SSD420I –

SATA III 6Gb/s SSD

Thanks to the Ultra-slim (fit the standard dimensions of 2.5" SATA Hard Disk Drives) form factor, huge capacity, SATA 6Gb/s speed, and low power consumption, Solid State Drives have become the perfect storage device replacement for Ultrabooks, PCs, Laptops, gaming systems, and handheld devices.

- Fully compatible with devices and OS that support the SATA III 6.0Gb/s standard

- Non-volatile Flash Memory for outstanding data retention

- Supports Trim and NCQ command

Features

• Advanced Global Wear-Leveling and Block management for reliability

• Supports Advanced Garbage Collection

• Features a DDR3 DRAM cache

• Built-in ECC (Error Correction Code) functionality

• Power shield to prevent data loss in the event of a sudden power outage

• Real time full drive encryption with Advanced Encryption Standard (AES) (Optional)

• Supports DEVSLP mode

• Supports Enhanced S.M.A.R.T. function

• RoHS compliant

• Provides great shock resistance

• Slim, elegant and light design

Specifications

Physical Specification			
Form Factor		2.5 inch	
Storage Capacities		32 GB to 1TB	
Dimensions	**Length**	100.00±0.25 mm	3.937 ±0.01 inch
	Width	69.85±0.25 mm	2.750 ±0.01 inch
	Height	6.80±0.2 mm	0.268 ±0.008 inch
Input Voltage		5V±5%	
Weight		Max. 63 g	
Connector		SATA 22 pins connector	

Environmental Specifications		
Operating Temperature		- 40 ºC to 85 ºC
Storage Temperature		-40 ºC to 85 ºC
Humidity	**Operating**	0 % to 95 % (Non-condensing)
	Non-Operating	0 % to 95 % (Non-condensing)

Performance								
	ATTO		CrystalDiskMark				IOmeter	
Model P/N	**Max. Read ***	**Max. Write ***	**Sequential Read ****	**Sequential Write ****	**Random Read (4KB QD32) ****	**Random Write (4KB QD32) ****	**IOPS Random Read (4KB QD32) *****	**IOPS Random Write (4KB QD32) *****
TS32GSSD420I	280	55	280	55	110	55	26K	13K
TS64GSSD420I	560	110	520	100	210	100	50K	25K
TS128GSSD420I	570	210	530	210	290	210	70K	50K
TS256GSSD420I	570	400	530	400	300	330	75K	75K
TS512GSSD420I	570	470	530	470	300	320	75K	75K
TS1TSSD420I	570	470	530	470	300	320	75K	75K

Note: Maximum transfer speed recorded
* 25 ºC, test on GIGABYTE GA-Z87X-D3H, 4GB, Windows® 7 Professional with AHCI mode, benchmark utility ATTO (version 2.41), unit MB/s
** 25 ºC, test on GIGABYTE GA-Z87X-D3H, 4GB, Windows® 7 Professional with AHCI mode, benchmark utility CrystalDiskMark (version 3.0.1), copied file 1000MB, unit MB/s
*** 25 ºC, test on GIGABYTE GA-Z87X-D3H, 4GB, Windows® 7 Professional with AHCI mode, benchmark utility IOmeter2008 with 4K file size and queue depth of 32, unit IOPs
**** The recorded performance is obtained while the SSD is not operating as an OS disk Physical Specification

Actual Capacity

Model P/N	LBA	Cylinder	Head	Sector
TS32GSSD420I	62,533,296	16,383	16	63
TS64GSSD420I	125,045,424	16,383	16	63
TS128GSSD420I	250,069,680	16,383	16	63
TS256GSSD420I	500,118,192	16,383	16	63
TS512GSSD420I	1,000,215,216	16,383	16	63
TS1TSSD420I	2,000,409,264	16,383	16	63

Power Requirements

Input Voltage		5V±5% @ 25 °C
Mode P/N / Power Consumption		**Typical (mA)**
TS32GSSD420I	Max Write*	170
	Max Read*	170
	Idle*	70
TS64GSSD420I	Max Write*	220
	Max Read*	210
	Idle*	70
TS128GSSD420I	Max Write*	340
	Max Read*	220
	Idle*	70
TS256GSSD420I	Max Write*	490
	Max Read*	240
	Idle*	70
TS512GSSD420I	Max Write*	500
	Max Read*	260
	Idle*	70
TS1TSSD420I	Max Write*	530
	Max Read*	290
	Idle*	80

*Tested with IOmeter running sequential reads/writes and idle mode

Reliability

	Capacity	* TBW	** TBW (Base on JEDEC Standard)
Data Reliability	Supports 42 bits in 1024 bytes		
MTBF	1,500,000 hours		
Endurance (Terabytes Written)	32 GB	90 (TB)	45 (TB)
	64 GB	180 (TB)	90 (TB)
	128 GB	360 (TB)	180 (TB)
	256 GB	740 (TB)	370 (TB)
	512 GB	1480 (TB)	740 (TB)
	1 TB	2940 (TB)	1470 (TB)
DWPD(Drive writes per day)	2.6		

*Tested under burn-in tool, TBW value may vary due to host environment.

**Tested under JESD219A endurance workloads specification.

Vibration

Operating	5 G (peak-to-peak), 5 - 800 Hz
Non-Operating	20 G (peak-to-peak), 5 - 800 Hz

* Note: Reference to the IEC 60068-2-6 Testing procedures; Operating-Sine wave, 5-800Hz/1 oct., 1.5mm, 3g, 0.5 hr./axis, total 1.5 hrs.
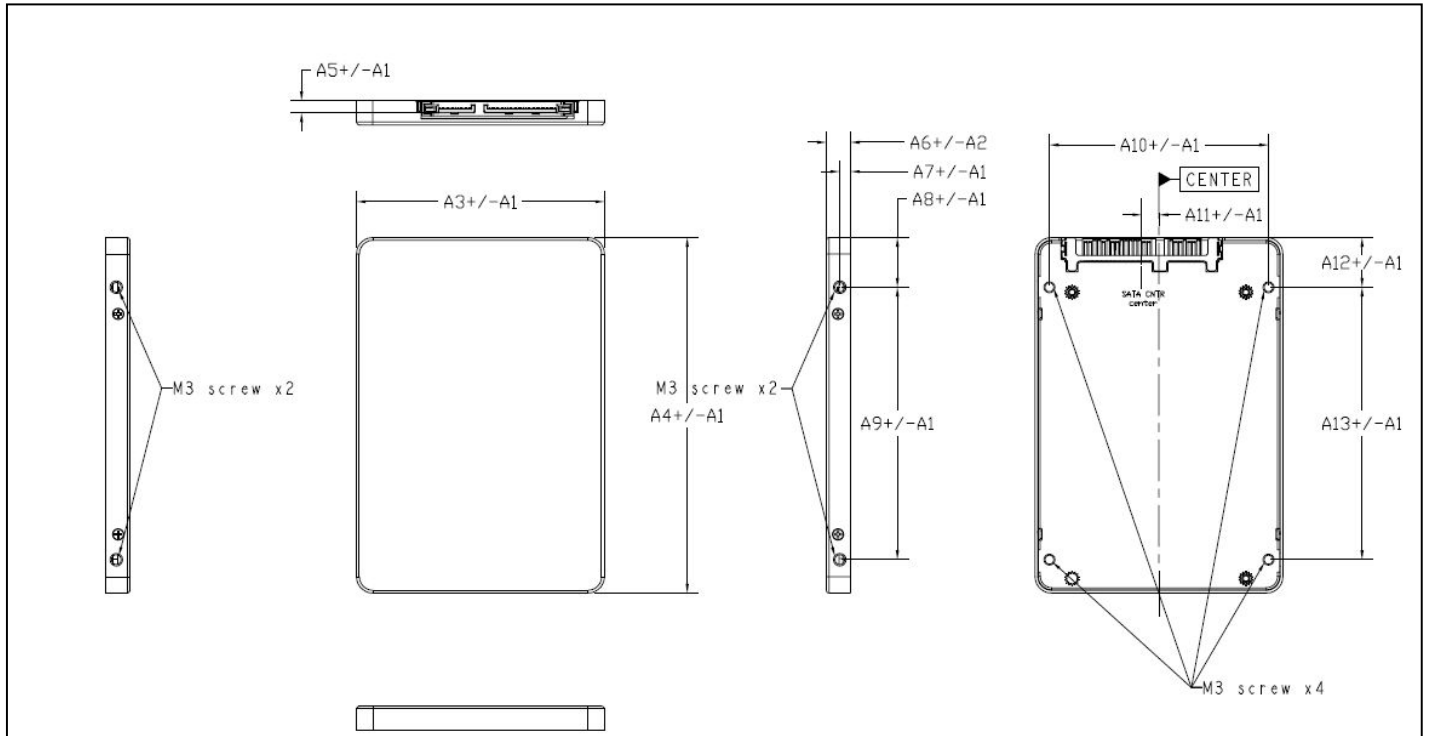
Shock

Operating	1500 G, 0.5 ms
Non-Operating	1500 G, 0.5 ms

* Reference to IEC 60068-2-27 Testing procedures; Operating-Half-sine wave, 1500g, 0.5ms, 3 times/dir., total 18 times.

Regulations

Compliance	CE, FCC and BSMI

Package Dimensions

The figure below illustrates the Transcend 2.5" SATA Solid State Drive. All dimensions are in mm.
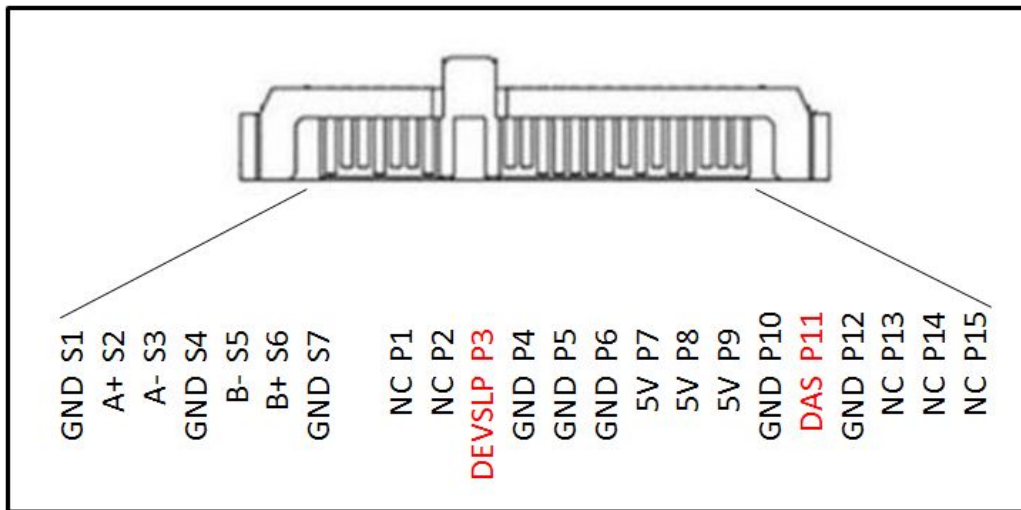

Item	Milimeter	Item	Milimeter
A1	0.25	A11	4.8
A2	0.2	A12	14.0
A3	69.85	A13	76.6
A4	100.0		
A5	3.5		
A6	6.8		
A7	3.0		
A8	14.0		
A9	76.6		
A10	61.72		

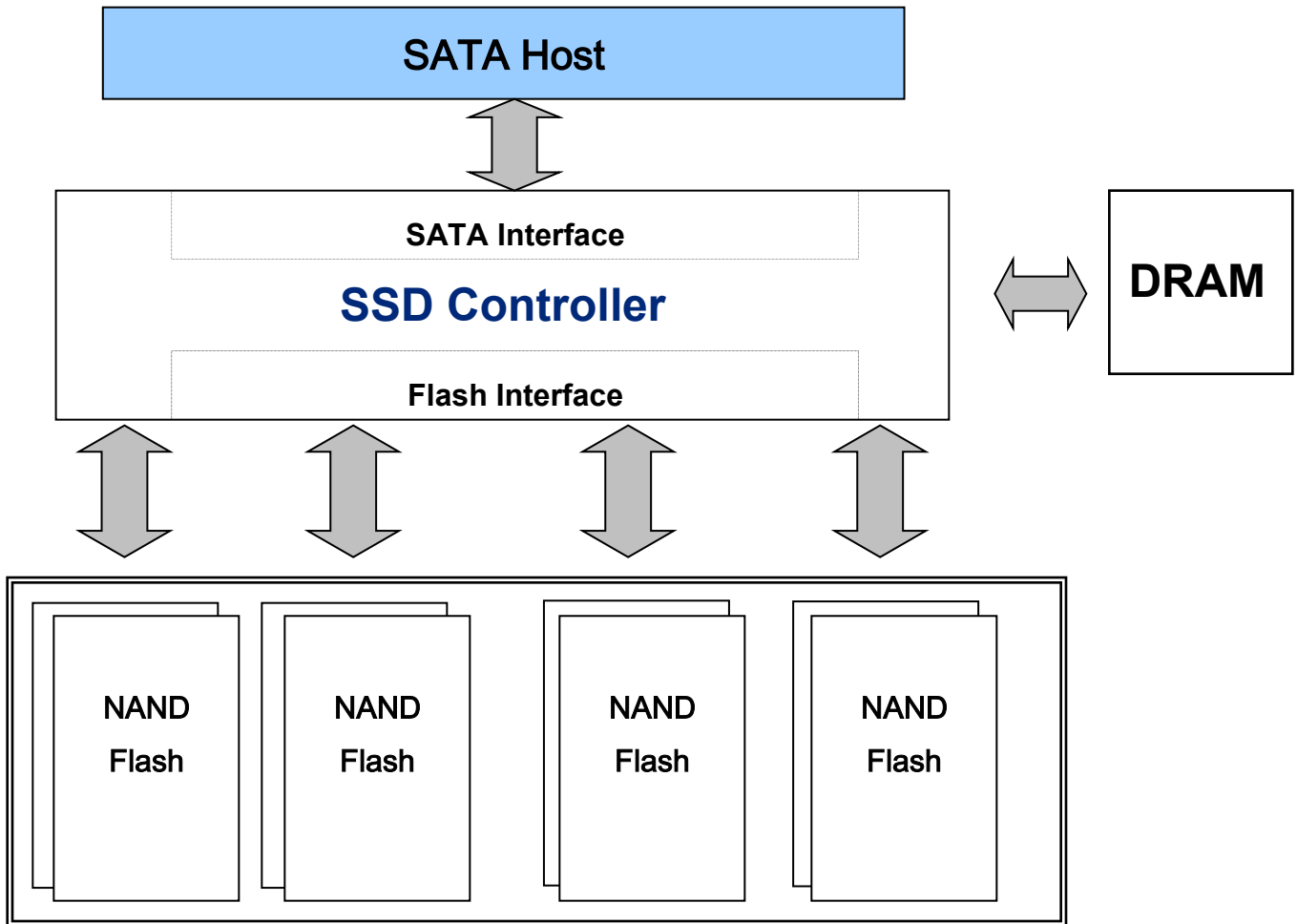*Note: Tighten mounting screws with no more than 2 Kgf-cm of torque.

Pin Assignments

Pin No.	Pin Name	Pin No.	Pin Name
S1	GND	S2	A+
S3	A-	S4	GND
S5	B-	S6	B+
S7	GND	P1	NC
P2	NC	P3	DEVSLP
P4	GND	P5	GND
P6	GND	P7	5V
P8	5V	P9	5V
P10	GND	P11	DAS
P12	GND	P13	NC
P14	NC	P15	NC

Pin Layout

Block Diagram

*The quantity of NAND flash varies by capacity.

Features

Wear-Leveling algorithm

The controller supports static/dynamic wear leveling. When the host writes data, the controller will find and use the block with the lowest erase count among the free blocks. This is known as dynamic wear leveling. When the free blocks 'erase count is higher than the data blocks', it will activate the static wear leveling, replacing the not-so-frequently-used user blocks with the high erase count free blocks.

Bad-block management

When the flash encounters ECC fail, program fail or erase fail, the controller will mark the block as a bad block to prevent using this block and cause data loss in the future.

Enhanced S.M.A.R.T. function

Transcend's SSDs support the innovative S.M.A.R.T. command (Self-Monitoring, Analysis, and Reporting Technology) that allows the users to evaluate the health information of their SSD in an efficient way.

StaticDataRefresh Technology

Normally, ECC engine corrections are taken place without affecting the host normal operations. As time passes by, the number of error bits accumulated in the read transaction exceeds the correcting capability of the ECC engine, resulting in corrupted data being sent to the host. To prevent this, the controller monitors the error bit levels at each read operation; when it reaches the preset threshold value, the controller automatically performs data refresh to "restore" the correct charge levels in the cell. This implementation practically restores the data to its original, error-free state, and hence, lengthening the life of the data.

ATA Command Register

This table and the following paragraphs summarizes the ATA command set.

Command Table

Support ATA/ATAPI Command	Code	Protocol
General Feature Set		
EXECUTE DIAGNOSTICS	90h	Device diagnostic
FLUSH CACHE	E7h	Non-data
IDENTIFY DEVICE	ECh	PIO data-In
Initialize Drive Parameters	91h	Non-data
READ DMA	C8h	DMA
READ LOG Ext	2Fh	PIO data-In
READ MULTIPLE	C4h	PIO data-In
READ SECTOR(S)	20h	PIO data-In
READ VERIFY SECTOR(S)	40h or 41h	Non-data
SET FEATURES	EFh	Non-data
SET MULTIPLE MODE	C6h	Non-data
WRITE DMA	Cah	DMA
WRITE MULTIPLE	C5h	PIO data-out
WRITE SECTOR(S)	30h	PIO data-out
NOP	00h	Non-data
READ BUFFER	E4h	PIO data-In
WRITE BUFFER	E8h	PIO data-out
Power Management Feature Set		
CHECK POWER MODE	E5h or 98h	Non-data
IDLE	E3h or 97h	Non-data
IDLE IMMEDIATE	E1h or 95h	Non-data
SLEEP	E6h or 99h	Non-data
STANDBY	E2h or 96h	Non-data
STANDBY IMMEDIATE	E0h or 94h	Non-data
Security Mode Feature Set		
SECURITY SET PASSWORD	F1h	PIO data-out
SECURITY UNLOCK	F2h	PIO data-out
SECURITY ERASE PREPARE	F3h	Non-data
SECURITY ERASE UNIT	F4h	PIO data-out
SECURITY FREEZE LOCK	F5h	Non-data
SECURITY DISABLE PASSWORD	F6h	PIO data-out
SMART Feature Set		
SMART Disable Operations	B0h	Non-data
SMART Enable/Disable Autosave	B0h	Non-data
SMART Enable Operations	B0h	Non-data
SMART Execute Off-Line Immediate	B0h	Non-data
SMART Read LOG	B0h	PIO data-In
SMART Read Data	B0h	PIO data-In
SMART Read THRESHOLD	B0h	PIO data-In
SMART Return Status	B0h	Non-data
SMART SAVE ATTRIBUTE VALUES	B0h	Non-data
SMART WRITE LOG	B0h	PIO data-out

Host Protected Area Feature Set		
Read Native Max Address	F8h	Non-data
Set Max Address	F9h	Non-data
Set Max Set Password	F9h	PIO data-out
Set Max Lock	F9h	Non-data
Set Max Freeze Lock	F9h	Non-data
Set Max Unlock	F9h	PIO data-out
48-bit Address Feature Set		
Flush Cache Ext	Eah	Non-data
Read Sector(s) Ext	24h	PIO data-in
Read DMA Ext	25h	DMA
Read Multiple Ext	29h	PIO data-in
Read Native Max Address Ext	27h	Non-data
Read Verify Sector(s) Ext	42h	Non-data
Set Max Address Ext	37h	Non-data
Write DMA Ext	35h	DMA
Write Multiple Ext	39h	PIO data-out
Write Sector(s) Ext	34h	PIO data-out
NCQ Feature Set		
Read FPDMA Queued	60h	DMA Queued
Write FPDMA Queued	61h	DMA Queued
Other		
Data Set Management	06h	DMA
SEEK	70h	Non-data

SMART Data Structure

BYTE	F / V	Description
0-1	X	Revision code
2-361	X	Vendor specific
362	V	Off-line data collection status
363	X	Self-test execution status byte
364-365	V	Total time in seconds to complete off-line data collection activity
366	X	Vendor specific
367	F	Off-line data collection capability
368-369	F	SMART capability
370	F	Error logging capability 7-1 Reserved 0 1=Device error logging supported
371	X	Vendor specific
372	F	Short self-test routine recommended polling time (in minutes)
373	F	Extended self-test routine recommended polling time (in minutes)
374	F	Conveyance self-test routine recommended polling time (in minutes)
375-385	R	Reserved
386-395	F	Firmware Version/Date Code
396-397	F	Reserved
398-399	V	Reserved
400-406	V	TS6500
407-415	X	Vendor specific
416	F	Reserved
417	F	Program/write the strong page only
418-419	V	Number of spare block
420-423	V	Average Erase Count
424-510	X	Vendor specific
511	V	Data structure checksum

F = content (byte) is fixed and does not change.

V= content (byte) is variable and may change depending on the state of the device or the commands executed by the device.

X= content (byte) is vendor specific and may be fixed or variable.

R= content (byte) is reserved and shall be zero.

SMART Attributes

The following table shows the vendor specific data in byte 2 to 361 of the 512-byte SMART data

Attribute ID (hex)	Raw Attribute Value							Attribute Name
01	MSB	00	00	00	00	00	00	Read Error Rate
05	LSB	MSB	00	00	00	00	00	Reallocated sectors count
09	LSB	-	-	MSB	00	00	00	Power-on hours
0C	LSB	-	-	MSB	00	00	00	Power Cycle Count
A0	LSB	-	-	MSB	00	00	00	Uncorrectable sectors count when read/write
A1	LSB	MSB	00	00	00	00	00	Number of valid spare blocks
A3	LSB	MSB	00	00	00	00	00	Number of initial invalid blocks
A4	LSB	-	-	MSB	00	00	00	Total erase count
A5	LSB	-	-	MSB	00	00	00	Maximum erase count
A6	LSB	-	-	MSB	00	00	00	Minimum erase count
A7	LSB	-	-	MSB	00	00	00	Average erase count
A8	LSB	-	-	MSB	00	00	00	Max erase count of spec
A9	LSB	-	-	MSB	00	00	00	Remain Life (percentage)
AF	LSB	-	-	MSB	00	00	00	Program fail count in worst die
B0	LSB	MSB	00	00	00	00	00	Erase fail count in worst die
B1	LSB	-	-	MSB	00	00	00	Total wear level count
B2	LSB	MSB	00	00	00	00	00	Runtime invalid block count
B5	LSB	-	-	MSB	00	00	00	Total program fail count
B6	LSB	MSB	00	00	00	00	00	Total erase fail count
C0	LSB	MSB	00	00	00	00	00	Power-off retract Count
C2	MSB	00	00	00	00	00	00	Controlled temperature
C3	LSB	-	-	MSB	00	00	00	Hardware ECC recovered
C4	LSB	-	-	MSB	00	00	00	Reallocation event count
C5	LSB	MSB	00	00	00	00	00	Current Pending Sector Count
C6	LSB	-	-	MSB	00	00	00	Uncorrectable error count off-line
C7	LSB	MSB	00	00	00	00	00	Ultra DMA CRC Error Count
E8	LSB	MSB	00	00	00	00	00	Available reserved space
F1	LSB	-	-	-	-	-	MSB	Total LBA written (each write unit = 32MB)
F2	LSB	-	-	-	-	-	MSB	Total LBA read (each read unit = 32MB)
F5	LSB	-	-	-	-	-	MSB	Flash write sector count

Ordering Information

Capacity	Model P/N
32GB	TS32GSSD420I
64GB	TS64GSSD420I
128GB	TS128GSSD420I
256GB	TS256GSSD420I
512GB	TS512GSSD420I
1TB	TS1TSSD420I

The technical information above is based on industry standard data and has been tested to be reliable. However, Transcend makes no warranty, either expressed or implied, as to its accuracy and assumes no liability in connection with the use of this product. Transcend reserves the right to make changes to the specifications at any time without prior notice.

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Version	**Date**	**Modification Content**
1.0	2017/04/25	Initial release