



SMART
Storage
Products

Product Specification

XCEED SD/SDHC MEMORY CARDS



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REVISION HISTORY

Date	Revision	Section(s)	Description
May 2009	A	All	New Release
July 2009	B	1.3.1 2.1	Performance correction to 18MBs reads and 13MBs writes Remove controller reference from diagram
Aug 2009	C	Page 2	Update DNV logo to TUV and address change
Oct 2009	D	Page 4	Update wear leveling to static and dynamic
Dec 2009	E	Page 13 Page 14	Provides t_{OLDY} . Lists t_{WL} , t_{WH} , t_{TLH} , t_{THL} separately Lists t_{WL} , t_{WH} , t_{TLH} , t_{THL} separately
Mar 2010	F	1.2, 1.3.4, 6.1, 6.2	Added industrial and commercial temperature information/options.
Mar 2010	G	4.2, 4.3.1, 5.1	Added information about industrial-temp card setting the drive strength output; changed the input voltage to 2.5; added information about product name field (PNM).
Jul 2010	H	3	Added dimension tolerances to agree with SD spec.
Aug 2010	J	6.1, 6.2	Changed card rev to 01; added 16 G commercial offering.
Dec 2010	K	6.1	Changed card rev to 02 for all P/Ns except SG9SD16GPHCC01.



ESD Caution – Handling

Static electricity may be discharged through this disk subsystem. In extreme cases, this may temporarily interrupt the operation or damage components. To prevent this, make sure you are working in an ESD-safe environment. For example, before handling the disk subsystem, touch a grounded device, such as a computer case, prior to handling.

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America

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1. GENERAL DESCRIPTION

1.1. Overview

SMART is a leading independent manufacturer of memory and embedded modular sub-systems inclusive of board-level through systems level design, manufacturing, test, and fulfillment services. We offer more than 500 standard and custom products to leading OEMs in the computer, industrial, networking and telecommunications industries worldwide.

SMART's high-performance Industrial Grade Xceed SD/SDHC Memory Card product offering is specifically targeted at the needs of OEM markets such as networking, telecommunications and data communications applications. SMART's Secure Digital products are also a natural fit for mobile and embedded computing, medical, automotive and industrial applications.

SMART's Xceed SD products offer reliable, high performance operation in an industry standard ultrasonic welded Secure Digital housing. They are available in capacities from 1GB to 16GB.

Incorporating on-board error detection and correction algorithms and static and dynamic wear leveling techniques insure SMART's Xceed SD product provides years of reliable operation over the life cycle. SMART further increases the reliability of its Secure Digital product offering - yielding greater than 2 Million Program/Erase cycles for most applications - by using Single Level Cell NAND Flash technology which betters comparable Multi Level Cell technology by a factor of 10X in reliability and 2X in speed.

SMART has built its foundation by providing proven technology and quality products to the most demanding Fortune 100 OEMs. SMART engineers its products to perform at the highest degree of reliability & compatibility while backing these products with outstanding services and technology expertise.

1.2. Features

- Secure Digital Specification Standard (V2.0)
- Capacity Range 1GB to 16GB
- Low Power Dissipation
 - 80 mA Read
 - 80 mA Write
- On-Board Wear Leveling
- RoHS compliant
- Optional Industrial Temp Range -40°C to +85°C

1.3. Operational Characteristics

All listed values are typical unless otherwise stated.

1.3.1. Performance

Table 1: Performance Characteristics

Item	Performance
Read (Maximum)	18 MB/s
Write (Maximum)	13 MB/s

1.3.2. Reliability

Table 2: Reliability Characteristics

Item	Value
Data Reliability	10 ¹⁴ bits read
Data Retention	10 years
Endurance	> 2,000,000 program/erase cycles

1.3.3. Power

Table 3: Power Requirements

Parameter	Value (Typ)	Unit
Vcc	3.3	V
Read	80	mA
Write	80	mA
Idle	150	uA

1.3.4. Environmental Conditions

Table 4: Environmental Conditions and Testing

Parameter	Value
Shock – Operating	50g max. @ 11 ms
Vibration – Operating	15g peak to peak
Operating Temperature – Commercial	0 to 70°C
Operating Temperature – Industrial	-40°C to 85°C
Storage Temperature – Commercial	-25°C to 85°C
Storage Temperature – Industrial	-50°C to 125°C
Humidity	5% to 95%
Altitude	Up to 80,000 ft

1.3.5. Physical Characteristics

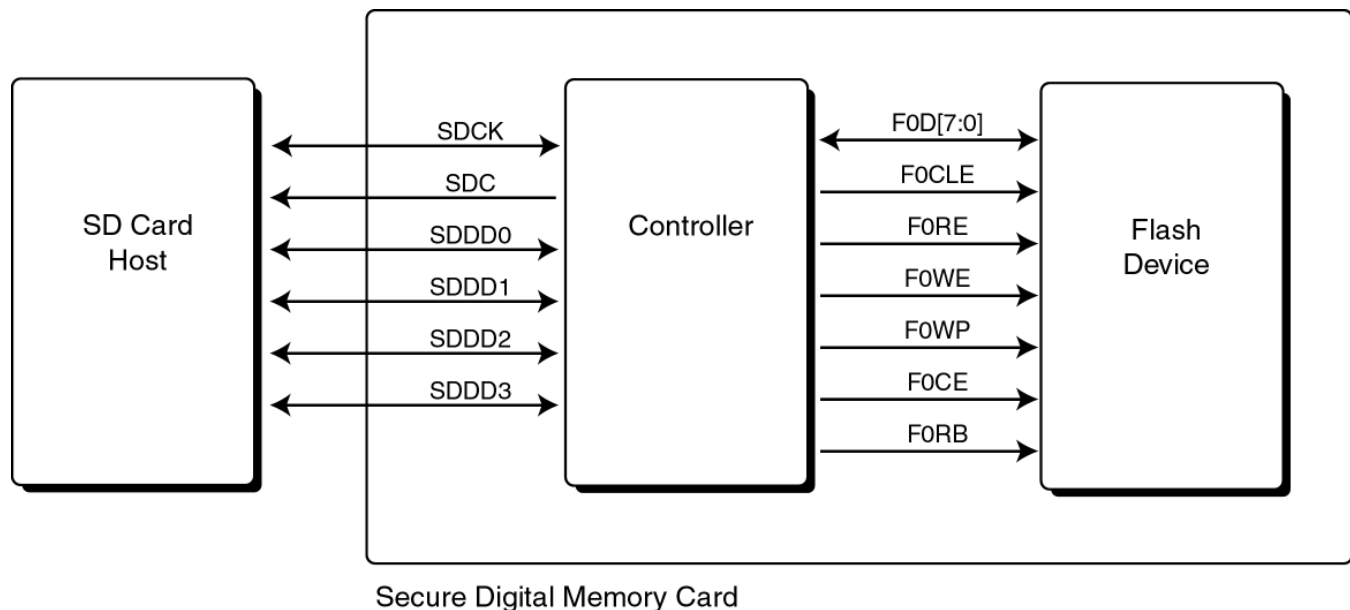
Table 5: Physical Characteristics

Parameter	Value
Length	32.0 mm [1.26 in]
Width	24.0 mm [0.95 in]
Thickness	2.1 mm [0.08 in]
Weight	2.0 g [0.07 oz]

2. PRODUCT DESCRIPTION

SMART's Secure Digital (SD) Memory Card product line is offered in a UL approved housing with an advanced 9-pin connector. It contains a controller and a flash memory device. The on-board controller interfaces with a SD Card Host allowing data to be written to and read from the flash memory device.

2.1. Functional Block Diagram



2.2. Regulatory Compliance

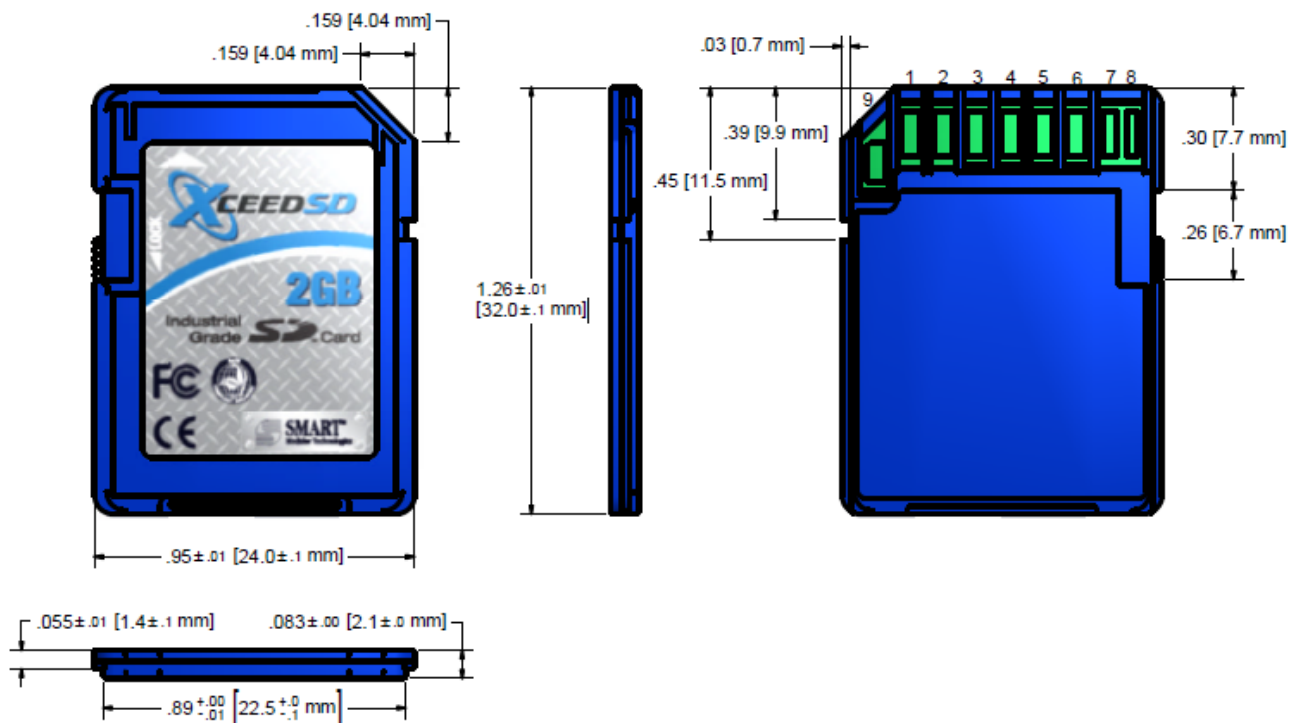
The SMART Modular Xceed SD product complies with the regulatory requirements identified in the following table.

Table 6: Regulatory Description

Regulation	Compliance
EMC/Emissions	EN 55022 Class B, CISPR 22 Class B, AS/NZS 3548 Class B, BSMI CNS 13438 Class B, FCC Part 15 Class B
EMC/Immunity	EN 61000-3-2, EN 61000-3-3



3. MECHANICAL SPECIFICATION



3.1. Label

Below is an example of the standard label for the SMART Secure Digital (SD) card.



4. ELECTRICAL SPECIFICATION

4.1. Electrical Interface

The SMART Secure Digital (SD) Memory Cards are fully compliant with the Secure Digital specification (V1.1 and V1.01). *Table 7* describes the I/O signals of the card. Signals whose source is the Host are designated as inputs (I) while signals that the Secure Digital Card sources are outputs (O). Bi-directional signals are designated as Input/Output (I/O).

Table 7: Pin Assignments and Pin Types

Pin	Signal Name	Type	Signal Description
1	SDD3	I/O	SD Interface Bus [3]
2	SDC	I/O	SD Command Line
3	GND	GND	Ground
4	VCC	VCC	Supply
5	SDCLK	I	SD Synchronous Clock Input
6	GND	GND	Ground
7	SDD0	I/O	SD Interface Bus [0]
8	SDD1	I/O	SD Interface Bus [1]
9	SDD2	I/O	SD Interface Bus [2]

When the industrial-temperature card is driving the I/O, the drive strength outputs are set to 0x01. The drive strength of the 16GB commercial card is 0x02.

4.2. Absolute Maximum Ratings

Table 8: Voltage and Temperature Ratings

Symbol	Parameter	Ratings	Unit
V _{CC}	Input Power	-0.3 – 3.6	V
V _{DIFF}	Input Differential	-0.3 – 0.3	V
T _{STG}	Storage Temperature – Commercial	-25 – 85	°C
	Storage Temperature – Industrial	-50 – 125	°C
I _{OP}	Operating Current	80	mA
I _{STB}	Standby Current	2	mA

4.3. Recommended Operating Conditions

Table 9: Recommended Operating Conditions

Symbol	Parameter	Ratings	Unit
V_{CC}	Input Power	2.7 to 3.6	V
T_A	Operating Temperature – Commercial	0 to 70	°C
	Operating Temperature – Industrial	-40 to 85	°C

4.4. Power consumption

Table 10: Power Consumption

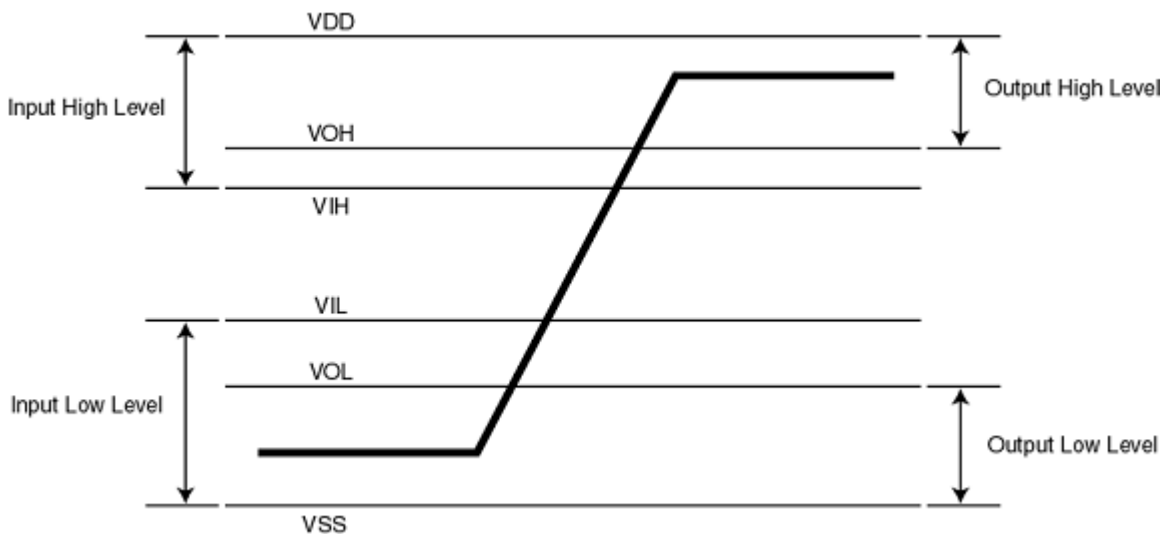
Parameter	Max	Unit
Read Current	80	mA
Write Current	80	mA
Pre-initialization standby current	3	mA
Post-initialization standby current	150	μ A

4.5. Bus Signal Line Loading

Table 11: Bus Signal Line Loading

Symbol	Parameter	Ratings	Unit
R_{CMD}	Pull-up R for SDC Line	10 – 100	$K\Omega$
R_{DAT}	Pull-up R for SDD Line	10 – 100	$K\Omega$
C_L	Bus Line Capacitance	40	pF
	Signal Line Inductance	16	nH

4.5.1. Bus Signal Level


Table 12: Bus Signal Level

Symbol	Parameter	Min.	Max.	Unit
V_{OH}	Output High Voltage	2.5		V
V_{OL}	Output Low Voltage		0.4	V
V_{IH}	Input High Voltage	2.0		V
V_{IL}	Input Low Voltage		0.8	V

4.5.2. Bus Timing (High Speed)

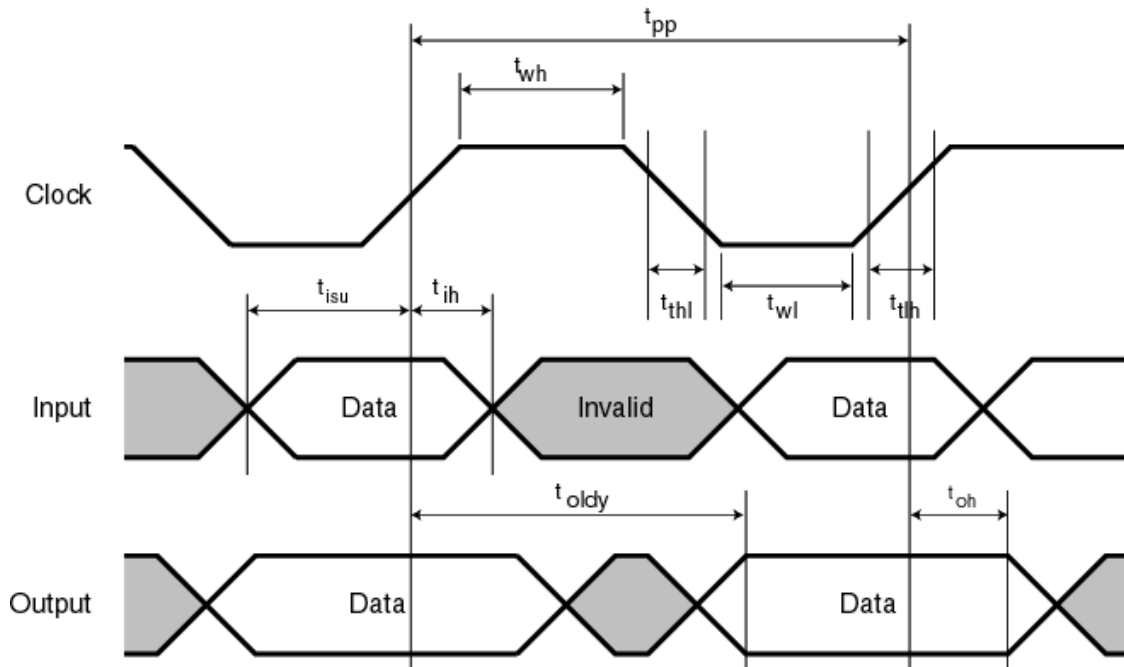


Table 13: Bus Timing (High Speed)

Symbol	Parameter	Min.	Max.	Unit	Remark
t_{pp}	Clock freq. data transfer mode	0	50	MHz	$C_L \leq 10$ pF
t_{WL}	Clock low time	7		ns	$C_L \leq 10$ pF
t_{WH}	Clock high time	7		ns	$C_L \leq 10$ pF
t_{TLH}	Clock rise time		3	ns	$C_L \leq 10$ pF
t_{THL}	Clock fall time		3	ns	$C_L \leq 10$ pF
t_{ISU}	Input setup time	6		ns	$C_L \leq 10$ pF
t_{IH}	Input hold time	2		ns	$C_L \leq 10$ pF
t_{OLDY}	Output delay time		14	ns	$C_L \leq 10$ pF
t_{OH}	Output hold time	2.5	50	ns	$C_L \leq 10$ pF

4.5.3. Bus Timing (Low Speed)

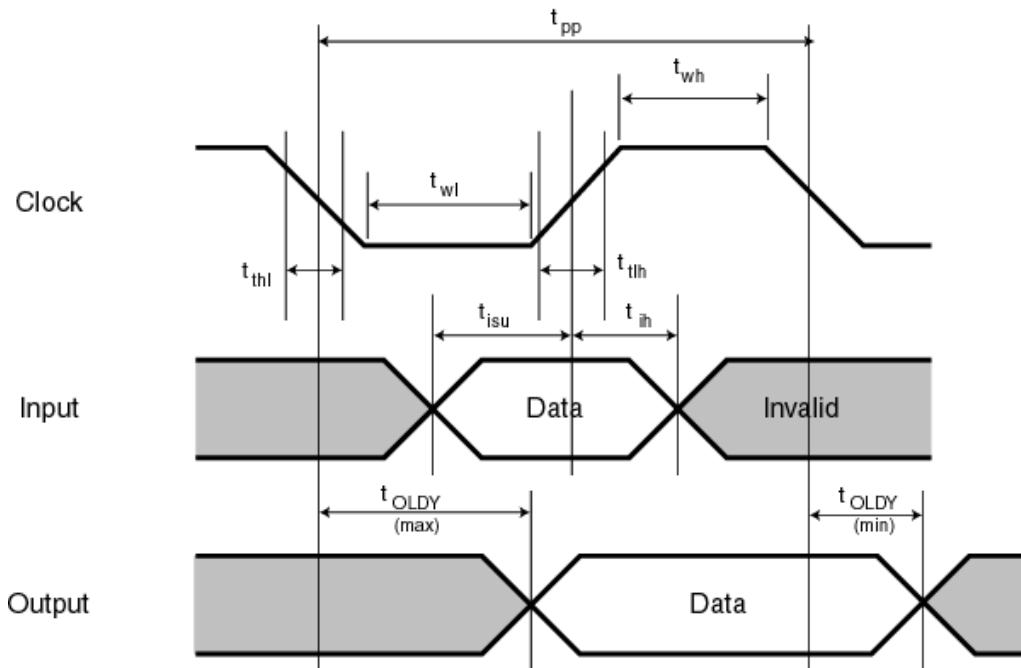


Table 14: Bus Timing (Low Speed)

Symbol	Parameter	Min.	Max.	Unit	Remark
t_{pp}	Clock freq. data transfer mode	0	25	MHz	
t_{OD}	Clock freq. ident. mode	0	400	KHz	$C_L \leq 10$ pF
t_{WL}	Clock low time	10		ns	$C_L \leq 10$ pF
t_{WH}	Clock high time	10		ns	$C_L \leq 10$ pF
t_{TLH}	Clock rise time		10	ns	$C_L \leq 10$ pF
t_{THL}	Clock fall time		10	ns	$C_L \leq 10$ pF
t_{ISU}	Input setup time	5		ns	$C_L \leq 10$ pF
t_{IH}	Input hold time	5		ns	$C_L \leq 10$ pF
t_{OLDY}	Output delay time (Data Transfer Mode)	0	14	ns	$C_L \leq 10$ pF
t_{OLDY}	Output delay time (Identification Mode)	0	50	ns	$C_L \leq 10$ pF

5. REGISTERS

The registers are used in the SMART Secure Digital cards are shown in *Table 15*. These registers are described in the sections that follow.

Table 15: Supported SD Registers

Name	Width	Description
CID	128	Card Identification
RCA	16	Relative Card Address
CSD	128	Card Specific Data
SCR	64	SD Configuration Register
OCR	32	Operation Condition Register

5.1. Card Identification Register (CID)

The Card Identification (CID) register is 128 bits wide. It contains the information used during the card identification phase. Every individual flash card will have a unique identification number. The fields for the CID register are presented in *Table 16*.

Table 16: Card Identification Register (CID) Fields

Bits	Width	Name	Field
[127:120]	8	Manufacturer ID	MID
[119:104]	16	OEM/Application ID	OID
[103:56]	48	Product Name	PNM
[55:48]	8	Product Revision	PRV
[47:16]	32	Product Serial Number	PSN
[15:8]	8	Manufacturing Date	MDT
[7:1]	7	CRC7 checksum	CRC
[0]	1	Not used, always 1	---

Industrial-temp drives contain SD-IT in the product name field (PNM), regardless of the drive capacity. Commercial-temp drives contain SDXXG, where “XX” indicates the drive capacity.

5.2. Relative Card Address (RCA)

The Relative Card Address (RCA) register is 16 bits wide. It contains the card address assigned by the host during the card identification. This address is used for the addressed host-card communication after the identification procedure. The default value of the RCA register is 0x0001.

5.3. Card Specific Data (CSD)

The Card Specific Data (CSD) register is 128 bits wide. It provides information on how to access the card contents. The fields for the CSD register are presented in *Table 17*.

Table 17: Card Specific Data (CSD) Fields

Bits	Width	Name	Field	Value	Note
[127:126]	2	CSD structure	CSD_STRUCTURE	00b	V1.0
[125:120]	6	Reserved	---	---	---
[119:112]	8	Data read access time 1	TAAC	5Eh	5 ms
[111:104]	8	Data read access time 2	NSAC	00h	0 clks
[103:96]	8	Max. bus clock freq.	TRAN_SPEED	32h	25 MHz
[95:84]	12	Card command classes	CCC	5F5h	(1)
[83:80]	4	Max read block data length	READ_BL_LEN	9h	512 bytes
[79]	1	Partial block read allowed	READ_BL_PARTIAL	1b	Supported
[78]	1	Write block misalignment	WRITE_BLK_MISALIGN	1b	Supported
[77]	1	Read block misalignment	READ_BLK_MISALIGN	1b	Supported
[76]	1	DSR implemented	DSR_IMP	0b	Not supp.
[75:74]	2	Reserved	---	---	---
[73:62]	12	Device size	C_SIZE	(2)	(2)
[61:59]	3	Max R_curr @ V _{DD} min	VDD_R_CURR_MIN	111b	100 mA
[58:56]	3	Max R curr @ V _{DD} max	VDD_R_CURR_MAX	111b	200 mA
[55:53]	3	Max W_curr @ V _{DD} min	VDD_W_CURR_MIN	111b	100 mA
[52:50]	3	Max W curr @ V _{DD} max	VDD_W_CURR_MAX	111b	200 mA
[49:47]	3	Device size multiplier	C_SIZE_MULT	(2)	(2)
[46]	1	Erase single block enable	ERASE_BLK_EN	1b	Supported
[45:39]	7	Erase sector size	SECTOR_SIZE	(2)	(2)
[38:32]	7	Write protect group size	WP_GRP_SIZE	(2)	(2)
[31]	1	Write protect group enable	WP_GRP_ENABLE	1b	Supported
[30:29]	2	Reserved	---	---	---
[28:26]	3	Write speed factor	R2W_FACTOR	010b	8X
[25:22]	4	Max write data block length	WRITE_BL_LEN	9h	512 bytes
[21]	1	Partial block write allowed	WRITE_BL_PARTIAL	0b	Not supp.

- (1) – Support command class: 0, 2, 4, 5, 6, 7, and 8. Include: Basic, Block Read/Write, Erase, Write-Protection, Lock Card and Application support. Not supported command class: 1 and 3. Include: Stream Read/Write
- (2) This field depends upon the flash used with the controller

5.4. SD Configuration Register (SDR)

The SD Configuration Register (SDR) is 64 bits wide. It is another configuration register. SCR provides information about the SD card's special features that were configured into the given card. The fields for the SDR register are presented in *Table 18*.

Table 18: SD Configuration Register (SDR) Fields

Bits	Width	Name	Field	Value	Note
[63:60]	4	SCR structure	SCR_STRUCTURE	0000b	V1.0
[59:56]	4	SD card spec. version	SD_SPEC	0010b	V2.0
[55]	1	Data status after erase	DATA_STAT_AFTER_ERASE	0b	Zero
[54:52]	3	SD security support	SD_SECURITY	010b	Sec V2.0
[51:48]	4	DAT bus width support	SD_BUS_WIDTH	0101b	1/4 bit
[47:32]	16	Reserved	---	---	---
[31:0]	32	Reserved	---	---	---

5.5. Operation Condition Register (OCR)

The Operation Condition Register (OCR) register is 32 bits wide. The fields for the OCR register are presented in *Table 19*.

Table 19: Operation Condition Register (OCR) Fields

Bits	Width	VDD Voltage Window	value
[31]	1	Card power up status bit	
[30:24]	7	Reserved	000 0000b
[23:15]	9	2.7V – 3.6V	1 1111 1111b
[14:8]	7	2.0V – 2.6V	000 0000b
[7]	1	1.65V – 1.95V	0b
[6:0]	7	Reserved	000 0000b

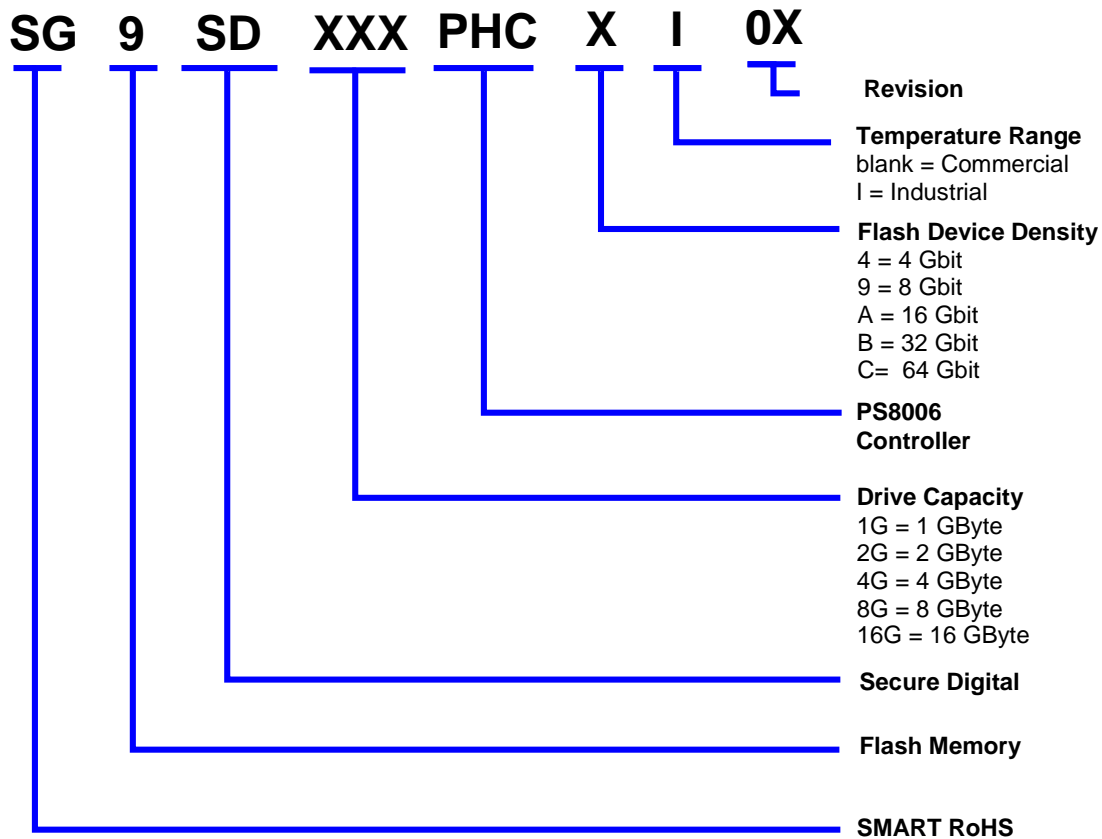
6. PART NUMBERS

6.1. Part Numbering Information

Table 20: Part Numbering Information

SMART Part Number ¹	Drive Capacity	Unformatted Capacity ²	Sectors/Card ²
SG9SD1GPHC9y02	1GB	972 MB	1,990,655
SG9SD2GPHCAy02	2GB	1910 MB	3,911,680
SG9SD4GPHCBy02	4GB	3830 MB	7,844,864
SG9SD8GPHCBy02	8GB	7678 MB	15,724,544
SG9SD16GPHCC01	16GB	15390 MB	31,518,720

6.2. Part Number Decoder



*Note: Up to and including 2GB are "SD" formatted with FAT 16
 4GB and larger are SDHC formatting FAT 32*

¹ = In the part number, "y" indicates the temperature range (blank = Commercial; I = Industrial).

² = Typical



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