SanDisk

SSD SATA 5000 2.5"

Product Manual

Preliminary, Rev 0.7

Document No. 80-11-01488

July 2008

SanDisk Corporation

Corporate Headquarters • 601 McCarthy Blvd. • Milpitas, CA 95035

Phone (408) 801-1000 • Fax (408) 801-8657

www.sandisk.com

Table of Contents

1. Introduction

1.1 *General Description*

SanDisk SSD SATA 5000 2.5" is designed to drive the shift of mobile PC users and blade server users from the hard disk drive to the solid state drive (SSD). A drop-in replacement for the hard disk drive, it delivers far superior durability, performance and power efficiency — keeping mobile PCs and blade servers working optimally in the toughest of conditions.

SanDisk SSD SATA 5000 2.5" (SanDisk SSD), with 8, 16, 32 and 64 gigabyte[1] (GB) flash memory, is targeted at enterprise users as the first step in mass consumer adoption of the SSD in the mobile PC market.

With no moving parts, SanDisk SSD does not need to spin up into action or to seek files in the way that conventional hard disk drives do —enabling SanDisk SSD to work much faster.

SanDisk, the industry leader in flash storage, is uniquely positioned to drive the paradigm shift in mobile computing to SSDs. Inside enterprise computers, such as the thin & light laptops and transportable laptops; SanDisk SSD delivers unbeatable durability, system performance and power efficiency.

This manual describes the functional, mechanical and interface specifications for the following SanDisk SSD 5000 model drives:

- SDS5C-064G-000010
- SDS5C-032G-000010
- SDS5C-016G-000010
- SDS5C-008G-000010
- SDS5C-064G-0000E0
- SDS5C-032G-0000E0
- SDS5C-016G-0000E0
- SDS5C-008G-0000E0

1.2 *Key Features*

High capacity in small form factor

- 2.5" small form factor, supporting unformatted capacity of 8, 16, 32, 64GB
- 9.5mm case height
- SATA 7+15 pins combo connector

Interface to host

- Standards: SATA 1.0a 1.5Gb/s

High performance

- Host transfer rate: 150MB/s

[1] 1 megabyte (MB) = 1 million bytes; 1 gigabyte (GB) = 1 billion bytes. Some of the listed capacity is used for formatting and other functions, and thus is not available for data storage.

- Internal transfer read rate: 68MB/s
- Internal transfer write rate: 60MB/s
- Random Read (4KB): 4800 IOPS
- Average access time: 0.11msec

Low power consumption

- Supply voltage: 5Vdc
- Typical read: 180mA
- Typical write: 190mA
- Typical idle: 110mA
- Typical standby: 70mA

Highly reliable

- Mean time to failure (MTTF): 2,000,000 hours, based on Part Stress Analysis
- Operating shock: 1,500G, 0.5msec half sine
- Operating vibration: 16.3gRMS, 10-2000 Hz
- Operating temperature:
  - Commercial: 0˚C to 70˚C
  - Enhanced: -25˚C to 75˚C
- Non-operating temperature and storage: -55˚C to 95˚C

1.3 *Block Diagram*

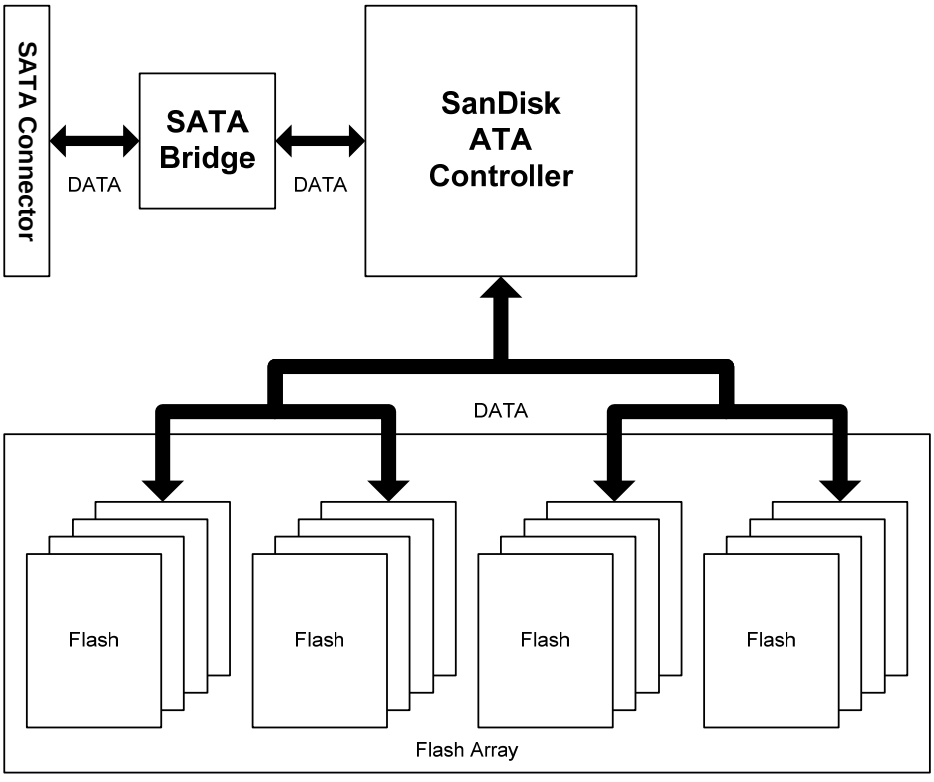


Figure 1: SanDisk SSD SATA 5000 2.5" Block Diagram

2. General Product Specifications

2.1 *Interface*

The SSD interface complies with the following standards:

SATA 1.0a Gen1i (1.5Gb/s)

SATA 2.5

ATA-7

The SSD supports Serial ATA 1.5Gbps (150MB/sec) interface rate.

2.2 *Capacity*

This datasheet refer to the 8, 16, 32, 64GB version.

Table 1: SanDisk SSD SATA 5000 2.5" Capacity

Unformatted Capacity	Total Number of User-Addressable Sectors in LBA Mode	Number of Logical Cylinders	Number of Logical Heads	Number of Logical Sectors per Track
8GB	15,649,200	15,311	16	63
16GB	31,277,232	16,383	16	63
32GB	62,533,296	16,383	16	63
64GB	125,045,424	16,383	16	63

2.3 *Performance*

Table 2: SanDisk SSD SATA 5000 2.5" Performance

Parameter	Specifications
Host transfer rate:	
Ultra DMA mode[1]	150MB/s
Internal transfer rate (maximum):	
Sequential Read[1,2]	68MB/s
Sequential Write[1,2,6]	60MB/s
Random Read[1,3]	68MB/s
Random Write[1,3]	6MB/s
IOPS:	
Random Read (4KB)[1,3]	4800
Random Write (4KB)[1,3]	10
Average access time[1,2,4]	0.11 msec
Typical power-on ready time[5]	1.0 sec

1. Tested in Ultra DMA 150MB/s
2. H2BENCH.c,v 3.6 2002/10/31, Windows 32-bit
3. IOMETER 2003.12.16
4. SSD does not have seek time or latency time
5. Assume proper shutdown process.
6. Write Buffer of 32KB is used to optimize small transfer size transactions.

3. Power Characteristics

3.1 *Supply Voltage*

Table 3: SanDisk SSD SATA 5000 2.5" Supply Voltage

Parameter	Specifications
Input Voltage	5V ± 5%
Maximum Ripple	100mV (peak to peak), 0 – 30MHz
Supply Rise Time	7 msec to 100 msec
Maximum Supply Fall Time	5 sec

3.2 *Power Consumption*

Table 4: SanDisk SSD SATA 5000 2.5" Power Consumption

Parameter	Specifications (W)
Maximum	1.1
Read (Typical)	0.9
Write (Typical)	0.95
Active Idle (Typical)	0.55
Idle (Typical)	0.45
Standby (Typical)	0.34
Sleep (Typical)	0.31

3.3 *Power Consumption Efficiency*

Table 5: SanDisk SSD SATA 5000 2.5" Power Consumption Efficiency (Watts/GB) [1]

Capacity (GB)	Specifications (W)
8	0.0562
16	0.0281
32	0.0140
64	0.0070[2]

1. Power consumption efficiency is calculated as Power Consumption Idle (watts)/Capacity (GB)
2. Preliminary

4. Physical Characteristics

4.1 *Mechanical*

Table 6: SanDisk SSD SATA 5000 2.5" Mechanical Dimensions and Weight

Parameter	Specifications
Width	69.85 ± 0.25 mm
Height	9.5 ± 0.2 mm
Length	102.0 ± 0.25 mm
Maximum Weight	96 gr

4.2 *Mounting Instructions*

Before unpacking and installing the drive, take anti-static measures in order to avoid damage to the drive. The drive may be exposed to potential handling and electrostatic discharge (ESD) hazards. The following guidelines are recommended:

Keep the drive in ESD bag until the drive is ready to be installed.

Wear an ESD-proof wrist strap when handling the drive.

Avoid touching the drive's connector. Handle the drive using its edge or frame.

Rest the drive on an antistatic surface until mounting it.

Handle the drive carefully, taking care not to drop or bang it against other objects.

Do not remove, damage or cover any product labels. Removal of such labels voids the warranty.

The ambient temperature at the top cover should not exceed the maximum operating temperature of the drive.

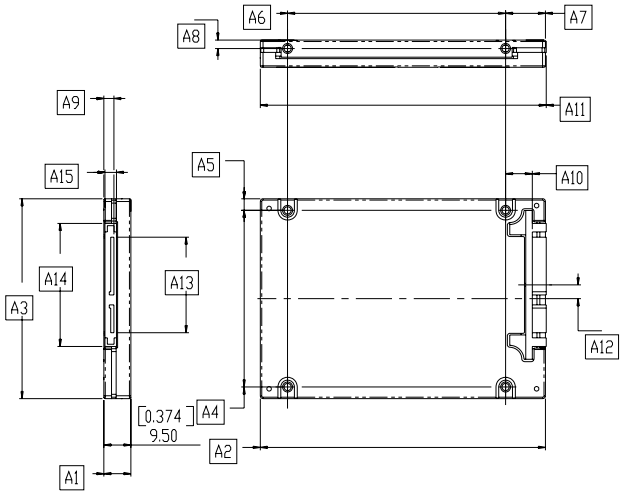
Exercise caution when removing the drive from the host as the drive may have heated up.

The recommended mounting screw torque is 0.675Nm.

The recommended mounting screw depth is 4.0mm (0.157in) for bottom for horizontal mounting.

4.3 *Installation Orientation*

The SSD can be installed in all axes (6 directions). For a mechanical drawing, see Figure 2.



Dimention	Milimeters	Inches
A1	9.50 ± 0.20	0.374 ± 0.008
A2	100.2 ± 0.25	3.945 ± 0.010
A3	69.85 ± 0.25	2.750 ± 0.010
A4	61.72 ± 0.25	2.430 ± 0.010
A5	4.07 ± 0.25	0.160 ± 0.010
A6	76.60 ± 0.25	3.016 ± 0.010
A7	14.00 ± 0.25	0.551 ± 0.010
A8	3.00 ± 0.25	0.118 ± 0.010
A9	3.50 ± 0.38	0.138 ± 0.015
A10	9.40 ± 0.25	0.370 ± 0.010
A11	100.50 ± 0.25	3.957 ± 0.010
A12	4.80 ± 0.25	0.189 ± 0.010
A13	33.39 ± 0.10	1.315 ± 0.004
A14	42.73 REF	1.682 REF
A15	4.00 REF	0.157 REF

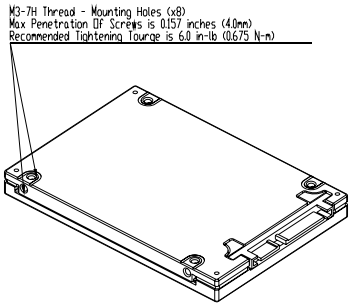


Figure 2: SanDisk SSD SATA 5000 2.5" Mechanical Drawing

5. Environmental Specifications

5.1 *Temperature*

Table 7: SanDisk SSD SATA 5000 2.5" Temperature Support

Parameter	Specifications
Operating:	
Commercial Version	0°C to 70°C
Enhanced Version	-25°C to 75°C
Non-operating	-55°C to 95°C
Storage	-55°C to 95°C
Maximum temperature gradient	30°C per hour

5.2 *Humidity*

Table 8: SanDisk SSD SATA 5000 2.5" Humidity Support

Parameter	Specifications
Operating	
Humidity (Non condensation)	5% to 95%
Maximum web bulb	29°C
Non-operating	
Humidity (Non condensation)	5% to 95%
Maximum web bulb	38°C
Maximum relative humidity gradient	20% per hour

5.3 *Vibration*

Table 9: SanDisk SSD SATA 5000 2.5" Vibration Support

Parameter	Specifications
Operating	16.3 gRMS, 10 – 2000Hz

5.4 *Shock*

Table 10: SanDisk SSD SATA 5000 2.5" Shock Support

Parameter	Acceleration Force (G)	Half-sine Pulse Duration (msec)
Operating	500	2
	1,500	1
	1,500	0.5
Non-operating	200	10
	1,500	1
	1,500	0.5

5.5 *Altitude*

Table 11: SanDisk SSD SATA 5000 2.5" Altitude Support

Parameter	Specifications
Operating	-400m to 24,384m (-1,312ft. to 80,000ft.)
Non-operating	-400m to 24,384m (-1,312ft. to 80,000ft.)

5.6 *Acoustics*

The SSD does not generate any acoustic noise (0dB).

5.7 *Regulations*

The SSD is certified with the following standards.

Table 12: SanDisk SSD SATA 5000 2.5" Regulation Standards

Standard	Details
Underwriters Laboratories (UL)	UL 60950-1
UL Canadian (ULc)	CAN/CSA C22.2 No. 60950-1-03 (UL 60950)
Technischer Überwachungsverein (TÜV)	EN 60950:2000
Ministry of Information and Communication (MIC)	CISPR Pub. 22 Class B
Bureau of Standards, Metrology and Inspection (BSMI)	CNS 13438:2006, Class B
Australian Communications Authority (ACA)	AS/NZS CISPR 22:2002, Class B
Voluntary Control Council for Interference by Information Technology Equipment (VCCI)	R-1113 and C-1172, Class B[1]

1. This is a Class B product based on the standard of the Voluntary Control Council for Interference by Information Technology Equipment (VCCI). If this equipment is used in a domestic environment, it may cause radio interference. Install and use the equipment according to the instruction manual.

5.7.1 *EMC*

Directive 73/23/ECC for product safety

Directive 89/336/EEC:

Table 13: SanDisk SSD SATA 5000 2.5" Electromagnetic Compatibility Support

Parameter	Standard
Emission	EN55022:1998, A1:2000,A2:2003
	IEC 61000-3-3
Immunity	EN55024:1998, A1:2001, A2:2003
	IEC 61000-4-2
	IEC 61000-4-3
	IEC 61000-4-4
	IEC 61000-4-5
	IEC 61000-4-6
	IEC 61000-4-8
	IEC 61000-4-11

5.7.2 *FCC*

FCC 47CFR part 15 subpart B class B.

5.8 *RoHS*

Directive of the European Parliament and of the Council on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment, 2002/95/EC, January 2003. (RoHS Directive).

6. Reliability Characteristics

6.1 *Error Rate*

The non-recoverable error rate is 1 error per 10^{14} bits read.

6.2 *Product Life*

The product life is at least 5 years or 43,800 power-on hours, whichever comes earlier, under the following conditions:

Power-on hours = 8,760 per year

Operating time = 100% of power-on hours

Active/Idle duty cycle = 90% of the time

Environmental = temperature, altitude, humidity and voltage within operating ranges

The drive should be protected from electrostatic discharge (ESD)

- The product life does not represent any warranty or warranty period. Applicable warranty and warranty period are covered by the purchasing agreement.

Note: Product life is defined as time in service at systems conditions while maintaining compliance to the MTTF specification for the device.

Applicable warranty and warranty period are covered by the purchase agreement.

6.3 *Mean Time to Failure*

Mean Time to failure (MTTF) is calculated based on part stress analysis.

The following conditions are set for calculation:

Ambient temperature = 25°C

Table 14: SanDisk SSD SATA 5000 2.5" MTTF

Capacity (GB)	MTTF (hours)
8, 16, 32, 64	2,000,000

6.4 *Preventive Maintenance*

No preventive maintenance is required.

7. Interface

7.1 *Supported Standards*

The SSD complies with the following standards:

ATA/ATAPI-7: ANSI INCITS 397-2005, AT Attachment with Packet Interface-7.

Serial ATA Revision 2.5 Specification (Ratification Date: October 27, 2005).

7.2 *Interface Connector Characteristics*

Table 15: SanDisk SSD SATA 5000 2.5" Connector Characteristics

Parameter	Specifications
Drive Connector	FCI, 10039651-001LF
Mating/Unmating force	The force to mate a receptacle connector and compatible plug connector should not exceed 45N (4.6kgf) The unmating force should not be less than 10N (1.0kgf)
Durability	5,000 cycles

7.3 *Hotplug Support*

The SSD supports hotplug operation per SATA 2.5 specification.

7.4 *SATA Bridge Support*

The SSD supports Marvell's Serial ATA bridge (P/N: 88SA8040).

7.5 *Interface Connector Drawing*

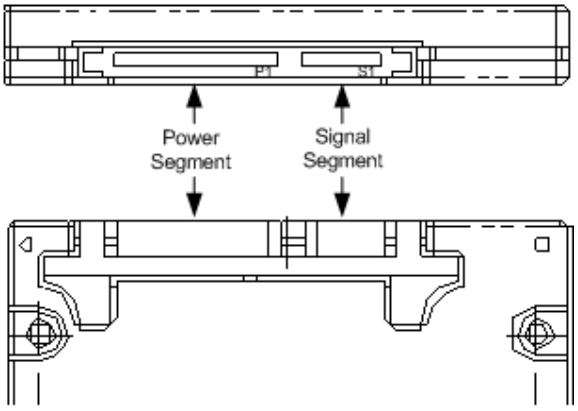


Figure 3: Interface Connector View

7.6 *Pin Assignment*

Table 16: SanDisk SSD SATA 5000 2.5" Pin Assignment

	Pin	Function	Description
Signal Segment	S1	Ground	2nd mate
	S2	A+	Differential Signal Pair A
	S3	A-	
	S4	Ground	2nd mate
	S5	B-	Differential Signal Pair A
	S6	B+	
	S7	Ground	2nd mate
Power Segment	P1	V_{33}	3.3V Power
	P2	V_{33}	3.3V Power
	P3	V_{33}	3.3V Power, Pre-charge, 2nd Mate
	P4	Ground	1st Mate
	P5	Ground	2nd Mate
	P6	Ground	2nd Mate
	P7	V_5	5V Power, Pre-charge, 2nd Mate
	P8	V_5	5V Power
	P9	V_5	5V Power
	P10	Ground	2nd Mate
	P11	DAS	Device Activity Signal The corresponding pin to be mated with P11 in the power cable receptacle connector shall always be grounded.
	P12	Ground	1st Mate
	P13	V_{12}	12V Power, Pre-charge, 2nd Mate
	P14	V_{12}	12V Power
	P15	V_{12}	12V Power

1. All pins are in a single row, with a 1.27 mm (0.050") pitch.

8. Supported ATA Commands

Command Name		Command Code
ATA standard commands		
Download Microcode		92h
Execute Device Diagnostic		90h
Flush Cache		E7h
Flush Cache Ext		EAh
Identify Device		ECh
Device Configuration Restore		B1h/C0h
Device Configuration Freeze lock		B1h/C1h
Device Configuration Identify		B1h/C2h
Device Configuration Set		B1h/C3h
Identify Device DMA		EEh
Initialize Device Parameters		91h
NOP		00h
Read Buffer		E4h
Read DMA		C8h or C9h
Read DMA Extended		25h
Read Multiple		C4h
Read Multiple Extended		29h
Read Sectors		20h or 21h
Read Sectors Extended		24h
Read Verify Sectors		40h or 41h
Read Verify Sectors Extended		42h
Read Native Max Address		F8h
Read Native Max Address Ext		27h
Set Max Address		F9h
Set Max Address Extended		37h
Recalibrate		10h
Seek		70h
Read Log Ext		2Fh
Write Log Ext		3Fh
Set Features		EFh
Set Features sub-commands:	Enable write cache (default: On)	02h
	Set transfer mode	03h
	Enable Advanced Power Management	05h
	Enable SATA Feature - software Setting Preservation	10h
	Enable automatic acoustic management	42h
	Disable look-ahead	55h
	Disable reverting to power-on defaults	66h

	Disable write cache	82h
	Disable Advanced Power Management	85h
	Enable SATA Feature- software Setting Preservation	90h
	Enable look-ahead	AAh
	Disable automatic acoustic management	C2h
	Enable reverting to power-on defaults	CCh
S.M.A.R.T Read Data		B0h/D0h
S.M.A.R.T Read Attribute Thresholds		B0h/D1h
S.M.A.R.T Enable Disable Attribute Autosave		B0h /D2h
S.M.A.R.T Save Attribute Values		B0h /D3h
S.M.A.R.T Execute Offline Immediate		B0h /D4h
S.M.A.R.T Read Log		B0h /D5h
S.M.A.R.T Write Log		B0h /D6h
S.M.A.R.T Enable Operations		B0h /D8h
S.M.A.R.T Disable Operations		B0h /D9h
S.M.A.R.T Return Status		B0h /DAh
S.M.A.R.T Disable automatic offline		B0h /DBh
Set Multiple Mode		C6h
Write Buffer		E8h
Write DMA		CAh
Write DMA Extended		35h
Write Multiple		C5h
Write Multiple Extended		39h
Write Sectors		30h or 31h
Write Sectors Extended		34h
Write Verify		3Ch
ATA standard Security commands		
Security Disable Password		F6h
Security Erase Prepare		F3h
Security Erase Unit		F4h
Security Freeze Lock		F5h
Security Set Password		F1h
Security Unlock		F2h
ATA standard power management commands		
Check Power Mode		98h or E5h
Idle		97h or E3h
Idle Immediate		95h or E1h
Sleep		99h or E6h
Standby		96h or E2h
Standby Immediate		94h or E0h

8.1 *Troubleshooting*

8.2 *Basic Checks*

Most disk problems are caused by improper disk installation. If a problem arises, the following should be checked:

Cable:

- Improper cable has been used
- Cables are too long to support the transfer rate
- Improper cable connection to the device

Device connector: Improperly locked

Power supply: Below SSD requirements

8.3 *BIOS Setup*

Verify that the disk is enabled in the BIOS. In most new BIOSs, there is an option for drive auto-identification.

8.4 *Slow Drive Performance*

Poor disk performance may be due to one of the following:

Check that Write Caching is enabled in the drive under the category Properties.

9. Ordering Information

Table 17: SanDisk SSD SATA 5000 2.5" Ordering Information

SDIGF-CCCU-XXXXGY	
SD	SanDisk
I	Interface: S – SATA
G	Generation: 5 – 5000 (5^{th})
F	Form factor: C – 2.5" (9.5mm)
CCC	Capacity (GB): 008 016 032 064
U	Units: G (GB)
XXXX	Customer code reference
G	Component generation 0 – Initial generation, Commercial Temperature. 1 - first generation, Commercial Temperature E - first generation, Enhanced Temperature Support (-25˚C to 75˚C)
Y	Change code

Example:

SanDisk SSD SATA 5000 2.5" 64GB: SDS5C-064G-000010

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Document No. 80-11-01431 07/08 Printed in U.S.A.

Revision History

February 2007	*Preliminary Rev 0.1 – 1st release*
May 2007	*Rev 0.2 – 2nd release (containing preliminary info on 64GB)*
July 2008	*Rev 0.7 – (Containing preliminary information)*