

Amtron Technology, Inc.

Industrial Grade CFast Memory Card

AK Series

Product Datasheet

V2.1

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1. INTRODUCTION



1.1. Description

Amtron industrial AK series CFast card is designed with the Serial ATA III interface and is fully compliant with the standard CFast form factor. It can reach up to 550 MB/s read and 460 MB/s write high performance. These CFast 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 8GB to 64GB [SLC], 16GB to 128GB [pSLC], 32GB to 256GB [MLC], 16GB to 128GB [3D pSLC], 64GB to 512GB [3D TLC].

1.2. Product Features

- CFast form factor
- SATA 3.2 interface
- RoHS compliant [Lead free]
- SLC, MLC, 3D TLC NAND Flash
- High speed:
 - Read 550 MB/s max., Write 480 MB/s max.
- Endure severe thermal and dynamic environments
- Very low power consumption
- MTBF > 3,000,000 hours
- Support SMART and TRIM Commands
- Controlled Bill of Materials (BOM)

1.3. Product Overview

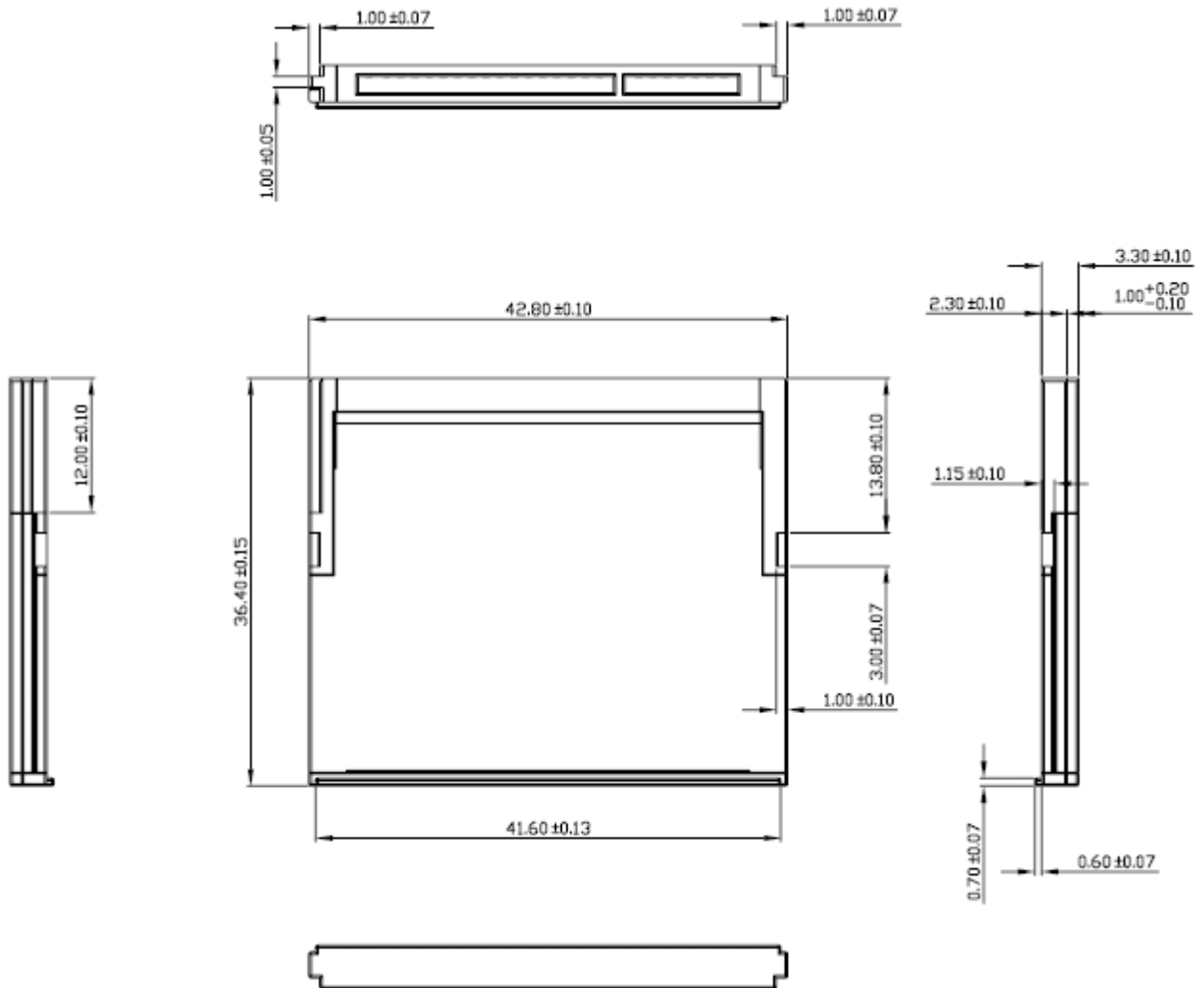
- **SATA Interface**
 - SATA Revision 3.2
 - SATA 1.5Gbps, 3Gbps, and 6Gbps interface
- **Form Factor**
 - CFast Type I
- **Capacity**
 - SLC: 8GB to 64GB
 - pSLC: 16GB to 128GB
 - MLC: 32GB to 256GB
 - 3D TLC: 64GB to 512GB
 - 3D pSLC: 16GB to 128GB
- **Flash Interface**
 - Flash Type: SLC, MLC, 3D TLC
- **Performance**
 - Read up to 550 MB/s
 - Write up to 480 MB/s
- **MTBF ¹**
 - SLC: > 3,000,000 hours
 - pSLC: >2,500,000 hours
 - MLC: >2,000,000 hours
 - 3D TLC: >2,000,000 hours
- **Advanced Flash Management**
 - Static & Dynamic Wear Leveling
 - Bad Block Management
 - TRIM
 - SMART
 - Over-Provision
- **Temperature Range**
 - Operation (standard): 0°C to 70°C
 - Operation (wide): -40°C to 85°C
 - Storage: -40°C to 85°C
- **Low Power Management**
 - DIPM/HIPM Mode
 - DEVSLP Mode (Optional)
- **Power Consumption ²**
 - Active mode: < 1900mW
 - Idle mode: <325 mW
- **Compliant**
 - RoHS
 - CE & FCC

Note:

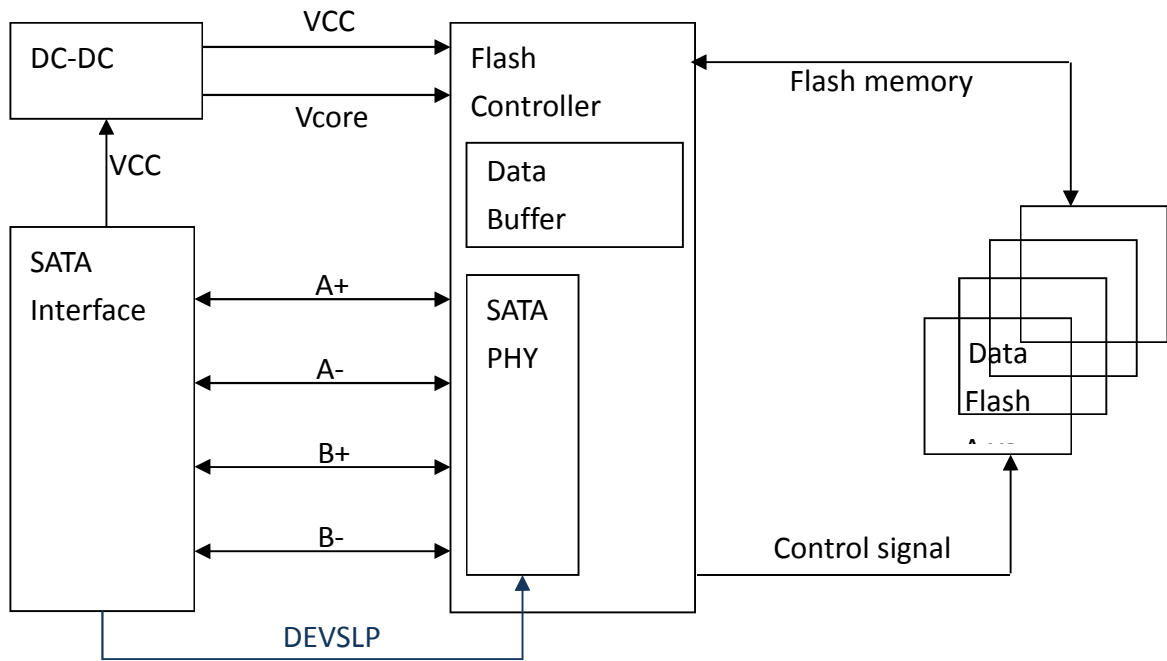
1. **MTBF** (mean time between failures) is a measure of how reliable a hardware product is. Its value represents the average time between a failure repair and the next failure. The unit of MTBF is typically in hours. The higher the MTBF value, the higher the reliability of the product. Please note that a lower MTBF is expected for higher capacity drives. To be conservative, the lowest MTBF is reported in this document.
2. See Section 4.2 “Power Consumption” for details.

1.4. Product Dimension

36.4mm (L) x 42.8mm (W) x 3.3mm (H)



1.5. Block Diagram



Cfast Card Block Diagram

2. PRODUCT SPECIFICATIONS



2.1. Specifications

- **Capacity**
 - MLC: From 32GB up to 256GB (support 48-bit addressing mode)
 - pSLC: From 16GB up to 128GB (support 48-bit addressing mode)
 - SLC: From 8GB up to 64GB (support 48-bit addressing mode)
 - 3D Bics3: From 64GB up to 512GB (support 48-bit addressing mode)
 - Bics3 pSLC: From 16GB up to 128GB (support 48-bit addressing mode)
 - 3D Bics4: From 128GB up to 512GB (support 48-bit addressing mode)
- **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
 - ◆ Embedded BIST function for SATA PHY for low cost mass production
- **Built-in 2-channel NAND flash interface controller**
 - Compliant with Toggle 1.0 and Toggle 2.0 NAND Flash interface
 - Compliant with ONFI 4.0 interface:
 - ◆ SDR up to mode 5
 - ◆ NV-DDR up to mode 5
 - ◆ NV-DDR2 up to mode 7
 - ◆ NV-DDR3 up to mode 8
- **Supported NAND Flash**
 - Support up to 16 Flash Chip Enables (CE) within single design
 - 15nm/3D-NAND MLC and 24nm SLC
 - Support all types of SLC/MLC /3D-NAND, 8KB/page and 16K/page NAND flash
- **ECC Scheme**
 - Applies the LDPC (Low Density Parity Check) of ECC algorithm
- **UART function**

- **GPIO**
- **Support SMART and TRIM commands**
- **Capacity Information**

| Capacity | Cylinders | Heads | Sectors | Total Sectors | User Data Size |
|----------|-----------|-------|---------|---------------|-----------------------------|
| 8GB | 15,525 | 16 | 63 | 15,649,200 | Depended on file management |
| 16GB | 16,383 | 16 | 63 | 31,277,232 | |
| 30GB | 16,383 | 16 | 63 | 58,626,288 | |
| 32GB | 16,383 | 16 | 63 | 62,533,296 | |
| 60GB | 16,383 | 16 | 63 | 117,231,408 | |
| 64GB | 16,383 | 16 | 63 | 125,045,424 | |
| 120GB | 16,383 | 16 | 63 | 234,441,648 | |
| 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 | |

- Performance

- MLC:

| Capacity | Flash Structure | Flash Type | Sequential | |
|----------|-----------------|------------|-------------|--------------|
| | | | Read (MB/s) | Write (MB/s) |
| 32GB | 32GB x 1 | 15nm, BGA | 350 | 160 |
| 64GB | 32GB x 2 | 15nm, BGA | 550 | 310 |
| 128GB | 64GB x 2 | 15nm, BGA | 550 | 460 |
| 256GB | 128GB x 2 | 15nm, BGA | 550 | 460 |

- pSLC:

| Capacity | Flash Structure | Flash Type | Sequential | |
|----------|-----------------|------------|-------------|--------------|
| | | | Read (MB/s) | Write (MB/s) |
| 16GB | 32GB x 1 | 15nm, BGA | 350 | 160 |
| 32GB | 32GB x 2 | 15nm, BGA | 550 | 310 |
| 64GB | 64GB x 2 | 15nm, BGA | 550 | 460 |
| 128GB | 128GB x 2 | 15nm, BGA | 550 | 460 |

- SLC:

| Capacity | Flash Structure | Flash Type | Sequential | |
|----------|-----------------|------------|-------------|--------------|
| | | | Read (MB/s) | Write (MB/s) |
| 8GB | 8GB x 1 | 24nm, BGA | 320 | 70 |
| 16GB | 8GB x 2 | 24nm, BGA | 540 | 150 |
| 32GB | 16GB x 2 | 24nm, BGA | 510 | 300 |
| 64GB | 32GB x 2 | 24nm, BGA | 510 | 300 |

■ **3D Bics3:**

| Capacity | Flash Structure | Flash Type | Sequential | |
|----------|-----------------|------------|-------------|--------------|
| | | | Read (MB/s) | Write (MB/s) |
| 64GB | 64GB x 1 | Bics3, BGA | 330 | 225 |
| 128GB | 64GB x 2 | Bics3, BGA | 550 | 450 |
| 256GB | 128GB x 2 | Bics3, BGA | 550 | 480 |
| 512GB | 256GB x 2 | Bics3, BGA | 550 | 470 |

■ **Bics3 pSLC:**

| Capacity | Flash Structure | Flash Type | Sequential | |
|----------|-----------------|------------|-------------|--------------|
| | | | Read (MB/s) | Write (MB/s) |
| 16GB | 64GB x 1 | Bics3, BGA | 320 | 190 |
| 32GB | 64GB x 2 | Bics3, BGA | 550 | 380 |
| 64GB | 128GB x 2 | Bics3, BGA | 550 | 460 |
| 128GB | 256GB x 2 | Bics3, BGA | 550 | 470 |

■ **3D Bics4:**

| Capacity | Flash Structure | Flash Type | Sequential | |
|-------------|-----------------|------------|-------------|--------------|
| | | | Read (MB/s) | Write (MB/s) |
| 120GB/128GB | 64GB x 2 | Bics4, BGA | 540 | 450 |
| 240GB/256GB | 128GB x 2 | Bics4, BGA | 540 | 480 |
| 480GB/512GB | 256GB x 2 | Bics4, BGA | 540 | 480 |

Notes:

1. The performance was estimated based on 2D/3D NAND flash.
2. Performance may differ according to flash configuration and platform.
3. The table above is for reference only.

- **TBW (Terabytes Written)**

- **MLC:**

| Capacity | Flash Structure | TBW |
|----------|-----------------|-----|
| 32GB | 32GB x 1 | 13 |
| 64GB | 32GB x 2 | 30 |
| 128GB | 64GB x 2 | 87 |
| 256GB | 128GB x 2 | 198 |

- **pSLC:**

| Capacity | Flash Structure | TBW |
|----------|-----------------|-----|
| 16GB | 32GB x 1 | 49 |
| 32GB | 32GB x 2 | 106 |
| 64GB | 64GB x 2 | 215 |
| 128GB | 128GB x 2 | 649 |

- **SLC:**

| Capacity | Flash Structure | TBW |
|----------|-----------------|-----|
| 8GB | 8GB x 1 | 74 |
| 16GB | 8GB x 2 | 153 |
| 32GB | 16GB x 2 | 325 |
| 64GB | 32GB x 2 | 761 |

- **3D Bics3:**

| Capacity | Flash Structure | TBW |
|----------|-----------------|-----|
| 64GB | 64GB x 1 | 42 |
| 128GB | 64GB x 2 | 75 |
| 256GB | 128GB x 2 | 180 |
| 512GB | 256GB x 2 | 425 |

- **Bics3 pSLC:**

| Capacity | Flash Structure | TBW |
|----------|-----------------|------|
| 16GB | 64GB x 1 | 374 |
| 32GB | 64GB x 2 | 769 |
| 64GB | 128GB x 2 | 1682 |
| 128GB | 256GB x 2 | 5034 |

- **3D Bics4:**

| Capacity | Flash Structure | TBW |
|-------------|-----------------|-----|
| 120GB/128GB | 64GB x 2 | 70 |
| 240GB/256GB | 64GB x 4 | 155 |
| 480GB/512GB | 128GB x 4 | 328 |

Notes:

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

2.2. MTBF

MTBF (mean time between failures) is a measure of how reliable a hardware product is. Its value represents the average time between a failure repair and the next failure. The unit of MTBF is typically in 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.

- SLC: > 3,000,000 hours
- pSLC: >2,500,000 hours
- MLC: >2,000,000 hours
- 3D TLC: >2,000,000 hours

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)
 - ◆ Wide grade: RH 95% under 55°C (operational)

■ High Temperature Test Condition

| | Temperature | Humidity | Test Time |
|----------------------|-------------|----------|-----------|
| Operation (Standard) | 70°C | 0% RH | 72 hours |
| Operation (Wide) | 85°C | 0% RH | 72 hours |
| Storage (Standard) | 85°C | 0% RH | 72 hours |
| Storage (Wide) | 85°C | 0% RH | 168 hours |

Result: No abnormality is detected.

■ Low Temperature Test Condition

| | Temperature | Humidity | Test Time |
|----------------------|-------------|----------|-----------|
| Operation (Standard) | 0°C | 0% RH | 72 hours |
| Operation (Wide) | -40°C | 0% RH | 72 hours |
| Storage (Standard) | -40°C | 0% RH | 72 hours |
| Storage (Wide) | -40°C | 0% RH | 168 hours |

Result: No abnormality is detected.

■ High Humidity Test Condition

| | Temperature | Humidity | Test Time |
|----------------------|-------------|----------|-----------|
| Operation (Standard) | 40°C | 93% RH | 24 hours |
| Operation (Wide) | 55°C | 95% RH | 72 hours |
| Storage (Standard) | 40°C | 95% RH | 72 hours |
| Storage (Wide) | 55°C | 95% RH | 96 hours |

Result: No abnormality is detected.

■ Temperature Cycle Test

| | Temperature | Test Time | Cycle |
|----------------------|-------------|-----------|-----------|
| Operation (Standard) | 0°C | 30 min | 10 cycles |
| | 70°C | 30 min | |
| Operation (Wide) | -40°C | 30 min | 20 cycles |
| | 85°C | 30 min | |
| Storage (Standard) | -40°C | 30 min | 10 cycles |
| | 85°C | 30 min | |
| Storage (Wide) | -40°C | 30 min | 50 cycles |
| | 85°C | 30 min | |

Result: No abnormality is detected.

3.1.2. Shock

■ Shock Specification

| | Acceleration Force | Half Sin Pulse Duration |
|-----------------|--------------------|-------------------------|
| Non-Operational | 1500G | 0.5ms |
| Operational | 1500G | 0.5ms |

Result: No abnormality is detected when power on.

3.1.3. Vibration

■ Vibration Specification

| | Condition | | Vibration Orientation |
|-------------|------------------------|------------------------|------------------------------|
| | Frequency/Displacement | Frequency/Acceleration | |
| Operational | 20Hz~80Hz/1.52mm | 80Hz~2000Hz/20G | X, Y, Z axis/60 min for each |

Result: No abnormality is detected when power on.

3.1.4. Drop

■ Drop Specification

| | Height of Drop | Number of Drop |
|-----------------|----------------|------------------------------|
| Non-operational | 80cm free fall | 6 face of each unit, 2 times |

Result: No abnormality is detected when power on.

3.1.5. Bending

■ Bending Specification

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

Result: No abnormality is detected when power on.

3.1.6. Electrostatic Discharge (ESD)

■ Contact ESD Specification

| Device | Capacity | Temperature | Relative Humidity | +/- 4KV | Result |
|--------|----------------|-------------|-------------------|---|--------|
| CFast | 128GB 256GB | 24.0°C | 49% (RH) | Device functions are affected, but EUT will be back to its normal or operational state automatically. | PASS |

3.2. Certification & Compliance

- RoHS
- CE / FCC

4. ELECTRICAL SPECIFICATIONS



4.1. Supply Voltage

| Parameter | Rating |
|---------------------|---------------|
| Operating Voltage | 3.3V , ±5% |
| Rise Time (Max/min) | 100ms / 0.1ms |
| Fall Time (Max/min) | 5s / 1ms |

4.2. Power Consumption

■ MLC

| Capacity | Flash Structure | Flash Type | Read | Write | Partial | Slumber | Idle | DEVSLP |
|----------|-----------------|------------|-------|-------|---------|---------|------|--------|
| 32GB | 32GB x 1 | 15nm, BGA | 1,000 | 1,100 | 19 | 14 | 260 | 4.9 |
| 64GB | 32GB x 2 | 15nm, BGA | 1,040 | 1,215 | 19 | 14 | 260 | 4.9 |
| 128GB | 64GB x 2 | 15nm, BGA | 1,090 | 1,475 | 19 | 14 | 260 | 4.9 |
| 256GB | 128GB x 2 | 15nm, BGA | 1,190 | 1,570 | 19 | 14 | 260 | 4.9 |

Unit: mW

■ pSLC

| Capacity | Flash Structure | Flash Type | Read | Write | Partial | Slumber | Idle | DEVSLP |
|----------|-----------------|------------|-------|-------|---------|---------|------|--------|
| 16GB | 32GB x 1 | 15nm, BGA | 1,000 | 1,100 | 19 | 14 | 260 | 4.9 |
| 32GB | 32GB x 2 | 15nm, BGA | 1,040 | 1,215 | 19 | 14 | 260 | 4.9 |
| 64GB | 64GB x 2 | 15nm, BGA | 1,090 | 1,475 | 19 | 14 | 260 | 4.9 |
| 128GB | 128GB x 2 | 15nm, BGA | 1,190 | 1,570 | 19 | 14 | 260 | 4.9 |

Unit: mW

■ SLC

| Capacity | Flash Structure | Flash Type | Read | Write | Partial | Slumber | Idle | DEVSLP |
|----------|-----------------|------------|-------|-------|---------|---------|------|--------|
| 8GB | 8GB x 1 | 24nm, BGA | 1,200 | 1,000 | 20 | 15 | 325 | 4.9 |
| 16GB | 8GB x 2 | 24nm, BGA | 1,600 | 1,250 | 20 | 15 | 325 | 4.9 |
| 32GB | 16GB x 2 | 24nm, BGA | 1,650 | 1,700 | 20 | 15 | 325 | 4.9 |
| 64GB | 32GB x 2 | 24nm, BGA | 1,700 | 1,950 | 20 | 15 | 325 | 4.9 |

Unit: mW

■ 3D Bics3

| Capacity | Flash Structure | Flash Type | Read | Write | Partial | Slumber | Idle | DEVSLP |
|----------|-----------------|----------------|-------|-------|---------|---------|------|--------|
| 64GB | 64GB x 1 | TSB Bics3, BGA | 1,270 | 1,350 | 20 | 15 | 325 | 4.9 |
| 128GB | 64GB x 2 | TSB Bics3, BGA | 1,270 | 1,360 | 20 | 15 | 325 | 4.9 |
| 256GB | 128GB x 2 | TSB Bics3, BGA | 1,360 | 1,440 | 20 | 15 | 325 | 4.9 |
| 512GB | 256GB x 2 | TSB Bics3, BGA | 1,700 | 1,690 | 20 | 15 | 325 | 4.9 |

Unit: mW

■ Bics3 pSLC

| Capacity | Flash Structure | Flash Type | Read | Write | Partial | Slumber | Idle | DEVSLP |
|----------|-----------------|----------------|-------|-------|---------|---------|------|--------|
| 16GB | 64GB x 1 | TSB Bics3, BGA | 985 | 1000 | 20 | 15 | 325 | 4.9 |
| 32GB | 64GB x 2 | TSB Bics3, BGA | 1,150 | 1,210 | 20 | 15 | 325 | 4.9 |
| 64GB | 128GB x 2 | TSB Bics3, BGA | 1,300 | 1,310 | 20 | 15 | 325 | 4.9 |
| 128GB | 256GB x 2 | TSB Bics3, BGA | 1,320 | 1,400 | 20 | 15 | 325 | 4.9 |

Unit: mW

■ 3D Bics4

| Capacity | Flash Structure | Flash Type | Read | Write | Partial | Slumber | Idle | DEVSLP |
|----------|-----------------|----------------|-------|-------|---------|---------|------|--------|
| 128GB | 64GB x 2 | TSB Bics4, BGA | 1,350 | 1,300 | 15 | 11 | 215 | 4.9 |
| 256GB | 128GB x 2 | TSB Bics4, BGA | 1,400 | 1,450 | 16 | 12 | 220 | 4.9 |
| 512GB | 256GB x 2 | TSB Bics4, BGA | 1,430 | 1,390 | 16 | 12 | 225 | 4.9 |

Unit: mW

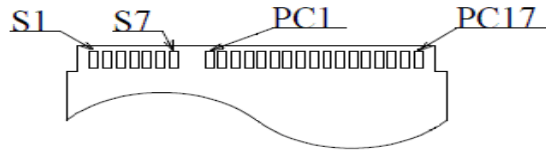
Notes:

1. Average value of power consumption is achieved based on 100% conversion efficiency.
2. The measured power voltage is 3.3V.
3. Samples were built using 2D/3D NAND flash and measured under normal temperature.
4. Sequential R/W is measured while testing 4000MB sequential R/W 5 times by CrystalDiskMark.
5. Power Consumption may differ according to flash configuration and platform.

5. INTERFACE



5.1. Pin Assignment and Descriptions



| Pin # | Segment | Pin Definition | Type | Description | Meting Sequence |
|-------|---------|----------------|-------------------|--------------------------------------|-----------------|
| S1 | SATA | SGND | Signal GND | Ground for signal integrity | 1 st |
| S2 | SATA | A+ | SATA Differential | Signal Pair A | 2 nd |
| S3 | SATA | A- | SATA Differential | Signal Pair A | 2 nd |
| S4 | SATA | SGND | Signal GND | Ground for signal integrity | 1 st |
| S5 | SATA | B- | SATA Differential | Signal Pair B | 2 nd |
| S6 | SATA | B+ | SATA Differential | Signal Pair B | 2 nd |
| S7 | SATA | SGND | Signal GND | Ground for signal integrity | 1 st |
| | Key | | | | |
| | Key | | | | |
| PC1 | PWR/CTL | CDI | Input | Card Detect In | 3 rd |
| PC2 | PWR/CTL | PGND | Device GND | | 1 st |
| PC3 | PWR/CTL | DEVSLP | DEVSLP Card Input | DevSleep Power State Enable | 2 nd |
| PC4 | PWR/CTL | | | Reserved | 2 nd |
| PC5 | PWR/CTL | | | Reserved | 2 nd |
| PC6 | PWR/CTL | | | Reserved | 2 nd |
| PC7 | PWR/CTL | PGND | Device GND | | 1 st |
| PC8 | PWR/CTL | LED1 | LED Output | LED Output | 2 nd |
| PC9 | PWR/CTL | LED2 | LED Output | LED Output | 2 nd |
| PC10 | PWR/CTL | | | Reserved | 2 nd |
| PC11 | PWR/CTL | | | Reserved | 2 nd |
| PC12 | PWR/CTL | IFDet | GND | Card output, connect to PGND on card | 2 nd |
| PC13 | PWR/CTL | PWR | 3.3V | Device Power (3.3V) | 2 nd |
| PC14 | PWR/CTL | PWR | 3.3V | Device Power (3.3V) | 2 nd |
| PC15 | PWR/CTL | PGND | Device GND | Device Ground | 1 st |
| PC16 | PWR/CTL | PGND | Device GND | Device Ground | 1 st |
| PC17 | PWR/CTL | CDO | Output | Card Detect Out | 3 rd |

| Pin # | Segment | Pin Definition | Type | Description | Meting Sequence |
|-------------|---------|----------------|-------------------|--------------------------------------|-----------------|
| S1 | SATA | SGND | Signal GND | Ground for signal integrity | 1 st |
| S2 | SATA | A+ | SATA Differential | Signal Pair A | 2 nd |
| S3 | SATA | A- | SATA Differential | Signal Pair A | 2 nd |
| S4 | SATA | SGND | Signal GND | Ground for signal integrity | 1 st |
| S5 | SATA | B- | SATA Differential | Signal Pair B | 2 nd |
| S6 | SATA | B+ | SATA Differential | Signal Pair B | 2 nd |
| S7 | SATA | SGND | Signal GND | Ground for signal integrity | 1 st |
| | Key | | | | |
| | Key | | | | |
| PC1 | PWR/CTL | CDI | Input | Card Detect In | 3 rd |
| PC2 | PWR/CTL | PGND | Device GND | | 1 st |
| PC3 | PWR/CTL | DEVSLP | DEVSLP Card Input | DevSleep Power State Enable | 2 nd |
| PC4 | PWR/CTL | | | Reserved | 2 nd |
| PC5 | PWR/CTL | | | Reserved | 2 nd |
| PC6 | PWR/CTL | | | Reserved | 2 nd |
| PC7 | PWR/CTL | PGND | Device GND | | 1 st |
| PC8 | PWR/CTL | LED1 | LED Output | LED Output | 2 nd |
| PC9 | PWR/CTL | LED2 | LED Output | LED Output | 2 nd |
| PC10 | PWR/CTL | | | Reserved | 2 nd |
| PC11 | PWR/CTL | | | Reserved | 2 nd |
| PC12 | PWR/CTL | IFDet | GND | Card output, connect to PGND on card | 2 nd |
| PC13 | PWR/CTL | PWR | 3.3V | Device Power (3.3V) | 2 nd |
| PC14 | PWR/CTL | PWR | 3.3V | Device Power (3.3V) | 2 nd |
| PC15 | PWR/CTL | PGND | Device GND | Device Ground | 1 st |
| PC16 | PWR/CTL | PGND | Device GND | Device Ground | 1 st |
| PC17 | PWR/CTL | CDO | Output | Card Detect Out | 3 rd |

6. SUPPORTED COMMANDS



6.1. ATA Command List

| Op-Code | Command Description | Op-Code | Command Description | |
|---------|-----------------------------------|------------------------------------|------------------------------|---|
| 00h | NOP | 60h | Read FPDMA Queued | |
| 06h | Data Set Management | 61h | Write FPDMA Queued | |
| 10h | Recalibrate | 70h | Seek | |
| 20h | Read Sectors | 90h | Execute Device Diagnostic | |
| 21h | Read Sectors without Retry | 91h | Initialize Device Parameters | |
| 24h | Read Sectors EXT | 92h | Download Microcode | |
| 25h | Read DMA EXT | 93h | Download Microcode DMA | |
| 27h | Read Native Max Address EXT | B0h | SMART | |
| 29h | Read Multiple EXT | B0h | D0h | SMART READ DATA |
| 2Fh | Read Log EXT | B0h | D1h | SMART READ DATA ATTRIBUTE THRESHOLD |
| 30h | Write Sectors | B0h | D2h | SMART ENABLE/DISABLE ATTRIBUTE AUTOSAVE |
| 31h | Write Sectors without Retry | B0h | D3h | SMART SAVE ATTRIBUTE VALUES |
| 34h | Write Sectors EXT | B0h | D4h | SMART EXECUTE OFF-LINE IMMEDIATE |
| 35h | Write DMA EXT | B0h | D5h | SMART READ LOG |
| 37h | Set Native Max Address EXT | B0h | D6h | SMART WRITE LOG |
| 39h | Write Multiple EXT | B0h | D8h | SMART ENABLE OPERATIONS |
| 3Dh | Write DMA FUA EXT | B0h | D9h | SMART DISABLE OPERATIONS |
| 3Fh | Write Long EXT | B0h | DAh | SMART RETURN STATUS |
| 40h | Read Verify Sectors | B0h | DBh | SMART ENABLE/DISABLE AUTOMATIC OFF-LINE |
| 41h | Read Verify Sectors without Retry | B1h | | DEVICE CONFIGURATION OVERLAY |
| 42h | Read Verify Sectors EXT | B1h | C0h | DEVICE CONFIGURATION RESTORE |
| 45h | Write Uncorrectable EXT | B1h | C1h | DEVICE CONFIGURATION FREEZE LOCK |
| 47h | Read Log DMA EXT | B1h | C2h | DEVICE CONFIGURATION IDENTIFY |
| 57h | Write Log DMA EXT | B1h | C3h | DEVICE CONFIGURATION SET |
| B1h | C4h | DEVICES CONFIGURATION IDENTIFY DMA | ECh | Identify Device |
| B1h | C5h | DEVICES CONFIGURATION SET DMA | EFh | Set Features |
| C4h | Read Multiple | EFh | 02h | Enable 8-bit PIO transfer mode |

| Op-Code | | Command Description | Op-Code | | Command Description |
|---------|-----|---------------------------------------|---------|---------|---|
| C5h | | Write Multiple | EFh | 03h | Set transfer mode based on value in Count field |
| C6h | | Set Multiple Mode | EFh | 05h | Enable advanced power management |
| C8h | | Read DMA | EFh | 10h | Enable use of Serial ATA feature |
| C9h | | Read DMA without Retry | EFh | 10h 02h | Enable DMA Setup FIS Auto-Activate optimization |
| CAh | | Write DMA | EFh | 10h 03h | Enable Device-initiated interface power state (DIPM) transitions |
| CBh | | Write DMA without Retry | EFh | 10h 06h | Enable Software Settings Preservation (SSP) |
| CEh | | Write Multiple FUA EXT | EFh | 10h 07h | Enable Device Automatic Partial to Slumber transitions |
| E0h | | Standby Immediate | EFh | 10h 09h | Enable Device Sleep |
| E1h | | Idle Immediate | EFh | 55h | Disable read look-ahead feature |
| E2h | | Standby | EFh | 66h | Disable reverting to power-on defaults |
| E3h | | Idle | EFh | 82h | Disable write cache |
| E4h | | Read Buffer | EFh | 85h | Disable advanced power management |
| E5h | | Check Power Mode | EFh | 90h | Disable use of Serial ATA feature set |
| E6h | | Sleep | EFh | 90h 02h | Disable DMA Setup FIS Auto-Activate optimization |
| E7h | | Flush Cache | EFh | 90h 03h | Disable Device-initiated interface power state (DIPM) transitions |
| E8h | | Write Buffer | EFh | 90h 06h | Disable Software Settings Preservation (SSP) |
| E9h | | Read Buffer DMA | EFh | 90h 07h | Disable Device Automatic Partial to Slumber transitions |
| EAh | | Flush Cache EXT | EFh | 90h 09h | Disable Device Sleep |
| EBh | | Write Buffer DMA | EFh | AAh | Enable read look-ahead feature |
| EFh | CCh | Enable reverting to power-on defaults | F4h | | Security Erase Unit |
| F1h | | Security Set Password | F5h | | Security Freeze Lock |
| F2h | | Security Unlock | F6h | | Security Disable Password |
| F3h | | Security Erase Prepare | F8h | | Read Native Max Address |

6.2. Identify Device Data

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

| 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 (xxxxxxx) |
| 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 | 00000000h | 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 | 000000000000 0000h | 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 | 000000000000 0000h | 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) |
|------------------|------------------------|--------------------|--------------------|----------------------|
| 8 | 3CA5h | EEC9B0h | EEC9B0h | EEC9B0h |
| 16 | 3FFFh | FBFC10h | 1DD40B0h | 1DD40B0h |
| 30 | 3FFFh | FBFC10h | 37E90F0h | 37E90F0h |
| 32 | 3FFFh | FBFC10h | 3BA2EB0h | 3BA2EB0h |
| 60 | 3FFFh | FBFC10h | 6FCCF30h | 6FCCF30h |
| 64 | 3FFFh | FBFC10h | 7740AB0h | 7740AB0h |
| 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 |

7. ACRONYMS



| Acronym | Definition |
|---------|--|
| DIPM | Device initiated power management |
| ECC | Error Correcting Code |
| LBA | Logical block addressing |
| MB | Mega-byte |
| MLC | Multi-level Cell |
| MTBF | Mean time between failures |
| pSLC | Pseudo SLC |
| SATA | Serial advanced technology attachment |
| SDR | Synchronous dynamic access memory |
| SLC | Single-level Cell |
| SMART | Self-monitoring, analysis and reporting technology |
| TLC | Triple-level Cell |

8. PART NUMBER DECODER



CFA-AKX¹X²X³X⁴X⁵X⁶X⁷X⁸

| Item | Series | Capacity | NAND Flash & Temperature Grade | Option |
|--|--------|--|--|-------------------------------|
| | | X ¹ X ² X ³ X ⁴ X ⁵ | X ⁶ | X ⁷ X ⁸ |
| CFA | AK | 008GB 016GB 030GB 032GB 060GB 064GB 120GB 128GB 240GB 256GB 480GB 512GB | C: SLC Standard (0°C to +70°C) I: SLC Industrial (-40°C to +85°C) K: MLC Standard (0°C to +70°C) M: MLC Industrial (-40°C to +85°C) P: pSLC Standard (0°C to +70°C) F: pSLC Industrial (-40°C to +85°C) A: 3D TLC Standard (0°C to +70°C) B: 3D TLC Industrial (-40°C to +85°C) V: 3D pSLC Standard (0°C to +70°C) W: 3D pSLC Industrial (-40°C to +85°C) | See below |
| <p>X⁸ X⁹ (Reserved for specific requirement)</p> <p>Blank: Standard</p> <p>06: Conformal Coating (CC)</p> <p>26: Thermal Sensor (TS)</p> <p>38: TS + CC</p> | | | | |