

UD info Corp.

Industrial SATA Solid State Drive

FIPS 140-2

HF3-25DA Series

Product DataSheet



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Revision History

Revision	Draft Date	History	Author
1.0	2021/7/8	New release	Golden Lee
1.1	2024/6/12	Add BiCS5 NAND support for Wide temperature	Golden Lee



Product Overview

- **Capacity**
 - 128GB up to 4TB
- **Form Factor**
 - 2.5" inch
- **SATA Interface**
 - SATA Revision 3.1
- **Flash Interface**
 - Flash Type: 3D TLC
 - Up to 8pcs of BGA132 flash
- **Performance**
 - Read up to 550 MB/s
 - Write up to 530 MB/s
- **Power Consumption^{Note1}**
 - Active mode: < 4,100 mW
 - Idle mode: < 155 mW
- **Reliability**
 - MTBF 1,600,000 hours
 - Uncorrectable Bit Error Rate (UBER)
< 1 sector per 10¹⁶ bits read
- **Advanced Flash Management**
 - Advanced Wear Leveling
 - Bad Block Management
 - TRIM
 - SMART
 - Over-Provision
- **Temperature Range**
 - Operation:
 - Standard: 0°C ~ 70°C
 - Wide: -40°C ~ 85°C
 - Storage: -40°C ~ 85°C
- **Compliant**
 - RoHS
- **Features Support List:**
 - End to end data path protection
 - Thermal throttling
 - SmartECC™
 - SmartRefresh™
 - TCG OPAL
 - FIPS 140-2 lv2 certified:
Certificate number #3940

Notes:

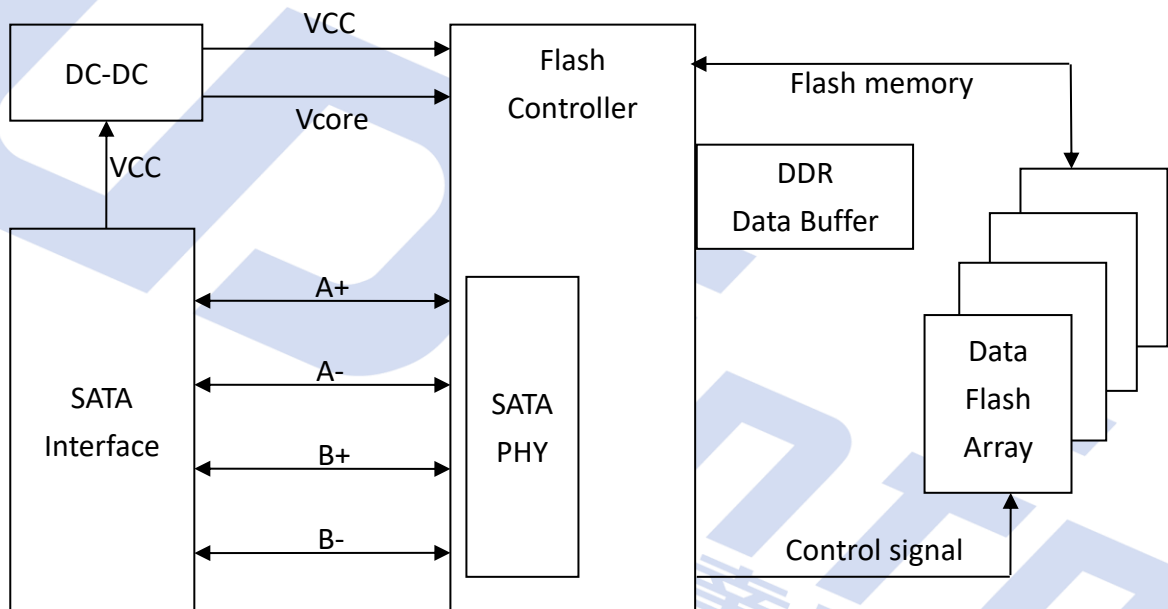
1. Please see "Power Consumption" for details.

1. INTRODUCTION

1.1. General Description

UDinfo 2.5" FIPS SATA SSD delivers all the advantages of flash disk technology with Serial ATA I/II/III interface, including being fully compliant with standard 2.5-inch form factor, providing low power consumption compared to traditional hard drive and hot-swapping when removing/replacing/upgrading flash disks. The device is designed based on the standard 7-pin interface for data segment and 15-pin for power segment. Its capacity could provide a wide range up to 4TB. Moreover, it can reach up to 550MB/s read as well as 530MB/s write high performance based on 3D TLC NAND flash.

1.2. Block Diagram



2.5" SATA SSD Block Diagram

2. PRODUCT SPECIFICATIONS



2.1. Product Specifications

- **Capacity**
 - 128GB up to 4TB
- **Electrical/Physical Interface**
 - Compliant with SATA Revision 3.1
 - Compatible with SATA 1.5Gbps, 3Gbps and 6Gbps interface
 - Support power management
 - Support expanded register for SATA protocol 48 bits addressing mode
- **Supported NAND Flash**
 - Support up to 32 Flash Chip Enables (CE) within single design
 - Support 8pcs BGA132 flash
 - Support OFNI 4.0 & Toggle 3.0 interface
 - Support Kioxia 3D TLC
- **ECC Scheme**
 - Applies the LDPC (Low Density Parity Check) of ECC algorithm
- **UART / GPIO function**
- **Support SMART and TRIM commands**
- **Security features**
 - FIPS 140-2 lv2 certified: when used in FIPS approved mode (When installed, initialized and configured as specified in the Security Rules Section of the UDinfo FIPS 140-2 non-proprietary Security Policy)
 - Full disk AES-XTS 256bit hardware encryption to protect user data storage
 - RSA-2048 Digital Signature Verification for secure boot and secure firmware update
 - On-chip Deterministic Random Number Generator used for key generation
 - Tamper-Evidence Protection
 - Support of TCG OPAL SSC 2.0

- **Capacity Information**

Capacity	Cylinders	Heads	Sectors	Total Sectors	User Data Size
128GB	16,383	16	63	250,069,680	Depended on file management
256GB	16,383	16	63	500,118,192	
512GB	16,383	16	63	1,000,215,216	
1TB	16,383	16	63	2,000,409,264	
2TB	16,383	16	63	4,000,797,360	
4TB	16,383	16	63	8,001,573,552	

- **Performance**

- Standard Temperature Grade Performance

Capacity	Flash Structure	Sequential		Random	
		Read (MB/s)	Write (MB/s)	Read (IOPS)	Write (IOPS)
128GB	64GB x2, BGA, 256Gb DDP	550	530	94K	90K
256GB	64GB x4, BGA, 256Gb DDP	550	530	98K	90K
512GB	64GB x 8, BGA, 256Gb DDP	550	530	99K	90K
1TB	128GB x 8, BGA, 256Gb QDP	550	530	99K	91K
2TB	256GB x 8, BGA, 512Gb QDP	550	530	99K	90K

- Wide Temperature Grade Performance

Capacity	Flash Structure	Sequential		Random	
		Read (MB/s)	Write (MB/s)	Read (IOPS)	Write (IOPS)
256GB	128GB x2, BGA, 512Gb DDP	550	140	50K	36K
512GB	128GB x4, BGA, 512Gb DDP	550	350	95K	86K
1TB	256GB x4, BGA, 512Gb QDP	550	520	98K	89K
2TB	256GB x8, BGA, 512Gb QDP	550	520	98K	89K
4TB	512GB x 8, BGA, 512Gb ODP	550	520	98K	88K

Notes:

1. The performance was estimated based on Kioxia 3D TLC NAND flash.
2. Performance may differ according to flash configuration and platform.
3. The table above is for reference only. Any criteria for accepting goods shall be discussed based on different flash configuration.
4. Performance is measured with the following conditions

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- (a) CrystalDiskMark 6.0.0, 1GB range, QD32
- (b) IO Meter, 1GB range, 4K datasize, QD32

● **TBW (Terabytes Written)**

Temperature Grade	Capacity	TBW
Standard Temp. 0°C ~ 70°C	128GB	120
	256GB	280
	512GB	605
	1TB	1275
	2TB	3465
Wide Temp. -40°C ~ 85°C	256GB	260
	512GB	640
	1TB	1400
	2TB	3110
	4TB	6890

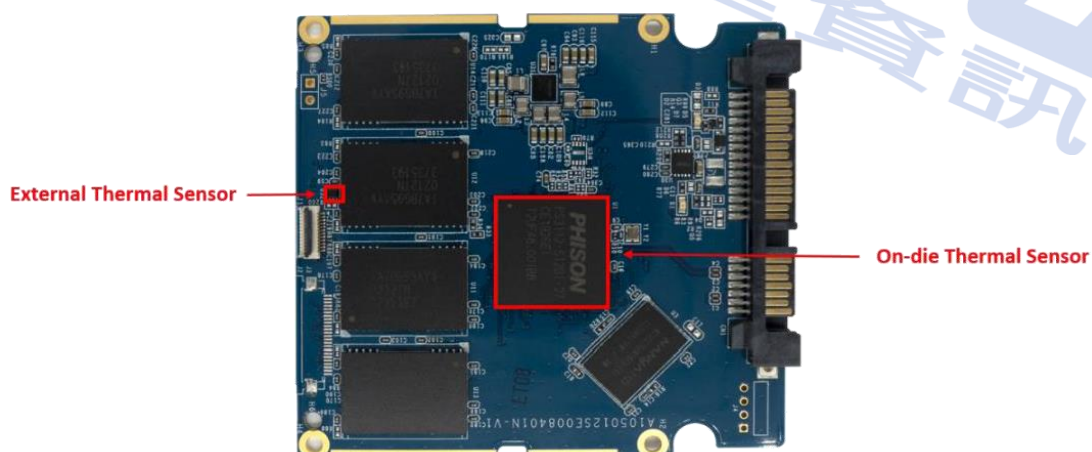
Notes:

1. Samples were built using Kioxia 3D TLC NAND flash.
2. The test followed JEDEC219A client endurance workload.
3. TBW may differ according to flash configuration and platform.
4. The endurance of SSD could be estimated based on user behavior, NAND endurance cycles, and write amplification factor. It is not guaranteed by flash vendor.

2.2. Thermal Throttling

The purpose of thermal throttling is to prevent any components in a SSD from over-heating during read and write operations. The controller is designed with an on-die thermal sensor and with its accuracy, firmware can apply different levels of throttling to achieve the purpose of protection efficiently and proactively via S.M.A.R.T. reading.

- **SSD Configuration:**
 - Example 480GB SSD: (BiCS3 256Gb x 2CE) x 8pcs BGA132/152, total 16CE
 - CE = Chip Enable pins, max CE = All 16CE enabled. Total CE numbers depends on SSD configuration
- **Purpose of Thermal Throttling:**
 - In order to keep the optimal performance in the safe range of the temperature.
- **Thermal sensors:**
 - We have external thermal sensor & on-die thermal sensor (internal controller) to detect temperature. There is 1pcs external thermal sensor on PCB, the position depends on different form factor (The thermal sensor is shown below. The picture is for reference only).
 - External thermal sensor would detect flash temperature; On-die thermal sensor detect controller temperature.



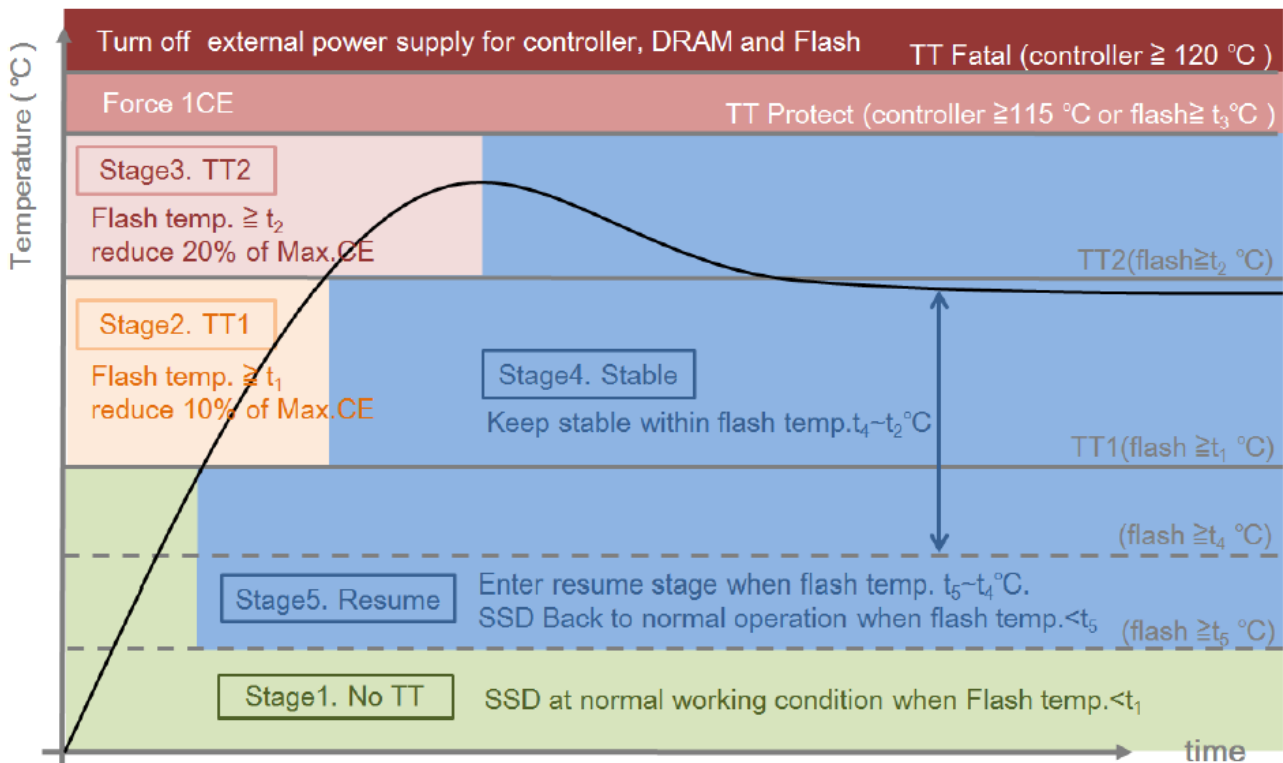


Figure 2-1 Thermal Throttling Schematic

	Operation temp. of Normal-temp. grade: 0-70°C	Operation temp. of Wide-temp. grade: -40-85°C
t₁	68°C	82°C
t₂	70°C	85°C
t₃	80°C	95°C
t₄	64°C	78°C
t₅	60°C	74°C

Notes:

1. TT shown on Figure 2-1 means "Thermal Throttling".
2. CE = Chip Enable.
3. temp. = temperature

2.3. TCG Opal 2.0 (Optional, Not Default Function)

The Opal specification is a set of specifications for self-encrypting drives published by the Trusted Computing Group (TCG), a non-profit organization that develops, defines, and promotes standards and specifications for secure computing. The Opal Security Subsystem Class(SSC) 2.0 defines the details of data management in storage devices and the classes authority for data access, and secures data from theft and tampering by unauthorized persons who are able to gain access to the storage device or host system.

TCG Opal 2.0 Main Features:

- AES 256-bit Hardware Self Encryption
- Deploy Storage Device & Take Ownership:
The Storage Device is integrated into its target system and ownership transferred by setting or changing the Storage Device's owner credential.
- Activate or Enroll Storage Device:
LBA ranges are configured and data encryption and access control credentials (re)generated and/or set on the Storage Device. Access control is configured for LBA range unlocking.
- Lock & Unlock Storage Device:
Unlocking of one or more LBA ranges by the host and locking of those ranges under host control via either an explicit lock or implicit lock triggered by a reset event. MBR shadowing provides a mechanism to boot into a secure pre-boot authentication environment to handle device unlocking.
- Repurpose & End-of-Life:
Erasure of data within one or more.

3. ENVIRONMENTAL SPECIFICATIONS



3.1. Environmental Conditions

3.1.1. Temperature and Humidity

- Temperature:
 - ◆ Storage: -40°C to 85°C
 - ◆ Operational (Standard): 0°C to 70°C
 - ◆ Operational (Wide): -40°C to 85°C

■ High Temperature Test Condition

	Temperature	Humidity
Operation (Standard/Wide)	70°C/85°C	0% RH
Storage	85°C	0% RH

■ Low Temperature Test Condition

	Temperature	Humidity
Operation (Standard/Wide)	0°C/-40°C	0% RH
Storage	-40°C	0% RH

■ High Humidity Test Condition

	Temperature	Humidity
Operation	40°C	90% RH
Storage	40°C	93% RH

■ Temperature Cycle Test

	Temperature
Operation (Standard/Wide)	0°C/-40°C
	70°C/85°C ^{Note1}
Storage	-40°C
	85°C

Notes:

1. Operation temperature is measured by device temperature sensor. Airflow is suggested and it will allow device to be operated at appropriate temperature for each component during heavy workloads environment.

3.1.2. Shock

■ Shock Specification

	Acceleration Force	Number of Shock
Non-operational	1500G	6 faces of each unit 3 times for each face

3.1.3. Vibration

■ Vibration Specification

	Condition	
	Frequency/Displacement	Frequency/Acceleration
Non-operational	20Hz~80Hz/1.52mm	80Hz~2000Hz/20G

3.1.4. Drop

■ Drop Specification

	Height of Drop	Number of Drop
Non-operational	80cm free fall	6 face of each unit

3.1.5. Bending

■ Bending Specification

	Force	Action
Non-operational	≥ 50N	Hold 1min/5times

3.1.6. Durability

■ Durability Specification

	Condition
Operational	1000 mating cycles

3.1.7. Electrostatic Discharge (ESD)

■ Contact ESD Specification

Device	Temperature	Relative Humidity	+/- 4KV
2.5" SSD	25.0°C	50% (RH)	Device functions are affected, but EUT will be back to its normal or operational state automatically.

3.1.8. EMI Compliance

Specification
EN 55032, CISPR 32 (CE)
ANSI C63.4 (FCC)
VCCI-CISPR 32 (VCCI)
CNS 13438 (BSMI)

3.2. MTBF

MTBF, Mean Time Between Failures, is a measure of reliability of a device. Its value represents the average time between a repair and the next failure. The unit of MTBF is in hours. The higher the MTBF value, the higher the reliability of the device.

Our MTBF result is based on simulation software (Brand/Model). Please note that a lower MTBF should be expected for higher capacity drives, and we apply the lowest MTBF for all capacities.

3.3. Certification & Compliance

- RoHS
- WHQL
- SATA III (SATA Rev. 3.2)

4. ELECTRICAL SPECIFICATIONS



4.1. Supply Voltage

Parameter	Rating
Operating Voltage	5V ± 5%
Rise Time (Max/Min)	100ms / 0.1ms
Fall Time (Max/Min)	5s / 1ms
Min. off Time	1s

4.2. Power Consumption

■ Standard Temperature Grade Power Consumption

Capacity	Flash Structure	Read	Write	Partial	Slumber	Idle	Devslp
128GB	64GB x2, BGA, 256Gb DDP	2,000	1,700	25	20	95	5
256GB	64GB x4, BGA, 256Gb DDP	2,000	1,800	25	20	95	5
512GB	64GB x 8, BGA, 256Gb DDP	2,000	1,700	30	25	100	5
1TB	128GB x 8, BGA, 256Gb QDP	2,100	1,700	30	25	105	5
2TB	256GB x 8, BGA, 512Gb QDP	2,200	1,800	45	40	105	5

Unit: mW

■ Wide Temperature Grade Power Consumption

Capacity	Flash Structure	Read	Write	Partial	Slumber	Idle
256GB	128GB x2, BGA, 512Gb DDP	2,300	2,100	35	30	115
512GB	128GB x4, BGA, 512Gb DDP	2,300	3,100	45	40	125
1TB	256GB x4, BGA, 512Gb QDP	2,300	3,700	60	60	150
2TB	256GB x8, BGA, 512Gb QDP	2,500	4,000	70	60	150
4TB	512GB x 8, BGA, 512Gb ODP	2,600	4,100	70	60	150

Unit: mW

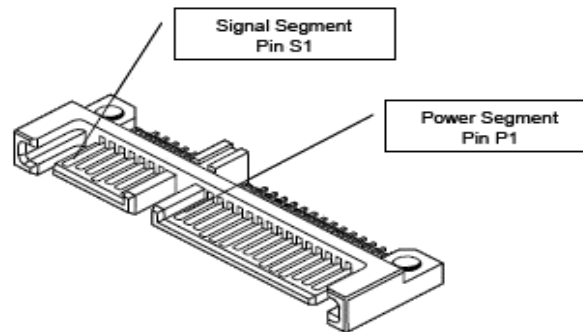
Notes:

1. Based on SCxU1xxx-series under ambient temperature.
2. The measured power voltage is 5V.
3. Use CrystalDiskMark 6.0.0 with the setting of 1000MB. Sequentially read and write the disk for 5 times, and measure power consumption during sequential Read [1/5]~[5/5] or sequential Write [1/5]~[5/5]
4. Power Consumption may differ according to flash configuration and platform.

5. INTERFACE



5.1. Pin Assignment and Descriptions



- Signal Segment Pin Assignment and Description

Pin Number	Function
S1	GND
S2	A+ (Differential Signal Pair A)
S3	A – (Differential Signal Pair A)
S4	GND
S5	B – (Differential Signal Pair B)
S6	B+ (Differential Signal Pair B)
S7	GND

- Power Segment Pin Assignment and Description

Pin Number	Function
P1	Not Used (3.3V)
P2	Not Used (3.3V)
P3	DEVSLP
P4	GND
P5	GND
P6	GND
P7	5V pre-charge
P8	5V
P9	5V
P10	GND
P11	Reserved (DAS)
P12	GND
P13	Not Used (12V pre-charge)
P14	Not Used (12V)
P15	Not Used (12V)

6. SUPPORTED COMMANDS



6.1. ATA Command List

Op Code	Support	Description	Op Code	Support	Description	
00h	Y	NOP	B6h	12h	-	NV Cache: QUERY NV CACHE PINNED SET DMA EXT
03h	-	CFA REQUEST EXTENDED ERROR	B6h	13h	-	NV Cache: QUERY NV CACHE MISSES DMA EXT
06h	Y	DATA SET MANAGEMENT	B6h	14h	-	NV Cache: FLUSH NV CACHE
08h	-	DEVICE RESET	C4h		Y	READ MULTIPLE
0Bh	-	REQUEST SENSE DATA EXT	C5h		Y	WRITE MULTIPLE
10h	Y	RECALIBRATE	C6h		Y	SET MULTIPLE MODE
11h-1Fh	-	RECALIBRATE	C7h		-	READ DMA QUEUED
20h	Y	READ SECTOR(S)	C8h		Y	READ DMA
21h	Y	READ SECTOR(S) WITHOUT RETRY	C9h		Y	READ DMA WITHOUT RETRY
22h	-	READ LONG	CAh		Y	WRITE DMA
23h	-	READ LONG WITHOUT RETRY	CBh		Y	WRITE DMA WITHOUT RETRY
24h	Y	READ SECTOR(S) EXT	CCh		-	WRITE DMA QUEUED
25h	Y	READ DMA EXT	CDh		-	CFA WRITE MULTIPLE WITHOUT ERASE
26h	-	READ DMA QUEUED EXT	CEh		Y	WRITE MULTIPLE FUA EXT
27h	Y	READ NATIVE MAX ADDRESS EXT	D1h		-	CHECK MEDIA CARD TYPE
29h	Y	READ MULTIPLE EXT	DAh		-	GET MEDIA STATUS
2Ah	-	READ STREAM DMA EXT	DEh		-	MEDIA LOCK
2Bh	-	READ STREAM EXT	DFh		-	MEDIA UNLOCK
2Fh	Y	READ LOG EXT	E0h		Y	STANDBY IMMEDIATE
30h	Y	WRITE SECTOR(S)	E1h		Y	IDLE IMMEDIATE
31h	Y	WRITE SECTOR(S) WITHOUT RETRY	E2h		Y	STANDBY
32h	-	WRITE LONG	E3h		Y	IDLE
33h	-	WRITE LONG WITHOUT RETRY	E4h		Y	READ BUFFER
34h	Y	WRITE SECTOR(S) EXT	E5h		Y	CHECK POWER MODE
35h	Y	WRITE DMA EXT	E6h		Y	SLEEP
36h	-	WRITE DMA QUEUED EXT	E7h		Y	FLUSH CACHE
37h	Y	SET MAX ADDRESS EXT	E8h		Y	WRITE BUFFER

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Op Code	Support	Description	Op Code	Support	Description		
38h	-	CFA WRITE SECTORS WITHOUT ERASE	E9h	Y	READ BUFFER DMA		
39h	Y	WRITE MULTIPLE EXT	EAh	Y	FLUSH CACHE EXT		
3Ah	-	WRITE STREAM DMA EXT	EBh	Y	WRITE BUFFER DMA		
3Bh	-	WRITE STREAM EXT	ECh	Y	IDENTIFY DEVICE		
3Ch	-	WRITE VERIFY	EDh	-	MEDIA EJECT		
3Dh	Y	WRITE DMA FUA EXT	EEh	-	IDENTIFY DEVICE DMA		
3Eh	-	WRITE DMA QUEUED FUA EXT	EFh	01h	-	SET FEATURES: Enable 8-bit PIO transfer mode (CFA feature set only)	
3Fh	Y	WRITE LOG EXT	EFh	02h	Y	SET FEATURES: Enable write cache	
40h	Y	READ VERIFY SECTOR(S)	EFh	03h	Y	SET FEATURES: Set transfer mode based on value in Count field	
41h	Y	READ VERIFY SECTOR(S) WITHOUT RETRY	EFh	05h	Y	SET FEATURES: Enable advanced power management	
42h	Y	READ VERIFY SECTOR(S) EXT	EFh	06h	-	SET FEATURES: Enable Power-Up In Standby feature set	
44h	-	Reserved	EFh	07h	-	SET FEATURES: Power-Up In Standby feature set device spin-up	
45h	O	WRITE UNCORRECTABLE EXT	EFh	0Ah	-	SET FEATURES: Enable CFA power mode 1	
47h	Y	READ LOG DMA EXT	EFh	0Bh	-	SET FEATURES: Enable Write-Read-Verify feature set	
50h	-	FORMAT TRACK	EFh	10h	01h	-	SET FEATURES: Enable use of Serial ATA feature
51h	-	CONFIGURE STREAM	EFh	10h	02h	Y	SET FEATURES: Enable DMA Setup FIS Auto-Activate optimization
57h	Y	WRITE LOG DMA EXT	EFh	10h	03h	Y	SET FEATURES: Enable Device-initiated interface power state (DIPM) transitions
60h	Y	READ FPDMA QUEUED	EFh	10h	04h	-	SET FEATURES: Enable use of Serial ATA feature
61h	Y	WRITE FPDMA QUEUED	EFh	10h	05h	-	SET FEATURES: Enable use of Serial ATA feature
70h	Y	SEEK	EFh	10h	06h	O	SET FEATURES: Enable Software Settings Preservation (SSP)

71-76h	-	SEEK	EFh	10h	07h	Y	SET FEATURES: Enable Device Automatic Partial to Slumber transitions	
Op Code	Support	Description	Op Code			Support	Description	
77h	Y	SET DATE AND TIME EXT	EFh	10h	09h	O	SET FEATURES: Enable Device Sleep	
78h	Y	ACCESSIBLE MAX ADDRESS CONFIGURATION	EFh	42h		-	SET FEATURES: Enable Automatic Acoustic Management feature set	
79-7Fh	-	SEEK	EFh	43h		-	SET FEATURES: Set Maximum Host Interface Sector Times	
87h	-	CFA TRANSLATE SECTOR	EFh	44h		-	SET FEATURES: Vendor Specific ECC byte	
90h	Y	EXECUTE DEVICE DIAGNOSTIC	EFh	55h		Y	SET FEATURES: Disable read look-ahead feature	
91h	Y	INITIALIZE DEVICE PARAMETERS	EFh	5Dh		-	SET FEATURES: Enable release interrupt	
92h	Y	DOWNLOAD MICROCODE	EFh	5Eh		-	SET FEATURES: Enable service interrupt	
93h	Y	DOWNLOAD MICROCODE DMA	EFh	5Fh		-	SET FEATURES: Enable NDRQ Feature	
94h	-	STANDBY IMMEDIATE	EFh	66h		Y	SET FEATURES: Disable reverting to power-on defaults	
95h	-	IDLE IMMEDIATE	EFh	81h		-	SET FEATURES: Disable 8-bit PIO transfer mode (CFA feature set only)	
96h	-	STANDBY	EFh	82h		Y	SET FEATURES: Disable write cache	
97h	-	IDLE	EFh	85h		Y	SET FEATURES: Disable advanced power management	
98h	-	CHECK POWER MODE	EFh	86h		-	SET FEATURES: Disable Power-Up In Standby feature set	
99h	-	SLEEP	EFh	8Ah		-	SET FEATURES: Disable CFA power mode	
A0h	-	PACKET	EFh	8Bh		-	SET FEATURES: Disable Write-Read-Verify feature set	
A1h	-	IDENTIFY PACKET DEVICE	EFh	90h	01h	-	SET FEATURES: Disable use of Serial ATA feature	
A2h	-	SERVICE	EFh	90h	02h	Y	SET FEATURES: Disable DMA Setup FIS Auto-Activate optimization	
B0h	D0h	Y	SMART: READ DATA	EFh	90h	03h	Y	SET FEATURES: Disable Device-

Op Code		Support	Description	Op Code		Support	Description	
							initiated interface power state (DIPM) transitions	
B0h	D1h	Y	SMART: READ ATTRIBUTE THRESHOLDS	EFh	90h	04h	-	SET FEATURES: Disable use of Serial ATA feature
B0h	D2h	Y	SMART: ENABLE/DISABLE AUTOSAVE	EFh	90h	05h	-	SET FEATURES: Disable use of Serial ATA feature
B0h	D3h	Y	SMART: SAVE ATTRIBUTE VALUES	EFh	90h	06h	Y	SET FEATURES: Disable Software Settings Preservation (SSP)
B0h	D4h	Y	SMART: EXECUTE OFF-LINE IMMEDIATE	EFh	90h	07h	Y	SET FEATURES: Disable Device Automatic Partial to Slumber transitions
B0h	D5h	Y	SMART: READ LOG	EFh	90h	09h	O	SET FEATURES: Disable Device Sleep
B0h	D6h	Y	SMART: WRITE LOG	EFh	AAh		Y	SET FEATURES: Enable read look-ahead feature
B0h	D8h	Y	SMART: ENABLE OPERATIONS	EFh	BBh		-	SET FEATURES: Default ECC byte
B0h	D9h	Y	SMART: DISABLE OPERATIONS	EFh	C2h		-	SET FEATURES: Disable Automatic Acoustic Management feature set
B0h	DAh	Y	SMART: RETURN STATUS	EFh	C3h		-	SET FEATURES: Enable/Disable the Sense Data Reporting feature set
B0h	DBh	Y	SMART: ENABLE/DISABLE AUTOMATIC OFF-LINE	EFh	CCh		Y	SET FEATURES: Enable reverting to power-on defaults
B0h	E0h	-	SMART: Vendor specific	EFh	DDh		-	SET FEATURES: Disable release interrupt
B1h	C0h	Y	DEVICE CONFIGURATION: RESTORE	EFh	DEh		-	SET FEATURES: Disable SERVICE interrupt
B1h	C1h	Y	DEVICE CONFIGURATION: FREEZE LOCK	EFh	DFh		-	SET FEATURES: Disable NDRQ Feature
B1h	C2h	Y	DEVICE CONFIGURATION: IDENTIFY	F1h		non-FIPS		SECURITY SET PASSWORD
B1h	C3h	Y	DEVICE CONFIGURATION: SET	F2h		non-FIPS		SECURITY UNLOCK
B1h	C4h	Y	DEVICE CONFIGURATION: IDENTIFY DMA	F3h		non-FIPS		SECURITY ERASE PREPARE
B1h	C5h	Y	DEVICE CONFIGURATION: SET DMA	F4h		non-FIPS		SECURITY ERASE UNIT
B4h	0000h	O	SANITIZE DEVICE: SANITIZE STATUS EXT	F5h		non-FIPS		SECURITY FREEZE LOCK

Op Code		Support	Description	Op Code		Support	Description
B4h	0011h	O	SANITIZE DEVICE: CRYPTO SCRAMBLE EXT	F6h		non-FIPS	SECURITY DISABLE PASSWORD
B4h	0012h	O	SANITIZE DEVICE: BLOCK ERASE EXT	F8h		Y	READ NATIVE MAX ADDRESS
B4h	0014h	O	SANITIZE DEVICE: OVERWRITE EXT	F9h	00h	Y	SET MAX: SET MAX ADDRESS
B4h	0020h	O	SANITIZE DEVICE: SANITIZE FREEZE LOCK EXT	F9h	01h	Y	SET MAX: SET MAX PASSWORD
B4h	0040h	O	SANITIZE DEVICE: SANITIZE ANTIFREEZE LOCK EXT	F9h	02h	Y	SET MAX: SET MAX LOCK
B6h	00h	-	NV Cache: SET NV CACHE POWER MODE EXT	F9h	03h	Y	SET MAX: SET MAX UNLOCK
B6h	01h	-	NV Cache: RETURN FROM NV CACHE POWER MODE EXT	F9h	04h	Y	SET MAX: SET MAX FREEZE LOCK
B6h	10h	-	NV Cache: ADD LBA(S) TO NV CACHE PINNED SET DMA EXT	F9h	05h	Y	SET MAX: SET MAX SET PASSWORD DMA
B6h	11h	-	NV Cache: REMOVE LBA(S) FROM NV CACHE PINNED SET DMA EXT	F9h	06h	Y	SET MAX: SET MAX UNLOCK DMA

Notes:

“Y” means “Support”.

“O” means “Option, default not support”.

“-” means “Not support”.

“non-FIPS” means “only supported when in non-FIPS mode”

6.2. Identify Device Data

The following table details the sector data returned by the IDENTIFY DEVICE command of ATA8-ACS4 SPEC.

Word	F: Fixed V: Variable X: retired/obsolete /reserved	Default Value	Description
0	F	0040h	General configuration bit-significant information
1	X	*1	Obsolete – Number of logical cylinders
2	F	C837h	Specific configuration
3	X	0010h	Obsolete – Number of logical heads (16)
4-5	X	00000000h	Retired
6	X	003Fh	Obsolete – Number of logical sectors per logical track (63)
7-8	X	00000000h	Reserved for assignment by the Compact Flash Association
9	X	0000h	Retired
10-19	V	Varies	Serial number (20 ASCII characters)
20-21	X	0000h	Retired
22	X	0000h	Obsolete
23-26	V	Varies	Firmware revision (8 ASCII characters)
27-46	V	Varies	Model number (xxxxxxxx)
47	X	8010h	7:0- Maximum number of sectors transferred per interrupt on MULTIPLE commands
48	F	4000h	Trusted Computing feature set options
49	F	2F00h	Capabilities
50	F	4000h	Capabilities
51-52	X	000000000h	Obsolete
53	F	0007h	Field validity
54	X	*1	Obsolete – Number of logical cylinders
55	X	0010h	Obsolete – Number of logical heads (16)
56	X	003Fh	Obsolete – Number of logical sectors per track (63)
57-58	X	*2	Obsolete – Current capacity in sectors
59	V	0110h	Number of sectors transferred per interrupt on MULTIPLE commands
60-61	V	*3	Maximum number of sector (28bit LBA mode)
62	X	0000h	Obsolete
63	V	0407h	Multi-word DMA modes supported/selected

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Word	F: Fixed V: Variable X: retired/obsolete /reserved	Default Value	Description
64	F	0003h	PIO modes supported
65	F	0078h	Minimum Multiword DMA transfer cycle time per word
66	F	0078h	Manufacturer's recommended Multiword DMA transfer cycle time
67	F	0078h	Minimum PIO transfer cycle time without flow control
68	F	0078h	Minimum PIO transfer cycle time with IORDY flow control
69	F	5F30h	Set max password(support)
70-74	X	0000h	Reserved
75	F	001Fh	Queue depth
76	V	E50Eh	Serial SATA capabilities
77	V	0006h	Serial ATA Additional Capabilities
78	V	004Ch	Serial ATA features supported
79	F	0040h	Serial ATA features enabled
80	F	07F8h	Major Version Number
81	F	0000h	Minor Version Number
82	F	746Bh	Command set/feature supported
83	F	7D09h	Command set/feature supported
84	F	4063h	WWN
85	F	7469h	Command set/feature supported or enabled
86	F	BC09h	Command set/feature supported or enabled
87	F	4063h	WWN
88	F	007Fh	Ultra DMA Modes
89	F	0001h	Time required for Normal Erase mode SECURITY ERASE UNIT command
90	F	0001h	Time required for an Enhanced Erase mode SECURITY ERASE UNIT command
91	F	00FEh	Current APM (advanced power management) value
92	F	FFFEh	Master Password Revision Code
93	F	0000h	Hardware reset result.
94	X	0000h	Obsolete
95	F	0000h	Stream Minimum Request Size
96	F	0000h	Streaming Transfer Time – DMA

Word	F: Fixed V: Variable X: retired/obsolete /reserved	Default Value	Description
97	F	0000h	Streaming Access Latency – DMA and PIO
98-99	F	0000h	Streaming Performance Granularity
100-103	V	*4	Maximum user LBA for 48bit Address feature set
104	F	0000h	Streaming Transfer Time – PIO
105	F	0008h	Maximum number of 512-byte blocks per DATA SET MANAGEMENT command
106	F	4000h	Physical sector size/Logical sector size
107	F	0000h	Inter-seek delay for ISO-7779 acoustic testing in microseconds
108-111	V	0000h	World Wide Name (WWN)
112-115	X	000000000000 0000h	Reserved
116	X	0000h	Reserved
117-118	F	00000000h	Words per logical Sector
119	V	4019h	Command set/Feature Supported
120	V	4019h	Command set/Feature Enabled/Supported
121-126	X	0000h	Reserved for expanded supported and enabled settings
127	X	0000h	Obsolete
128	F	0021h	Security status
129-159	V	0000h	Vendor specific
160-167	X	0000h	Reserved for CFA
168	V	Varies	Device Nominal Form Factor
169	F	0001h	DATA SET MANAGEMENT command is supported
170-173	F	0000h	Additional Product Identifier
174-175	X	0000h	Reserve
176-205	F	0000h	Current media serial number
206	V	0000h	SCT Command Transport
207-208	X	0000h	Reserved
209	F	4000h	Alignment of logical blocks within a physical block
210-211	F	0000h	Write-Read-Verify Sector Count Mode 3
212-213	F	0000h	Write-Read-Verify Sector Count Mode 2
214-216	X	0000h	Obsolete
217	F	0001h	Nominal media rotation rate

Word	F: Fixed V: Variable X: retired/obsolete /reserved	Default Value	Description
218	X	0000h	Reserved
219	X	0000h	Obsolete
220	V	0000h	Current mode of the Write-Read-Verify feature set
221	X	0000h	Reserved
222	V	107Fh	Transport major version number
223	F	0000h	Transport minor version number
224-229	X	0000h	reserved
230-233	F	0000h	Extend number of user addressable sectors
234	F	0001h	Minimum number of 512-byte data blocks per DOWNLOAD MICROCODE command for mode 03h
235	F	FFFFh	Maximum number of 512-byte data blocks per DOWNLOAD MICROCODE command for mode 03h
236-242	X	0000h	Reserved
243	F	0000h	Security feature 4000 : Self Encrypting Drive
244-254	F	0000h	Reserved
255	V	XXA5h XX is variable	Integrity word (Checksum and Signature)

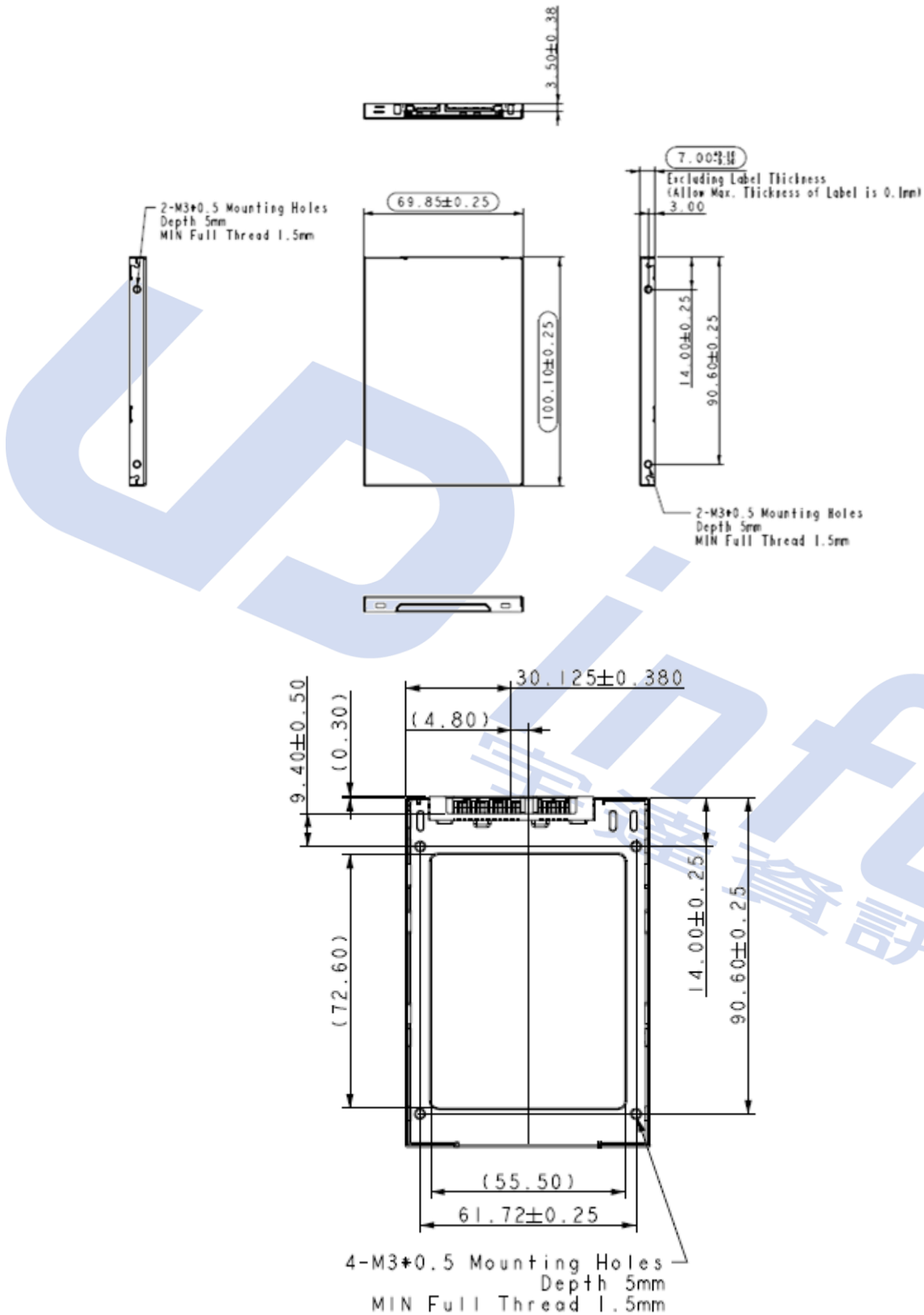
■ List of Device Identification for Each Capacity

Capacity (GB)	*1 (Word 1/Word 54)	*2 (Word 57–58)	*3 (Word 60–61)	*4 (Word 100–103)
128	3FFFh	FBFC10h	EE7C2B0h	EE7C2B0h
256	3FFFh	FBFC10h	0FFFFFFFh	1DCF32B0h
512	3FFFh	FBFC10h	0FFFFFFFh	3B9E12B0h
1024	3FFFh	FBFC10h	0FFFFFFFh	773BD2B0h
2048	3FFFh	FBFC10h	0FFFFFFFh	EE7752B0h
4096	3FFFh	FBFC10h	0FFFFFFFh	1DCEE52B0h

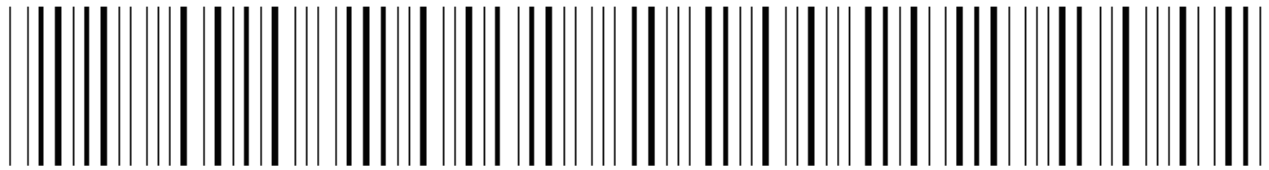
7. PHYSICAL DIMENSION



Dimension: 100mm(L) x 69.85mm(W) x 7.00mm(H)



8. BARCODE DESCRIPTION



H F 3 2 5 D A 0 0 2 T B A 8 P



9. ORDERING INFORMATION



Temperature Grade	Capacity	Part Number
Standard Temp. 0°C ~ 70°C	128GB	HF3-25DA128GB-A8P
	256GB	HF3-25DA256GB-A8P
	512GB	HF3-25DA512GB-A8P
	1TB	HF3-25DA001TB-A8P
	2TB	HF3-25DA002TB-A8P
Wide Temp. -40°C ~ 85°C	256GB	HF3-25DA256GB-B8P
	512GB	HF3-25DA512GB-B8P
	1TB	HF3-25DA001TB-B8P
	2TB	HF3-25DA002TB-B8P
	4TB	HF3-25DA004TB-B8P