Amtron Technology, Inc.

Industrial Grade CFexpress Memory Card

AE Series

Product Datasheet

V1.0

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1. INTRODUCTION

1.1. Description

Amtron industrial grade AE series CFexpress memory cards are designed with the PCIe Gen3 x2 interface, to reach up to 1,700MB/s read and 1,400MB/s write high performance. These PCIe CFexpress cards are offered in standard temperature grade (0°C to +70°C) and wide temperature grade (-40°C to +85°C). The memory capacities are available from 120GB to 1TB.

1.2. Product Features

- CFexpress Type B form factor
- PCI Express Base Version 3.1 and Compliant with NVMe 1.3
- PCIe Gen3 x 2 lane & backward compatible to PCIe Gen2 and Gen1
- RoHS compliant [Lead free]
- 3D Triple Level Cell (TLC) NAND Flash
- Capacity from 120GB up to 1TB
- High speed:
  - Read 1,700 MB/s max., Write 1,400 MB/s max.
- Endure severe thermal and dynamic environments
- Very low power consumption
- MTBF > 2,000,000 hours *****
- Support SMART and TRIM Command
- Controlled Bill of Materials (BOM)

***Note**: A lower MTBF is expected for higher capacity drives. To be conservative, the lowest MTBF is reported in this document

1.3. Product Overview

- **PCIe Interface**
  - NVMe PCIe 3.0 x2 (2 lanes)
- **Form Factor**
  - CFexpress Type B
- **Compliance**
  - NVMe 1.3d
  - PCI Express Base 3.1
  - WHQL
  - UNH-IOL NVM Express Logo
- **Capacity**
  - 120GB up to 1TB [1]
- **Flash Interface**
  - Flash Type: 3D NAND
  - Transfer rate up to 533Mbps
  - Up to 2 pcs of BGA152 flash [2]
  - Up to 4 pcs of BGA132/152 flash [2]
- **Performance**
  - Read up to 1,700 MB/s
  - Write up to 1,400 MB/s
- **Reliability**
  - MTBF [3] > 2,000,000 hours
  - Uncorrectable Bit Error Rate(UBER) < 1 sector per 10^{16} bits read
- **Power Consumption** [4]
  - Idle mode: < 70 mW
  - Active mode: < 3.1 W
  - L1.2 < 2 mW
- **Advanced Flash Management**
  - Advanced Wear Leveling
  - Bad Block Management
  - TRIM
  - SMART
  - Over-Provisioning
- **Power Management**
  - Support APST
  - Support ASPM
  - Support L1.2
- **Temperature Range**
  - Operation (standard): 0°C to 70°C
  - Operation (wide): -40°C to 85°C
  - Storage: -40°C to 85°C
- **Features Support List**
  - End to end data path protection
  - Thermal throttling
  - Dynamic SLC Cache
  - Drive log
  - Support TCG Pyrite/OPAL [5]
  - Hardware Write Protect (optional feature, available up to 512GB)
- **Certification**
  - RoHS
  - CE & FCC

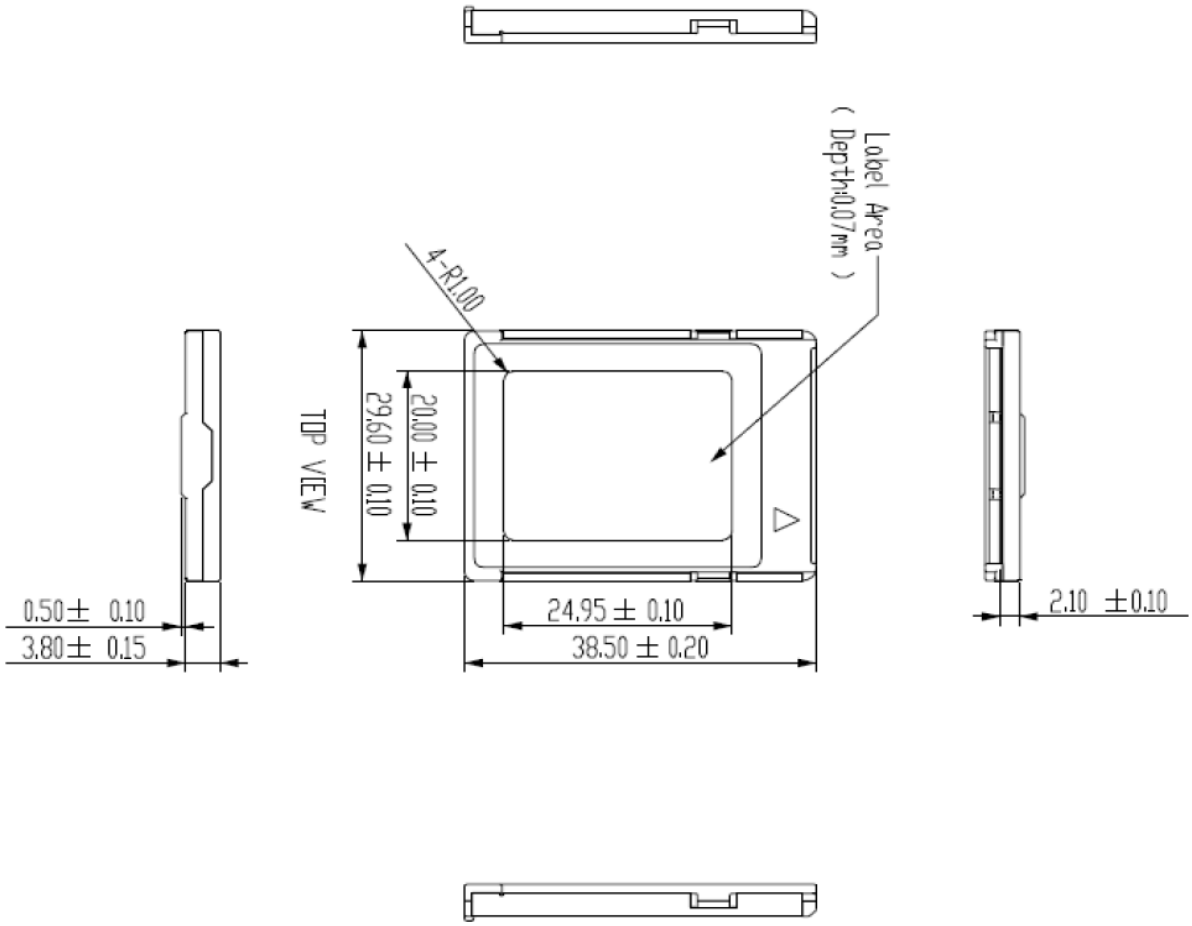
Note:

1. 1TB capacity
   (a) Only support standard temperature grade (0°C to 70°C)
   (b) Not support Write Protect (WP) function
2. Different printed circuit board assembly (PCBA)
   (a) BGA152: 2pcs PCBA for WP function
   (b) BGA132/152: 4pcs PCBA for non-WP function

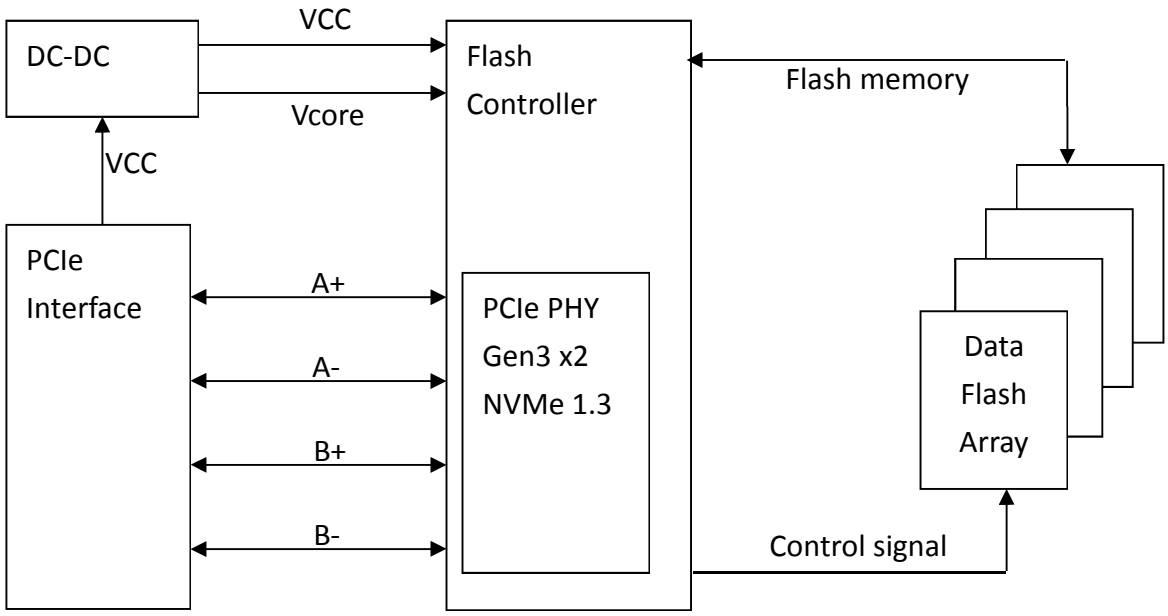
3. MTBF, an acronym for Mean Time Between Failures, is a measure of a device's reliability. Its value represents the average time between a repair and the next failure. The measure is typically in unit of hours. The higher the MTBF value, the higher the reliability of the product. Please note that a lower MTBF is expected for higher capacity drives. To be conservative, the lowest MTBF is reported in this document.
4. See Section 4.2 "Power Consumption" for details.
5. Supported by a separate firmware version. Further information available upon request.

1.4. Product Dimension

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



1.5. Block Diagram



PCIe CFexpress Card Block Diagram

2. PRODUCT SPECIFICATIONS

2.1. Specifications

- **Capacity**
  - 120GB up to 1TB
- **Electrical/Physical Interface**
  - PCIe Express Base Version 3.1
  - Compliant with NVMe 1.3
  - PCIe Gen3 x 2 lane and backward Compatible to PCIe Gen2 and Gen1
  - 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 up to 2pcs of BGA152 flash PCBA for WP function
  - Support up to 4pcs of BGA132/152 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 feature)**
- **LBA Range**
  - IDEMA standard

Capacity	Total Sectors (LBA)	User Data Size
120GB	234,441,648	Depend 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**
  - **KIOXIA**

Capacity	Flash Structure	Flash Type	CrystalDiskMark		IOMeter	
			Read (MB/s)	Write (MB/s)	Read (IOPS)	Write (IOPS)
120/128GB	64GB x 2	Bics3, BGA	1,500	450	70K	110K
240/256GB	128GB x 2	Bics3, BGA	1,700	1,000	140K	230K
480/512GB	128GB x 4	Bics3, BGA	1,700	1,400	200K	300K
120/128GB	64GB x 2	Bics4, BGA[5]	1,600	550	70K	110K
		Bics4, BGA	1,550	550	70K	120K
240/256GB	128GB x 2	Bics4, BGA	1,700	1,100	130K	230K
480/512GB	128GB x 4	Bics4, BGA	1,700	1,400	210K	295K
960GB/1TB	256GB x 4	Bics4, BGA	1,700	1,400	210K	295K

Notes:

1. The performance estimated based on Kioxia BiCS3/4 TLC NAND flash.
2. Performance may differ according to flash configuration and platform.
3. The table above is for reference only.
4. Performance is measured with the following conditions

(a) CrystalDiskMark 6.0, 1GB range, QD=32T1

(b) IOMeter, 1GB range, 4K data size, QD=32T8

(c) OS: Win10 64bit was, version 1709

5. For Write Protect PCBA

- **TBW (Terabytes Written)**

Capacity	Flash Type	TBW
120/128GB	3D TLC BiCS3	110
240/256GB	3D TLC BiCS3	240
480/512GB	3D TLC BiCS3	520
120/128GB	3D TLC BiCS4	110
240/256GB	3D TLC BiCS4	240
480/512GB	3D TLC BiCS4	520
960GB/1TB	3D TLC BiCS4	1120

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. Firmware can apply different levels of throttling to achieve the purpose of protection efficiently and proactively via SMART reading.

- **Purpose of Thermal Throttling:**
  - In order to keep the optimal performance in the safe range of the temperature.
- **Thermal sensors:**
  - External thermal sensor & on-die thermal sensor (internal controller) are used to detect temperature. There is 1 pcs of external thermal sensor on PCB. The position depends on different form factor.
  - External thermal sensor detects flash temperature; On-die thermal sensor detects controller temperature.

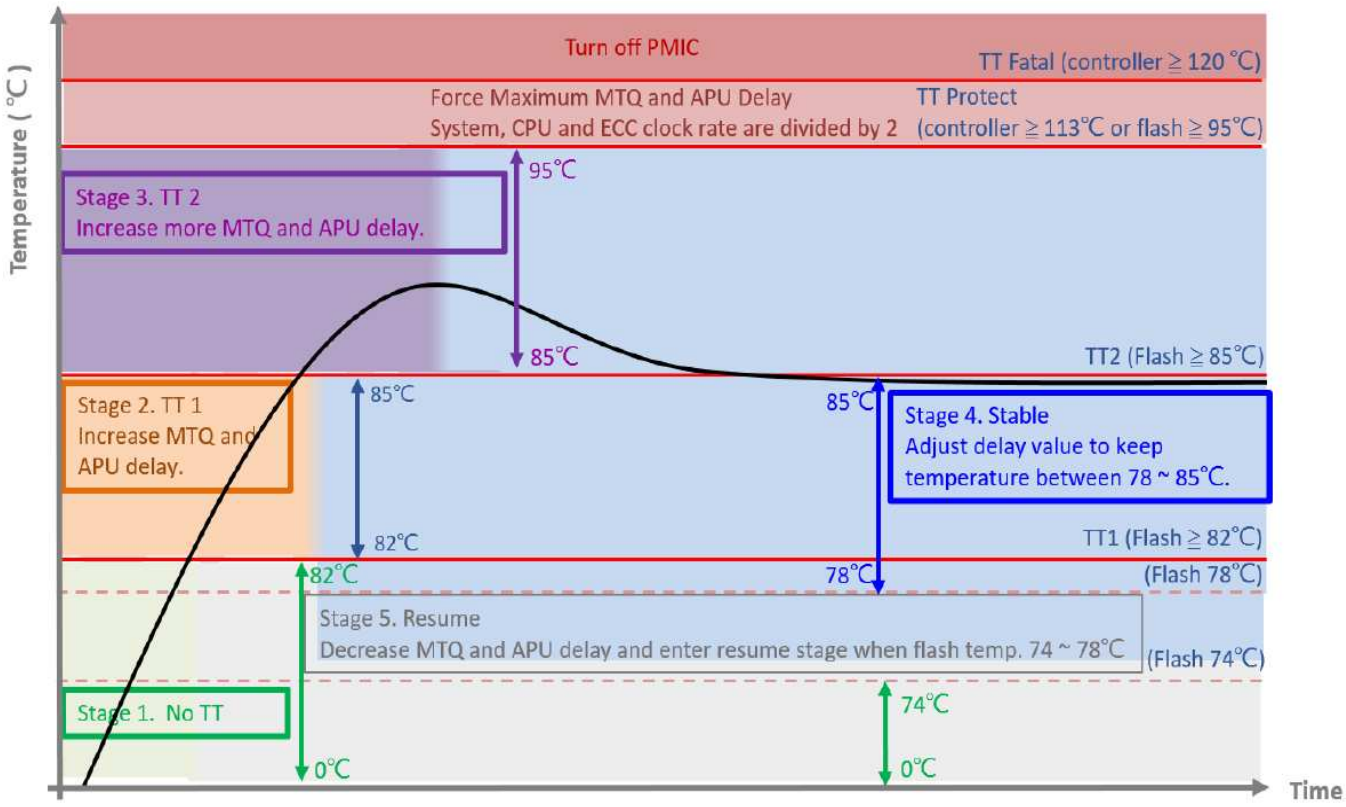


Figure 2-1 Thermal Throttling Schematic

Notes:

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

2.3. 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. Please note that a lower MTBF is expected for larger capacity drives. To be conservative, the lowest MTBF is reported in this document.

3. ENVIRONMENTAL SPECIFICATIONS

3.1. Environmental Conditions

3.1.1. Temperature and Humidity

- Temperature:
  - Storage: -40°C to 85°C
  - Operational (Standard grade): 0°C to 70°C
  - Operational (Wide grade): -40°C to 85°C
- Humidity:
  - Standard grade: RH 90% under 40°C (operational)

■ **High Temperature Test Condition**

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

Result: No abnormality is detected.

■ **Low Temperature Test Condition**

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

Result: No abnormality is detected.

■ **High Humidity Test Condition**

	Temperature	Humidity
Operation	55°C	95% RH
Storage	55°C	95% RH

Result: No abnormality is detected.

■ **Temperature Cycle Test**

	Temperature
Operation	Standard grade: 0°C to 70°C [1] Wide grade: -40°C to 85°C [1]
Storage	-40°C to 85°C

Result: No abnormality is detected.

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**

Result: No abnormality is detected.

3.1.3. Vibration

■ **Vibration Specification**

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

Result: No abnormality is detected.

3.1.4. Drop

■ **Drop Specification**

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

Result: No abnormality is detected.

3.1.5. Bending

■ **Bending Specification**

	Force	Action
Non-operational	≥ 20N	Hold 1 min / 5 times

Result: No abnormality is detected.

3.1.6. Torque

■ **Torque Specification**

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

Result: No abnormality is detected.

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. Certification

- RoHS
- CE / FCC

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 / 10ms
Min. off Time[Note1]	TBD

Note:

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

4.2. Power Consumption

- **KIOXIA**

Capacity	Flash Structure	Read (Max.)	Write (Max.)
120/128GB	Bics3, 64GB x 2	2,600	1,800
240/256GB	Bics3, 128GB x 2	2,900	2,400
480/512GB	Bics3, 128GB x 4	3,100	2,600
120/128GB	Bics4, 64GB x 2	2,400	1,700
240/256GB	Bics4, 128GB x 2	2,500	2,400
480/512GB	Bics4, 128GB x 4	2,600	3,100
960GB/1TB	Bics4, 256GB x 4	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.

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 100KΩ-200KΩis required on this pin.
2. A host pull-up resistor (≧5KΩ)
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.

- 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 closk.
	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	SN	Serial Number (SN)
63:24	M	Model Number	Model Number (MN)
71:64	M	FW Name	Firmware Revision (FR)
72	M	0x01	Recommended Arbitration Burst (RAB)
75:73	M	Assigned by IEEE/RAC	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	0x00000000	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)

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	M	0x00	Reserved
2079:2048	M	0x0081031600401C52 000000000000025800 00025800000316	Power State 0 Descriptor (PSD0)
2111:2080	O	0x0081031600401C52 010101010000025800 00025800000316	Power State 1 Descriptor (PSD1)

Bytes	O/M	Default Value	Description
2143:2112	O	0x0081031600401C52 020202020000025800 00025800000316	Power State 2 Descriptor (PSD2)
2175:2144	O	0x0081031600401C52 03030303000003E800 0003E8030003E8	Power State 3 Descriptor (PSD3)
2207:2176	O	0x0081031600401C52 24040404000186A000 00138803000032	Power State 4 Descriptor (PSD4)
…	-	0	(N/A) …
3071:3040	O	0x00	Power State 31 Descriptor (PSD31)
Vendor Specific			
4095:3072	O	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)

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

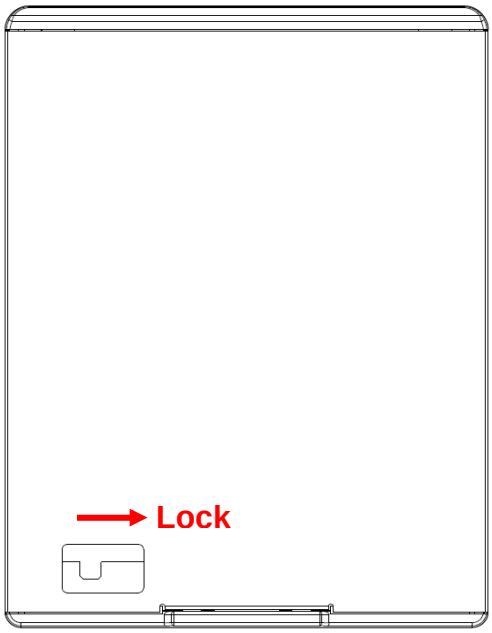
6.3. SMART Attributes

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



7. ACRONYMS

Acronym	Definition
AES	Advanced Encryption Standard
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
OPAL	Open Physics Abstraction Layer
PCIe	PCI Express / Peripheral Component Interconnect Express
PSID	Physical Security ID
SMART	Self-Monitoring, Analysis and Reporting Technology
TCG	Trusted Computing Group
TLC	Tipple Level Cell

8. PART NUMBER DECODER

CFX-AEX^{1}X^{2}X^{3}X^{4}X^{5}X^{6}X^{7}X^{8}

Item	Series	Capacity	NAND Flash & Temperature Grade	Option
		X^{1} X^{2} X^{3} X^{4} X^{5}	**X^{6}**	**X^{7} X^{8}**
CFX	AE	120GB 128GB 240GB 256GB 480GB 512GB 960GB 001TB	A: 3D TLC Standard (0˚C to +70˚C) B: 3D TLC Industrial (-40˚C to +85˚C)	See below

X^{7} X^{8} (Reserved for specific requirement)

Blank: Standard
01: Write Protection (WP) [available up to 512GB]
06: Conformal Coating (CC)
07: CC + WP