

# Industrial and Enterprise CFast<sup>™</sup> SSD DataSheet

Addonics<sup>®</sup>

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## Revision History

Revision	Draft Date	History	Author
1.0	2014/6/3	New release	GL
1.1	2014/11/11	Modify Part number decoder	GL
1.2	2015/7/3	Modify MLC highest capacity	GL

Addonics<sup>®</sup>

## Product Overview

- **Capacity**
  - SLC: 1GB up to 64GB
  - MLC: 4GB up to 256GB
- **SATA Interface**
  - SATA Revision 3.0
  - SATA 1.5Gbps, 3Gbps, and 6Gbps interface
- **Flash Interface**
  - Flash Type: SLC and MLC
- **Performance**
  - Read: up to 520 MB/s
  - Write: up to 190 MB/s
- **Power Consumption**<sup>Note1</sup>
  - Active mode: < 1600mW
  - Idle mode: < 300mW
  - DEVSLP mode: < 5mW
- **TBW (Terabyte Written)**
  - SLC: 3,410 TBW for 64GB
  - MLC: 635 TBW for 256GB
- **MTBF**
  - SLC: 3,000,000 hours
  - MLC: 2,000,000 hours
- **Advanced Flash Management**
  - Static and Dynamic Wear Leveling
  - Bad Block Management
  - TRIM
  - SMART
  - Over-Provision
- **Low Power Management**
  - DEVSLP Mode (Optional)
  - DIPM/HIPM Mode
- **Temperature Range**
  - Operation (Standard): 0°C ~ 70°C
  - Operation (Industrial): -40°C ~ 85°C
  - Storage: -40°C ~ 85°C
- **Compliant**
  - RoHS
  - CE & FCC

### Notes:

1. Please see "Power Consumption" for details.

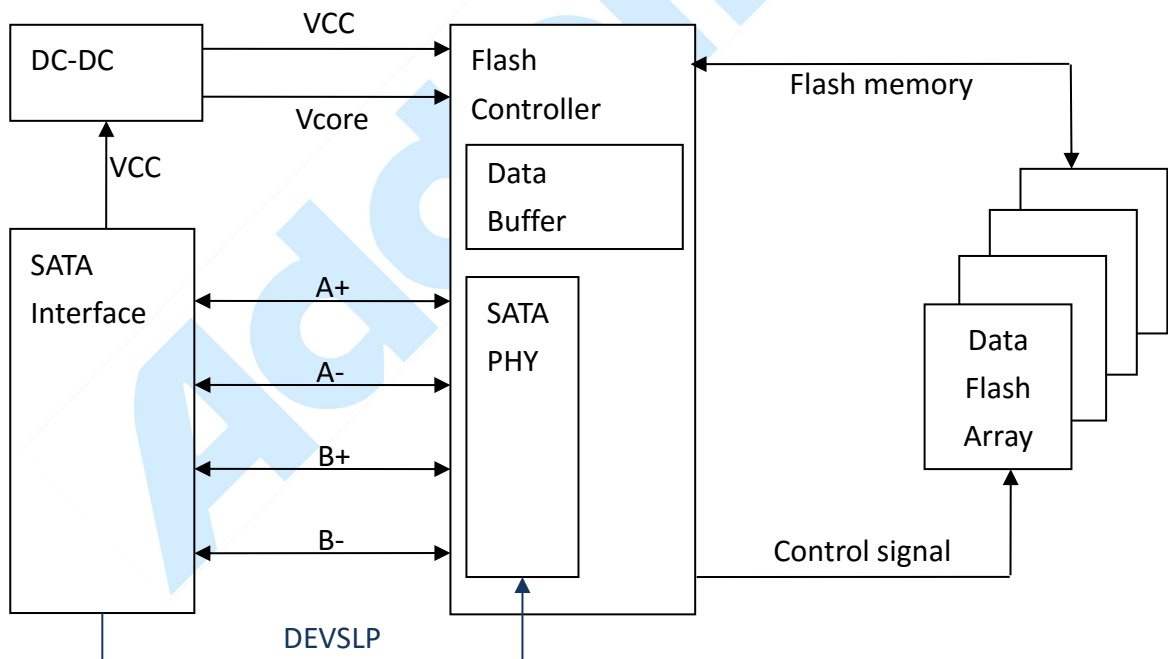
## 1. INTRODUCTION

### 1.1. General Description

Addonics CFast™ delivers all the advantages of Flash Disk technology with the Serial ATA III interface and is fully compliant with the standard CFast™ form factor. Given the features of the low power consumption, small form factor, and high shock-resistance, CFast™ is an attractive solution to replace the conventional [PATA-interfaced] CompactFlash card in industrial applications or markets where performance is a major concern.

CFast™, consisting of a SATA-based 7-pin standard interface for data segment and 17-pin for power and controller segment, is designed to operate at a maximum operating frequency of 300MHz with 40MHz external crystal. Its capacity could provide a wide range up to 256GB. Moreover, it can reach up to 520MB/s read as well as 190MB/s write high performance based on Toshiba NAND flash (with 32MB SDR enabled and measured by CrystalDiskMark v3.0).

### 1.2. Block Diagram



**CFast Block Diagram**

## 2. PRODUCT SPECIFICATIONS

- **Capacity**
  - SLC: From 1GB up to 64GB (support 48-bit addressing mode)
  - MLC: From 4GB up to 256GB (support 48-bit addressing mode)
- **Electrical/Physical Interface**
  - SATA Interface
    - ◆Compliant with SATA Revision 3.0
    - ◆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
- **Supported NAND Flash**
  - Toshiba SLC and MLC, Toggle1.0 and Toggle2.0
  - Supports SLC large block 4K, 8K/page NAND flash
  - Supports MLC large block 16K/page NAND flash
  - Support ONFI 2.3 and ONFI 3.0 interface: 4 channels at maximum
- **ECC Scheme**
  - Up to 72 bits / 1K Byte
- **UART function**
- **GPIO**
- **Support SMART and TRIM commands**

## 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 (Industrial grade): -40°C to 85°C
- Humidity:
  - ◆ Standard grade: RH 90% under 40°C (operational)
  - ◆ Industrial grade: RH 95% under 55°C (operational)

#### ■ High Temperature Test Condition

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

Result: No any abnormality is detected.

#### ■ Low Temperature Test Condition

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

Result: No any abnormality is detected.

#### ■ High Humidity Test Condition

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

Result: No any abnormality is detected.

■ **Temperature Cycle Test**

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

**Result:** No any abnormality is detected.

**3.1.2. Shock**

■ **Shock Specification**

	Acceleration Force	Half Sin Pulse Duration
Operational	1500G	0.5ms

**Result:** No any 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 any abnormality is detected when power on.

**3.1.4. Drop**

■ **Drop Specification**

	Height of Drop	Number of Drop
Non-operational	110cm free fall	6 face of each unit, 2 times

**Result:** No any abnormality is detected when power on.

**3.1.5. Bending**

■ **Bending Specification**

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



**Result:** No any abnormality is detected when power on.

### 3.1.6. Torque

#### ■ Torque Specification

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

**Result:** No any abnormality is detected when power on.

### 3.1.7. Electrostatic Discharge (ESD)

#### ■ Contact ESD Specification

Device	Capacity	Temperature	Relative Humidity	+/- 4KV	Result
CFast	64GB 128GB	24.0°C	49% (RH)	Device functions are affected, but EUT will be back to its normal or operational state automatically.	PASS

### 3.2. MTBF

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 units of hours. The higher the MTBF value, the higher the reliability of the device. The predicted result of Addonics's CFast is up to 3,000,000 hours.

### 3.3. Certification

- RoHS
- CE / FCC

### 3.4. Compliance

- SATA III (SATA Rev. 3.0)
- Up to ATA/ATAPI-8 (Including S.M.A.R.T)

## 4. ELECTRICAL SPECIFICATIONS

### 4.1. Supply Voltage

Parameter	Rating
Operating Voltage	3.3V

### 4.2. Power Consumption

Current	Read	Write	Partial	Slumber	Idle	DEVSLP
SLC (max.)	1350	1400	80	30	290	5
MLC (max.)	1600	1300	80	30	300	5

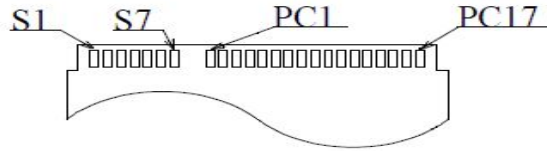
Unit: mW

**NOTES:**

1. It's average value of power consumption based on 100% conversion efficiency.
2. The measured power voltage is 3.3V.
3. Samples were built using Toshiba NAND flash and measured under normal temperature.
4. Sequential R/W is measured while testing 4000MB sequential R/W 5 times by CrystallDiskMark. DEVSLP is measured while entering device sleep mode for 5 minutes.
5. Power Consumption may differ according to flash configuration, SDR configuration, or platform.

## 5. INTERFACE

### 5.1. Pin Assignment and Descriptions



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

## 6. SUPPORTED COMMANDS

### 6.1. ATA Command List

Code	Description	Code	Description
00h	NOP	97h	IDLE
06h	Data Set Management	98h	CHECK POWER MODE
10h-1Fh	Recalibrate	99h	SLEEP
20h	Read Sectors	B0h	SMART
21h	Read Sectors without Retry	B1h	DEVICE CONFIGURATION
24h	Read Sectors EXT	C4h	Read Multiple
25h	Read DMA EXT	C5h	Write Multiple
27h	Read Native Max Address EXT	C6h	Set Multiple Mode
29h	Read Multiple EXT	C8h	Read DMA
2Fh	Read Log EXT	C9h	Read DMA without Retry
30h	Write Sectors	CAh	Write DMA
31h	Write Sectors without Retry	CBh	Write DMA without Retry
34h	Write Sectors EXT	CEh	Write Multiple FUA EXT
35h	Write DMA EXT	E0h	Standby Immediate
37h	Set Native Max Address EXT	E1h	Idle Immediate
38h	CFA WRITE SECTORS WITHOUT ERASE	E2h	Standby
39h	Write Multiple EXT	E3h	Idle
3Dh	Write DMA FUA EXT	E4h	Read Buffer
3Fh	Write Long EXT	E5h	Check Power Mode
40h	Read Verify Sectors	E6h	Sleep
41h	Read Verify Sectors without Retry	E7h	Flush Cache
42h	Read Verify Sectors EXT	E8h	Write Buffer
45h	WRITE UNCORRECTABLE EXT	EAh	Flush Cache EXT
60h	Read FPDMA Queued	ECh	Identify Device
61h	Write FPDMA Queued	EFh	Set Features
70h-7Fh	Seek	F1h	Security Set Password
90h	Execute Device Diagnostic	F2h	Security Unlock
91h	Initialize Device Parameters	F3h	Security Erase Prepare
92h	Download Microcode	F4h	Security Erase Unit
93h	DOWNLOAD MICROCODE DMA	F5h	Security Freeze Lock
94h	STANDBY IMMEDIATE	F6h	Security Disable Password
95h	IDLE IMMEDIATE	F8h	Read Native Max Address
96h	STANDBY	F9h	Set 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: Both	Default Value	Description
0	F	0040h	General configuration bit-significant information
1	X	<b>*1</b>	Obsolete – Number of logical cylinders
2	V	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	V	00000000h	Reserved for assignment by the Compact Flash Association
9	X	0000h	Retired
10-19	F	Varies	Serial number (20 ASCII characters)
20-21	X	0000h	Retired
22	X	0000h	Obsolete
23-26	F	Varies	Firmware revision (8 ASCII characters)
27-46	F	Varies	Model number (xxxxxxxx)
47	F	8010h	7:0- Maximum number of sectors transferred per interrupt on MULTIPLE commands
48	F	4000h	Trusted Computing feature set options(not support)
49	F	2F00h	Capabilities
50	F	4000h	Capabilities
51-52	X	000000000h	Obsolete
53	F	0007h	Words 88 and 70:64 valid
54	X	<b>*1</b>	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	<b>*2</b>	Obsolete – Current capacity in sectors
59	F	0110h	Number of sectors transferred per interrupt on MULTIPLE commands
60-61	F	<b>*3</b>	Maximum number of sector ( 28bit LBA mode)
62	X	0000h	Obsolete
63	F	0407h	Multi-word DMA modes supported/selected
Word	F: Fixed	Default Value	Description

	V: Variable X: Both		
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	0100h	Additional Supported (support download microcode DMA)
70	F	0000h	Reserved
71-74	F	0000000000000000 0h	Reserved for the IDENTIFY PACKET DEVICE command
75	F	001Fh	Queue depth
76	F	670eh	Serial SATA capabilities
77	F	0084h	Serial ATA Additional Capabilities
78	F	014Ch	Serial ATA features supported
79	V	0040h	Serial ATA features enabled
80	F	07F8h	Major Version Number
81	F	0000h	Minor Version Number
82	F	346bh	Command set supported
83	F	7d09h	Command set supported
84	F	6063h	Command set/feature supported extension
85	V	3469h	Command set/feature enabled
86	V	bc01h	Command set/feature enabled
87	V	6063h	Command set/feature default
88	V	003Fh	Ultra DMA Modes
89	F	0001h	Time required for security erase unit completion
90	F	001Eh	Time required for Enhanced security erase completion
91	V	0000h	Current advanced power management value
92	V	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.
<b>Word</b>	<b>F: Fixed</b>	<b>Default Value</b>	<b>Description</b>

	V: Variable X: Both		
94	V	0000h	Vendor's recommended and actual acoustic management value
95	F	0000h	Stream Minimum Request Size
96	V	0000h	Streaming Transfer Time – DMA
97	V	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	V	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	0000000000000000 0h	Unique ID
112-115	F	0000000000000000 0h	Reserved
116	V	0000h	Reserved
117-118	F	00000000h	Words per logical Sector
119	F	4014h	Supported settings
120	F	4014h	Command set/Feature Enabled/Supported
121-126	F	0h	Reserved
127	F	0h	Removable Media Status Notification feature set support
128	V	0021h	Security status
129-140	X	0h	Vendor specific
141	X	0001h	Vendor specific
142-159	X	0h	Vendor specific
160	F	0h	Compact Flash Association (CFA) power mode 1
161-167	X	0h	Reserved for assignment by the CFA
168	F	3h 2.5 inch 4h 1.8 inch 5h Less than 1.8 inch	Device Nominal Form Factor
<b>Word</b>	<b>F: Fixed</b>	<b>Default Value</b>	<b>Description</b>

	V: Variable X: Both		
169	F	0001h	DATA SET MANAGEMENT command is supported
170-173	F	0h	Additional Product Identifier
174-175		0h	Reserve
176-205	V	0h	Current media serial number
206	F	0h	SCT Command Transport
207-208	F	0h	Reserved
209	F	4000h	Alignment of logical blocks within a physical block
210-211	V	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		0000h	NV Cache relate (not support)
217	F	0001h	Non-rotating media device
218	F	0h	Reserved
219	F	0h	NV Cache relate (not support)
220	V	0h	Write read verify feature set current mode
221		0h	Reserved
222	F	107Fh	Transport major version number
223	F	0h	Transport minor version number
224-229		0h	reserved
230-233		0h	Extend number of user addressable sectors
234		0001h	Minimum number of 512-byte data blocks per DOWNLOAD MICROCODE command for mode 03h
235		0080h	Maximum number of 512-byte data blocks per DOWNLOAD MICROCODE command for mode 03h
236-254	F	0h	Reserved
255	X	XXA5h XX is variable	Integrity word (Checksum and Signature)

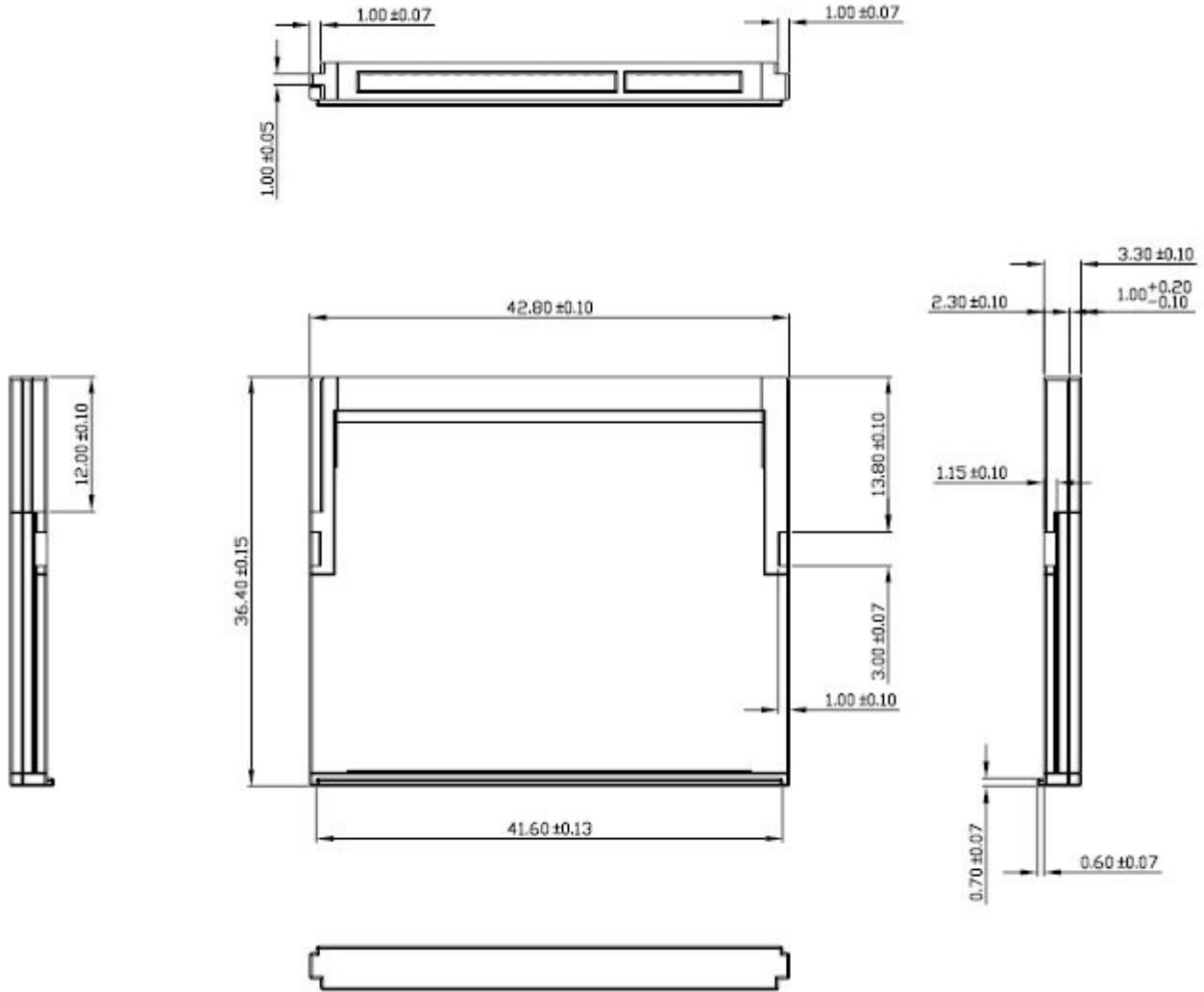


Capacity (GB)	*1 (Word 1/Word 54)	*2 (Word 57–58)	*3 (Word 60–61)	*4 (Word 100–103)
1	7A7h	1E2190h	1E2190h	1E2190h
2	F39h	3BF070h	3BF070h	3BF070h
4	1E5Dh	778E30h	778E30h	778E30h
8	3CA5h	EEC9B0h	EEC9B0h	EEC9B0h
16	3FFFh	FBFC10h	1DD40B0h	1DD40B0h
32	3FFFh	FBFC10h	3BA2EB0h	3BA2EB0h
64	3FFFh	FBFC10h	7740AB0h	7740AB0h
128	3FFFh	FBFC10h	EE7C2B0h	EE7C2B0h

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## 7. PHYSICAL DIMENSION

CFast™ Type I: 36.4mm (L) x 42.8mm (W) x 3.3mm (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
DEVSLP	Device Sleep Mode
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
SDR	Synchronous dynamic access memory
S.M.A.R.T.	Self-monitoring, analysis and reporting technology
SSD	Solid state disk