UD info Corp.

Industrial SATA Solid State Drive

HF3-25UF Series

Product DataSheet

UD info CORP.

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Revision History

Revision	Draft Date	History	Author
1.0	2018/12/4	New release	Golden Lee
1.1	2019/4/11	Modify capacity support and power consumption	Golden Lee
1.2	2019/5/10	Update TBW	Golden Lee
1.3	2019/10/4	Update performance / TBW / power consumption	Golden Lee
1.4	2020/3/31	Add Bics4 support	Golden Lee

Product Overview

- **Capacity**
  - 120GB(128GB) up to 1920GB(2TB)
- **Form Factor**
  - 2.5” SATA SSD
- **SATA Interface**
  - SATA Revision 3.2
  - SATA 1.5Gbps, 3Gbps, and 6Gbps interface
- **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]
  - Idle mode: < 2300 mW
  - Idle mode: < 105 mW
- **Reliability**
  - MTBF 1,600,000 hours
  - Uncorrectable Bit Error Rate (UBER) < 1 sector per 10^{16} bits read
- **Advanced Flash Management**
  - Static and Dynamic Wear Leveling
  - Bad Block Management
  - TRIM
  - SMART
  - Over-Provision
- **Temperature Range**
  - Operation: 0°C ~ 70°C
  - Storage: -40°C ~ 85°C
- **Compliant**
  - RoHS
  - CE & FCC
- **Features Support List**
  - End to end data path protection
  - Thermal throttling
  - SmartECC™
  - SmartRefresh™
  - Drive log
  - Support of AES/TCG OPAL[Note2]

Notes:

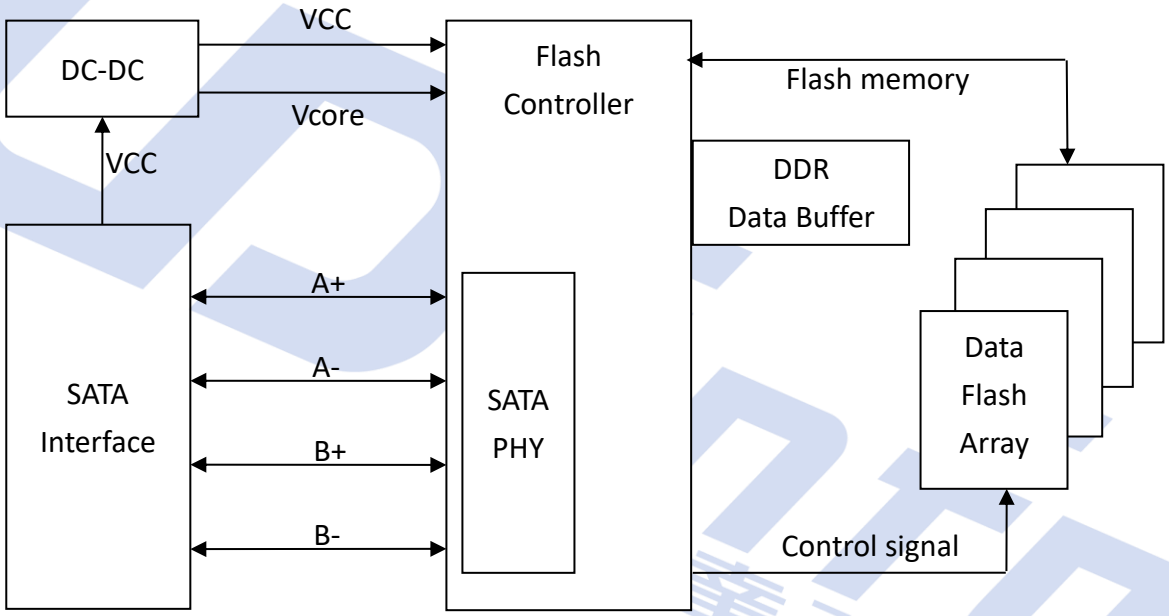
1. Please see “Power Consumption” for details.
2. Supported by separate firmware version. Further information available upon request.

1. INTRODUCTION

1.1. General Description

UDinfo 2.5” 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 2TB. Moreover, it can reach up to 550MB/s read as well as 530MB/s write high performance based on Toshiba’s 3D TLC NAND flash.

1.2. Block Diagram



2.5” SATA SSD Block Diagram

2. PRODUCT SPECIFICATIONS

- **Capacity**
  - From 120GB(128GB) up to 1920GB(2TB)
- **Electrical/Physical Interface**
  - SATA Interface
    - Compliant with SATA Revision 3.2
    - 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 and 8pcs BGA132 flash
  - Support OFNI 2.3/3.0/3.2/4.0 & Toggle 2.0/3.0 interface
  - Support Toshiba 3D Bics3/Bics4 TLC
- **ECC Scheme**
  - Applies the LDPC (Low Density Parity Check) of ECC algorithm
- **Supported Sector size**
  - 512 Bytes
- **UART / GPIO function**
- **Support SMART and TRIM commands**
- **Capacity Information**

Capacity	Cylinders	Heads	Sectors	Total Sectors	User Data Size
120GB	16,383	16	63	234,441,648	Depended on file management
128GB	16,383	16	63	250,069,680	
240GB	16,383	16	63	468,862,128	
256GB	16,383	16	63	500,118,192	
480GB	16,383	16	63	937,703,088	
512GB	16,383	16	63	1,000,215,216	
960GB	16,383	16	63	1,875,385,008	
1TB	16,383	16	63	2,000,409,264	
1920GB	16,383	16	63	3,750,748,848	
2TB	16,383	16	63	4,000,797,360	

- **Performance**

Capacity	Flash Structure	Flash Type	Sequential		Random	
			Read (MB/s)	Write (MB/s)	Read (IOPS)	Write (IOPS)
120/128GB	64GB x2, 256Gb, DDP	Bics3, BGA	550	530	86K	90K
240/256GB	64GB x4, 256Gb, DDP	Bics3, BGA	550	530	98K	89K
480/512GB	64GB x8, 256Gb, DDP	Bics3, BGA	550	530	97K	89K
960GB/1TB	128GB x8, 256Gb, QDP	Bics3, BGA	550	530	98K	89K
1920GB/2TB	256GB x8, 256Gb, ODP	Bics3, BGA	550	530	98K	89K
120/128GB	64GB x2, 256Gb, DDP	Bics4, BGA	550	530	94K	90K
240/256GB	64GB x4, 256Gb, DDP	Bics4, BGA	550	530	98K	90K
480/512GB	64GB x8, 256Gb, DDP	Bics4, BGA	550	530	99K	90K
960GB/1TB	128GB x8, 256Gb, QDP	Bics4, BGA	550	530	99K	91K
1920GB/2TB	256GB x8, 256Gb, ODP	Bics4, BGA	550	530	99K	90K
480/512GB	256GB x2, 512Gb, QDP	Bics4, BGA	550	530	99K	90K
960GB/1TB	256GB x4, 512Gb, QDP	Bics4, BGA	550	530	97K	89K
1920GB/2TB	256GB x8, 512Gb, QDP	Bics4, BGA	550	530	99K	90K

Notes:

1. The performance was estimated based on 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 confitions
   (a) CrystalDiskMark 6.0.0, 1GB range, QD32
   (b) IO Meter, 1GB range, 4K datasize, QD32

- **TBW (Terabytes Written)**

Capacity	Flash Type	TBW
128GB	Bics3, 256Gb, DDP	204
256GB	Bics3, 256Gb, DDP	431
512GB	Bics3, 256Gb, DDP	919
1024GB	Bics3, 256Gb, QDP	1796
2048GB	Bics3, 256Gb, ODP	3675
128GB	Bics4, 256Gb, DDP	120
256GB	Bics4, 256Gb, DDP	280
512GB	Bics4, 256Gb, DDP	605
1024GB	Bics4, 256Gb, QDP	1275
2048GB	Bics4, 256Gb, ODP	3370
512GB	Bics4, 512Gb, QDP	620
1024GB	Bics4, 512Gb, QDP	1330
2048GB	Bics4, 512Gb, QDP	3465

Notes:

1. Samples were built using 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.

3. ENVIRONMENTAL SPECIFICATIONS

3.1. Environmental Conditions

3.1.1. Temperature and Humidity

- Temperature:
  - Storage: -40°C to 85°C
  - Operational: 0°C to 70°C

■ **High Temperature Test Condition**

	Temperature	Humidity
Operation	70°C	0% RH
Storage	85°C	0% RH

■ **Low Temperature Test Condition**

	Temperature	Humidity
Operation	0°C	0% RH
Storage	-40°C	0% RH

■ **High Humidity Test Condition**

	Temperature	Humidity
Operation (Standard)	40°C	90% RH
Storage (Standard)	40°C	93% RH

■ **Temperature Cycle Test**

	Temperature
Operation	0°C
	70°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
Non-operational	1000 mating cycles

3.1.7. Electrostatic Discharge (ESD)

- **Contact ESD Specification**

Specification	**+/- 4KV**
EN 55024, CISPR 24 EN 61000-4-2 and IEC 61000-4-2	Device functions are affected, but EUT will be back to its normal or operational state automatically.

3.1.8. EMI Compliance

Specification
FCC: CISPR22 CE: EN55022

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

Capacity	Flash Structure	Flash Type	Read	Write	Partial	Slumber	Idle
120/128GB	64GB x2, 256Gb, DDP	Bics3, BGA	2,000	1,700	25	20	95
240/256GB	64GB x4, 256Gb, DDP	Bics3, BGA	2,000	1,700	25	20	95
480/512GB	64GB x8, 256Gb, DDP	Bics3, BGA	1,900	1,700	30	25	95
960GB/1TB	128GB x8, 256Gb, QDP	Bics3, BGA	2,100	1,800	30	25	100
1920GB/2TB	256GB x8, 256Gb, ODP	Bics3, BGA	2,100	1,800	40	35	105
120/128GB	64GB x2, 256Gb, DDP	Bics4, BGA	2,000	1,700	25	20	95
240/256GB	64GB x4, 256Gb, DDP	Bics4, BGA	2,000	1,800	25	20	95
480/512GB	64GB x8, 256Gb, DDP	Bics4, BGA	2,000	1,700	30	25	100
960GB/1TB	128GB x8, 256Gb, QDP	Bics4, BGA	2,100	1,700	30	25	105
1920GB/2TB	256GB x8, 256Gb, ODP	Bics4, BGA	2,200	1,800	45	40	105
480/512GB	256GB x2, 512Gb, QDP	Bics4, BGA	2,000	1,800	35	30	105
960GB/1TB	256GB x4, 512Gb, QDP	Bics4, BGA	2,000	1,800	30	25	105
1920GB/2TB	256GB x8, 512Gb, QDP	Bics4, BGA	2,200	1,800	35	30	105

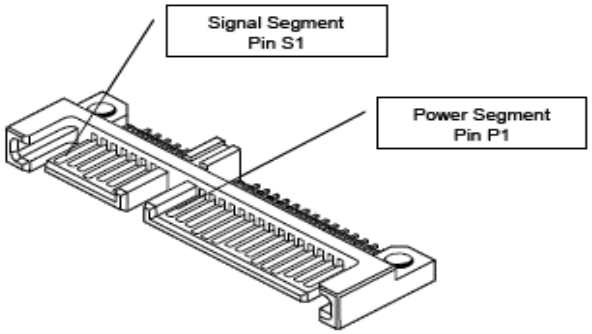
Unit: mW

Notes:

1. Based on SCFMxxxx-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

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)

Op Code	Support	Description	Op Code			Support	Description
71-76h	-	SEEK	EFh	10h	07h	Y	SET FEATURES: Enable Device Automatic Partial to Slumber transitions
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

Op Code		Support	Description	Op Code			Support	Description
B0h	D0h	Y	SMART: READ DATA	EFh	90h	03h	Y	SET FEATURES: Disable Device-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			Y	SECURITY SET PASSWORD
B1h	C3h	Y	DEVICE CONFIGURATION: SET	F2h			Y	SECURITY UNLOCK
B1h	C4h	Y	DEVICE CONFIGURATION: IDENTIFY DMA	F3h			Y	SECURITY ERASE PREPARE
B1h	C5h	Y	DEVICE CONFIGURATION: SET DMA	F4h			Y	SECURITY ERASE UNIT

Op Code		Support	Description	Op Code		Support	Description
B4h	0000h	O	SANITIZE DEVICE: SANITIZE STATUS EXT	F5h		Y	SECURITY FREEZE LOCK
B4h	0011h	O	SANITIZE DEVICE: CRYPTO SCRAMBLE EXT	F6h		Y	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".

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	F	8010h	7:0- Maximum number of sectors transferred per interrupt on MULTIPLE commands
48	F	4000h	Reserved
49	F	2F00h	Capabilities
50	F	4000h	Capabilities
51-52	X	000000000h	Obsolete
53	F	0007h	Words 88 and 70:64 valid
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	F	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	F	0407h	Multi-word DMA modes supported/selected

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	1F00h	Additional Supported
70	X	0000h	Reserved
71-74	X	0000000000000000h	Reserved for the IDENTIFY PACKET DEVICE command
75	F	001Fh	Queue depth
76	F	850Eh	Serial SATA capabilities
77	F	0006h	Supported Serial ATA Phy speed
78	F	004Ch	Serial ATA features supported
79	F	0040H	Serial ATA features enabled
80	F	0FF8h	Major Version Number
81	F	0000h	Minor Version Number
82	F	746Bh	Command set supported
83	F	7D01h	Command set supported
84	F	4163h	Command set/feature supported extension
85	F	7469h	Command set/feature supported or enabled
86	F	BC01h	Command set/feature supported or enabled
87	F	4163h	Command set/feature supported or enabled
88	F	007Fh	Ultra DMA Modes
89	F	000Ah	Time required for Normal Erase mode SECURITY ERASE UNIT command
90	F	001Eh	Time required for an Enhanced Erase mode SECURITY ERASE UNIT command
91	F	0000h	Current advanced power management value
92	F	FFFEh	Master Password Revision Code
93	F	0000h	Hardware reset result. The contents of the bits (12:0) of this word can be changed only during the execution of hardware

			reset.
Word	**F: Fixed V: Variable X: retired/obsolete /reserved**	**Default Value**	**Description**
94	X	0000h	Vendor's recommended and actual acoustic management value
95	F	0000h	Stream Minimum Request Size
96	F	0000h	Streaming Transfer Time – DMA
97	F	0000h	Streaming Access Latency – DMA and PIO
98-99	F	0000h	Streaming Performance Granularity
100-103	V	***4**	Maximum user LBA for 48 bit 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	F	Varies	Reserved
112-115	X	0000000000000000h	Reserved
116	X	0000h	Reserved
117-118	F	00000000h	Words per logical Sector
119	F	401Ch	Supported settings
120	F	401Ch	Command set/Feature Enabled/Supported
121-126	X	0h	Reserved
127	X	0h	Obsolete
128	F	0021h	Security status
129-159	V	Varies	Vendor specific
160	X	0h	Compact Flash Association (CFA) power mode 1
161-167	X	0h	Reserved for assignment by the CFA
168	V	Varies	Device Nominal Form Factor
169	F	0001h	DATA SET MANAGEMENT command is supported
170-173	F	0h	Additional Product Identifier
174-175	X	0h	Reserve
176-205	F	0h	Current media serial number
206	F	0039h	SCT Command Transport(

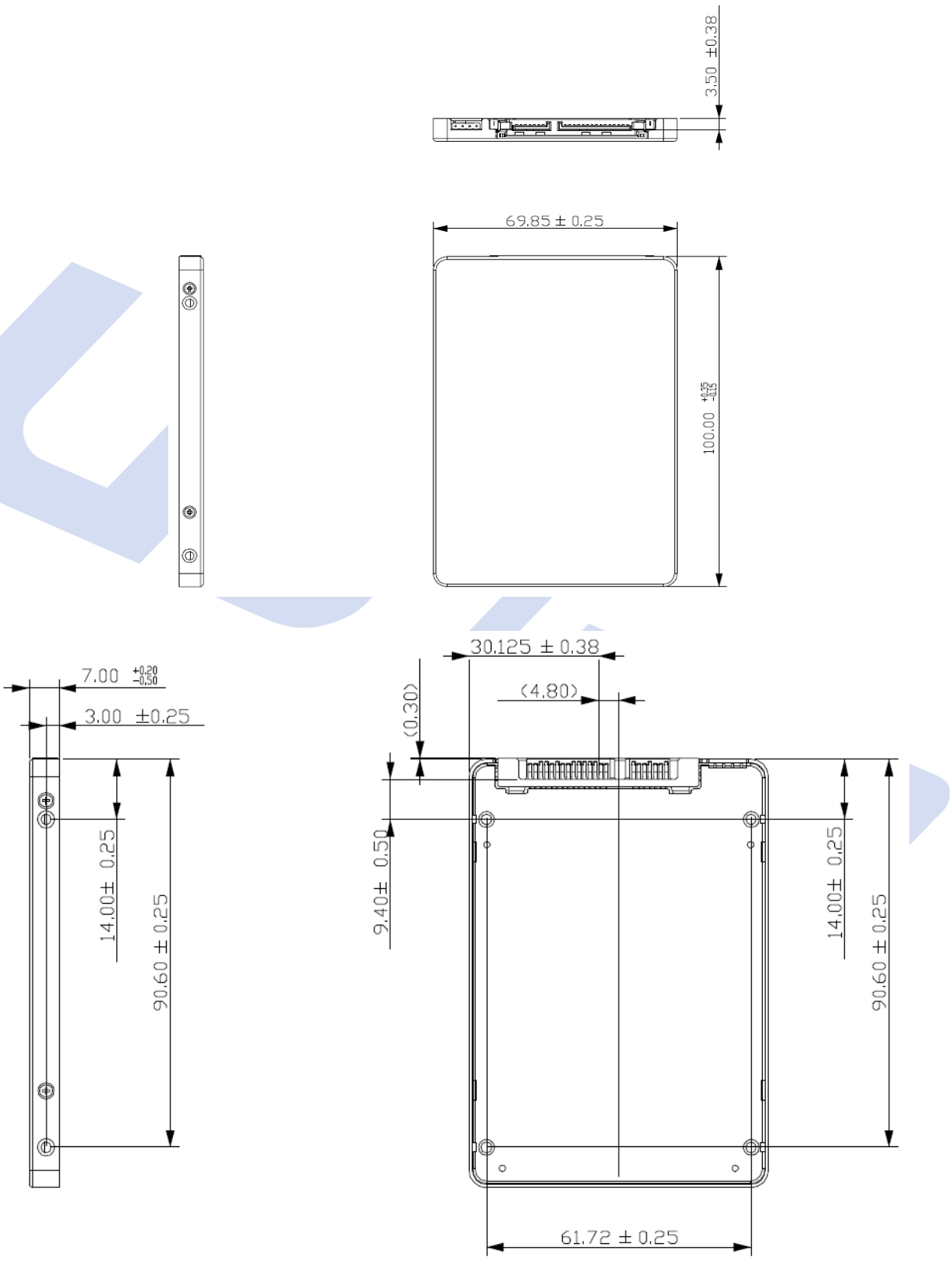
Word	F: Fixed V: Variable X: retired/obsolete /reserved	Default Value	Description
207-208	X	0h	Reserved
209	F	4000h	Alignment of logical blocks within a physical block
210-211	F	0000h	Write-Read-Verify Sector Count Mode 3 (not support)
212-213	F	0000h	Write-Read-Verify Sector Count Mode 2 (not support)
214-216	X	0000h	NV Cache relate (not support)
217	F	0001h	Non-rotating media device
218	X	0h	Reserved
219	X	0h	NV Cache relate (not support)
220	V	0h	Write read verify feature set current mode
221	X	0h	Reserved
222	F	10FFh	Transport major version number
223	F	0h	Transport minor version number
224-229	X	0h	reserved
230-233	F	0h	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	FFFEh	Maximum number of 512-byte data blocks per DOWNLOAD MICROCODE command for mode 03h
236-242	X	0h	Reserved
243	X	0000h	Reserved
244-254	X	0h	Reserved
255	F	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)
120	3FFFh	FBFC10h	DF94BB0h	DF94BB0h
128	3FFFh	FBFC10h	EE7C2B0h	EE7C2B0h
240	3FFFh	FBFC10h	0FFFFFFFh	1BF244B0h
256	3FFFh	FBFC10h	0FFFFFFFh	1DCF32B0h
480	3FFFh	FBFC10h	0FFFFFFFh	37E436B0
512	3FFFh	FBFC10h	0FFFFFFFh	3B9E12B0h
960	3FFFh	FBFC10h	0FFFFFFFh	6FC81AB0h
1024	3FFFh	FBFC10h	0FFFFFFFh	773BD2B0h
1920	3FFFh	FBFC10h	0FFFFFFFh	DF8FE2B0h
2048	3FFFh	FBFC10h	0FFFFFFFh	EE7752B0h

7. PHYSICAL DIMENSION

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

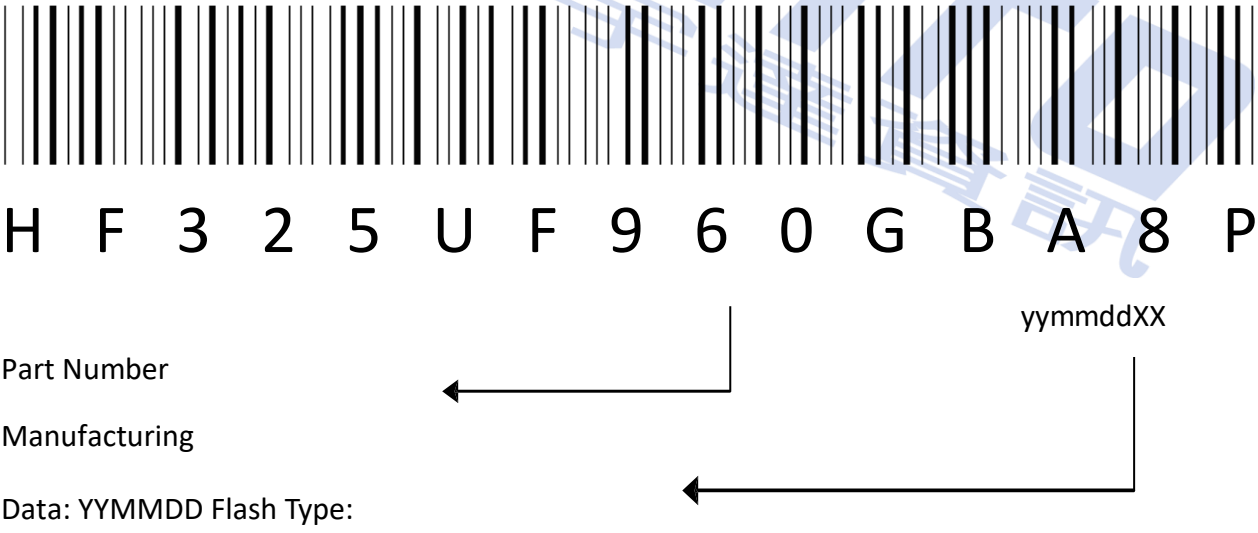


8. TERMINOLOGY

The following table is to list out the acronyms that have been applied throughout the document.

Term	Definitions
ATTO	Commercial performance benchmark application
DDR	Double data rate (SDRAM)
DIPM	Device initiated power management
HIPM	Host initiated power management
LBA	Logical block addressing
MB	Mega-byte
MTBF	Mean time between failures
NCQ	Native command queue
SATA	Serial advanced technology attachment
S.M.A.R.T.	Self-monitoring, analysis and reporting technology
SSD	Solid state disk

9. BARCODE DESCRIPTION



10. PARTNUMBER DECODER

HF3-25UF$X^8X^9X^{10}X^{11}X^{12}X^{13}X^{14}X^{15}X^{16}X^{17}$

$X^1X^2X^3$	X^4X^5	X^6X^7	X^8 X^9 X^{10} X^{11} X^{12}		X^{13}	X^{14}	X^{15}	$X^{16}X^{17}$
HF3	25	UF	120GB 240GB 480GB 960GB 1920G	128GB 256GB 512GB 001TB 002TB	A: 3D TLC Standard (0ºC ~ +70ºC)	8	P	blank

$X^{16}X^{17}$

06: Conformal Coating (CC)

31: AES+OPAL (PSID code)

32: PLP+AES+OPAL (PSID code)