

UD info Corp.

Industrial CFexpress PCIe SSD CFX-21DE Series Product DataSheet



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Revision History

Revision	Draft Date	History	Author
	2020/11/3	Preliminary version	Golden Lee



Product Overview

- **Capacity**
 - 128GB up to 1TB^{Note1}
- **Form Factor**
 - CFX (Type B)
- **PCIe Interface**
 - NVMe PCIe Gen3 x2
- **Compliance**
 - NVMe 1.3
 - PCI Express Base 3.1
- **Flash Interface**
 - Transfer rate up to 800Mbps
 - Up to 2pcs of BGA152 flash^{Note2}
 - Up to 4pcs of BGA152 flash^{Note2}
- **Performance**^{Note3}
 - Read up to 1,700 MB/s
 - Write up to 1,550 MB/s
- **Power Consumption**^{Note4}
 - Idle mode < 70 mW
 - L1.2 < 2 mW
- **Reliability**
 - MTBF 1,500,000 hours
 - Uncorrectable Bit Error Rate (UBER)
< 1 sector per 10¹⁶ bits read
- **Compliant**
 - RoHS
- **Advanced Flash Management**
 - Advanced Wear Leveling
 - Bad Block Management
 - TRIM
 - SMART
 - Over-Provision
- **Power Management**
 - Support APST
 - Support ASPM
 - Support L1.2
- **Temperature Range**^{Note5}
 - Operation (Standard): 0°C ~ 70°C
(128GB~1TB)
 - Operation (Wide): -40°C ~ 85°C
(128GB~512GB)[only BiCS3]
 - Storage: -40°C ~ 85°C
- **Features Support List**
 - End to end data path protection
 - Thermal throttling
 - Dynamic SLC Cache
 - Drive log
 - Support of TCG OPAL^{Note6}
 - Support of TCG Pyrite
- **Hardware Write Protect(WP) Function Support (optional)**

Notes:

1. 1TB capacity
 - (a) Only support 0°C ~ 70°C
 - (b) Not support Write Protect (WP) function
2. Difference PCBA
 - (a) BGA152 *2pcs PCBA for WP function
 - (b) BGA152 *4pcs PCBA for non-WP function
3. Refer to Chapter 2 for more details.

4. Refer to Chapter 4, section 4.2 power consumption for more details.
5. The operation temperature means the case temperature, in which can be detected via the S.M.A.R.T.
6. Supported by a separate firmware version. Further information available upon request.

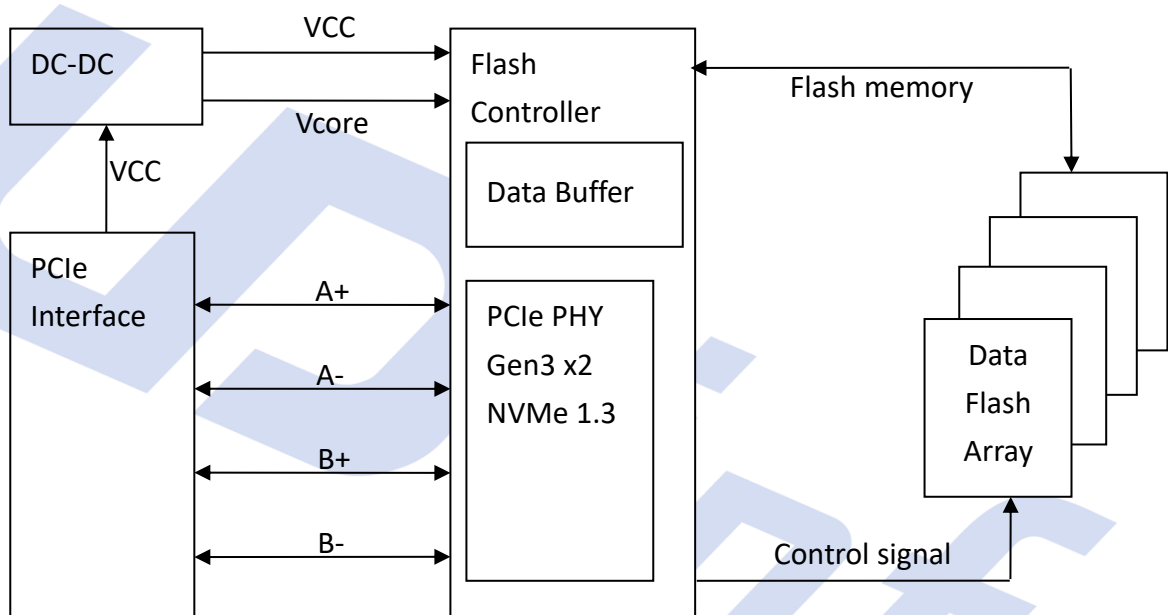


1. INTRODUCTION

1.1. General Description

UDinfo's CF Express PCIe solid state Drive delivers all the advantages of flash disk technology with PCIe Gen3 x2 interface. The CF Express could provide the capacity range from 128GB to 1TB. Moreover, it can reach up to 1700 MB/s read as well as 1550 MB/s write high performance. Its lower power consumption makes it an ideal storage choice for high performance embedded platforms.

1.2. Block Diagram



CF Express PCIe SSD Block Diagram

2. PRODUCT SPECIFICATIONS



2.1. Product Specifications

- **Capacity**
 - 128GB up to 1TB
- **Electrical/Physical Interface**
 - PCI Express Base Ver 3.1 & Compliant with NVMe 1.3
 - PCIe Gen3 x 4 lane & backward compatible to PCIe Gen2 and Gen1
 - Support up to QD 128 with queue depth of up to 64K.
 - Support power management
- **Supported NAND Flash**
 - Support up to 16 Chip Enables (CE) within a single design and up to 4pcs of BGA132 flash
 - Support KIOXIA BiCS3/BiCS4 TLC/QLC & WD BiCS3/BiCS4 TLC
 - Support Micron / Intel 3D NAND
 - Support up to 2pcs of BGA152 flash PCBA for WP function
 - Support up to 4pcs of BGA152 flash PCBA for non-WP function
- **ECC Scheme**
 - Applies LDPC + RAID ECC algorithm
- **Sector Size Support**
 - 512Bytes
 - 4KB
- **Support SMART and TRIM commands**
- **Support Hardware Write Protect function (optional)**

- **LBA Range**

- IDEMA standard

Capacity	Total Sectors (LBA)	User Data Size
120GB	234,441,648	Depended on file management
128GB	250,069,680	
240GB	468,862,128	
256GB	500,118,192	
480GB	937,703,088	
512GB	1,000,215,216	
960GB	1,875,385,008	
1TB	2,000,409,264	

- **Performance**

- WD BiCS3 with Write Protect function PCBA

Capacity	Flash Structure	CE#	Flash Type	Sequential (CDM)		Random (IOMeter)	
				Read (MB/s)	Write (MB/s)	Read (IOPS)	Write (IOPS)
128GB	64GB x 2	4	Bics3, BGA	TBD	TBD	TBD	TBD
256GB	128GB x 2	8	Bics3, BGA	TBD	TBD	TBD	TBD
512GB	256GB x 2	16	Bics3, BGA	TBD	TBD	TBD	TBD

- WD BiCS4 with Write Protect function PCBA

Capacity	Flash Structure	CE#	Flash Type	Sequential (CDM)		Random (IOMeter)	
				Read (MB/s)	Write (MB/s)	Read (IOPS)	Write (IOPS)
128GB	64GB x 2	4	Bics4, BGA	TBD	TBD	TBD	TBD
256GB	128GB x 2	8	Bics4, BGA	TBD	TBD	TBD	TBD
512GB	256GB x 2	8	Bics4, BGA	TBD	TBD	TBD	TBD

■ KIOXIA BiCS3 without Write Protect function PCBA

Capacity	Flash Structure	CE#	Flash Type	Sequential (CDM)		Random (IOMeter)	
				Read (MB/s)	Write (MB/s)	Read (IOPS)	Write (IOPS)
128GB	64GB x 2	4	Bics3, BGA	1,400	450	65K	110K
256GB	128GB x 2	8	Bics3, BGA	1,550	850	115K	200K
512GB	128GB x 4	16	Bics3, BGA	1,550	950	260K	310K

■ KIOXIA BiCS4 without Write Protect function PCBA

Capacity	Flash Structure	CE#	Flash Type	Sequential (CDM)		Random (IOMeter)	
				Read (MB/s)	Write (MB/s)	Read (IOPS)	Write (IOPS)
128GB	64GB x 2	4	Bics4, BGA	1,550	550	70K	120K
256GB	64GB x 4 128GB x 2	8	Bics4, BGA	1,700	1,100	130K	230K
512GB	128GB x 4	16	Bics4, BGA	1,700	1,400	210K	295K
1TB	256GB x 4	16	Bics4, BGA	1,700	1,400	210K	295K

Notes:

1. The performance was estimated based on BiCS3/4 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 configurations.
4. Performance is measured with the follow conditions
 - (a) CrystalDiskMark 6.0, 1GB range, QD=32T1
 - (b) IOMeter, 1GB range, 4K data size, QD=32T8
 - (c) OS: Win10 64bit, version 1709

- **TBW (Terabytes Written)**

Capacity	Flash Type	TBW
128GB	3D TLC BiCS3	TBD
256GB	3D TLC BiCS3	TBD
512GB	3D TLC BiCS3	TBD
128GB	3D TLC BiCS4	117
256GB	3D TLC BiCS4	328
512GB	3D TLC BiCS4	853
1TB	3D TLC BiCS4	1717

Notes:

1. Samples were built using 3D TLC NAND flash.
2. The test followed JEDEC218/219A 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.

- **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.

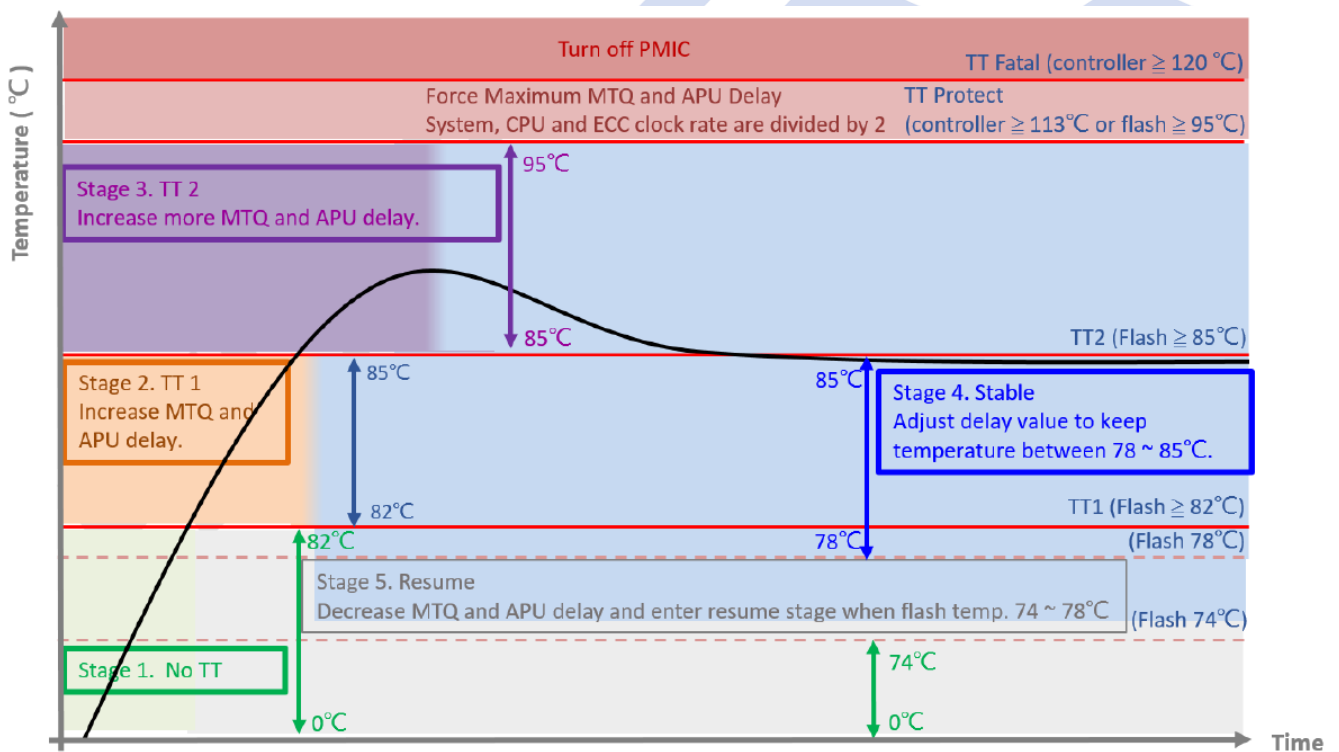


Figure 2-1 Thermal Throttling Schematic

Notes:

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



3. ENVIRONMENTAL SPECIFICATIONS



3.1. Environmental Conditions

3.1.1. Temperature and Humidity

- ◆ Operational (Standard grade): 0°C to 70°C (128GB~1TB)
- ◆ Operational (Wide grade): -40°C to 85°C (128GB~512GB)
- ◆ Storage: -40°C to 85°C

■ High Temperature Test Condition

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

■ Low Temperature Test Condition

	Temperature	Humidity
Operation	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	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. The operation temperature means the case temperature, in which can be detected via the S.M.A.R.T.

3.1.2. Shock

■ Shock Specification

	Acceleration Force
Non-Operational	1500G
Operational	1500G

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	≥ 20N	Hold 1min/5times

3.1.6. Torque

■ Torque Specification

	Force	Action
Non-operational	0.5N-m or ±2.5 deg	Hold 1min/5times

3.1.7. Electrostatic Discharge (ESD)

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
EN 55032, CISPR 32 (CE)
AS/NZS 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 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 Telcorida methodology. Please note that a lower MTBF should be expected for higher capacity drives, and we apply the lowest MTBF all capacities.

3.3. Certification & Compliance

- RoHS
- WHQL
- PCI Express Base 3.1
- UNH-IOL NVM Express Logo

4. ELECTRICAL SPECIFICATIONS



4.1. Supply Voltage

Parameter	Rating
Operating Voltage	Min = 3.14V Max = 3.47V
Rise Time (Max/Min)	100ms / 0.1ms
Fall Time (Max/Min)	5s / 1ms
Min. off Time ^{Note1}	1.5 s

Note:

1. Minimum time between power removed from SSD (Vcc < 100mW) and power re-applied to the drive.

4.2. Power Consumption

■ KIOXIA BiCS3 TLC

Capacity	Flash Sturcture	CE#	Read (Max.)	Write (Max.)
128GB	64GB x 2	4	2,600	1,800
256GB	128GB x 2	8	2,900	2,400
512GB	128GB x 4	16	3,100	2,600

Unit: mW

■ KIOXIA BiCS4 TLC

Capacity	Flash Sturcture	CE#	Read (Max.)	Write (Max.)
128GB	64GB x 2	4	2,400	1,700
256GB	64GB x 4	8	2,500	2,400
	128GB x 2			
512GB	128GB x 4	16	2,600	3,100
	256GB x 2	8		
1TB	256GB x 4	16	2,700	3,100

Unit: mW

Notes

1. Based on EDFM0xxx-series under ambient temperature.
2. Use CrystalDiskMark 6.0 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]
3. Power Consumption may differ according to flash configuration and platform.
4. The measured power voltage is 3.3V.

■ Power State Power Consumption with KIOXIA BiCS3 TLC

Capacity	Flash Structure	CE#	Active			PS3	PS4
			PS0	PS1	PS2		
128GB	64GB x 2	4	TBD	TBD	TBD	TBD	TBD
256GB	64GB x 4	8	TBD	TBD	TBD	TBD	TBD
512GB	128GB x 4	16	TBD	TBD	TBD	TBD	TBD

Unit: mW

■ Power State Power Consumption with KIOXIA BiCS4 TLC

Capacity	Flash Structure	CE#	Active			PS3	PS4
			PS0	PS1	PS2		
128GB	64GB x 2	4	1550	1250	1140	70	2
256GB	64GB x 4	8	2260	1380	1200	70	2
	128GB x 2						
512GB	128GB x 4	16	2630	1500	1260	70	2
	256GB x 2	8					
1TB	256GB x 4	16	2900	1550	1290	70	2

Unit: mW

Notes

1. Based on EDFM0xxx-series under ambient temperature.
2. The average value of power consumption is achieved based on 100% conversion efficiency.
3. The measured power voltage is 3.3V.
4. The temperature of a storage device in PS1 should remain constant or should slightly decrease for all workloads so the actual power in PS1 should be lower than PS0.
5. The temperature of a storage device in PS2 should decrease sharply for all workloads so the actual power in PS2 should be lower than PS1.

■ Mobile Mark 2014 Average Power consumption with KIOXIA BiCS3 TLC

Capacity	Flash Structure	CE#	Primary
128GB	64GB x 2	4	TBD
256GB	64GB x 4	8	TBD
512GB	128GB x 4	16	TBD

Unit: mW

■ Mobile Mark 2014 Average Power consumption with KIOXIA BiCS4 TLC

Capacity	Flash Structure	CE#	Primary
128GB	64GB x 2	4	TBD
256GB	64GB x 4	8	TBD
	128GB x 2		
512GB	128GB x 4	16	TBD
	256GB x 2	8	
1TB	256GB x 4	16	TBD

Unit: mW

Notes

1. Based on EDFM0xxx-series under ambient temperature.
2. The measured power voltage is 3.3V.
3. The average value of power consumption is achieved based on 100% conversion efficiency.

5. INTERFACE



5.1. Pin Assignment and Descriptions

The follow table lists the pin assignment of the media.

The I/O column indicates the signal direction viewed from the media: “I” indicates the signal input to the media and “O” indicates the signal output from the media. In the Connection column, “R” indicates the signal is required, “Opt” indicates the signal is optional, and “NC” indicates the signal shall not be connected.

Pin #	Signal	I/O	Media	Host	Notes
21	GND		R	R	
20	PETp0	I	R	R	
19	PETn0	I	R	R	
18	GND		R	R	
17	PERp0	O	R	R	
16	PERn0	O	R	R	
15	GND		R	R	
14	REFCLK+	I	R	R	
13	REFCLK-	I	R	R	
12	INS#	O	R	R	1
11	CLKREQ#	O	R	Opt	2
10	+3.3V		R	R	
9	PERST#	I	R	R	
8	Reserved		NC	NC	
7	Reserved		NC	NC	4
6	PETp1	I	Opt	Opt	
5	PETn1	I	Opt	Opt	
4	GND		R	Opt	3
3	PERp1	O	Opt	Opt	
2	PERn1	O	Opt	Opt	
1	GND		R	R	

Notes

1. A host pull-up resistor in the range of 100K Ω -200K Ω is required on this pin.
2. A host pull-up resistor ($\geq 5K\Omega$)
3. If the PCI Express Transmitter differential pair Lane 1 and Receiver differential pair Lane 1 are implemented, this pin shall be connected to ground.
4. Note that this pin is assigned to USBEN in XQD specification.

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■ Signal / Pin Descriptions

Category	Signal Name	Description
PCI Express	PETp0	PCI Express 8GT/s two Lane. 2 transmitter differential pairs and 2 receiver differential pairs.
	PETn0	
	PERp0	
	PERn0	
	PETp1	
	PETn1	
	PERp1	
	PERn1	
Auxiliary	REFCLK+	PCI Express differential (and spread-spectrum) reference clock.
	REFCLK-	
	PERST#	PCI Express functional reset.
	INS#	This signal is used for media detection and power control.
	CLKREQ#	This signal is used to indicate when REFCLK is needed for the PCI Express interface.
Power Source	+3.3V	3.3V power
Ground	GND	Ground

6. SUPPORTED COMMANDS



6.1. NVMe Command List

Table 6-1 Admin Commands

Op-Code	Command Description
00h	Delete I/O Submission Queue
01h	Create I/O Submission Queue
02h	Get Log Page
04h	Delete I/O Completion Queue
05h	Create I/O Completion Queue
06h	Identify
08h	Abort
09h	Set Features
0Ah	Get Features
0Ch	Asynchronous Event Request
10h	Firmware Activate
11h	Firmware Image Download
14h	Device Self-test
15h	Namespace Attachment
18h	Keep Alive

Table 6-2 Admin Commands – NVM Command Set Specific

Op-Code	Command Description
80h	Format NVM
81h	Security Send
82h	Security Receive
84h	Sanitize

Table 6-3 NVM Commands

Op-Code	Command Description
00h	Flush
01h	Write
02h	Read
04h	Write Uncorrectable
05h	Compare
08h	Write Zeroes
09h	Dataset Management



6.2. Identify Device Data

The following table details the sector data returned by the IDENTIFY DEVICE command.

■ Identify Controller Data Structure

Bytes	O/M	Default Value	Description
01:00	M	0x1987	PCI Vendor ID (VID)
03:02	M	0x1987	PCI Subsystem Vendor ID (SSVID)
23:04	M	TBD	Serial Number (SN)
63:24	M	TBD	Model Number (MN)
71:64	M	TBD	Firmware Revision (FR)
72	M	0x01	Recommended Arbitration Burst (RAB)
75:73	M	TBD	IEEE OUI Identifier (IEEE)
76	O	0x00	Controller Multi-Path I/O and Namespace Sharing Capabilities (CMIC)
77	M	0x09	Maximum Data Transfer Size (MDTS)
79:78	M	0x0000	Controller ID (CNTLID)
83:80	M	0x00010300	Version (VER)
87:84	M	0x124F80	RTD3 Resume Latency (RTD3R)
91:88	M	0x2191C0	RTD3 Entry Latency (RTD3E)
95:92	M	0x00000100	Optional Asynchronous Events Supported (OAES)
99:96	M	0x00	Controller Attributes (CTRATT)
239:100	-	0x00	Reserved
255:240	-	0x00	Refer to the NVMe Management Interface Specification for definition
257:256	M	0x001F	Optional Admin Command Support (OACS)
258	M	0x00	Abort Command Limit (ACL)
259	M	0x03	Asynchronous Event Request Limit (AERL)
260	M	0x12	Firmware Updates (FRMW)
261	M	0x0E	Log Page Attributes (LPA)
262	M	0x0F	Error Log Page Entries (ELPE)
263	M	0x04	Number of Power States Support (NPSS)
264	M	0x01	Admin Vendor Specific Command Configuration (AVSCC)
265	O	0x01	Autonomous Power State Transition Attributes (APSTA)
267:266	M	0x0155	Warning Composite Temperature Threshold (WCTEMP)
269:268	M	0x0157	Critical Composite Temperature Threshold (CCTEMP)
271:270	O	0x2710	Maximum Time for Firmware Activation (MTFA)
275:272	O	0x00	Host Memory Buffer Preferred Size (HMPRE)
279:276	O	0x00	Host Memory Buffer Minimum Size (HMMIN)

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Bytes	O/M	Default Value	Description
295:280	O	Non-zero	Total NVM Capacity (TNVMCAP)
311:296	O	0x00	Unallocated NVM Capacity (UNVMCAP)
315:312	O	0x00	Replay Protected Memory Block Support (RPMBS)
317:316	O	0x001E	Extended Device Self-test Time (EDSTT)
318	O	0x01	Device Self-test Options (DSTO)
319	M	0x04	Firmware Update Granularity (FWUG)
321:320	M	0x0001	Keep Alive Support (KAS)
323:322	O	1	Host Controlled Thermal Management Attributes (HCTMA)
325:324	O	0x111	Minimum Thermal Management Temperature (MNTMT)
327:326	O	0x157	Maximum Thermal Management Temperature (MXTMT)
331:328	O	0x00000006	Sanitize Capabilities (SANICAP)
511:316	-	0	Reserved
NVM Command Set Attributes			
512	M	0x66	Submission Queue Entry Size (SQES)
513	M	0x44	Completion Queue Entry Size (CQES)
515:514	-	0x0000	Reserved
519:516	M	0x00000001	Number of Namespaces (NN)
521:520	M	0x005F	Optional NVM Command Support (ONCS)
523:522	M	0x0000	Fused Operation Support (FUSES)
524	M	0x01	Format NVM Attributes (FNA)
525	M	0x01	Volatile Write Cache (VWC)
527:526	M	0x00FF	Atomic Write Unit Normal (AWUN)
529:528	M	0x0000	Atomic Write Unit Power Fail (AWUPF)
530	M	0x01	NVM Vendor Specific Command Configuration (NVSCC)
531	-	0x00	Reserved
533:532	O	0x0000	Atomic Compare & Write Unit (ACWU)
535:534	-	0x0000	Reserved
539:536	O	0x00000000	SGL Support (SGLS)
703:540	-	0x00	Reserved
IO Command Set Attributes			
2047:704	-	0x00	Reserved
2079:2048	M	TBD	Power State 0 Descriptor (PSD0)
2111:2080	O	0x00	Power State 1 Descriptor (PSD1)
2143:2112	O	0x00	Power State 2 Descriptor (PSD2)
2175:2144	O	0x00	Power State 3 Descriptor (PSD3)

Bytes	O/M	Default Value	Description
2207:2176	0	0x00	Power State 4 Descriptor (PSD4)
2239:2208	0	0x00	Power State 5 Descriptor (PSD5)
2271:2240	0	0x00	Power State 6 Descriptor (PSD6)
2303:2272	0	0x00	Power State 7 Descriptor (PSD7)
2335:2304	0	0x00	Power State 8 Descriptor (PSD8)
2367:2336	0	0x00	Power State 9 Descriptor (PSD9)
2399:2368	0	0x00	Power State 10 Descriptor (PSD10)
2431:2400	0	0x00	Power State 11 Descriptor (PSD11)
2463:2432	0	0x00	Power State 12 Descriptor (PSD12)
2495:2464	0	0x00	Power State 13 Descriptor (PSD13)
2527:2496	0	0x00	Power State 14 Descriptor (PSD14)
2559:2528	0	0x00	Power State 15 Descriptor (PSD15)
2591:2560	0	0x00	Power State 16 Descriptor (PSD16)
2623:2592	0	0x00	Power State 17 Descriptor (PSD17)
2655:2624	0	0x00	Power State 18 Descriptor (PSD18)
2687:2656	0	0x00	Power State 19 Descriptor (PSD19)
2719:2688	0	0x00	Power State 20 Descriptor (PSD20)
2751:2720	0	0x00	Power State 21 Descriptor (PSD21)
2783:2752	0	0x00	Power State 22 Descriptor (PSD22)
2815:2784	0	0x00	Power State 23 Descriptor (PSD23)
2847:2816	0	0x00	Power State 24 Descriptor (PSD24)
2879:2848	0	0x00	Power State 25 Descriptor (PSD25)
2911:2880	0	0x00	Power State26 Descriptor (PSD26)
2943:2912	0	0x00	Power State 27 Descriptor (PSD27)
2975:2944	0	0x00	Power State 28 Descriptor (PSD28)
3007:2976	0	0x00	Power State 29 Descriptor (PSD29)
3039:3008	0	0x00	Power State 30 Descriptor (PSD30)
3071:3040	0	0x00	Power State 31 Descriptor (PSD31)
Vendor Specific			
4095:3072	0	Vendor Reserved	Vendor Specific (VS)

■ Identify Namespace Data Structure & NVM Command Set Specific

Bytes	O/M	Description
7:0	M	Namespace Size (NSZE)
15:8	M	Namespace Capacity (NCAP)
23:16	M	Namespace Utilization (NUSE)
24	M	Namespace Features (NSFEAT)
25	M	Number of LBA Formats (NLBAF)
26	M	Formatted LBA Size (FLBAS)
27	M	Metadata Capabilities (MC)
28	M	End-to-end Data Protection Capabilities (DPC)
29	M	End-to-end Data Protection Type Settings (DPS)
30	O	Namespace Multi-path I/O and Namespace Sharing Capabilities (NMIC)
31	O	Reservation Capabilities (RESCAP)
32	O	Format Progress Indicator (FPI)
33	-	Reserved
35:34	O	Namespace Atomic Write Unit Normal (NAWUN)
37:36	O	Namespace Atomic Write Unit Power Fail (NAWUPF)
39:38	O	Namespace Atomic Compare & Write Unit (NACWU)
41:40	O	Namespace Atomic Boundary Size Normal (NABSN)
43:42	O	Namespace Atomic Boundary Offset (NABO)
45:44	O	Namespace Atomic Boundary Size Power Fail (NABSPF)
47:46	-	Reserved
63:48	O	NVM Capacity (NVMCAP)
103:64	-	Reserved
119:104	O	Namespace Globally Unique Identifier (NGUID)
127:120	O	IEEE Extended Unique Identifier (EUI64)
131:128	M	LBA Format 0 Support (LBAF0)
135:132	O	LBA Format 1 Support (LBAF1)
139:136	O	LBA Format 2 Support (LBAF2)
143:140	O	LBA Format 3 Support (LBAF3)
147:144	O	LBA Format 4 Support (LBAF4)
151:148	O	LBA Format 5 Support (LBAF5)
155:152	O	LBA Format 6 Support (LBAF6)
159:156	O	LBA Format 7 Support (LBAF7)
163:160	O	LBA Format 8 Support (LBAF8)
167:164	O	LBA Format 9 Support (LBAF9)

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Bytes	O/M	Description
171:168	O	LBA Format 10 Support (LBAF10)
175:172	O	LBA Format 11 Support (LBAF11)
179:176	O	LBA Format 12 Support (LBAF12)
183:180	O	LBA Format 13 Support (LBAF13)
187:184	O	LBA Format 14 Support (LBAF14)
191:188	O	LBA Format 15 Support (LBAF15)
383:192	-	Reserved
4095:384	O	Vendor Specific (VS)

■ List of Identify Namespace Data Structure for Each Capacity

Capacity (GB)	Byte[7:0]: Namespace Size (NSZE)
120	DF94BB0h
128	EE7C2B0h
240	1BF244B0h
256	1DCF32B0h
480	37E436B0h
512	3B9E12B0h
960	6FC81AB0h
1024	773BD2B0h

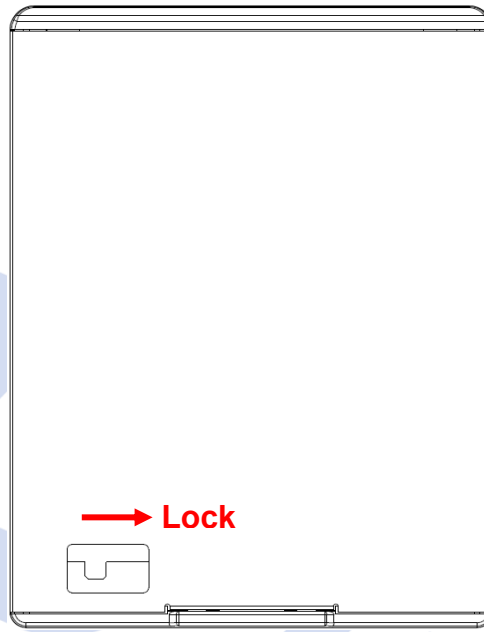
6.3. SMART Attributes

■ SMART Attributes (Log Identifier 02h)

Bytes Index	Bytes	Description
[0]	1	Critical Warning
[2:1]	2	Composite Temperature
[3]	1	Available Spare
[4]	1	Available Spare Threshold
[5]	1	Percentage Used
[31:6]	26	Reserved
[47:32]	16	Data Units Read
[63:48]	16	Data Units Written
[79:64]	16	Host Read Commands
[95:80]	16	Host Write Commands
[111:96]	16	Controller Busy Time
[127:112]	16	Power Cycles
[143:128]	16	Power On Hours
[159:144]	16	Unsafe Shutdowns
[175:160]	16	Media and Data Integrity Errors
[191:176]	16	Number of Error Information Log Entries
[195:192]	4	Warning Composite Temperature Time
[199:196]	4	Critical Composite Temperature Time
[201:200]	2	Temperature Sensor 1 (Current Temperature)
[203:202]	2	Temperature Sensor 2 (N/A)
[205:204]	2	Temperature Sensor 3 (N/A)
[207:206]	2	Temperature Sensor 4 (N/A)

6.4. Write Protect Function

The write protect function is triggered by slid switch. This used to set the device as a write protection device after power up. When the function is triggered, the data can't be written to the device. The device is then set as read only.



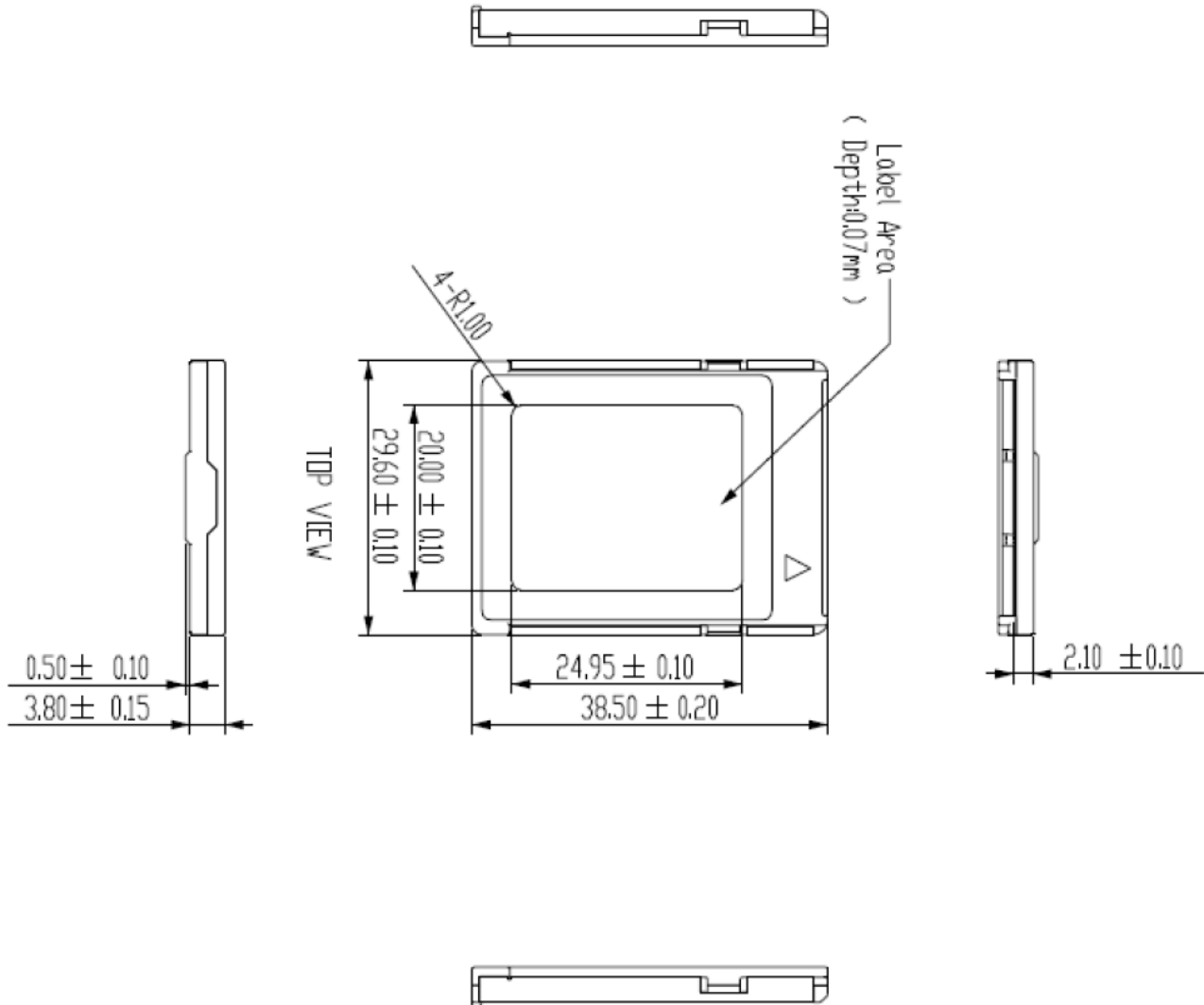
7. PHYSICAL DIMENSION



■ Dimension:

Type B: 38.5mm(L) x 29.6mm(W) x 3.8mm(H)

Unit : mm



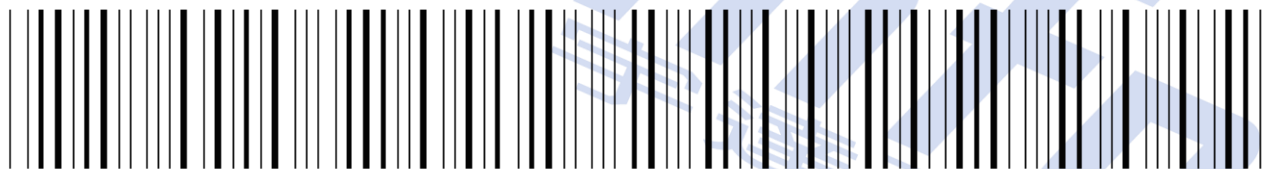
8. TERMINOLOGY



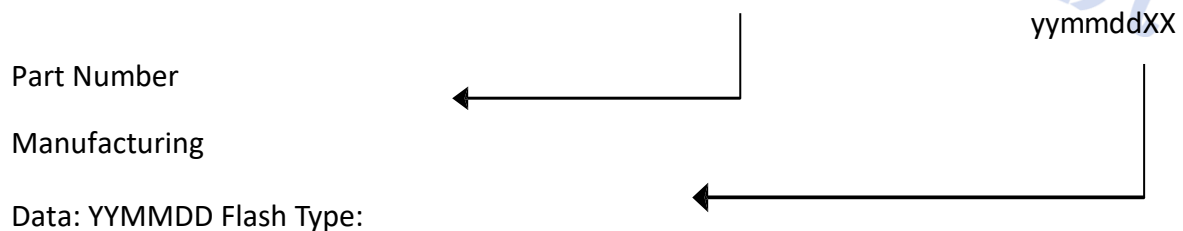
The following table is to list out the acronyms that have been applied throughout the document.

Term	Definitions
ATTO	Commercial performance benchmark application
DDR	Double data rate (SDRAM)
ASPM	Active States Power Management
APST	Autonomous Power State Transition
LBA	Logical block addressing
MTBF	Mean time between failures
PCIe	PCI Express / Peripheral Component Interconnect Express
S.M.A.R.T.	Self-monitoring, analysis and reporting technology

9. BARCODE DESCRIPTION



C F X 2 1 D E 1 2 0 G B A D U



10. PARTNUMBER DECODER



CFX-21DEX⁸X⁹X¹⁰X¹¹X¹²X¹³X¹⁴X¹⁵X¹⁶X¹⁷

X ¹ X ² X ³	X ⁴ X ⁵	X ⁶ X ⁷	X ⁸ X ⁹ X ¹⁰ X ¹¹ X ¹²		X ¹³	X ¹⁴	X ¹⁵	X ¹⁶ X ¹⁷
CFX	21	DE	120GB 240GB 480GB 960GB	128GB 256GB 512GB 001TB	A: 3D TLC Standard (0°C ~ +70°C) B: 3D TLC Industrial (-40°C ~ +85°C)	D	P U	blank
<p>X¹⁶X¹⁷ Blank: standard 01: Write Protection (WP) 06: Conformal Coating (CC) 07: CC + WP</p>								

