

# Intel® Solid State Drive Data Center S3100 Series

## Product Specification

- **Capacity:**
  - 2.5-inch 180GB, 240GB, 480GB, 1.0TB
- **Components:**
  - TLC NAND Flash Memory
  - Standard Endurance Technology (SET)
- **Form Factor:** 2.5-inch
- **Read and Write IOPS<sup>1,2</sup>**  
(Full LBA Range, IOMeter\* Queue Depth 32)
  - Random 4KB<sup>3</sup> Reads: Up to 59,000 IOPS
  - Random 4KB Writes: Up to 4,700 IOPS
  - Random 8KB<sup>3</sup> Reads: Up to 48,000 IOPS
  - Random 8KB Writes: Up to 2,200 IOPS
- **Bandwidth Performance<sup>1</sup>**
  - Sustained Sequential Read: Up to 535 MB/s<sup>4</sup>
  - Sustained Sequential Write: Up to 118 MB/s
- **Endurance at 3 Years**  
(Endurance boundary is SMART E9h=1)
  - 180GB: 0.37 DW/D    – 240 GB: 0.27 DW/D
  - 480GB: 0.14 DW/D    – 1.0 TB: 0.10 DW/D
- **Latency (average sequential)**
  - Read: 55 µs (TYP)
  - Write: 55 µs (TYP)
- **Quality of Service<sup>6,8</sup>**
  - Read: <350us / Write: <30ms (99.9%)
- **Performance Consistency<sup>7,8</sup>**
  - Read/Write: Up to 90%/80% (99.9%)
- **AES 256-bit Encryption**
- **Altitude<sup>9</sup>**
  - Operating: -1,000 to 10,000 ft
  - Operating<sup>10</sup>: 10,000 to 15,000 ft
  - Non-operating: -1,000 to 40,000 ft
- **Product Ecological Compliance:**
  - RoHS\*
- **Compliance:**
  - SATA Revision 3.2; compatible with SATA 6Gb/s, 3Gb/s and 1.5Gb/s interface rates
  - ATA/ATAPI Command Set – 2 (ACS-2 Rev 7); includes SCT (Smart Command Transport) and device statistics log support
  - Enhanced SMART ATA feature set
  - Native Command Queuing (NCQ) command set
  - Data set management Trim command
- **Power Management:**
  - 5V Supply Rail<sup>11</sup>
  - SATA Interface Power Management
- **Power<sup>12</sup>**
  - Active: Up to 4.9 W<sup>8</sup> (TYP)
  - Idle: 650 mW
- **Weight:**
  - 180GB, 240GB: 62 grams ± 2 grams
  - 480-GB, 1.0TB: 68 grams ± 2 grams
- **Temperature Boundary:**
  - Operating: 0° C to 70° C
  - Non-Operating<sup>13</sup>: -55° C to 95° C
  - Temperature monitoring and logging
- **Shock (operating and non-operating):**
  - 1,000 G/0.5 ms
- **Vibration:**
  - Operating: 2.17 G<sub>RMS</sub> (5-700 Hz)
  - Non-Operating: 3.13 G<sub>RMS</sub> (5-800 Hz)
- **Reliability:**
  - Uncorrectable Bit Error Rate (UBER): 1 sector per 10<sup>16</sup> bits read
  - Mean Time Between Failures (MTBF): 1.6 million hours
- **Certifications and Declarations:**
  - UL\*, CE\*, RCM Mark\*, BSMI\*, KCC\*, Microsoft\* WHCK, VCCI\*, SATA-IO\*
- **Compatibility:**
  - Windows 8\*, and Windows 8.1\*
  - Windows 10\*
  - Windows Server 2016\*
  - Windows Server 2012\* R2
  - Windows Server 2012\*
  - Windows Server 2008\* Enterprise 32/64bit SP2
  - Windows Server 2008\* R2 SP1
  - Red Hat\* / Ubuntu\* Linux

1. Performance values vary by capacity. For system test and configuration information, see page 2.
2. Performance specifications apply to both compressible and incompressible data
3. 4KB = 4,096 bytes; 8KB = 8,192 bytes
4. MB/s = 1,000,000 bytes/second
5. Based on JESD218 standard
6. Based on Random 4KB QD=1 workload, measured as the time taken for 99.9 percentile of commands to finish the round-trip from host to drive and back to host
7. Based on Random 4KB QD=32 workload, measured as the (IOPS in the 99.9<sup>th</sup> percentile slowest 1-second interval)/(average IOPS during the test)
8. Measurement taken once the workload has reached steady state but including all background activities required for normal operation and data reliability
9. Altitude pressure is simulated in a test chamber; excludes soft error
10. Extended operation at a higher altitude might impact reliability
11. Based on 5V power supply
12. Please contact your Intel representative for details on the non-operating temperature range



## Revision History

Revision	Description	Date
001	Initial release.	March 2016
002	Corrected values in the initial release.	April 2016

## Ordering Information

Contact your local Intel sales representative for ordering information.

Intel may make changes to specifications and product descriptions at any time, without notice. Designers must not rely on the absence or characteristics of any features or instructions marked "reserved" or "undefined." Intel reserves these for future definition and shall have no responsibility whatsoever for conflicts or incompatibilities arising from future changes to them. The information here is subject to change without notice. Do not finalize a design with this information.

Tests document performance of components on a particular test, in specific systems. Differences in hardware, software, or configuration will affect actual performance. Consult other sources of information to evaluate performance as you consider your purchase.

**System Configuration for all performance testing:** Intel® Core™ i7-3960x on Intel® DX79SI desktop motherboard, BIOS Version 0537 – SIX7910J.86A.0537.2012.0723.1217 8GB DDR3 LSI 9265-8i, FW 3.190.25-1776, Intel® SSD DC S3100 FW G2010130

All documented endurance test results are obtained in compliance with JESD218 Standards; refer to individual sub-sections within this document for specific methodologies. See [www.jedec.org](http://www.jedec.org) for detailed definitions of JESD218 Standards.

The products described in this document may contain design defects or errors known as errata which may cause the product to deviate from published specifications. Current characterized errata are available on request.

Contact your local Intel sales office or your distributor to obtain the latest specifications and before placing your product order.

Copies of documents which have an order number and are referenced in this document, or other Intel literature, may be obtained by calling 1-800-548-4725, or go to: <http://www.intel.com/design/literature.htm>.

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## Terminology

Term	Definition
ATA	Advanced Technology Attachment
CRC	Cyclic Redundancy Check
DAS	Device Activity Signal
DMA	Direct Memory Access
ECC	Error Correction Code
EXT	Extended
FPDMA	First Party Direct Memory Access
GB	Gigabyte. <b>Note:</b> The total usable capacity of the SSD may be less than the total physical capacity because a small portion of the capacity is used for NAND flash management and maintenance purposes.
Gb	Gigabit
HDD	Hard Disk Drive
HET	High Endurance Technology
KB	Kilobyte
I/O	Input/Output
IOPS	Input/Output Operations Per Second
ISO	International Standards Organization
LBA	Logical Block Address
MB	Megabyte (1,000,000 bytes)
MLC	Multi-level Cell
MTBF	Mean Time Between Failures
NCQ	Native Command Queuing
NOP	No Operation
PB	Petabyte
PCB	Printed Circuit Board
PIO	Programmed Input/Output
RDT	Reliability Demonstration Test
RMS	Root Mean Square
SATA	Serial Advanced Technology Attachment
SCT	SMART Command Transport
SMART	Self-Monitoring, Analysis and Reporting Technology. This is an open standard for developing hard drives and software systems that automatically monitors the health of a drive and reports potential problems.
SSD	Solid State Drive
TB	Terabyte
TYP	Typical
UBER	Uncorrectable Bit Error Rate



## 1 Overview

This document describes the specifications and capabilities of the Intel® SSD DC S3100 Series.

The DC S3100 Series is an entry level Data Center Solid State Drive intended for Read Intensive operations including System Boot and Edge Caching. It does not provide some of the advanced Intel Data Center specific features such as Power Loss protection and End-To-End data protection. The product is non-customizable and ships as a Generic Product only.

The Intel SSD DC S3100 Series delivers good performance and Quality of Service combined with high reliability for Serial Advanced Technology Attachment (SATA)-based computers in capacities of 180GB, 240GB, 480GB, and 1.0TB in a 2.5-inch form factor. This product is intended for Read Intensive workloads.

By combining TLC NAND Flash Memory technology with SATA 6Gb/s interface support, the Intel SSD DC S3100 Series delivers Sequential Read speeds of up to 535 MB/s and Sequential Write speeds of up to 118 MB/s. The Intel SSD DC S3100 Series also delivers Random 4k Read speeds of up to 65,000 IOPS and Random 4K Write speeds of up to 4700 IOPS based on a JEDEC data center work load

The industry-standard 2.5-inch form factor enables interchangeability with existing hard disk drives (HDDs) and native SATA HDD drop-in replacement with the enhanced performance, reliability, ruggedness, and power savings offered by an SSD.

Intel SSD DC S3100 Series offers these key features:

- Standard Endurance Technology
- High Read performance
- Inrush current management
- Low power
- High reliability
- Temperature monitor via SMART attribute
- Thermal Throttling



## 2 Product Specifications

### 2.1 Capacity

**Table 1: User-Addressable Sectors**

Intel SSD DC S3100 Series	Unformatted Capacity (Total User Addressable Sectors in LBA Mode)
180GB	351,651,888
240GB	468,862,128
480GB	937,703,088
1.0TB	1,953,525,168

**Notes:**

1GB = 1,000,000,000 bytes; 1 sector = 512 bytes.

LBA count shown represents total user storage capacity and will remain the same throughout the life of the drive.

The total usable capacity of the SSD may be less than the total physical capacity because a small portion of the capacity is used for NAND flash management and maintenance purposes.

### 2.2 Performance<sup>1</sup>

**Table 2: Random Read/Write Input/Output Operations Per Second (IOPS)<sup>2</sup> Full Span**

Specification	Unit	Intel SSD DC S3100 Series			
		180GB	240GB	480GB	1.0TB
Random 4KB Read (up to) <sup>3</sup>	IOPS	50,400	54,000	55,300	59,000
Random 4KB Write (up to)	IOPS	2,900	4,400	4,700	3,900
Random 8KB Read (up to) <sup>4</sup>	IOPS	43,000	47,100	48,800	46,100
Random 8KB Write (up to)	IOPS	1,600	2,200	2,000	1,600
Random 4KB 70/30 Read/Write (up to) <sup>3</sup>	IOPS	8,100	11,300	12,500	12,600
Random 8KB 70/30 Read/Write (up to) <sup>4</sup>	IOPS	4,600	6,500	7,300	7,700

**Notes:**

1. System Configuration for all performance testing: Intel® Core™ i7-3960x on Intel® DX79SI desktop motherboard, BIOS Version 0537 – SIX7910J.86A.0537.2012.0723.1217 8GB DDR3 LSI 9265-8i, FW 3.190.25-1776, Intel® SSD DC S3100 FW G2010130
2. Performance measured using IOMeter\* with Queue Depth 32. Measurements are performed on a full Logical Block Address (LBA) span of the drive
3. 4KB = 4,096 bytes
4. 8KB = 8,192 bytes



Table 3: Sequential Bandwidth

Specification <sup>1</sup>	Unit	Intel SSD DC S3100 Series			
		180GB	240GB	480GB	1.0TB
Sequential Read (SATA 6Gb/s) <sup>2</sup>	MB/s	510	535	501	502
Sequential Write (SATA 6Gb/s) <sup>2</sup>	MB/s	81	106	118	114

**Note:**

1. System Configuration for all performance testing: Intel® Core™ i7-3960x on Intel® DX79SI desktop motherboard, BIOS Version 0537 – SIX7910J.86A.0537.2012.0723.1217 8GB DDR3 LSI 9265-8i, FW 3.190.25-1776, Intel® SSD DC S3100 FW G2010130
2. Performance measured using IOMeter\* with 128KB (131,072 bytes) of transfer size with Queue Depth 32.

Table 4: Random Read/Write IOPS Consistency<sup>1</sup>

Specification <sup>2</sup>	Unit	Intel SSD DC S3100 Series			
		180GB	240GB	480GB	1.0TB
Random 4KB Read (up to) <sup>3</sup>	%	96	96	96	93
Random 4KB Write (up to)	%	18	13	12	12
Random 8KB Read (up to) <sup>4</sup>	%	98	98	98	98
Random 8KB Write (up to)	%	17	17	16	14

**Notes:**

1. Performance consistency measured using IOMeter\* based on Random 4/8 KB QD=32 workload, measured as the (IOPS in the 99.9th percentile slowest 1-second interval) / (average IOPS during the test). Measurements are performed on a full Logical Block Address (LBA) span of the drive once the workload has reached steady state but including all background activities required for normal operation and data reliability
2. System Configuration for all performance testing: Intel® Core™ i7-3960x on Intel® DX79SI desktop motherboard, BIOS Version 0537 – SIX7910J.86A.0537.2012.0723.1217 8GB DDR3 LSI 9265-8i, FW 3.190.25-1776, Intel® SSD DC S3100 FW G2010130
3. 4KB = 4,096 bytes
4. 8KB = 8,192 bytes





**Table 5: Latency**

Specification <sup>1</sup>	Intel SSD DC S3100 Series			
	180GB	240GB	480GB	1.TB
Latency (TYP) <sup>2</sup> Read	55us	55us	55us	55us
Latency (TYP) <sup>2</sup> Write	55us	55us	55us	55us
Power On to Ready <sup>3</sup>	<500ms	<500ms	<500ms	<500ms

**Notes:**

1. System Configuration for all performance testing: Intel® Core™ i7-3960x on Intel® DX79SI desktop motherboard, BIOS Version 0537 – SIX7910J.86A.0537.2012.0723.1217 8GB DDR3 LSI 9265-8i, FW 3.190.25-1776, Intel® SSD DC S3100 FW G2010130
2. Device measured using IOMeter. Latency measured using 4KB (4,096 bytes) transfer size with Queue Depth equal to 1 on a sequential workload.
3. Power On To Ready time assumes proper shutdown. Time varies if shutdown is not preceded by STANDBY IMMEDIATE command. For 95% of the time, the maximum time for power on to ready will be less than 10 seconds.

**Table 6: Quality of Service**

Specification <sup>1</sup>	Unit	Intel SSD DC S3100 Series			
		180GB	240GB	480GB	1.0TB
<b>Quality of Service<sup>2,3</sup> (99.99%)</b>					
4K Random Rd QD1	us	450	450	450	450
4K Random Wr QD1	ms	100	100	300	250
8K Random Rd QD1	us	650	650	500	500
8K Random Rd QD1	ms	400	400	300	300

**Notes:**

1. System Configuration for all performance testing: Intel® Core™ i7-3960x on Intel® DX79SI desktop motherboard, BIOS Version 0537 – SIX7910J.86A.0537.2012.0723.1217 8GB DDR3 LSI 9265-8i, FW 3.190.25-1776, Intel® SSD DC S3100 FW G2010130
2. Device measured using IOMeter\*. Quality of Service measured using a random workload on a full Logical Block Address (LBA) span of the drive once the workload has reached steady state but including all background activities required for normal operation and data reliability.
3. Measured as the time taken for 99.99 percent of commands to finish the round-trip from host to drive and back to host.



### 2.3 Electrical Characteristics

**Table 7: Operating Voltage**

Electrical Characteristics	Intel SSDDC S3100 Series
	180GB, 240GB, 480GB, 1.0TB
Operating Voltage for 5 V (±5%)	
Min	4.75 V
Max	5.25 V
Startup Rise Time (Max/Min)	100 ms / 0.1 ms
Shutdown Fall Time (Max/Min)	5 s / 1 ms
Noise Tolerance	300 mV (10 Hz – 100 KHz) 70mv 100Khz – 30Mhz
Min Off Time <sup>1</sup>	1 s

**Notes:**

1. Minimum time from when power removed from drive (Vcc < 100 mV) to when power can be reapplied to drive.

**Table 8: Power Consumption (5V Supply)**

Specification	Unit	Intel SSD DC S3100 Series			
		180GB	240GB	480GB	1.0TB
Active Power <sup>1</sup>	W	2.2	2.8	3.5	3.6
Burst Power <sup>2</sup>	W	2.5	3.8	3.9	4.9
Idle	W	0.65	0.65	0.65	0.69

**Notes:**

1. The workload equates 128 KB (131,072 bytes) Queue Depth equal to 32 sequential writes. Average Power is measured using Agilent Power Analyzer over a 100 ms sample.
2. The workload equates 128 KB (131,072 bytes) Queue Depth equal to 32 sequential writes. Burst Power is measured using Agilent Power Analyzer over a 500 µs sample period.



## 2.4 Environmental Conditions

**Table 9: Temperature, Shock, Vibration**

Temperature	Range
Case Temperature Operating Non-operating <sup>1</sup>	0 – 70° C -55 – 95° C
Temperature Gradient <sup>2</sup> Operating Non-operating	30° C/hr (Typical) 30° C/hr (Typical)
Humidity Operating Non-operating	5 – 95 % 5 – 95 %
Shock and Vibration	Range
Shock <sup>3</sup> Operating Non-operating	1,500 G (Max) at 0.5 ms 1,500 G (Max) at 0.5 ms
Vibration <sup>4</sup> Operating Non-operating	2.17 G <sub>RMS</sub> (5-700 Hz) Max 3.13 G <sub>RMS</sub> (5-800 Hz) Max

**Notes:**

- Contact your Intel representative for details on the non-operating temperature range.
- Temperature gradient measured without condensation.
- Shock specifications assume the SSD is mounted securely with the input vibration applied to the drive-mounting screws. Stimulus may be applied in the X, Y or Z axis. Shock specification is measured using Root Mean Squared (RMS) value.
- Vibration specifications assume the SSD is mounted securely with the input vibration applied to the drive-mounting screws. Stimulus may be applied in the X, Y or Z axis. Vibration specification is measured using RMS value.

## 2.5 Product Regulatory Compliance

Intel SSD DC S3100 Series meets or exceeds the regulatory or certification requirements listed in the table below.

**Table 10: Product Regulatory Compliance Specifications**

Title	Description	Region For Which Conformity Declared
TITLE 47-Telecommunications CHAPTER 1— FEDERAL COMMUNICATIONS COMMISSION PART 15 — RADIO FREQUENCY DEVICES ICES-003, Issue 5 Interference-Causing Equipment Standard Digital Apparatus	FCC Part 15B Class B  CA/CSA-CEI/IEC CISPR 22-10. (Ref. CISPR 22:2008)	USA  Canada
IEC 55024 Information Technology Equipment — Immunity characteristics— Limits and methods of measurement CISPR24:2010	EN-55024: 2010 and its amendments	European Union
IEC 55022 Information Technology Equipment — Radio disturbance Characteristics— Limits and methods of measurement CISPR24:2008 (Modified)	EN-55022: 2010 and its amendments	European Union
EN-60950-1 2 <sup>nd</sup> Edition	Information Technology Equipment — Safety — Part 1: General Requirements	USA/Canada
UL/CSA EN-60950-1 2 <sup>nd</sup> Edition	Information Technology Equipment — Safety — Part 1: General Requirements	USA/Canada



## 2.6 Reliability

Intel SSD DC S3100 Series meets or exceeds SSD endurance and data retention requirements as specified in the JESD218 standard. Reliability specifications are listed in the table below:

**Table 11: Reliability Specifications**

Parameter	Value
Uncorrectable Bit Error Rate (UBER)	
Uncorrectable bit error rate will not exceed one sector in the specified number of bits read. In the unlikely event of a non-recoverable read error, the SSD will report it as a read failure to the host; the sector in error is considered corrupt and is not returned to the host.	< 1 sector per 10 <sup>16</sup> bits read
Mean Time Between Failures (MTBF)	
Mean Time Between Failures is estimated based on Telcordia* methodology and demonstrated through Reliability Demonstration Test (RDT).	≥ 1.6 million hours
Power On/Off Cycles Power On/Off Cycles is defined as power being removed from the SSD, and then restored. Most host systems remove power from the SSD when entering suspend and hibernate as well as on a system shutdown.	25 per day
Insertion Cycles SATA/power cable insertion/removal cycles.	250 on backplane
Data Retention The time period for retaining data in the NAND at maximum rated endurance.	1 year power-off retention once SSD reaches rated write endurance at 40 °C
Endurance Rating While running JESD218 standard <sup>1</sup> and based on JESD219 workload.	180GB: 72TBW / 5 Years 0.22 DW/D <sup>2</sup> for 5 Years 0.37 DW/D for 3 Years <sup>3</sup> 240GB: 72TBW / 5 Years 0.17 DW/D for 5 Years 0.27 DW/D for 3 Years <sup>3</sup> 480GB: 72TBW / 5 Years 0.08 DW/D for 5 Years 0.14 DW/D for 3 years <sup>3</sup> 1.0TB: 72TBW / 5 Years 0.05 DW/D for 5 Years 0.10 DW/D for 3 Years <sup>3</sup>

**Note:**

1. Refer to JESD218 standard table 1 for UBER, FFR and other Enterprise SSD endurance verification requirements. Endurance verification acceptance criterion based on establishing <1E-16 at 60 confidence.
2. DW/D = Drive Writes per Day
3. Example for 3 year NAND usage with SMART E9>1



## 2.7 Temperature Sensor

The Intel SSD DC S3100 Series has an internal temperature sensor which can be monitored using SMART attributes: Airflow Temperature (BEh). For more information on supported SMART attributes, see "SMART Attributes" table on page 18.

## 2.8 Power Loss Protection

Data Center power loss protection is not supported on the DC S3100 Series.

## 2.9 Hot Plug Support

Hot Plug insertion is supported in the presence of a proper connector and appropriate operating system (OS), as described in the SATA 3.0 specification.

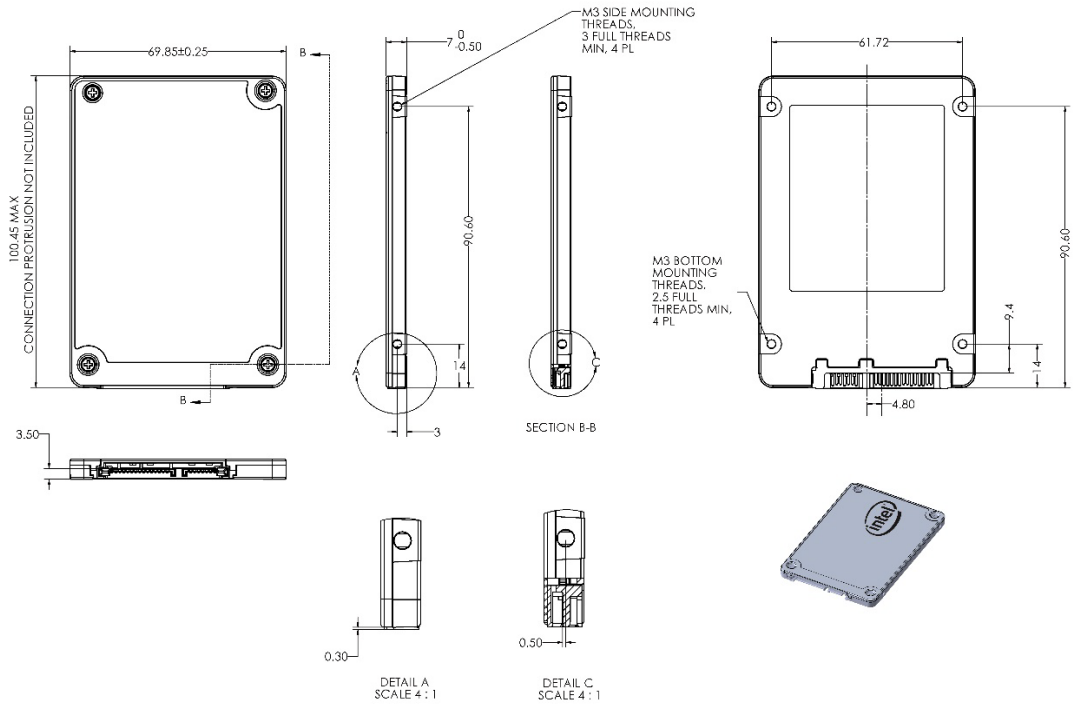
This product supports asynchronous signal recovery and issues an unsolicited COMINIT when first mated with a powered connector to guarantee reliable detection by a host system without hardware device detection.

Hot Plug Removal is not supported on the DC S3100.

### 3 Mechanical Information

Figure 1 shows the physical package information for the Intel SSD DC S3100 Series. All dimensions are in millimeters.

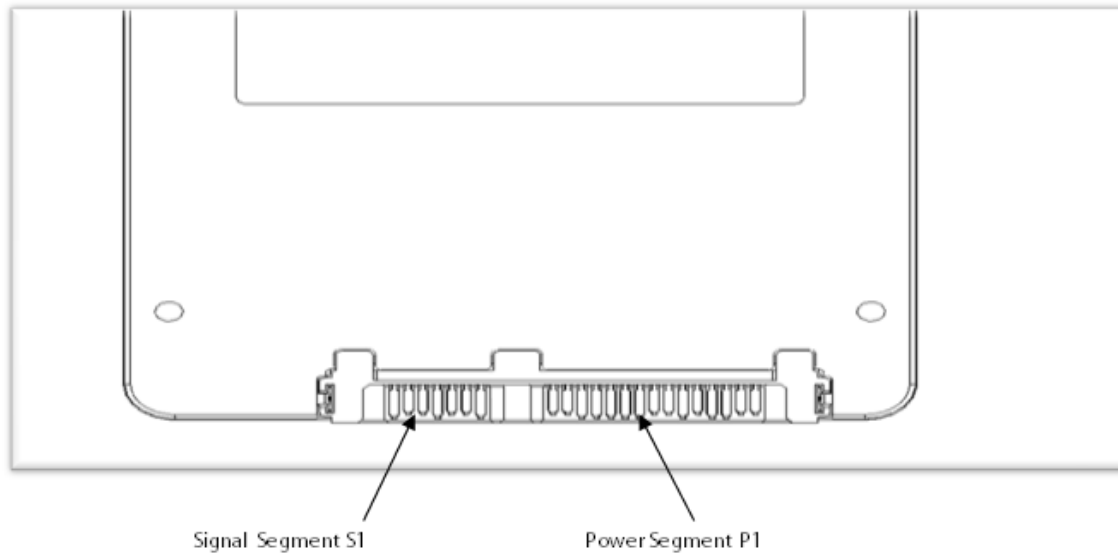
**Figure 1: Intel SSD DC S3100 Series Dimensions**



## 4 Pin and Signal Descriptions

### 4.1 Pin Locations

Figure 2: Layout Signal and Power Segment Pins



**Note:** 2.5-inch connector supports built in latching capability.

### 4.2 Connector Pin Signal Definitions

Table 12: Serial ATA Connector Pin Signal Definitions

Pin	Function	Definition
S1	Ground	1 <sup>st</sup> mate
S2	A+	Differential signal pair A
S3	A-	
S4	Ground	1 <sup>st</sup> mate
S5	B-	Differential signal pair B
S6	B+	
S7	Ground	1 <sup>st</sup> mate

**Note:** Key and spacing separate signal and power segments.



### 4.3 Power Pin Signal Definitions

Table 13: Serial ATA Power Pin Definitions

Pin <sup>1</sup>	Function	Definition	Mating Order
P1 <sup>2</sup>	Not connected	(3.3V Power)	--
P2 <sup>2</sup>	Not connected	(3.3V Power)	--
P3 <sup>2</sup>	Not connected	(3.3V Power; pre-charge)	2 <sup>nd</sup> Mate
P4 <sup>3,4</sup>	Ground	Ground	1 <sup>st</sup> Mate
P5 <sup>3</sup>	Ground	Ground	1 <sup>st</sup> Mate
P6 <sup>3</sup>	Ground	Ground	1 <sup>st</sup> Mate
P7 <sup>3,5</sup>	V <sub>5</sub>	5V Power	1 <sup>st</sup> Mate
P8 <sup>3,5</sup>	V <sub>5</sub>	5V Power	2 <sup>nd</sup> Mate
P9 <sup>3,5</sup>	V <sub>5</sub>	5V Power	2 <sup>nd</sup> Mate
P10 <sup>3</sup>	Ground	Ground	1 <sup>st</sup> Mate
P11 <sup>6</sup>	DAS	Device Activity Signal	2 <sup>nd</sup> Mate
P12 <sup>3,4</sup>	Ground	Ground	1 <sup>st</sup> Mate
P13 <sup>7</sup>	V <sub>12</sub>	12V Power	1 <sup>st</sup> Mate
P14 <sup>7</sup>	V <sub>12</sub>	12V Power	2 <sup>nd</sup> Mate
P15 <sup>7</sup>	V <sub>12</sub>	12V Power	2 <sup>nd</sup> Mate

**Notes:**

1. All pins are in a single row, with a 1.27 mm (0.050-inch) pitch.
2. Pins P1, P2 and P3 are connected together, although they are not connected internally to the device. The host may put 3.3V on these pins.
3. The mating sequence is:
  - ground pins P4-P6, P10, P12 and the 5V power pin P7
  - signal pins and the rest of the 5V power pins P8-P9
4. Ground connectors P4 and P12 may contact before the other 1st mate pins in both the power and signal connectors to discharge ESD in a suitably configured backplane connector.
5. Power pins P7, P8, and P9 are internally connected to one another within the device.
6. The host may ground P11 if it is not used for Device Activity Signal (DAS).
7. Pins P13, P14 and P15 are internally connected to one another within the device. The host may put 12V on these pins.





## 5 Supported Command Sets

The Intel SSD DC S3100 Series supports all mandatory ATA (Advanced Technology Attachment) commands defined in the ATA8-ACS specification described in this section.

### 5.1 ATA General Feature Command Set

The Intel SSD DC S3100 Series supports the ATA General Feature command set (non- PACKET), which consists of:

- EXECUTE DEVICE DIAGNOSTIC
- SET FEATURES
- IDENTIFY DEVICE

**Note:** See Appendix A, "IDENTIFY DEVICE Command Data" for details on the sector data returned after issuing an IDENTIFY DEVICE command.

The Intel SSD DC S3100 Series also supports the following optional commands:

- READ DMA
- WRITE DMA
- READ SECTOR(S)
- READ VERIFY SECTOR(S)
- READ MULTIPLE
- SEEK
- SET FEATURES
- WRITE SECTOR(S)
- SET MULTIPLE MODE<sup>1</sup>
- WRITE MULTIPLE
- FLUSH CACHE
- READ BUFFER
- WRITE BUFFER
- NOP
- DOWNLOAD MICROCODE
- WRITE UNCORRECTABLE EXT

1. The only multiple supported will be multiple 1

### 5.2 Power Management Command Set

The Intel SSD DC S3100 Series supports the Power Management command set, which consists of:

- CHECK POWER MODE
- IDLE
- IDLE IMMEDIATE
- SLEEP
- STANDBY
- STANDBY IMMEDIATE



### 5.3 Security Mode Feature Set

The Intel SSD DC S3100 Series supports the Security Mode command set, which consists of:

- SECURITY SET PASSWORD
- SECURITY UNLOCK
- SECURITY ERASE PREPARE
- SECURITY ERASE UNIT
- SECURITY FREEZE LOCK
- SECURITY DISABLE PASSWORD

### 5.4 SMART Command Set

The Intel SSD DC S3100 Series supports the SMART command set, which consists of:

- SMART READ DATA
- SMART READ ATTRIBUTE THRESHOLDS
- SMART ENABLE/DISABLE ATTRIBUTE AUTOSAVE
- SMART SAVE ATTRIBUTE VALUES
- SMART EXECUTE OFF-LINE IMMEDIATE
- SMART READ LOG SECTOR
- SMART WRITE LOG SECTOR
- SMART ENABLE OPERATIONS
- SMART DISABLE OPERATIONS
- SMART RETURN STATUS
- SMART ENABLE/DISABLE AUTOMATIC OFFLINE

#### 5.4.1 Attributes

The following table lists the SMART attributes supported by the Intel SSD DC S3100 Series and the corresponding status flags and threshold settings. (Status Flags are defined in Table 15.)

**Table 14: SMART Attributes**

ID	Attribute	Status Flags						Threshold
		SP	EC	ER	PE	OC	PW	
05h	Re-allocated Sector Count The raw value of this attribute shows the number of retired blocks since leaving the factory (grown defect count).	1	1	0	0	1	0	0 (none)
09h	Power-On Hours Count The raw value reports power-on time, cumulative over the life of the SSD, integer number in hour time units.	1	1	0	0	1	0	0 (none)
0Ch	Power Cycle Count The raw value of this attribute reports the cumulative number of power cycle events over the life of the device.	1	1	0	0	1	0	0 (none)
AAh	Available Reserved Space (See Attribute E8)	1	1	0	0	1	1	10
ABh	Program Fail Count The raw value of this attribute shows total count of program fails and the normalized value, beginning at 100, shows the percent remaining of allowable program fails.	1	1	0	0	1	0	0 (none)



ID	Attribute	Status Flags						Threshold
		SP	EC	ER	PE	OC	PW	
ACh	<p>Erase Fail Count</p> <p>The raw value of this attribute shows total count of erase fails and the normalized value, beginning at 100, shows the percent remaining of allowable erase fails.</p>	1	1	0	0	1	0	0 (none)
A Eh	<p>Unexpected Power Loss</p> <p>Also known as "Power-off Retract Count" per magnetic-drive terminology.</p> <p>Reports number of unclean shutdowns, cumulative over the life of the SSD.</p> <p>An "unclean shutdown" is the removal of power without STANDBY IMMEDIATE as the last command (regardless of PLI activity using capacitor power).</p>	1	1	0	0	1	0	0 (none)
B7h	<p>SATA Downshift Count</p> <p>The count of the number of times SATA interface selected lower signaling rate due to error.</p>	1	1	0	0	1	0	0 (none)
B8h	<p>End-to-End Error Detection Count</p> <p>Reports number of errors encountered during end-to-end error detection within the SSD data path</p>	1	1	0	0	1	1	90
BBh	<p>Uncorrectable Error Count</p> <p>The raw value shows the count of errors that could not be recovered using Error Correction Code (ECC).</p>	1	1	0	0	1	0	0 (none)
BEh	<p>Case Temperature</p> <p>Reports real-time temperature of drive as measured by temperature sensor on drive PCB. The normalized value reports the current temperature value. The raw value shows current, lifetime highest and lifetime lowest temperatures. Byte 1:0 = current temp Celsius; Byte 3:2 = lifetime highest temp Celsius; Byte 5:4 = lifetime lowest temp Celsius.</p>	1	0	0	0	1	0	0 (none)
C0h	<p>Power-Off Retract Count (Unsafe Shutdown Count)</p> <p>The raw value of this attribute reports the cumulative number of unsafe (unclean) shutdown events over the life of the device. An unsafe shutdown occurs whenever the device is powered off without STANDBY IMMEDIATE being the last command.</p>	1	1	0	0	1	0	0 (none)
C7h	<p>CRC Error Count</p> <p>The total number of encountered SATA interface cyclic redundancy check (CRC) errors.</p>	1	1	0	0	1	0	0 (none)
E1h	<p>Host Writes</p> <p>The raw value of this attribute reports the total number of sectors written by the host system. The raw value is increased by 1 for every 65,536 sectors (32MB) written by the host.</p>	1	1	0	0	1	0	0 (none)



ID	Attribute	Status Flags						Threshold
		SP	EC	ER	PE	OC	PW	
E2h	<p>Timed Workload Media Wear</p> <p>Measures the wear seen by the SSD (since reset of the workload timer, attribute E4h), as a percentage of the maximum rated cycles.</p>	1	1	0	0	1	0	0 (none)
E3h	<p>Timed Workload Host Read/Write Ratio</p> <p>Shows the percentage of I/O operations that are read operations (since reset of the workload timer, attribute E4h).</p>	1	1	0	0	1	0	0 (none)
E4h	<p>Timed Workload Timer</p> <p>Measures the elapsed time (number of minutes since starting this workload timer).</p>	1	1	0	0	1	0	0 (none)
E8h	<p>Available Reserved Space</p> <p>This attribute reports the number of reserve blocks remaining. The normalized value begins at 100 (64h), which corresponds to 100 percent availability of the reserved space. The threshold value for this attribute is 10 percent availability.</p>	1	1	0	0	1	1	10
E9h	<p>Media Wearout Indicator</p> <p>This attribute reports the number of cycles the NAND media has undergone. The normalized value declines linearly from 100 to 1 as the average erase cycle count increases from 0 to the maximum rated cycles. Once the normalized value reaches 1, the number will not decrease, although it is likely that significant additional wear can be put on the device.</p>	1	1	0	0	1	0	0 (none)
F1h	<p>Total LBAs Written</p> <p>The raw value of this attribute reports the total number of sectors written by the host system. The raw value is increased by 1 for every 65,536 sectors (32MB) written by the host.</p>	1	1	0	0	1	0	0 (none)
F2h	<p>Total LBAs Read</p> <p>The raw value of this attribute reports the total number of sectors read by the host system. The raw value is increased by 1 for every 65,536 sectors (32MB) read by the host.</p>	1	1	0	0	1	0	0 (none)
F3h	<p>Total Bytes Written</p> <p>The raw value of this attribute reports the total number of sectors written to the NAND media. This includes NAND writes triggered by host writes, defrag, background data refresh and wear level relocation writes etc. The raw value is increased by 1 for every 65,536 sectors (32MB) writes to the NAND media. Upon NAND write, new value returned once per minute.</p>	1	1	0	0	1	0	0 (none)
F9h	<p>Total NAND Writes - Raw value reports the number of writes to NAND in 1 GB increments.</p>	1	1	0	0	1	0	0 (none)



Table 15: SMART Attribute Status Flag Definitions

Status Flag	Description	Value = 0	Value = 1
SP	Self-preserving attribute	Not a self-preserving attribute	Self-preserving attribute
EC	Event count attribute	Not an event count attribute	Event count attribute
ER	Error rate attribute	Not an error rate attribute	Error rate attribute
PE	Performance attribute	Not a performance attribute	Performance attribute
OC	Online collection attribute	Collected only during offline activity	Collected during both offline and online activity
PW	Pre-fail warranty attribute	Advisory	Pre-fail

## 5.5 SMART Command Transport (SCT)

With SMART Command Transport (SCT), a host can send commands and data to an SSD and receive status and data from an SSD using standard write/read commands to manipulate two SMART Logs:

- Log Address E0h ("SCT Command/Status") — used to send commands and retrieve status
- Log Address E1h ("SCT Data Transfer") — used to transport data

Intel SSD DC S3100 supports the following standard SCT actions:

- Write Same — DC S3100 Series implements this action code as described in the ATA specification.
- Error Recovery Control — DC S3100 Series accepts this action code, and will store and return error-recovery time limit values.
- Feature Control - DC S3100 Series supports feature code 0001h (write cache) feature code 0002h (write cache reordering), and feature code 0003h (time interval for temperature logging). It also supports D000h (Power Safe Write Cache capacitor test interval), D001h (read/write power governor mode), D002h (read thermal governor mode), D003h (read power governor burst power), and D004h (read power governor average power).
- Data table command - DC S3100 Series supports data table command as specified in ATA8-ACS2. This will read out temperature logging information in table ID 0002h.
- Read Status Support - DC S3100 supports read status log
- By using SCT command 0xD801 with State=0, Option=1, ID Word 106 can be changed from 0x6003 to 0x4000 (4KB physical sector size to 512B physical sector size support change).

## 5.6 Data Set Management Command Set

Intel SSD DC S3100 Series supports the Data Set Management command set Trim attribute, which consists of:

- DATA SET MANAGEMENT



## 5.7 Host Protected Area Command Set

Intel SSD DC S3100 Series supports the Host Protected Area command set, which consists of:

- READ NATIVE MAX ADDRESS
- SET MAX ADDRESS
- READ NATIVE MAX ADDRESS EXT
- SET MAX ADDRESS EXT

Intel SSD DC S3100 Series also supports the following optional commands:

- SET MAX SET PASSWORD
- SET MAX LOCK
- SET MAX FREEZE LOCK
- SET MAX UNLOCK

## 5.8 48-Bit Address Command Set

Intel SSD DC S3100 Series supports the 48-bit Address command set, which consists of:

- FLUSH CACHE EXT
- READ DMA EXT
- READ NATIVE MAX ADDRESS EXT
- READ SECTOR(S) EXT
- READ VERIFY SECTOR(S) EXT
- SET MAX ADDRESS EXT
- WRITE DMA EXT
- WRITE MULTIPLE EXT
- WRITE SECTOR(S) EXT
- WRITE MULTIPLE FUA EXT
- WRITE DMA FUA EXT

## 5.9 General Purpose Log Command Set

Intel SSD DC S3100 Series supports the General Purpose Log command set, which consists of:

- READ LOG EXT
- WRITE LOG EXT

## 5.10 Native Command Queuing

Intel SSD DC S3100 Series supports the Native Command Queuing (NCQ) command set, which includes:

- READ FPDMA QUEUED
- WRITE FPDMA QUEUED

**Note:** With a maximum Queue Depth set to 32.

## 5.11 Software Settings Preservation

Intel SSD DC S3100 Series supports the SET FEATURES parameter to enable/disable the preservation of software settings.



## 6 Certifications and Declarations

The following table describes the Device Certifications supported by the Intel SSD DC S3100 Series.

**Table 16: Device Certifications and Declarations**

Certification	Description
CE Compliant	Low Voltage DIRECTIVE 2006/95/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 12 December 2006, and EMC Directive 2004/108/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 15 December 2004.
UL Recognized	Underwriters Laboratories, Inc. Bi-National Component Recognition; UL 60950-1, 2nd Edition, 2007-03-27 (Information Technology Equipment - Safety - Part 1: General Requirements) CSA C22.2 No. 60950-1-07, 2nd Edition, 2007-03 (Information Technology Equipment - Safety - Part 1: General Requirements)
RCM Mark Compliant	Compliance with the Australia/New Zealand Standard AS/NZS3548 and Electromagnetic Compatibility (EMC) Framework requirements of the Australian Communication Authority (ACA).
BSMI Compliant	Compliance to the Taiwan EMC standard CNS 13438: Information technology equipment - Radio disturbance Characteristics - limits and methods of measurement, as amended on June 1, 2006, is harmonized with CISPR 22: 2005.04.
KCC	Compliance with paragraph 1 of Article 11 of the Electromagnetic Compatibility Control Regulation and meets the Electromagnetic Compatibility (EMC) Framework requirements of the Radio Research Laboratory (RRL) Ministry of Information and Communication Republic of Korea.
VCCI	Voluntary Control Council for Interface to cope with disturbance problems caused by personal computers or facsimile.
RoHS Compliant	Restriction of Hazardous Substance Directive
WEEE	Directive on Waste Electrical and Electronic Equipment



## 7 References

The following table identifies the standards information referenced in this document.

**Table 17: Standards References**

Date	Title	Location
July 2012	Solid State Drive (SSD) Requirements and Endurance Test Method (JESD219)	<a href="http://www.jedec.org/standards-documents/results/jesd219">http://www.jedec.org/standards-documents/results/jesd219</a>
Sept 2010	Solid State Drive (SSD) Requirements and Endurance Test Method (JESD218)	<a href="http://www.jedec.org/standards-documents/docs/jesd218/">http://www.jedec.org/standards-documents/docs/jesd218/</a>
Dec 2008	VCCI	<a href="http://www.vcci.jp/vcci_e/">http://www.vcci.jp/vcci_e/</a>
June 2009	RoHS	<a href="http://qdms.intel.com/">http://qdms.intel.com/</a> Click <i>Search MDDS Database</i> and search for material description datasheet
August 2009	ACS-2-ATA/ATAPI Command Set 2 Specification	<a href="http://www.t13.org/">http://www.t13.org/</a>
June 2009	Serial ATA Revision 3.0	<a href="http://www.sata-io.org/">http://www.sata-io.org/</a>
May 2006	SFF-8223, 2.5-inch Drive w/Serial Attachment Connector	<a href="http://www.sffcommittee.org/">http://www.sffcommittee.org/</a>
May 2005	SFF-8201, 2.5-inch drive form factor	<a href="http://www.sffcommittee.org/">http://www.sffcommittee.org/</a>
1995 1996 1995 1995 1997 1994	International Electrotechnical Commission EN 61000 4-2 (Electrostatic discharge immunity test) 4-3 (Radiated, radio-frequency, electromagnetic field immunity test) 4-4 (Electrical fast transient/burst immunity test) 4-5 (Surge immunity test) 4-6 (Immunity to conducted disturbances, induced by radio-frequency fields) 4-11 (Voltage Variations, voltage dips, short interruptions and voltage variations immunity tests)	<a href="http://www.iec.ch/">http://www.iec.ch/</a>
1995	ENV 50204 (Radiated electromagnetic field from digital radio telephones)	<a href="http://www.dbicorporation.com/radimmun.htm/">http://www.dbicorporation.com/radimmun.htm/</a>





## Appendix A: IDENTIFY DEVICE Command Data

Table 18: Returned Sector Data

Word	F = Fixed V = Variable X = Both	Default Value	Description
0	X	0040h	General configuration bit-significant information
1	X	3FFFh	Obsolete - Number of logical cylinders (16,383)
2	V	C837h	Specific configuration
3	X	0010h	Obsolete - Number of logical heads (16)
4-5	X	0h	Retired
6	X	003Fh	Obsolete - Number of logical sectors per logical track (63)
7-8	V	0h	Reserved for assignment by the CompactFlash* Association (CFA)
9	X	0h	Retired
10-19	F	varies	Serial number (20 ASCII characters)
20-21	X	0h	Retired
22	X	0h	Obsolete
23-26	F	varies	Firmware revision (8 ASCII characters)
27-46	F	varies	Model number (Intel® Solid State Drive)
47	F	8010h	7:0—Maximum number of sectors transferred per interrupt on multiple commands
48	F	4000h	Trusted Computing Feature Set
49	F	2F00h	Capabilities
50	F	4000h	Capabilities
51-52	X	0h	Obsolete
53	F	0007h	Words 88 and 70:64 valid
54	X	3FFFh	Obsolete - Number of logical cylinders (16,383)
55	X	0010h	Obsolete - Number of logical heads (16)
56	X	003Fh	Obsolete - Number of logical sectors per logical track (63)
57-58	X	00FBFC10h	Obsolete
59	F	B110h	Number of sectors transferred per interrupt on multiple commands
60-61	V	180GB: 0FFFFFFFh 480GB: 0FFFFFFFh 800GB: 0FFFFFFFh 1000GB: 0FFFFFFFh	Total number of user-addressable sector for 28-bit commands
62	X	0h	Obsolete
63	X	0007h	Multi-word DMA modes supported/selected
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	4110h	Additional Supported
70	F	0000h	Reserved
71-74	F	0h	Reserved for IDENTIFY PACKET DEVICE command
75	F	001Fh	Queue depth
76	F	070Eh	Serial ATA capabilities
77	F	0086h	Reserved for future Serial ATA definition



Word	F = Fixed V = Variable X = Both	Default Value	Description
78	F	014Ch	Serial ATA features supported
79	V	0040h	Serial ATA features enabled
80	F	07FCh	Major version number
81	F	FFFFh	Minor version number
82	F	746Bh	Command set supported
83	F	7409h	Command sets supported
84	F	6163h	Command set/feature supported extension
85	X	7469h	Command set/feature enabled
86	X	B409h	Command set/feature enabled
87	X	6163h	Command set/feature default
88	X	407Fh	Ultra DMA Modes
89	F	0002h	Time required for security erase unit completion
90	F	0001h	Time required for enhanced security erase completion
91	V	00FEh	Current advanced power management value
92	V	FFFEh	Master Password Revision Code
93	X	0h	Hardware reset result: the contents of bits (12:0) of this word shall change only during the execution of a hardware reset
94	V	0h	Vendor's recommended and actual acoustic management value
95	F	0h	Stream minimum request size
96	V	0h	Streaming transfer time - DMA
97	V	0h	Streaming access latency - DMA and PIO
98-99	F	0h	Streaming performance granularity
100-103	V	180GB: 14F5C82Fh 480GB: 1BF244AFh 800GB: 37E436AFh 1000GB: 74706DAFh	Maximum user LBA for 48-bit address feature set
104	V	0h	Streaming transfer time - PIO
105	V	0008h	Maximum number of 512-byte blocks of LBA Range Entries per DATA SET MANAGEMENT command
106	F	4000h	Physical sector size / logical sector size – User Changeable by SCT command to report 512B
107	F	0h	Inter-seek delay for ISO-7779 acoustic testing in microseconds
108-111	F	varies	Unique ID
112-115	F	0h	Reserved for worldwide name extension to 128 bits
116	V	0h	Reserved for technical report
117-118	F	0h	Words per logical sector
119	F	401Ch	Supported settings
120	X	401Ch	Command set/feature enabled/supported
121-126	F	0h	Reserved
127	X	0h	Removable Media Status Notification feature set support
128	X	0021h	Security status
129	V	001Ch	Vendor-specific
130-139	X	0h	Vendor-specific
140-149	X	0h	Disable Logical Error Field
150-159	X	0h	Vendor-specific
160	X	0h	CompactFlash Association (CFA) power mode 1



Word	F = Fixed V = Variable X = Both	Default Value	Description
161-167	X	0h	Reserved for assignment by the CFA
168	X	0003h	Reserved for assignment by the CFA
169	X	0001h	Data set management Trim attribute support
170-175	F	0h	Reserved for assignment by the CFA
176-205	V	Varies	Current media serial number
206	X	0039h	SCT Command Transport
207-208	F	0000h	Reserved
209	X	4000h	Alignment of logical blocks within a physical block
210-211	V	0000h	Write-Read-Verify Sector Count Mode 3 (DWord)
212-213	F	0000h	Write-Read-Verify Sector Count Mode 2 (DWord)
214	X	0000h	NV Cache Capabilities
215-216	V	0000h	NV Cache Size in Logical Blocks (DWord)
217	F	0001h	Nominal media rotation rate
218	V	0000h	Reserved
219	F	0000h	NV Cache Options
220	V	0000h	Write-Read-Verify feature set
221	X	0000h	Reserved
222	F	101Fh	Transport major version number
223	F	0000h	Transport minor version number
224-229	F	0000h	Reserved
230-233	X	0000h	Extended Number of User Addressable Sectors (QWord)
234	F	00012h	Minimum number of 512-byte data blocks per DOWNLOAD MICROCODE command for mode 03h
235	F	0080h	Maximum number of 512-byte data blocks per DOWNLOAD MICROCODE command for mode 03h
236-254	X	0000h	Reserved
255	V	Varies	Integrity word

**Notes:**

**F = Fixed.** The content of the word is fixed and does not change. For removable media devices, these values may change when media is removed or changed.

**V = Variable.** The state of at least one bit in a word is variable and may change depending on the state of the device or the commands executed by the device.

**X = F or V.** The content of the word may be fixed or variable.