

RoHS Compliant

Industrial Secure Digital Card

Datasheet

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Version 1.1



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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 GB
- **Performance**
 - Sustained read: Up to 20 MB/sec
 - Sustained write: Up to 13 MB/sec
- **SD-protocol compatible**
- **Support SPI mode**
- **Support auto standby and sleep 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
- **Temperature ranges**
 - Operating temperature

Standard	0°C ~ 70°C
ET*	-40°C ~ 85°C
 - Storage temperature: -40°C ~ 100°C
- **Low power consumption**
- **Operation voltage: 2.7V ~ 3.6V**
- **Physical dimension: 24mm x 32mm x 2.1mm**
- **RoHS Compliant**

*Extended Temperature

TABLE OF CONTENTS

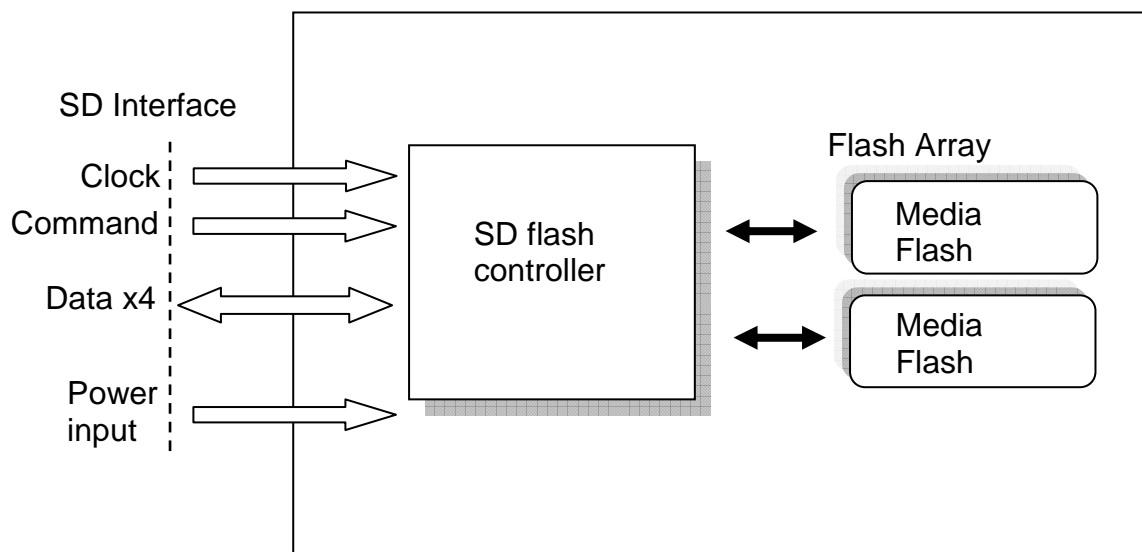
1. General Description	3
1.1 PRODUCT FUNCTION BLOCK	3
1.2 FUNCTIONAL DESCRIPTION	3
1.2.1 <i>Flash Management</i>	4
1.2.2 <i>Powerful ECC Algorithms</i>	4
1.2.3 <i>Power Management</i>	4
2. Electrical characteristics	5
2.1 CARD ARCHITECTURE	5
2.2 PIN ASSIGNMENT	5
2.3 CAPACITY SPECIFICATION	6
2.4 PERFORMANCE	6
2.5 ABSOLUTE MAXIMUM RATINGS	7
2.6 POWER CONSUMPTION	7
3. Physical Characteristics	8
3.1 PHYSICAL DIMENSION	8
3.2 SYSTEM RELIABILITY	10
3.3 ENVIRONMENTAL SPECIFICATIONS	10
4. AC Characteristics	11
4.1 BUS TIMING – SD STANDARD MODE	11
4.2 BUS TIMING – SD HIGH-SPEED MODE	12
5. Product Ordering Information	13
5.1 PRODUCT CODE DESIGNATIONS	13
5.2 VALID COMBINATIONS	14
5.2.1 <i>Standard Temperature</i>	14
5.2.2 <i>Extended Temperature</i>	14

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 for low power operation

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

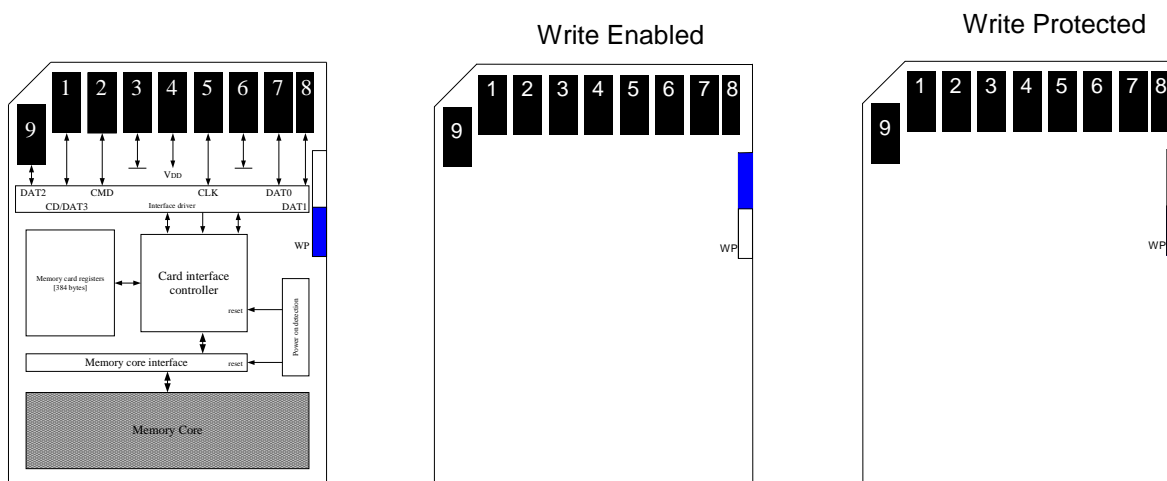
1.2.3 Power Management

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.

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 Embedded SD product family is available as the table below. The following table shows the specific 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	1,003,520	1,003,287	1,003,008	513,540,096
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	8,204,058,624

2.4 Performance

Performances of Embedded SD are shown in the table below.

Capacity \ Performance	256 MB	512 MB	1 GB	2 GB	4 GB	8 GB
Sustained Read (MB/s)	18	19	20	20	20	18
Sustained Write (MB/s)	7	7	10	13	12	13

Note: Performances vary from flash configurations.

2.5 Absolute Maximum Ratings

Symbol	Parameter	Min.	Typ.	Max.	Unit
Vcc	Power Supply Voltage	2.7	3.3	3.6	V
Vss	Power Supply Voltage	0	0	0	V

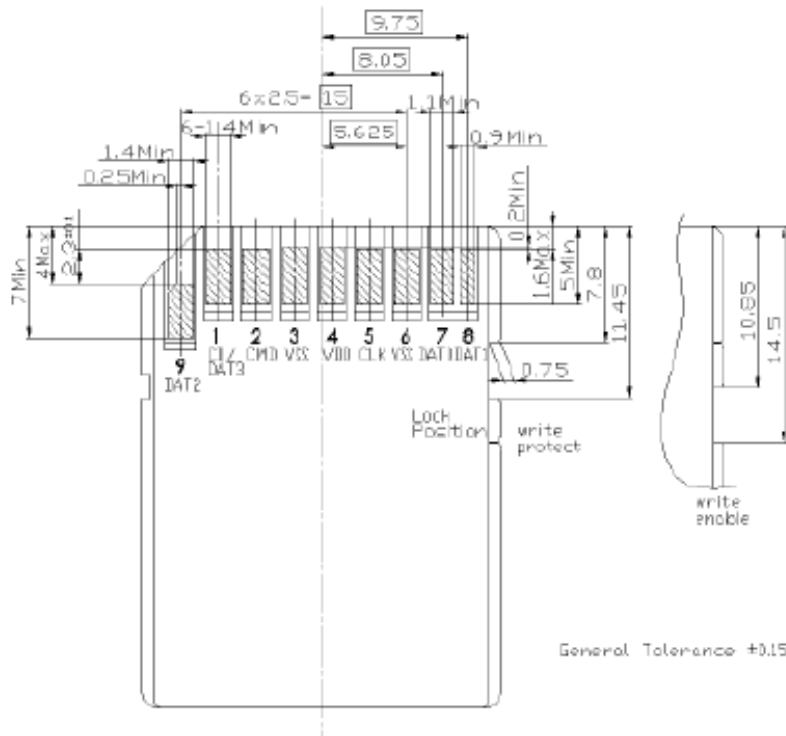
2.6 Power consumption

VCC 2.7V – 3.6V			
Mode	Value	Unit	Average
Standby	94	μ A	Max.
Read	10	mA	Typical
Write	15	mA	Typical

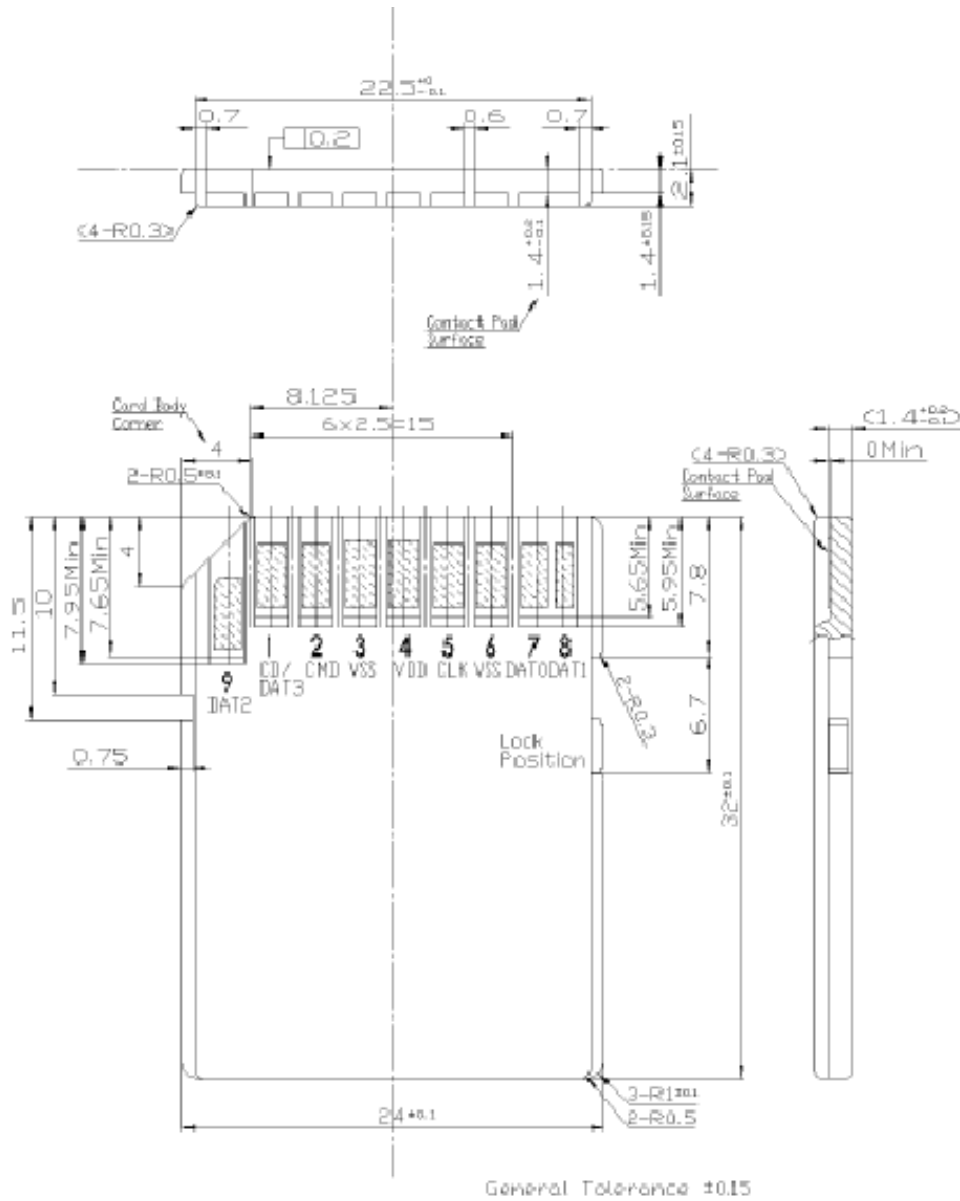
3. Physical Characteristics

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



Industrial Secure Digital Card AP-ISDxxxXXXX-XX



3.2 System Reliability

Durability	10,000 mating cycles
Data reliability	<1 non-recoverable error 10 ¹⁴ bits read

3.3 Environmental Specifications

Environmental Specification

Temperature	Operating	Standard: 0°C to 70°C/ ET*: -40°C to 85°C
	Storage	-40°C to 100°C
Humidity	Operating	25°C - 95%RH non-condensing
	Non-operating	40°C - 93%RH non-condensing
Salt Spray	Non-operating	5%wt NaCl Solution Temperature:35°C 24hr
Bending	Non-operating	10N
Torque	Non-operating	0.15N.m or angle = ± 2.5 deg.(Max)
Drop	Non-operating	1.5 m free fall
X-ray Exposure		0.1 Gy of medium-energy radiation (70 keV to 140 keV, cumulative dose per year) to both sides of the card, according to ISO 7816-1.
Minimum moving force of WP switch	Non-operating	Moving Force:40gf.(Ensures that the WP switch will not slide while it is inserted to the connector)
WP Switch cycles	Non-operating	Minimum 1,000 Cycles (@ Slideforce:0.4N~5N)

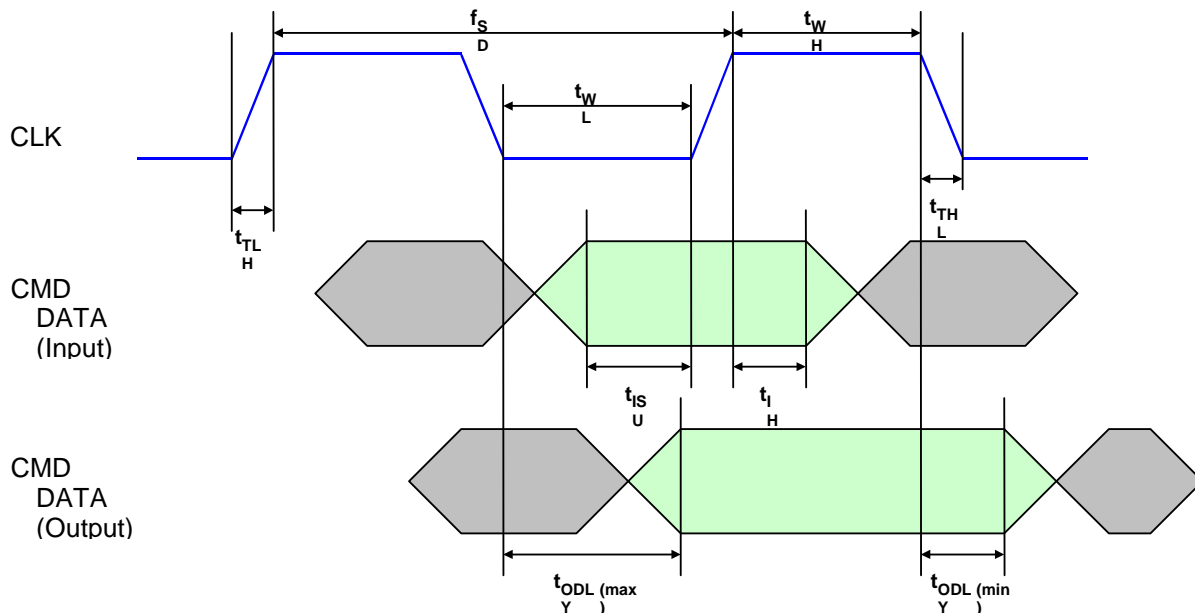
*Extended Temperature

4. AC Characteristics

4.1 Bus Timing – SD standard mode

SD Default Mode Bus Timing Parameter Value

SYMBOL	PARAMETER	MIN	MAX	UNIT	Note
f_{SD}	SD clock frequency	0	25	MHz	
t_{WL}	Clock low time	10	-	ns	
t_{WH}	Clock high time	10	-	ns	
t_{TLH}	Clock rise time	-	10	ns	
t_{THL}	Clock fall time	-	10	ns	
t_{ISU}	Input setup time	5	-	ns	
t_{IH}	Input hold time	5	-	ns	
t_{ODLY}	Output delay time	0	14	ns	

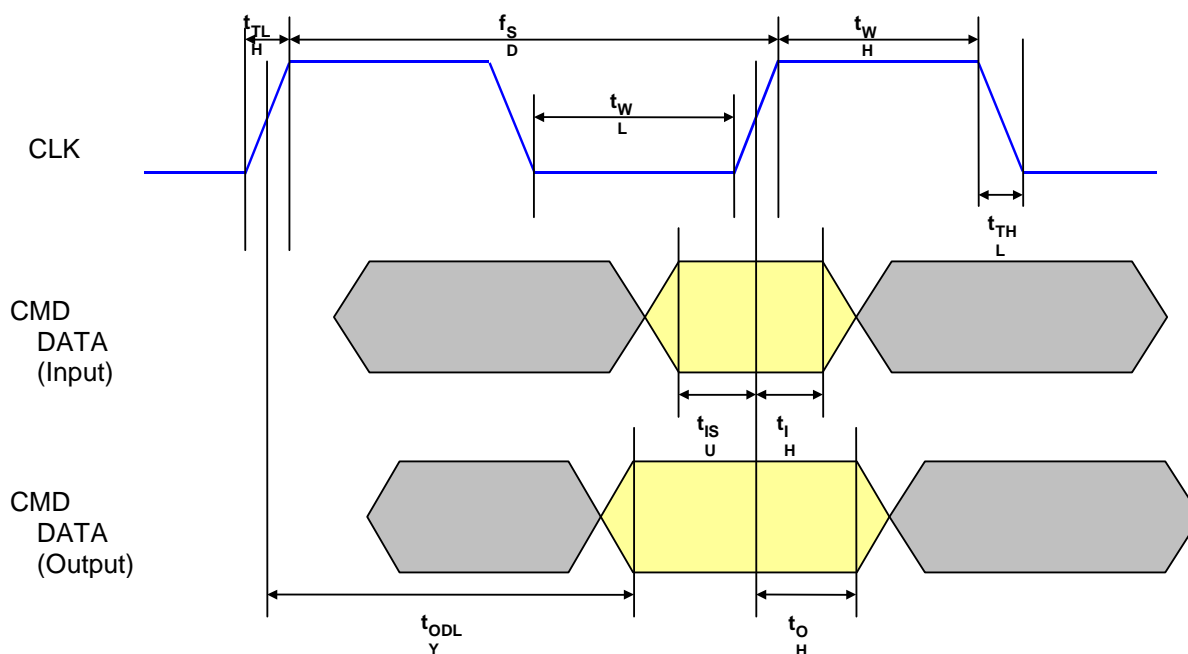


Timing Diagram of SD Default Mode Bus Timing

4.2 Bus Timing – SD High-speed mode

SD High-Speed Mode Bus Timing Parameter Value

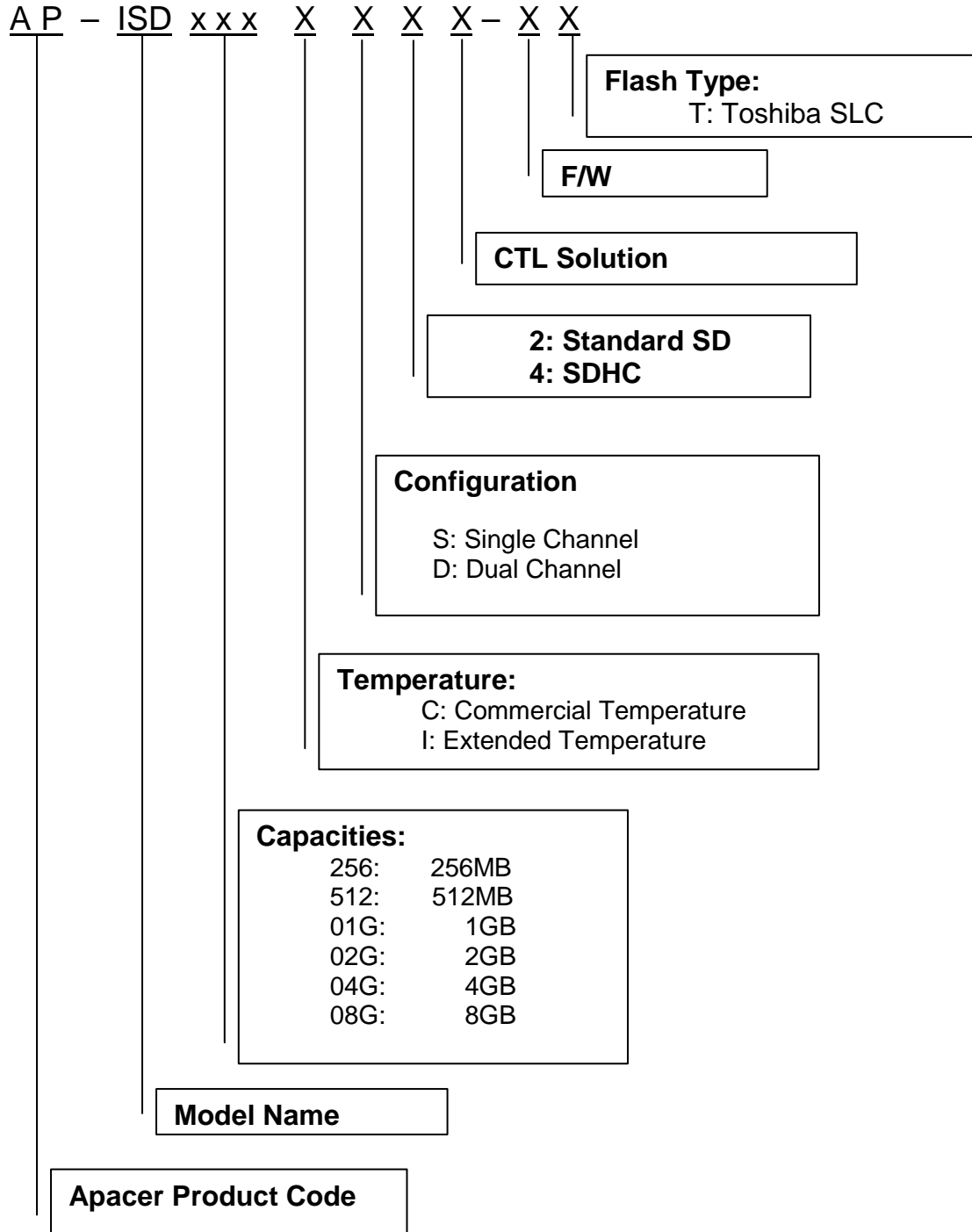
SYMBOL	PARAMETER	MIN	MAX	UNIT	Note
f_{SD}	SD clock frequency	0	50	MHz	
t_{WL}	Clock low time	7	-	ns	
t_{WH}	Clock high time	7	-	ns	
t_{TLH}	Clock rise time	-	3	ns	
t_{THL}	Clock fall time	-	3	ns	
t_{ISU}	Input setup time	6	-	ns	
t_{IH}	Input hold time	2	-	ns	
t_{ODLY}	Output delay time	-	14	ns	
t_{OH}	Output hold time	2.5	-	ns	



Timing Diagram of SD High-Speed Mode Bus Timing

5. Product Ordering Information

5.1 Product Code Designations



5.2 Valid Combinations

5.2.1 Standard Temperature

<i>Capacity</i>	<i>AP/N</i>
256 MB	AP-ISD256CS2A-T
512 MB	AP-ISD512CS2A-T
1 GB	AP-ISD01GCS2A-T
2 GB	AP-ISD02GCS2A-T
4 GB	AP-ISD04GCS4A-T
8 GB	AP-ISD08GCD4A-T

5.2.2 Extended Temperature

<i>Capacity</i>	<i>AP/N</i>
256 MB	AP-ISD256IS2B-T
512 MB	AP-ISD512IS2B-T
1 GB	AP-ISD01GIS2B-T
2 GB	AP-ISD02GIS2B-T
4 GB	AP-ISD04GIS4B-T
8 GB	AP-ISD08GID4B-T

Note: Valid combinations are those products in mass production or will be in mass production. Consult your Apacer sales representative to confirm availability of valid combinations and to determine availability of new combinations.

Revision History

Revision	Description	Date
1.0	Official release	04/15/2011
1.1	Revised Capacity Specification	05/10/2011

Global Presence

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