TOSHIBA
Leading Innovation

Solid State Drive HG6 Series Industrial Temperature Version

Key Features

- Hot-Plug/OS-Aware Hot Removal
- ClickConnect (a latch solution for internal cabled system application) supported (2.5-inch only)
- Deterministic Zeroing TRIM supported
- SED model supports TCG OPAL ver. 2.0 and Wipe Technology based on AES 256 hardware
- WWN (World Wide Name) supported
- Strong & highly-efficient ECC named Quadruple Swing-By Code (QSBC)
- Serial ATA DIPM (Device Initiated Power Management), HIPM (Host Initiated Power Management) and Device Sleep are supported for reduced power consumption
- Read only mode supported for emergency



Applications

- For General-purpose notebook PCs with Industrial Temperature Support

Specifications and Features

Form Factor	2.5-inch (7.0 mmH)	mSATA™ *1 Module	M.2 2280-D2 (Double-sided)
Connector Type	Standard SATA	mSATA™ *1	M.2 B-M
Memory	TOSHIBA MLC NAND flash memory		
Interface *2	ACS-2, SATA revision 3.1 1.5/3/6 Gbit/s		
Capacity *2	60/128/256/512 GB	60/128/256 GB	60/128/256/512 GB
Performance *2*3	Sequential Read: up to 534 MB/s{510 MiB/s} Sequential Write: up to 482 MB/s{460 MiB/s}		
Supply Voltage	5.0 V ±5 %	3.3 V ±5 %	
Power Consumption	Active: 3.3 W typ. Idle: 125 mW typ.	Active: 3.2 W typ. Idle: 65 mW typ.	
Temperature	Operating: -40 °C - 85 °C (case temperature) Non-operating: -40 °C – 85 °C	Operating: -40 °C - 85 °C (components temperature) Non-operating: -40 °C – 85 °C	
Shock	14.7 km/s^2 {1500 G} at 0.5 ms		
Vibration	Operating / Non-operating: 196 m/s^2 {20 G} at 10-2,000 Hz		
Reliability	Mean Time to Failure (MTTF): 1,500,000 hours Product Life: Approximately 5 years		
Size	100.0 mm x 69.85 mm x 7.0 mm	50.95 mm x 30.0 mm x 3.95 mm	80.0 mm x 22.0 mm x 3.58 mm
Weight	49 - 53 g typ.	7.3 - 7.7 g typ.	7.0 - 9.3 g typ.
More Features	• Translation mode which enables any drive configuration • 28-bit LBA mode commands and 48-bit LBA mode commands support • Automatic retries and corrections for read errors • NCQ (Native Command Queuing) function supported		
Compliance	UL, CSA, TÜV, KC, BSMI, CE, C-Tick		

*1) mSATA™ is a trademark of Serial ATA International Organization

*2) 1 MB = 1,000,000 bytes, 1 GB = 1,000,000,000 bytes, 1 Gbit = 1,000,000,000 bits

*3) 1 MiB (mebibytes) = 2^{20} bytes = 1,048,576 bytes

Products and specifications discussed herein are for reference purposes only and are subject to change without notice. All information discussed herein is provided on an “as is” basis, without warranties of any kind. Before creating and producing designs and using, customers must refer to and comply with the latest versions of the product specifications.

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Ordering Information

THN	SX	X	XXXG	X	X	X
1	2	3	4	5	6	7

1. Model Name — THN: Toshiba NAND drive
2. Model Type — SN: Non-SED, SF: SED
3. Controller Type — J: Type J
4. Capacity — 060G / 128G / 256G / 512G / …

   060G is 60 GB, 128G is 128 GB, 256G is 256 GB and 512G is 512 GB
   (1 GB = 1,000,000,000 bytes)
5. Form Factor — C: 2.5-inch case (7.0 mm height),

   M: mSATA Module type, 8/D: M.2 2280 Module type
6. Host I/F Type — S: Standard SATA, C: mSATA, N: M.2 B-M SATA type
7. NAND Type — U: MLC

Product Line up

Product Number	Capacity	Form Factor	Note
THNSNJ060WCSU	60 GB	2.5-inch 7.0 mm case	Non-SED
THNSNJ128WCSU	128 GB		Non-SED
THNSNJ256WCSU	256 GB		Non-SED
THNSNJ512WCSU	512 GB		Non-SED
THNSNJ060WMSU	60 GB	mSATA module	Non-SED
THNSNJ128WMSU	128 GB		Non-SED
THNSNJ256WMSU	256 GB		Non-SED
THNSNJ060W8NU (D2) *1	60 GB	M.2 2280 module	Non-SED
THNSNJ128W8NU (D2) *1	128 GB		Non-SED
THNSNJ256W8NU (D2) *1	256 GB		Non-SED
THNSNJ512WDNU (D2) *1	512 GB		Non-SED
THNSFJ060WCSU	60 GB	2.5-inch 7.0 mm case	SED
THNSFJ128WCSU	128 GB		SED
THNSFJ256WCSU	256 GB		SED
THNSFJ512WCSU	512 GB		SED
THNSFJ060WMCU	60 GB	mSATA module	SED
THNSFJ128WMCU	128 GB		SED
THNSFJ256WMCU	256 GB		SED
THNSFJ060W8NU (D2) *1	60 GB	M.2 2280 module	SED
THNSFJ128W8NU (D2) *1	128 GB		SED
THNSFJ256W8NU (D2) *1	256 GB		SED
THNSFJ512WDNU (D2) *1	512 GB		SED

*1) Double Side

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1. General Description

The TOSHIBA SSD HG series is a memory storage device using NAND flash memories, which has no mechanical moving parts and provides high performance and reliability compare to Hard Disk Drive.

The drive features an ACS-2 and Serial ATA revision 3.1 interface embedded controller that requires a simplified adapter board for interfacing to a Serial ATA or Serial ATA compatible bus. The drive is distinctive for its small and light body.

2. Product Specifications

2.1. Capacity

Table 2-1. User Addressable Sectors in LBA Mode

Capacity	Total Number of User Addressable Sectors in LBA Mode
60 GB	117,231,408
128 GB	250,069,680
256 GB	500,118,192
512 GB	1,000,215,216

NOTE: 1 GB (Gigabyte) = 1,000,000,000 bytes

Bytes per sector: 512 bytes

2.2. Performance

Table 2-2. Interface Speed and Data Transfer Rate in Read/Write

Parameter	Transfer Rate		
	THNSNJ060WCSU THNSNJ060WMCU THNSNJ060W8NU	THNSNJ128WCSU THNSNJ128WMCU THNSNJ128W8NU THNSNJ256WMCU THNSNJ256W8NU	THNSNJ256WCSU THNSNJ512WCSU THNSNJ512WDNU
Interface Speed	6 Gbit/s Max.		
Sequential Read *1	up to 534 MB/s {510 MiB/s}		
Sequential Write *1	up to 450 MB/s {430 MiB/s}	up to 471 MB/s {450 MiB/s}	up to 482 MB/s {460 MiB/s}

NOTE: *1) Under the condition of measurement with 128 KiB unit sequential access

(1 KiB = 1024 bytes)

3. Electrical Characteristics

3.1. Supply Voltage

Table 3-1. Supply Voltage

	2.5-inch Case(7.0 mm)	mSATA / M.2 2280 Module
Allowable voltage	5.0 V ±5 %	3.3 V ±5 %
Allowable noise/ripple	100 mV p-p or less	
Allowable supply rise time	2 –100 ms	

NOTE: These drive has over current protection circuit. (Rated current: 3.15A)

3.2. Power Consumption

Table 3-2. Power Consumption in 2.5-inch Case Type

Operation (Ta *1=25°C)	2.5-inch Case(7.0 mm)			
	THNSNJ060WCSU	THNSNJ128WCSU	THNSNJ256WCSU	THNSNJ512WCSU
Read *2	2.1 W typ.	2.5 W typ.	2.7 W typ.	3.0 W typ.
Write *2	2.1 W typ.	2.5 W typ.	3.2 W typ.	3.3 W typ.
Idle *3 *4	125 mW typ.	125 mW typ.	125 mW typ.	125 mW typ.
Standby *3 *4	120 mW typ.	120 mW typ.	120 mW typ.	120 mW typ
Sleep *3	120 mW typ.	120 mW typ	120 mW typ.	120 mW typ
DevSleep	5 mW max.	5 mW max.	5 mW max.	5 mW max.

Table 3-3. Power Consumption in mSATA / M.2 2280 Module Type

Operation (Ta *1=25°C)	mSATA / M.2 2280 Module			
	THNSNJ060WMCU THNSNJ060W8NU	THNSNJ128WMCU THNSNJ128W8NU	THNSNJ256WMCU THNSNJ256W8NU	THNSNJ512WDNU
Read *2	2.1 W typ.	2.4 W typ.	2.5 W typ.	2.9 W typ.
Write *2	2.0 W typ.	2.4 W typ.	2.5 W typ.	3.2 W typ.
Idle *3 *4	65 mW typ.	65 mW typ.	65 mW typ.	65 mW typ.
Standby *3 *4	60 mW typ.	60 mW typ.	60 mW typ.	60 mW typ.
Sleep *3	60 mW typ.	60 mW typ.	60 mW typ.	60 mW typ.
DevSleep	5 mW max.	5 mW max.	5 mW max.	5 mW max.

NOTE:

*1) Ambient Temperature.

*2) The values are specified at the condition causing maximum power consumption.

*3) The values are based on using SATA power management features. The Slumber mode is used for the power consumption measurements.

*4) The drive may internally write to NAND flash memory, while the drive is in idle or standby. Therefore, drive power consumption may temporally change up to write power.

4. Environmental Conditions

4.1. Temperature and Humidity

Table 4-1. Temperature

Condition	Range		Gradient
	2.5-inch Case	mSATA / M.2 2280 Module	
Operating *1	-40 °C (Ta) – 85 °C (Tc)	-45 °C (Ta) – 85 °C (Tc)	30 °C (Ta)/h Max.
Non-operating	-40 °C – 85 °C		30 °C/h Max.
Under Shipment *2	-40 °C – 85 °C		30 °C/h Max.

NOTE: *1) Ta: Ambient Temperature, Tc: Case or Components Temperature

*2) Packaged in Toshiba's original shipping package

Table 4-2. Humidity

Condition	Range
Operating	5 % – 90 % R.H. (No condensation)
Non-operating	5 % – 95 % R.H. (No condensation)
Under Shipment *1	5 % – 95 % R.H.

NOTE: *1) Packaged in Toshiba's original shipping package

4.2. Shock and Vibration

Table 4-3. Shock

Condition	Range
Operating	14.7 km/s^2 {1500 G}, 0.5 ms, half sine wave
Non-operating	
Under Shipment *1	100 cm free drop

NOTE:

*1) Apply shocks in each direction of the drive's three mutually perpendicular axes, one axis at a time. Packaged in Toshiba's original shipping package.

Table 4-4. Vibration

Condition	Range
Operating	196 m/s^2 {20 G} Peak, 10 - 2,000 Hz (20 minutes per axis) x 3 axis
Non-operating	

5. Compliance

TOSHIBA SSD HG series complies with the following.

Table 5-1. Compliance

Mark Name	Description	Region
UL (Underwriters Laboratories)	UL 60950-1	USA
CSA (Canadian Standard Association) *Included UL logo mark	CSA-C22.2 No.60950-1	Canada
TÜV (Technischer Überwachungs Verein)	EN 60950-1	Germany
KC	KN22 KN24	Korea
BSMI (Bureau of Standards, Metrology and Inspection)	CNS13438(CISPR Pub. 22) Class B	Taiwan
CE	EN 55022, EN 55024	Europe
C-Tick	AS/NZS CISPR Pub. 22 Class B	Australia, New Zealand

6. Reliability

Table 6-1. Reliability

Parameter	Value
Mean Time to Failure	1,500,000 hours
Product Life	Approximately 5 years

7. Mechanical Specifications

7.1. 2.5-inch Case (7.0 mm)

Table 7-1. Weight and Dimensions

Model		Weight	Width	Height	Length
7.0 mm	THNSNJ060WCSU THNSNJ128WCSU	49 g typ.	69.85 mm	7.0 mm	100.0 mm
	THNSNJ256WCSU THNSNJ512WCSU	53 g typ.			

Figure 7-1. 2.5-inch Case (7.0 mm) Drive Dimension

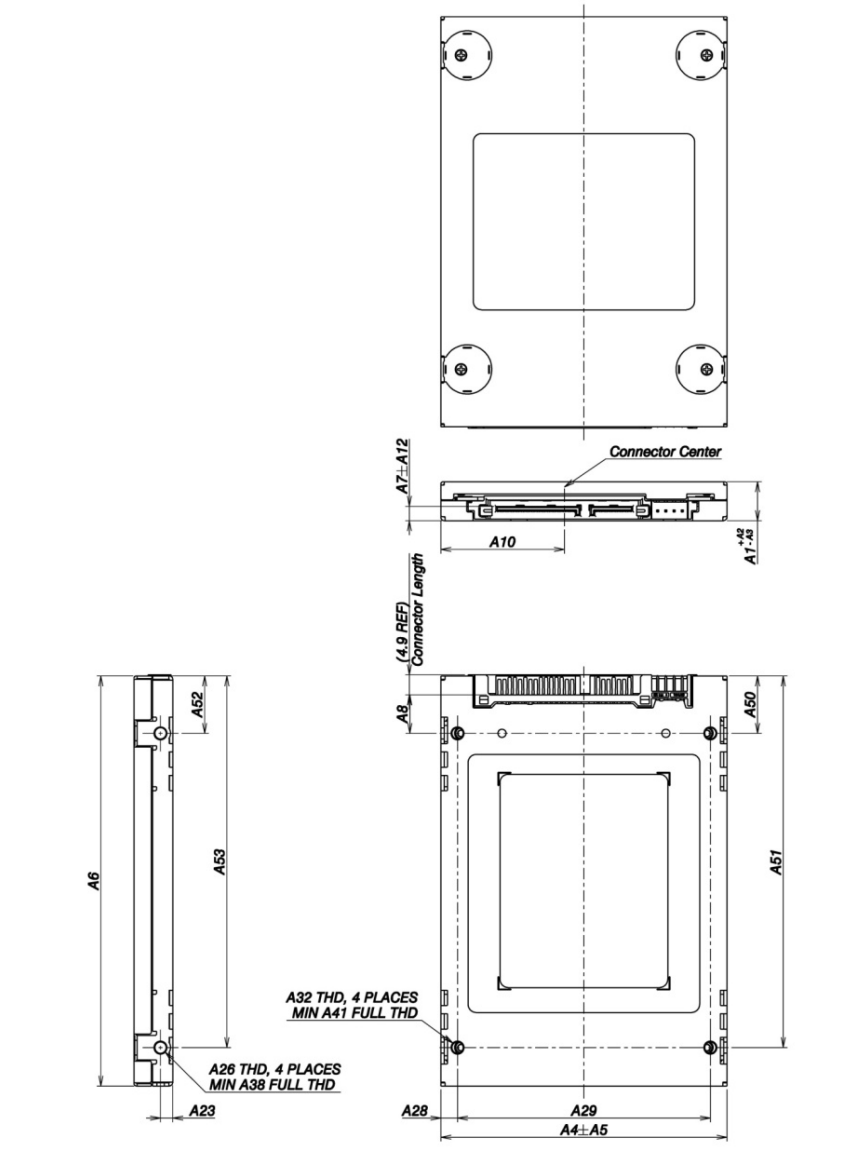


Table 7-2. Dimensions

Dimension	SFF-8200 Rev2.0 *1 SFF-8201 Rev2.4 SFF-8223 Rev2.5		Toshiba SSD (Differences only)	
	Millimeters (7.0 mm)	Inches (7.0 mm)	Millimeters	Inches
A1	7.00	0.276		
A2	0.00	0.000		
A3	0.50	0.020		
A4	69.85	2.750		
A5	0.25	0.010		
A6 *2	100.45 *	3.955 *	100.00±0.41	3.937±0.016
A7	3.5	0.138		
A8	9.40	0.370	9.40±0.51	0.370±0.020
A10 *3	-	-	30.125±0.28	1.186±0.011
A12	0.38	0.015		
A23	3.00	0.118	3.00±0.20	0.118±0.007
A26	M3	N/A		
A28	4.07	0.160	4.07 +0.295/-0.305	0.060 +0.011/-0.012
A29	61.72	2.430	61.72±0.25	2.430±0.010
A32	M3	N/A		
A38	3 #	3 #		
A41	2.5 #	2.5 #		
A50 *2	14.00	0.551	14.00±0.25	0.551±0.010
A51 *2	90.60	3.567	90.60±0.30	3.567±0.012
A52 *2	14.00	0.551	14.00±0.25	0.551±0.010
A53 *2	90.60	3.567	90.60±0.30	3.567±0.012

* = maximum

= minimum number of threads

NOTE:

*1) SFF-8200: Small Form Factor Standard

*2) PCA, Connector not included

*3) Connector Center defined the same as SFF-8223 All

7.2. mSATA Module

Table 7-3. Weight and Dimensions

Model	Weight	Width	Height	Length
THNSNJ060WMCU THNSNJ128WMCU	7.3 g typ.	30.0 mm	3.95 mm	50.95 mm
THNSNJ256WMCU	7.7 g typ.			

Figure 7-2. mSATA Module Drive Dimension

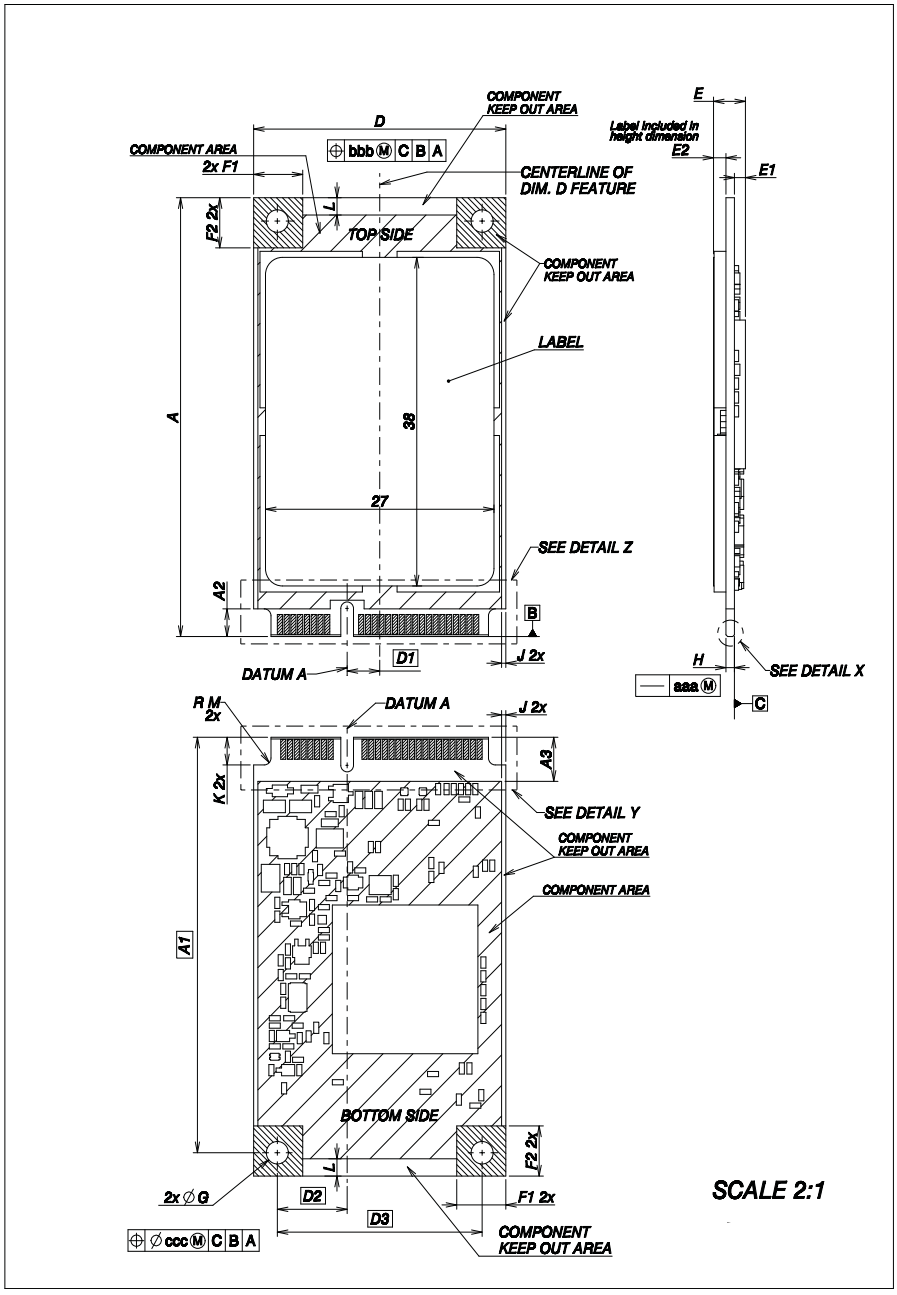


Table 7-4. Dimensions and Tolerances *1

JEDEC MO-300 B mSATA FULL SIZE VARIATION A				TOSHIBA
SYMBOL	MIN	NOM	MAX	(Differences only)
A	50.65	50.80	50.95	
A1		48.05 BASIC		
A2	3.20	-	-	
A3	5.10	-	-	
D	29.70	29.85	30.00	
D1		3.85 BASIC		
D2		8.25 BASIC		
D3		24.20 BASIC		
E	-	-	4.85	3.95 max.
E1	-	-	1.35	
E2	-	-	2.40	1.6 max.
F1	5.65	5.80	5.95	
F2	5.65	5.80	5.95	
G	2.50	2.60	2.70	
H	0.90	1.00	1.10	
J	0.50	-	-	
K	3.20	-	-	
L	2.00	-	-	
M	-	-	0.80	
P1	-	-	0.25	
P2	-	-	0.25	
aaa		0.22		
bbb		0.10		
ccc		0.10		

NOTE:

*1) Thickness applies across tabs and includes plating and/or metallization.

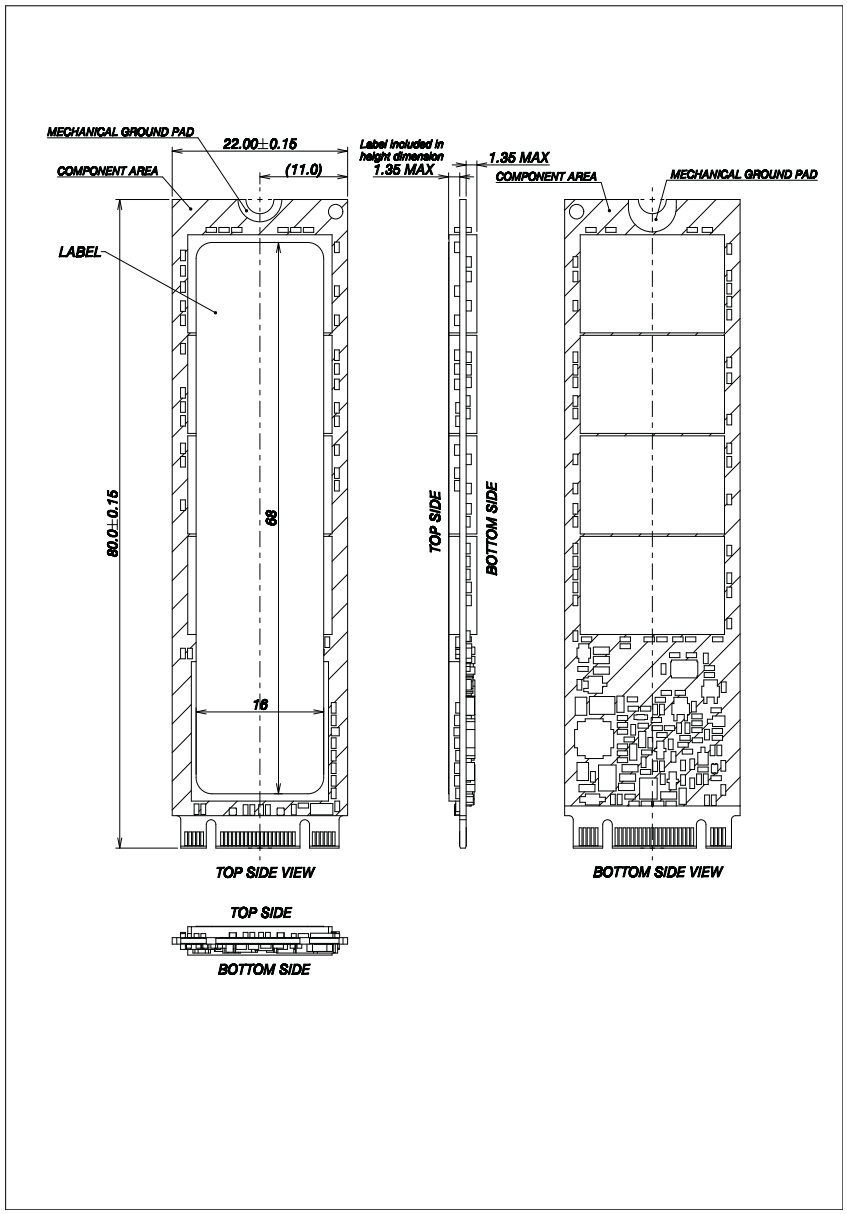
Unit: mm

7.3. M.2 2280 Module

Table 7-5. Weight and Dimensions

Model	Weight	Width	Height	Length
THNSNJ060W8NU(D2)	7.0 g typ.	22.0 mm	3.58 mm	80.0 mm
THNSNJ128W8NU(D2)	7.0 g typ.		3.58 mm	
THNSNJ256W8NU(D2)	7.1 g typ.		3.58 mm	
THNSNJ512WDNU(D2)	9.3 g typ		3.58 mm	

Figure 7-3. M.2 2280 Module Drive Dimension



Unit: mm

8. Interface Connector

8.1. 2.5-inch Case (7.0 mm)

Figure 8-1. 2.5-inch Case Serial ATA Interface Connector

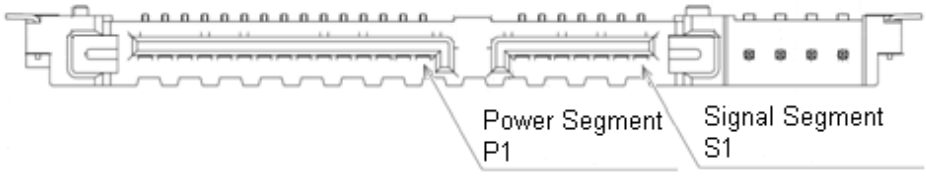


Table 8-1. 2.5-inch Case Drive Connecter Pin Assignment *1

Signal segment key			
Signal Segment	S1	GND	2nd Mate
	S2	A+	Differential Signal Pair A (Device Rx), 3rd Mate
	S3	A–	
	S4	GND	
	S5	B–	Differential Signal Pair B (Device Tx), 3rd Mate
	S6	B+	
	S7	GND	2nd Mate
Signal segment “L”			
Central connector polarizer			
Power segment “L”			
Power Segment	P1	Retired *2	
	P2	Retired *2	
	P3	DEVSLP *2	Enter/Exit DevSleep
	P4	GND	1st Mate
	P5	GND	2nd Mate
	P6	GND	2nd Mate
	P7	V5	5 V power, pre-charge *4, 2nd Mate
	P8	V5	5 V power, 3rd Mate
	P9	V5	5 V power, 3rd Mate
	P10	GND	2nd Mate
	P11	DAS/DSS *3	Drive Activity Signal, 3rd Mate
	P12	GND	1st Mate
	P13	V12	12 V power, pre-charge, 2nd Mate (Unused)
	P14	V12	12 V power (Unused), 3rd Mate
	P15	V12	12 V power (Unused), 3rd Mate
Power segment key			

U1	N.C.	Not connected
U2	TX	For test use, Not connected
U3	UX	For test use, Not connected
U4	GND	

NOTE: *1) The Mate orders are for backplane usage. Hot-Plug and OS-Aware Hot Removal are supported when using with a backplane connector. *2) Previously, 3.3 V was assigned to pins P1, P2 and P3 by Serial ATA International Organization. *3) DAS signal is option. DSS signal is not used for this drive. *4) Direct connect to non pre-charge pins.

8.2. mSATA Module

Figure 8-2. mSATA Interface Connector

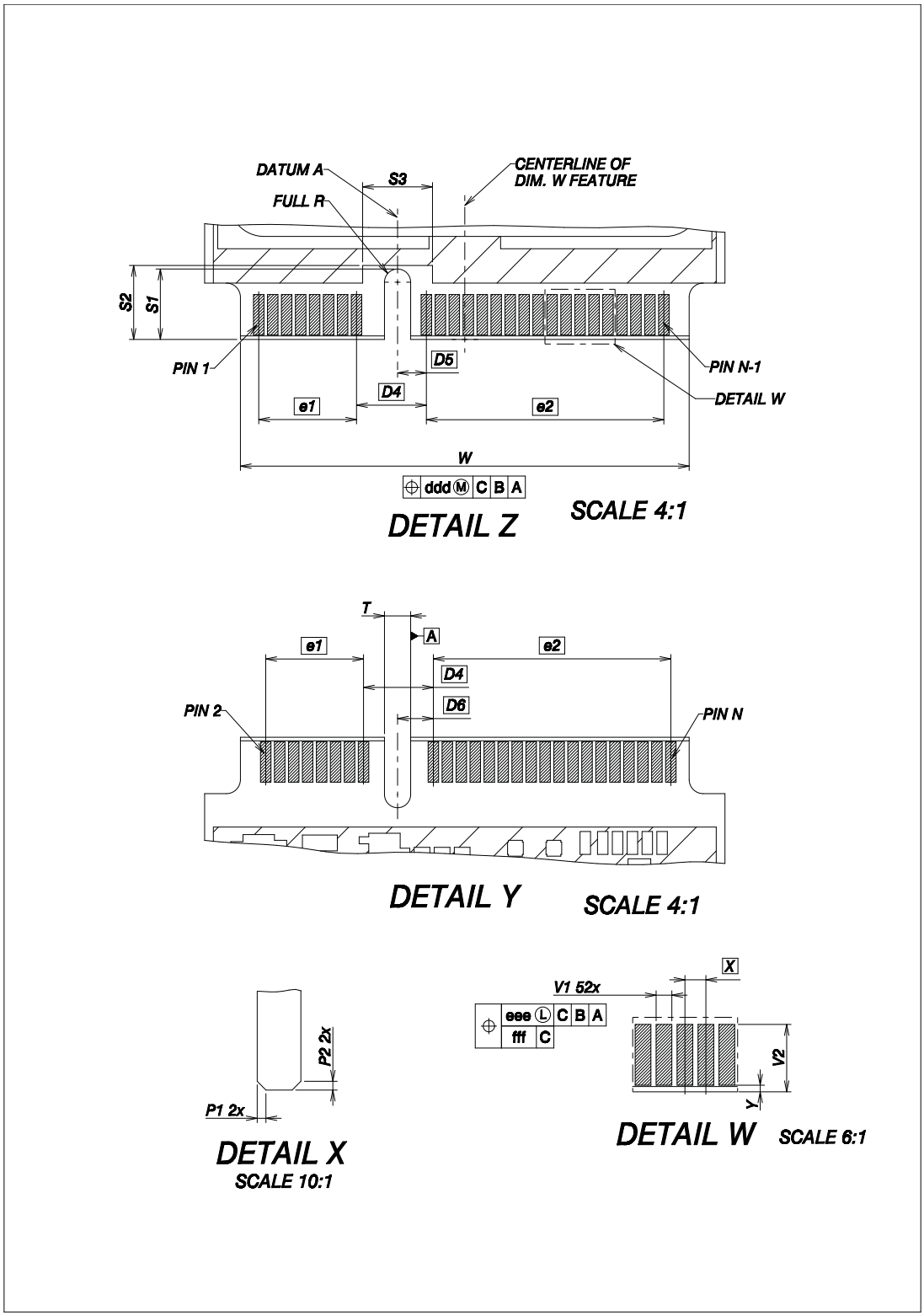


Table 8-2. Pin Assignment on mSATA Connector

Pin #	Name	Description	Pin #	Name	Description
1	Reserved	NC	2	+3.3V	3.3V Source
3	Reserved	NC	4	GND	Return Current Path
5	Reserved	NC	6	+1.5V	1.5V Source(Unused)
7	Reserved	NC	8	Reserved	NC
9	GND	Return Current Path	10	Reserved	NC
11	Reserved	NC	12	Reserved	NC
13	Reserved	NC	14	Reserved	NC
15	GND	Return Current Path	16	Reserved	NC
Key					
17	Reserved	NC	18	GND	Return Current Path
19	Reserved	NC	20	Reserved	NC
21	GND	Return Current Path	22	Reserved	NC
23	B+	Host Receiver Differential Signal Pair	24	+3.3V	3.3V Source
25	B-		26	GND	Return Current Path
27	GND	Return Current Path	28	+1.5V	1.5V Source(Unused)
29	GND	Return Current Path	30	Two Wire Interface	NC
31	A-	Host Transmitter Differential Signal Pair	32		NC
33	A+		34	GND	Return Current Path
35	GND	Return Current Path	36	Reserved	NC
37	GND	Return Current Path	38	Reserved	NC
39	+3.3V	3.3V source	40	GND	Return Current Path
41	+3.3V	3.3V source	42	Reserved	NC
43	Device Type *1	NC	44	DEVSLP	Enter/Exit DevSleep
45	Vendor	No connect at Host side	46	Reserved	NC
47	Vendor	No connect at Host side	48	+1.5V	1.5V Source(Unused)
49	DAS/DSS *2	Drive Activity Signal / Disable Staggered Spin-up	50	GND	Return Current Path
51	Presence *3	Presence Detection	52	+3.3V	3.3V Source

NOTE: *1) Given that non-mSATA devices ground P43, configurable shared-socket designs may use this pin to identify mSATA and non-mSATA devices.
*2) DAS signal is option. DSS signal is not used for this drive.
*3) Presence pin is connected to GND by device side. (220Ω Pull Down)

8.3. M.2 2280 Module

Figure 8-3. M.2 2280 Module Interface Connector

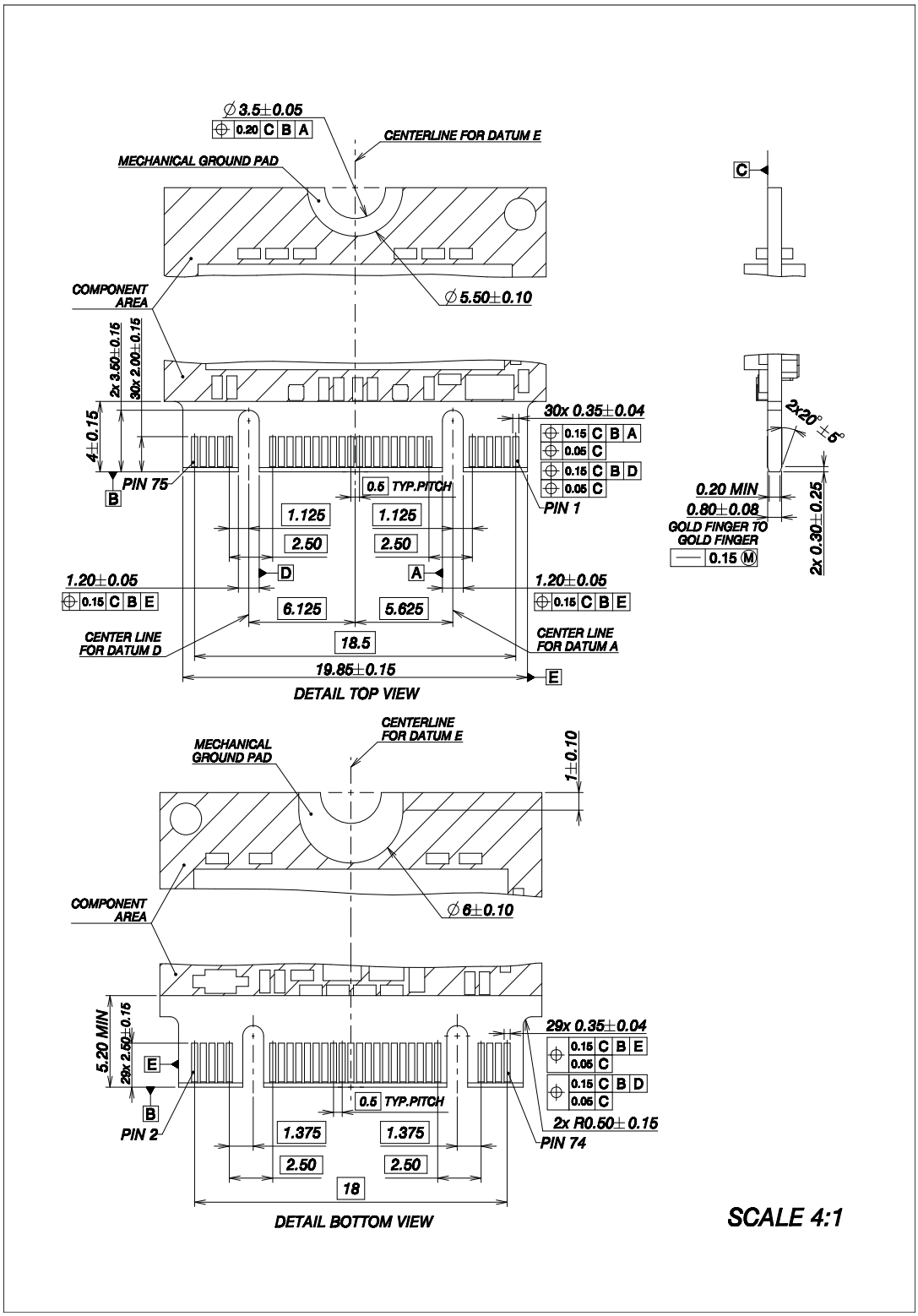


Table 8-3. Pin Assignment on M.2 2280 Module Connector

Pin #	Name	Description	Pin #	Name	Description
1	CONFIG_3	Defines module type(low)	2	+3.3V	3.3V Source
3	GND	GND	4	+3.3V	3.3V Source
5	Reserved	NC	6	Reserved	NC
7	Reserved	NC	8	Reserved	NC
9	Reserved	NC	10	DAS/DSS	Drive Activity Signal / Disable Staggered Spin-up
11	Reserved	NC	Notch		
Notch			20	Reserved	NC
21	CONFIG_0	Defines module type(low)	22	Reserved	NC
23	Reserved	NC	24	Reserved	NC
25	Reserved	NC	26	Reserved	NC
27	GND	GND	28	Reserved	NC
29	Reserved	NC	30	Reserved	NC
31	Reserved	NC	32	Reserved	NC
33	GND	GND	34	Reserved	NC
35	Reserved	NC	36	Reserved	NC
37	Reserved	NC	38	DEVSLP	DEVSLP signal
39	GND	GND	40	Reserved	NC
41	B+	Host Receiver Differential Signal Pair	42	Reserved	NC
43	B-		44	Reserved	NC
45	GND	GND	46	Reserved	NC
47	A-	Host Transmitter Differential Signal Pair	48	Reserved	NC
49	A+		50	Reserved	NC
51	GND	GND	52	Reserved	NC
53	Reserved	NC	54	Reserved	NC
55	Reserved	NC	56	MFG1	Manufacturing pin. Must be a no-connect on the host board.
57	GND	GND	58	MFG2	
Notch			Notch		
67	Reserved	NC	68	Reserved	NC
69	CONFIG_1	Defines module type(low)	70	+3.3V	3.3V Source
71	GND	GND	72	+3.3V	3.3V Source
73	GND	GND	74	+3.3V	3.3V Source
75	CONFIG_2	Defines module type(low)			

9. Command Descriptions

Table 9-1. Supported ATA Command Set

Op-Code		Command Description
00h		NOP
06h		DATA SET MANAGEMENT
10h		RECALIBRATE
20h		READ SECTOR(S)
21h		READ SECTOR(S) WITHOUT RETRY
24h		READ SECTOR(S) EXT
25h		READ DMA EXT
27h		READ NATIVE MAX ADDRESS EXT
29h		READ MULTIPLE EXT
2Fh		READ LOG EXT
30h		WRITE SECTOR(S)
31h		WRITE SECTOR(S) WITHOUT RETRY
34h		WRITE SECTOR(S) EXT
35h		WRITE DMA EXT
37h		SET MAX ADDRESS EXT
39h		WRITE MULTIPLE EXT
3Dh		WRITE DMA FUA EXT
3Fh		WRITE LOG EXT
40h		READ VERIFY SECTOR(S)
41h		READ VERIFY SECTOR(S) WITHOUT RETRY
42h		READ VERIFY SECTOR(S) EXT
45h		WRITE UNCORRECTABLE EXT
45h	55h	Create a pseudo-uncorrectable error with logging
45h	AAh	Create a flagged error without logging
47h		READ LOG DMA EXT
57h		WRITE LOG DMA EXT
5Bh		TRUSTED NON-DATA (SED model only)
5Ch		TRUSTED RECEIVE (SED model only)
5Dh		TRUSTED RECEIVE DMA (SED model only)
5Eh		TRUSTED SEND (SED model only)
5Fh		TRUSTED SEND DMA (SED model only)
60h		READ FPDMA QUEUED
61h		WRITE FPDMA QUEUED

Op-Code		Command Description
70h		SEEK
90h		EXECUTE DEVICE DIAGNOSTIC
91h		INITIALIZE DEVICE PARAMETERS
92h		DOWNLOAD MICROCODE
92h	03h	Download with offsets and save microcode for immediate and future use.
92h	07h	Download and save microcode for immediate and future use.
93h		DOWNLOAD MICROCODE DMA
93h	03h	Download with offsets and save microcode for immediate and future use.
93h	07h	Download and save microcode for immediate and future use.
B0h		SMART
B0h	D0h	SMART READ DATA
B0h	D1h	SMART READ ATTRIBUTE THRESHOLDS
B0h	D2h	SMART ENABLE/DISABLE ATTRIBUTE AUTOSAVE
B0h	D3h	SMART SAVE ATTRIBUTE VALUES
B0h	D4h	SMART EXECUTE OFF-LINE IMMEDIATE
B0h	D5h	SMART READ LOG
B0h	D6h	SMART WRITE LOG
B0h	D8h	SMART ENABLE OPERATIONS
B0h	D9h	SMART DISABLE OPERATIONS
B0h	DAh	SMART RETURN STATUS
B0h	DBh	SMART ENABLE/DISABLE AUTOMATIC OFF-LINE
B1h		DEVICE CONFIGURATION OVERLAY
B1h	C0h	DEVICE CONFIGURATION RESTORE
B1h	C1h	DEVICE CONFIGURATION FREEZE LOCK
B1h	C2h	DEVICE CONFIGURATION IDENTIFY
B1h	C3h	DEVICE CONFIGURATION SET
B1h	C4h	DEVICE CONFIGURATION IDENTIFY DMA
B1h	C5h	DEVICE CONFIGURATION SET DMA
B4h		SANITIZE DEVICE
B4h	00h	SANITIZE STATUS EXT
B4h	11h	CRYPTO SCRAMBLE EXT (SED model only)
B4h	12h	BLOCK ERASE EXT
B4h	20h	SANITIZE FREEZE LOCK EXT
C4h		READ MULTIPLE
C5h		WRITE MULTIPLE
C6h		SET MULTIPLE MODE

Op-Code			Command Description
C8h			READ DMA
C9h			READ DMA WITHOUT RETRY
CAh			WRITE DMA
CBh			WRITE DMA WITHOUT RETRY
CEh			WRITE MULTIPLE FUA EXT
E0h			STANDBY IMMEDIATE
E1h			IDLE IMMEDIATE
E2h			STANDBY
E3h			IDLE
E4h			READ BUFFER
E5h			CHECK POWER MODE
E6h			SLEEP
E7h			FLUSH CACHE
E8h			WRITE BUFFER
E9h			READ BUFFER DMA
EAh			FLUSH CACHE EXT
EBh			WRITE BUFFER DMA
ECh			IDENTIFY DEVICE
EFh			SET FEATURES
EFh	02h		Enable volatile write cache
EFh	03h		Set transfer mode
EFh	05h		Enable APM feature set
EFh	10h		Enable Serial ATA feature set
EFh	10h	02h	Enable DMA Setup FIS Auto-Activate optimization
EFh	10h	03h	Enable Device-initiated interface power state (DIPM) transitions
EFh	10h	06h	Enable Software Settings Preservation(SSP)
EFh	10h	07h	Enable Device Automatic Partial to Slumber transitions
EFh	10h	09h	Enable Device Sleep
EFh	55h		Disable read look-ahead
EFh	66h		Disable reverting to P-On default
EFh	82h		Disable volatile write cache
EFh	85h		Disable APM feature set
EFh	90h		Disable Serial ATA feature set
EFh	90h	02h	Disable DMA Setup FIS Auto-Activate optimization
EFh	90h	03h	Disable Device-initiated interface power state (DIPM) transitions
EFh	90h	06h	Software Settings Preservation(SSP)

Op-Code		Command Description	
EFh	90h	07h	Disable Device Automatic Partial to Slumber transitions
EFh	90h	09h	Disable Device Sleep
EFh	AAh	Enable read look-ahead	
EFh	CCh	Enable reverting to P-On default	
F1h		SECURITY SET PASSWORD	
F2h		SECURITY UNLOCK	
F3h		SECURITY ERASE PREPARE	
F4h		SECURITY ERASE UNIT	
F5h		SECURITY FREEZE LOCK	
F6h		SECURITY DISABLE PASSWORD	
F8h		READ NATIVE MAX ADDRESS	
F9h		SET MAX ADDRESS	
F9h	01h	SET MAX SET PASSWORD	
F9h	02h	SET MAX LOCK	
F9h	03h	SET MAX UNLOCK	
F9h	04h	SET MAX FREEZE LOCK	
F9h	05h	SET MAX SET PASSWORD DMA	
F9h	06h	SET MAX UNLOCK DMA	

10. Revision History

Rev.	Description	Date
0.1	Draft	Jan.6, 2015
0.2	Editorial Change	Jan.8, 2015
0.3	Editorial Change	Jan.13, 2015

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