

*RoHS Compliant*

# **Industrial Micro SD Card**

*Product Specifications*

October 18, 2016

*Version 1.5*



**Apacer Technology Inc.**

1F, No.32, Zhongcheng Rd., Tucheng Dist., New Taipei City, Taiwan, R.O.C

Tel: +886-2-2267-8000 Fax: +886-2-2267-2261

[www.apacer.com](http://www.apacer.com)

## FEATURES:

- **Fully compliant with SD Card Specifications 1.1 and 2.0**
- **Capacity**
  - 256, 512 MB
  - 1, 2, 4 GB
- **Performance\***
  - Sustained Read: Up to 20 MB/sec
  - Sustained Write: Up to 16 MB/sec
- **Flash Management**
  - Built-in advanced ECC algorithm: 24bits/1KB
  - Wear-leveling algorithms
  - Power failure management
- **SD-Protocol Compatible**
- **Standard Interface**
  - 8-pins SD interface
- **NAND Flash Type: SLC**
- **Endurance (TBW: Terabytes Written)**
  - 256MB: 3 TBW
  - 512MB: 6 TBW
  - 1GB: 12 TBW
  - 2GB: 24 TBW
  - 4GB: 49 TBW
- **Temperature Range**
  - Operating: -40°C to 85°C
  - Storage: -40°C to 85°C
- **Power Consumption:**
  - Operating mode: 50 mA
  - Standby mode: 100 uA
- **Operating Voltage: 2.7V ~ 3.6V**
- **Physical Dimensions: 15.0 mm(L) x 11.0 mm(W) x 1.0 mm(H)**
- **Supports S.M.A.R.T.**
- **RoHS Compliant**

\*Varies from capacities. Performance values presented here are typical and may vary depending on settings and platforms.

---

## TABLE OF CONTENTS

<b>1. General Description</b> .....	<b>3</b>
1.1 PRODUCT FUNCTION BLOCK .....	3
1.2 FUNCTIONAL DESCRIPTION .....	4
1.2.1 ECC Algorithms .....	4
1.2.2 Wear Leveling .....	4
1.2.3 Power Failure Management.....	4
<b>2. Product Characteristics</b> .....	<b>5</b>
2.1 CARD ARCHITECTURE .....	5
2.2 PIN ASSIGNMENT .....	5
2.3 CAPACITY SPECIFICATIONS .....	6
2.4 PERFORMANCE .....	6
2.5 ABSOLUTE MAXIMUM RATINGS.....	6
2.6 POWER CONSUMPTION .....	6
2.7 ENDURANCE .....	7
<b>3. Physical Characteristics</b> .....	<b>8</b>
<b>4. Electrical Characteristics</b> .....	<b>10</b>
4.1 BUS INTERFACE TIMING (STANDARD) .....	10
4.2 BUS INTERFACE TIMING (HIGH-SPEED) .....	11
<b>5. S.M.A.R.T.</b> .....	<b>12</b>
<b>6. Product Ordering Information</b> .....	<b>15</b>
6.1 PRODUCT CODE DESIGNATIONS .....	15
6.2 VALID COMBINATIONS.....	16

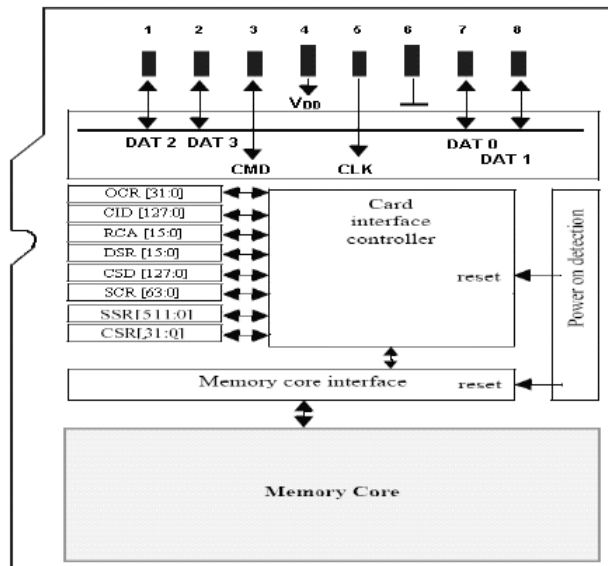
## 1. General Description

Micro SD card has been the favorable storage in both enterprise and consumer electronic devices for its compact size, relatively fast transfer speed and decent reliability. Apacer industrial micro SD card is capable of delivering optimal speed up to 20 MB/s. Reliability wise, the card can be put in operations with ambient temperatures ranging -40 to 85°C. Built with SLC NAND Flash, the card surpasses most of the typical of its kind in the market with regard in program/erase cycles.

The industrial SD card is compatible with SD Card 1.1/2.0 specification and delivers compatibility as well as reliability. The card is built in with hardware ECC engine that can detect and correct up to 24bits/1KB of transferring data. Moreover, this industrial card is designed with power smart mechanism that supports standby and sleep mode, making it an ideal portable storage when power supply is limited.

### 1.1 Product Function Block

The Micro SD contains a card controller and a memory core for the SD standard interface.



---

## 1.2 Functional description

---

The Micro SD device contains a high level, intelligent flash management that provides many capabilities including:

- Powerful ECC algorithms – correcting up to 24bits/1KB
- Wear-leveling
- Power failure management

### 1.2.1 ECC Algorithms

The powerful ECC algorithms will enhance flash block use rate and whole device life. The SD controller supports up to 68bits ECC circuits to protect data transfer.

### 1.2.2 Wear Leveling

NAND Flash devices can only undergo a limited number of program/erase cycles, and in most cases, the flash media are not used evenly. If some area get updated more frequently than others, the lifetime of the device would be reduced significantly. Thus, Wear Leveling technique is applied to extend the lifespan of NAND Flash by evenly distributing write and erase cycles across the media.

Apacer provides wear leveling algorithm, which can efficiently spread out the flash usage through the whole flash media area. Moreover, by implementing both dynamic and static Wear Leveling algorithms, the life expectancy of the NAND Flash is greatly improved.

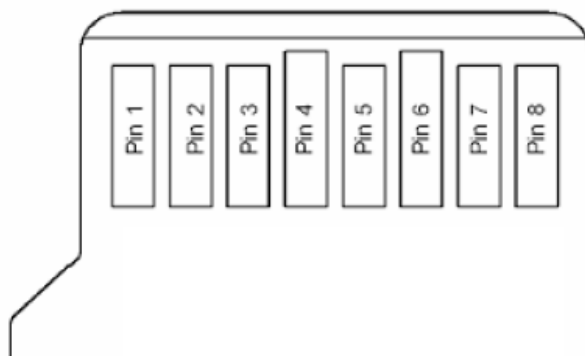
### 1.2.3 Power Failure Management

Apacer industrial SD and MicroSD cards provide complete data protection mechanism during every abnormal power shutdown situation, such as power failure at programming data, updating system tables, erasing blocks, etc. Apacer Power-Loss Protection mechanism includes:

- Maintaining data correctness and increasing the reliability of the data stored in the NAND Flash memory.
- Protecting F/W table and the data written to flash from data loss in the event of power off.

## 2. Product Characteristics

### 2.1 Card Architecture



### 2.2 Pin Assignment

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

## 2.3 Capacity Specifications

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

Note: Results may vary depending on settings and platforms. Please be noted that products are shipped with unformatted capacity. The number of user data bytes and usable storage space may vary from different host operating systems.

## 2.4 Performance

Performance of the SD card is shown in the table below.

Modes \ Capacity	256 MB	512 MB	1 GB	2GB	4GB
	Sequential Read (MB/s)	19	20	19	19
Sequential Write (MB/s)	10	16	11	14	16

Note: Results may vary depending on settings and platforms.

## 2.5 Absolute Maximum Ratings

Symbol	Parameter	Min.	Max.	Unit
V <sub>DD</sub>	Supply Voltage	2.7	3.6	V
T <sub>storage</sub>	Storage Temperature	-40	85	°C
T <sub>a</sub>	Ambient Operating Temperature	-40	85	°C

## 2.6 Power Consumption

Modes \ Capacity	256 MB	512 MB	1 GB	2 GB	4 GB
	Operating (mA)	34	34	33	34
Idle (uA)	60	60	60	60	100

\*Power consumption may differ from host system configurations.

---

## 2.7 Endurance

---

The endurance of a storage device is predicted by TeraBytes Written based on several factors related to usage, such as the amount of data written into the drive, block management conditions, and daily workload for the drive. Thus, key factors, such as Write Amplifications and the number of P/E cycles, can influence the lifespan of the drive.

Capacity	TeraBytes Written
256 MB	3
512 MB	6
1 GB	12
2 GB	24
4 GB	49

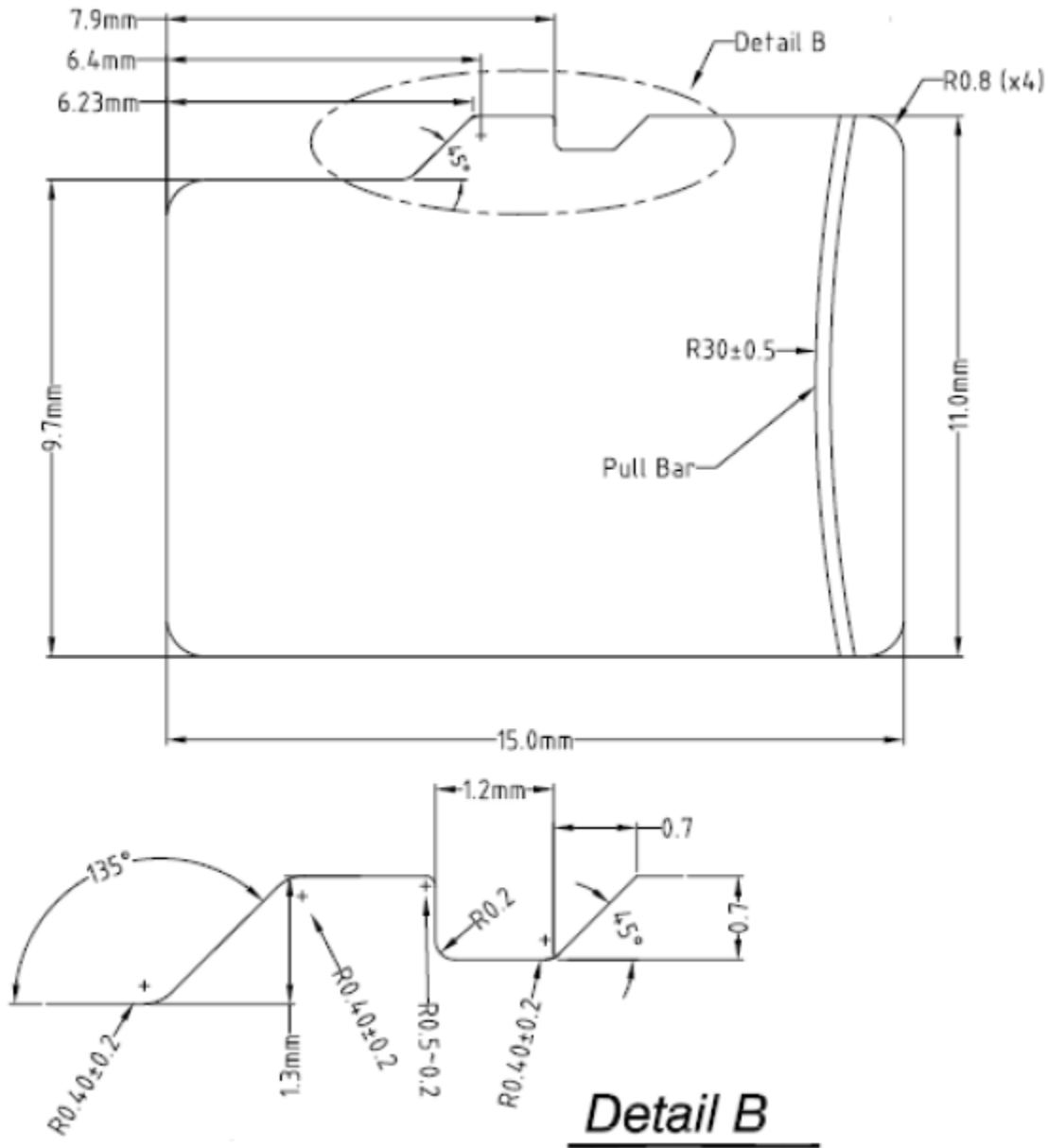
Note:

- The measurement assumes the data written to the SSD for test is under a typical and constant rate.
- The measurement follows the standard metric: 1 TB (Terabyte) = 1,000 GB.

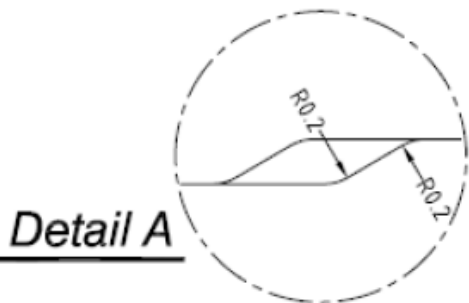
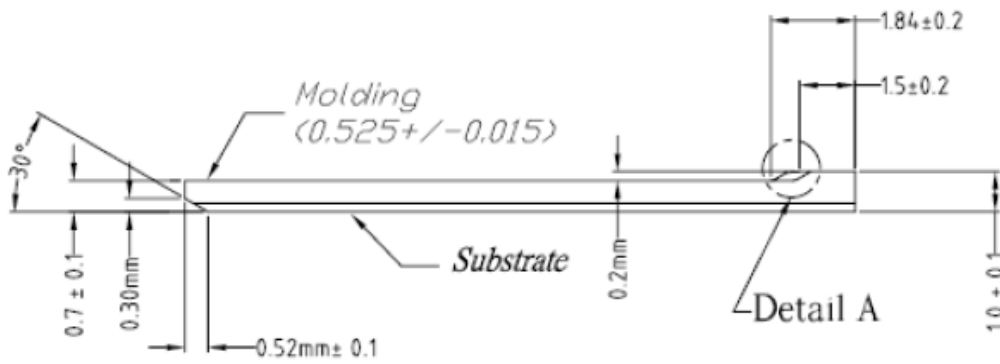
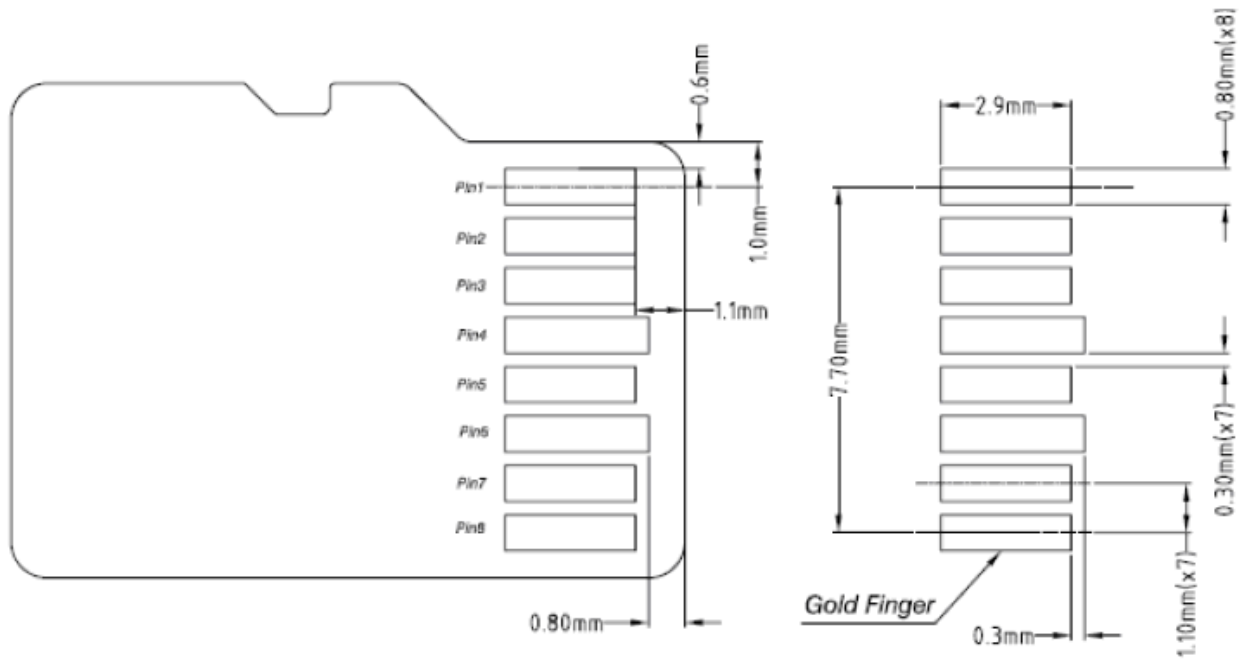


### 3. Physical Characteristics

#### Top View

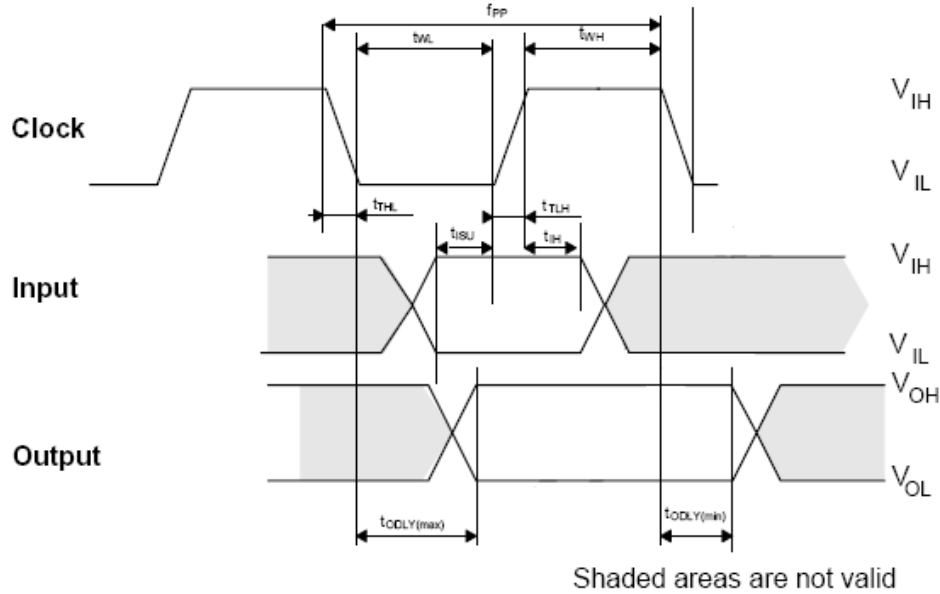


Bottom View



## 4. Electrical Characteristics

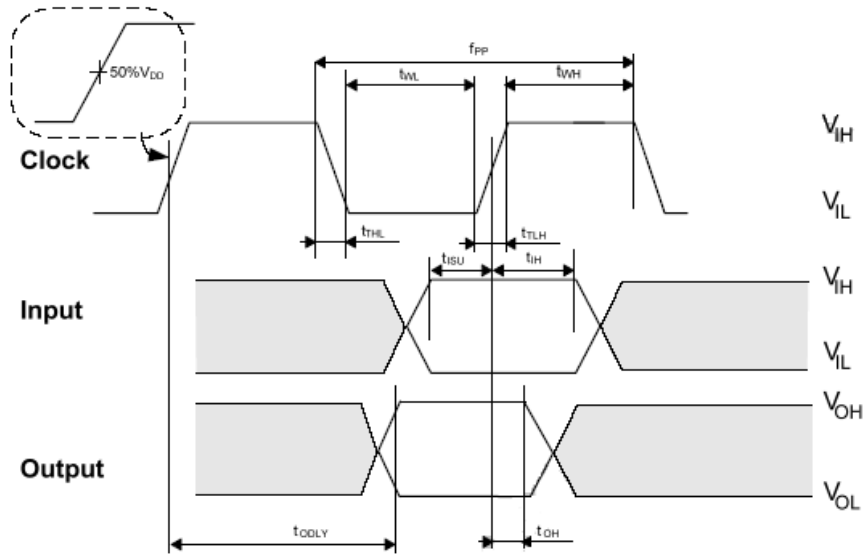
### 4.1 Bus Interface Timing (Standard)



SYMBOL	PARAMETER	MIN	MAX	UNIT	Note
<b>Clock CLK (All values are referred to min(V<sub>IH</sub>) and max(V<sub>IL</sub>))</b>					
f <sub>PP</sub>	Clock frequency Data Transfer Mode	0	25	MHz	C <sub>card</sub> ≤ 10 pF (1 card)
f <sub>OD</sub>	Clock frequency Identification Mode	0 <sub>(1)</sub> /100	400	kHz	C <sub>card</sub> ≤ 10 pF (1 card)
t <sub>WL</sub>	Clock low time	10	-	ns	C <sub>card</sub> ≤ 10 pF (1 card)
t <sub>WH</sub>	Clock high time	10	-	ns	C <sub>card</sub> ≤ 10 pF (1 card)
t <sub>TLH</sub>	Clock rise time	-	10	ns	C <sub>card</sub> ≤ 10 pF (1 card)
t <sub>THL</sub>	Clock fall time	-	10	ns	C <sub>card</sub> ≤ 10 pF (1 card)
t <sub>ISU</sub>	Input setup time	5	-	ns	C <sub>card</sub> ≤ 10 pF (1 card)
t <sub>IH</sub>	Input hold time	5	-	ns	C <sub>card</sub> ≤ 10 pF (1 card)
t <sub>ODLY</sub>	Output delay time	0	14	ns	C <sub>L</sub> ≤ 40 pF (1 card)
t <sub>ODLY</sub>	Output Delay time during Identification Mode	0	50	ns	C <sub>L</sub> ≤ 40 pF (1 card)

(1)0Hz means to stop the clock. The given minimum frequency range is for cases that requires the clock to be continued.

## 4.2 Bus Interface Timing (High-speed)



Shaded areas are not valid

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

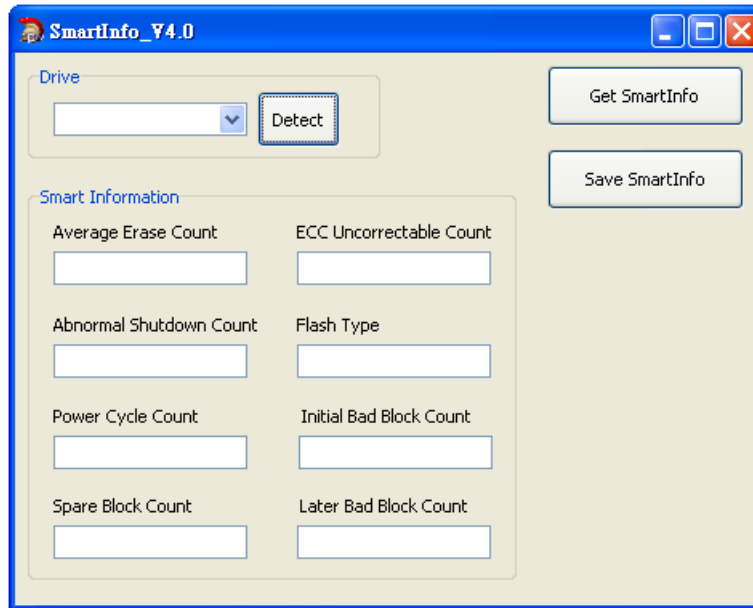
\*In order to satisfy severe timing, host shall run on only one card.

## 5. S.M.A.R.T.

S.M.A.R.T. is the abbreviation for Self-Monitoring, Analysis and Reporting Technology, an open standard allowing disk drives to automatically monitor their own health and report potential problems. It provides users critical drive status information and attributes parameters for anticipation purposes. Ideally, this should prevent unexpected drive failure and data loss.

Depending on product ordering requests, we provide customizable user interfaces for our S.M.A.R.T utility. The utility program comes in two types of interfaces versions: complete and simple.

### Complete User Interface Version:



### Detailed Description for SMART Information

#### 1. Average Erase Count

Value: To record average erase ratio.

This value is calculated by “total erase counts”, “Flash P/E cycles”, “Flash total blocks”.

Initial value = 00.00%

Maximum value = 100.00%

#### 2. Abnormal Shutdown Count

Value: To record abnormal shutdown condition.

Increasing this value by 1 when detected error in the power on stage.

Initial value = 0.

Maximum value = 4294967295.

---

### 3. Power Cycle Count

Value: To record power cycle condition.

Increasing this value by 1 when a power Cycle (both normal and abnormal) occurred.

Initial value = 0.

Maximum value = 4294967295.

### 4. Spare Block Count

Value: To record spare block counts.

Decreasing this variable when detected run-time bad blocks.

(Note: run-time bad blocks may be “erase error”, “program error”, “read error”.)

Initial value = depend on Flash.

Maximum value = 255.

Minimum value = 0.

### 5. ECC Uncorrectable Count

Value: To record ECC uncorrectable block counts.

Increase this value by 1 when fatal error occurred in Flash read operation.

Initial value = 0.

Maximum value = 255.

### 6. Flash Type

Value: To determinate mounted Flash type, and always keep in original value.

0: SLC, 1: MLC.

Initial value = depend on Flash.

### 7. Initial Bad Block Count

Value: To record initial bad blocks when MP process, and always keep in original value.

Initial value = depend on Flash.

Maximum value = 65535.

### 8. Later Bad Block Count

Value: To record run time bad blocks.

Increasing this variable when detected run-time bad blocks.

Initial value = 0.

Maximum value = 65535.

**Simple User Interface Version:**



**Average Erase Count**

Value: To record average erase ratio.

This value is calculated by “total erase counts”, “Flash P/E cycles”, “Flash total blocks”.

Initial value = 00.00%

Maximum value = 100.00%

**Detect**

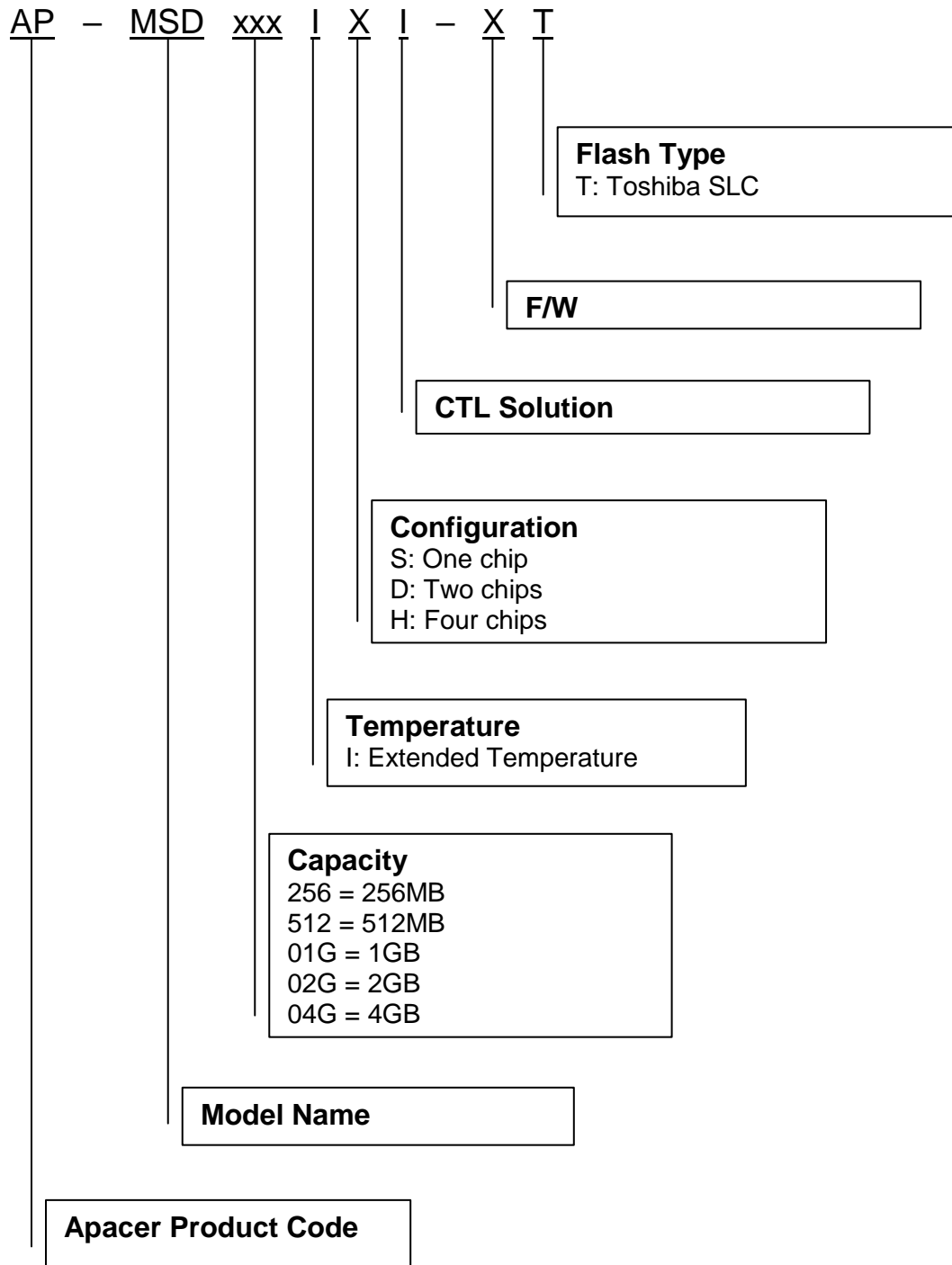
Detect the available drive for S.M.A.R.T. monitoring.

**Get SmartInfo**

Click it to display the health status of the monitored drive, which appears as a dashboard presence.

## 6. Product Ordering Information

### 6.1 Product Code Designations





---

## 6.2 Valid Combinations

---

<i>Capacity</i>	<i>AP/N</i>
256MB	AP-MSD256ISI-1T
512MB	AP-MSD512IDI-1T
1GB	AP-MSD01GISI-T
2GB	AP-MSD02GIDI-T
4GB	AP-MSD04GIHI-T

**Note:**

- Valid combinations list out the available models for mass production.
- Products are normally shipped in unformatted capacities unless required otherwise.
- For customization request, please consult with Apacer sales representatives.

## Revision History

Revision	Description	Date
1.0	Official release	03/21/2014
1.1	- SD Card Specifications 1.1 compliant. - Modified "Features" page → Fully compliant with SD Card Specifications 1.1 and 2.0	04/02/2015
1.2	Combined microSD SLC models of all capacities into one spec sheet.	10/01/2015
1.3	Added Power Failure Management to Features and General Description	10/3/2016
1.4	Removed "The data written at the exact moment power off will be lost, and the max data loss is 16 sectors." from 1.2.3 Power Failure Management	10/7/2016
1.5	Removed the word "Customized" from the cover page	10/18/2016

---

## Global Presence

<b>Taiwan (Headquarters)</b>	<b>Apacer Technology Inc.</b> 1F., No.32, Zhongcheng Rd., Tucheng Dist., New Taipei City 236, Taiwan R.O.C. Tel: 886-2-2267-8000 Fax: 886-2-2267-2261 <a href="mailto:amtsales@apacer.com">amtsales@apacer.com</a>
<b>U.S.A.</b>	<b>Apacer Memory America, Inc.</b> 46732 Lakeview Blvd., Fremont, CA 94538 Tel: 1-408-518-8699 Fax: 1-510-249-9551 <a href="mailto:sa@apacerus.com">sa@apacerus.com</a>
<b>Japan</b>	<b>Apacer Technology Corp.</b> 5F, Matsura Bldg., Shiba, Minato-Ku Tokyo, 105-0014, Japan Tel: 81-3-5419-2668 Fax: 81-3-5419-0018 <a href="mailto:jpservices@apacer.com">jpservices@apacer.com</a>
<b>Europe</b>	<b>Apacer Technology B.V.</b> Science Park Eindhoven 5051 5692 EB Son, The Netherlands Tel: 31-40-267-0000 Fax: 31-40-267-0000#6199 <a href="mailto:sales@apacer.nl">sales@apacer.nl</a>
<b>China</b>	<b>Apacer Electronic (Shanghai) Co., Ltd</b> Room D, 22/FL, No.2, Lane 600, JieyunPlaza, Tianshan RD, Shanghai, 200051, China Tel: 86-21-6228-9939 Fax: 86-21-6228-9936 <a href="mailto:sales@apacer.com.cn">sales@apacer.com.cn</a>
<b>India</b>	<b>Apacer Technologies Pvt Ltd,</b> Unit No.201, "Brigade Corner", 7 <sup>th</sup> Block Jayanagar, Yediyur Circle, Bangalore – 560082, India Tel: 91-80-4152-9061 Fax: 91-80-4170-0215 <a href="mailto:sales_india@apacer.com">sales_india@apacer.com</a>