3C

Note: Please consult with Apacer sales representatives for availabilities.

Revision History

Revision	Description	Date
1.0	Official release	06/14/2011
1.1	Updated operating voltage information - Add a short note of +/- 10% tolerance and lowest at 1.8V	02/17/2012
1.2	Updated Product Ordering Information due to firmware upgrade	10/23/2012
1.3	Corrected the mistake in Product Ordering Information: from single/dual channels to single/dual chips as SD card is designed in single channel	01/02/2013

Global Presence

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