Intel® X18-M/X25-M SATA Solid State Drive

SSDSA1MH080G1, SSDSA2MH080G1, SSDSA1MH160G1, SSDSA2MH160G1
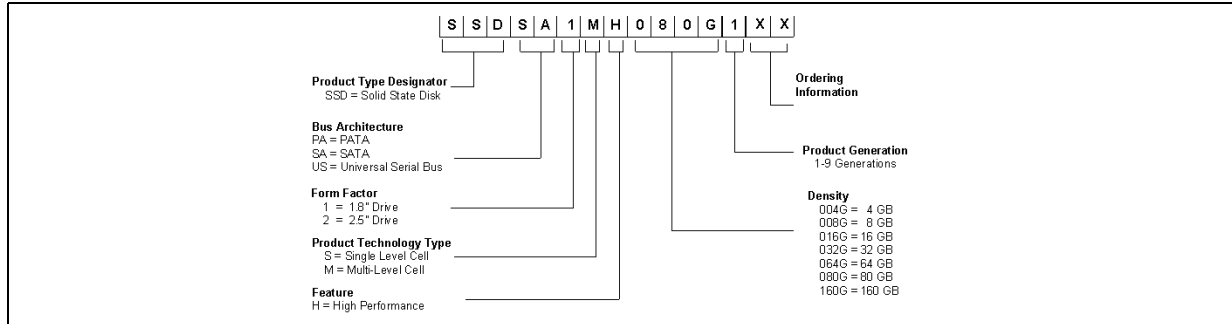
Product Manual

- Available in 1.8″ and 2.5″ Form Factors
- Capacity: 80 GB and 160 GB
- Uses Intel NAND flash memory Multi-Level Cell (MLC) components
- Bandwidth Performance Specifications
  — Sustained Sequential Read: Up to 250 MB/s
  — Sustained Sequential Write: Up to 70 MB/s
- Read and Write IOPS specifications (IOmeter Queue Depth 32)
  — Random 4 KB Reads: Up to 35 K IOPS
  — Random 4 KB Writes: Up to 3.3 K IOPS
- Latency Specifications:
  — Read: 85 µs
  — Write: 115 µs
- PCMark* Vantage Benchmark HDD Score: 20,000
- Compatibility
  — Intel® Matrix Storage Manager
  — SATA Revision 2.6 compliant, compatible with SATA 1.5 Gb/s and 3 Gb/s interface rates
  — ATA/ATAPI-7 Compliant
  — SSD Enhanced SMART ATA feature set
  — Native Command Queuing (NCQ) command set
- Certifications
  — UL*
  — CE*
  — C-Tick*
  — BSMI*
  — MIC*
  — Microsoft* WHQL
  — RoHS*

- Power Management
  — 3.3 V (1.8″) or 5 V (2.5″) SATA Supply Rail
  — SATA Interface Power Management
  — OS-Aware Hot Plug/Removal
- Power Specifications
  — Active: 0.150 W TYP
  — Idle: 0.060 W TYP
- Temperature
  — Operating: 0° C to 70° C
  — Non-Operating: -55° C to 95° C
- Reliability
  — Read Error Rate (BER): 1 sector per 10^{15} bits read
  — Mean Time Between Failures (MTBF) 1,200,000 hours
  — Minimum of five years of useful life
- Shock
  — Operating and Non-operating: 1,000 G/0.5 msec
- Vibration
  — Operating: 2.17 G_{RMS} (7-800 Hz)
  — Non-operating: 3.13 G_{RMS} (10-500 Hz)
- Weight
  — 1.8″ 5 mm Form Factor: 35 +/-2 grams
  — 1.8″ 8 mm Form Factor: 47 +/-2 grams
  — 2.5″ 7 mm Form Factor: 80 +/-2 grams
  — 2.5″ 9.5 mm Form Factor: 86 +/-2 grams

Order Number: 319765-008US
May 2009

Ordering Information

Decoder

S S D S A 1 M H 0 8 0 G 1 X X

Product Type Designator
SSD = Solid State Disk

Ordering Information
X

Bus Architecture
PA = PATA
SA = SATA
US = Universal Serial Bus

Product Generation
1-9 Generations

Form Factor
1 = 1.8" Drive
2 = 2.5" Drive

Density
004G = 4 GB
008G = 8 GB
016G = 16 GB
032G = 32 GB
064G = 64 GB
080G = 80 GB
160G = 160 GB

Product Technology Type
S = Single Level Cell
M = Multi-Level Cell

Feature
H = High Performance

Intel High Performance Solid State Drive Ordering Information

Part Number	MM Numbers	Device Nomenclature	Order Quantity
SSDSA1MH080G1	894401	80 GB SATA 1.8" 5 mm Drive, MLC, Production Sample	1
	894400	80 GB SATA 1.8" 5 mm Drive, MLC, Production Sample	50
SSDSA2MH080G1	894103	80 GB SATA 2.5" 7 mm Drive, MLC, Production Sample	1
	894125	80 GB SATA 2.5" 7 mm Drive, MLC, Production Sample	50
	899854	80 GB SATA 2.5" 9.5 mm Drive, MLC, Production Sample	1
	901776	80 GB SATA 2.5" 9.5 mm Drive, MLC, Production Sample	50
SSDSA1MH160G1	898094	160 GB SATA 1.8" 8 mm Drive, MLC, Qualification Sample	1
SSDSA2MH160G1	900292	160 GB SATA 2.5" 7 mm Drive, MLC, Qualification Sample	1
	900291	160 GB SATA 2.5" 9.5 mm Drive, MLC, Qualification Sample	1

Contents

1.0 Introduction

The Intel® X18-M/X25-M SATA Solid State Drive (SSD) delivers leading performance in industry standard 1.8″ and 2.5″ form factors while simultaneously improving system responsiveness for mobile applications over standard rotating drive media or hard disk drives. By combining Intel's leading NAND flash memory technology with our innovative high performance controller, Intel delivers an SSD for Native Serial Advanced Technology Attachment (SATA) hard disk drive drop-in replacement with enhanced performance, reliability, ruggedness and power savings.

Since there are no rotating platters, moving heads, fragile actuaters, or unnecessary delays due to spin-up time or positional seek time that can slow down the storage subsystem significantly, the Intel X18-M/X25-M SATA SSD enables fast read/write access times and a significant I/O and throughput performance improvement as compared to rotating media or hard disk drives.

This document describes the specifications of the Intel X18-M/X25-M SATA SSD in the 1.8″ and 2.5″ form factors.

1.1 Product Overview

The Intel X18-M/X25-M SATA SSDs primarily target SATA based laptop PCs, highly rugged mobile client devices, as well as thin and light, mini/sub-notebooks. Key attributes include high performance, low power, increased system responsiveness, high reliability and enhanced ruggedness as compared to standard mobile SATA hard drives. Intel X18-M/X25-M SATA SSDs are available in 1.8″ and 2.5″ form factors that are electrically, mechanically, and software compatible with existing 1.8″ and 2.5″ Serial ATA slots and cables. Our flexible design allows interchangeability with existing mobile hard drives based on the SATA interface standard.

1.2 Block Diagram

Figure 1. Block Diagram
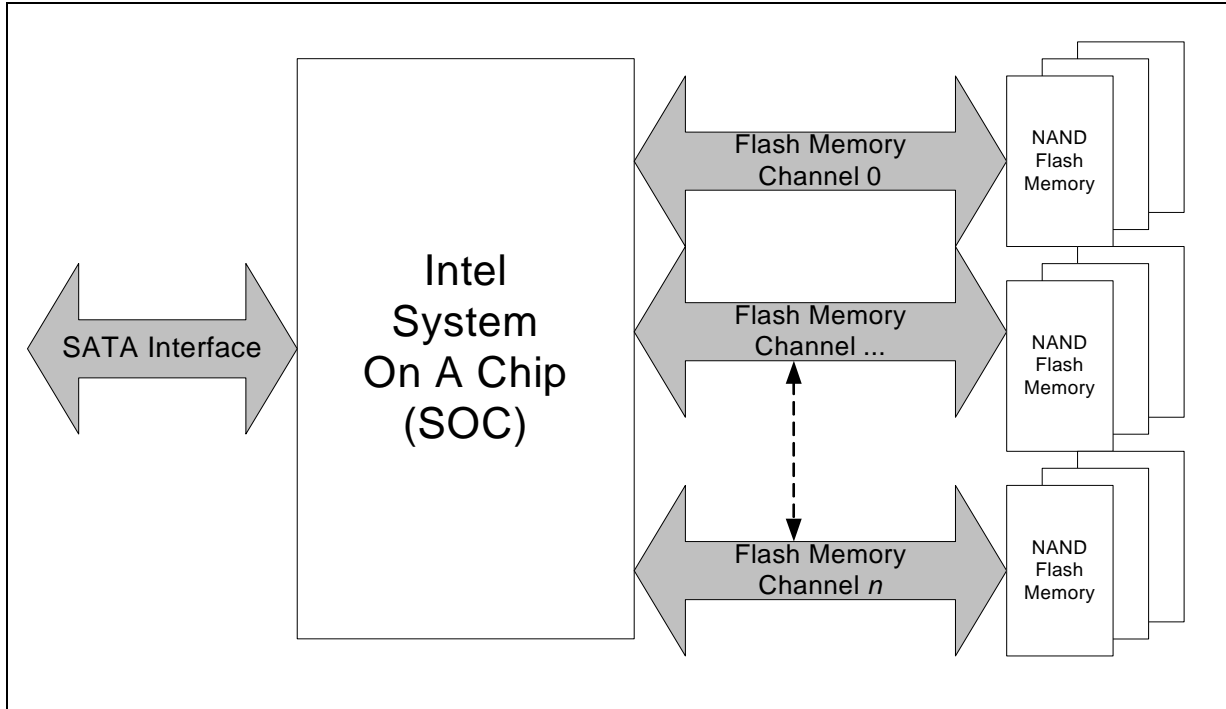
1.3 Architecture

The Intel X18-M/X25-M SATA SSDs utilize a cost effective System on a Chip (SOC) design to manage a full SATA 3 Gb/s bandwidth with the host while managing multiple flash memory devices on multiple channels internally.

2.0 Certifications

Table 1. Device Certifications

Certification	Description
CE Compliant	Indicates conformity with the essential health and safety requirements set out in European Directives Low Voltage Directive and EMC Directive.
UL Certified	Underwriters Laboratories, Inc. Component Recognition UL60950-1.
C-Tick 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 "Limits and methods of measurement of radio disturbance characteristics of information technology equipment, CNS 13438 Class B."

Table 1.   Device Certifications (Continued)

Certification	Description
MIC Certified	Compliance with paragraph 1 of Article 11 of the Electromagnetic Compatibility control Regulation and meet the Electromagnetic Compatibility (EMC) Framework requirements of the Radio Research Laboratory (RRL) Ministry of Information and Communication Republic of Korea.
Microsoft WHQL	Microsoft Windows Hardware Quality Labs
RoHS Compliant	Restriction of Hazardous Substance Directive

3.0   Product Specifications

3.1   Capacity

Table 2.   User Addressable Sectors

Unformatted Capacity	Total User Addressable Sectors in LBA Mode
80 GB	156,301,488
160 GB	312,581,808

Notes:
1.   1 GB = 1,000,000,000 Byte and not all of the memory can be used for data storage.
2.   1 Sector = 512 Byte.

3.2   Performance

Table 3.   Maximum Sustained Read and Write Bandwidth

Access Type	MB/s
Sequential Read	Up to 250
Sequential Write	Up to 70

Notes:
1.   Performance measured using IOmeter with queue depth equal to 32.
2.   1 MB/sec = 1,048,576 bytes/sec was used in measuring sequential performance. If 1 MB/sec equals 1 million bytes/sec, performance numbers will be 4.85 percent higher than quoted.

Table 4.   PCMark* Vantage Benchmark

Benchmark	Score
PCMark Vantage HDD Score	20,000

Note: Performance tests and ratings are measured using HP* Compaq* 6910p notebook with Intel Core™2 Duo CPU T7300 @ 2.0 GHz processor and 2 GB DRAM running Microsoft* Windows Vista* Enterprise Edition and reflects the approximate performance as measured by that configuration. Any difference in system hardware or software design or configuration may affect actual performance.

Table 5.   Latency Specifications

Type	Average Latency
Read	85 µs (TYP)
Write	115 µs (TYP)
Power On to Ready	1 s

Notes:
1.   Write Cache Enabled.
2.   Device measured using IOmeter.
3.   Power On To Ready time assumes proper shutdown (power removal preceded by STANDBY command).
4.   Read/Write latency measured on 4 K transfers.

Table 6.   Random Read/Write Input/Output Operations Per Second

Access Type	IOPS
4K Read	35,000
4K Write	3,300

Notes:
1.   Performance measured using IOmeter with queue depth set to 32.
2.   Write Cache enabled.
3.   Measurements are performed on 8 GB span.

3.3   Electrical Characteristics

3.3.1   Supply Voltage

Table 7.   Operating Voltage

Description	Min	Max	Unit
Operating Voltage for 3.3 V (+/- 5%)	3.14	3.47	V
Operating Voltage for 5 V (+/- 5%)	4.75	5.25	V

3.3.2   Power Consumption

Table 8.   Typical Power Consumption

Mode	Typ	Unit
Active	0.150	W
Idle	0.060	W

Note: Active power is measured during execution of MobileMark* 2007 with DIPM (Device Initiated Power Management) enabled.

3.4 Environmental Conditions

3.4.1 Temperature

Table 9.   Temperature Related Specifications

	Mode	Min	Typ	Max	Unit
Ambient Temperature	Operating	0		70	°C
	Non-Operating	-55		95	°C
Temperature Gradient	Operating		20		°C/hr *
	Non-Operating		30		°C/hr *
Humidity	Operating	5		95	%
	Non-Operating	5		95	%

Note: Measured without condensation.

3.4.2 Altitude

The drive is not sensitive to changes in altitude because it has no moving parts. Drive tested within -1K and +40K feet.

3.4.3 Shock and Vibration

Table 10.   Shock and Vibration Specifications

	Mode	Timing/Frequency	Max
Shock[1]	Operating	at 0.5 msec	1,000 G
	Non-Operating	at 0.5 msec	1,000 G
Vibration[2]	Operating	7-800 Hz	2.17 G
	Non-Operating	10-500 Hz[3]	3.13 G

Notes:
1.   Shock specifications assumes that 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.
2.   Vibration specifications assumes that 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.The measured specification is in root mean sqaured form.
3.   Sine wave sweeping 1 oct/min.

3.4.4 Acoustics

The SSD has no moving or noise-emitting parts; therefore, it produces negligible sound (0 dB) in all modes of operation.

3.4.5 Electromagnetic Immunity

Electromagnetic Immunity tests assume the SSD is properly installed in the representative host system. The drive will operate properly without errors or degradation in performance when subjected to radio frequency (RF) environments defined in the following table:

Table 11. Radio Frequency Specifications

Test	Description	Performance Criteria	Reference Standard
Electrostatic discharge	Contact, HCP, VCP: ±8kV; Air: ± 15 kV	B	EN 61000-4-2: 95
Radiated RF immunity	80 to 1,000 MHz, 3 V/m, 80% AM with 1 kHz sine 900 MHz, 3 V/m, 50% pulse modulation at 200 Hz	A	EN 61000-4-3: 96 ENV 50204: 95
Electrical fast transient	± 1 kV on AC mains, ± 0.5 kV on external I/O	B	EN 61000-4-4: 95
Surge immunity	± 1 kV differential, ± 2 kV common, AC mains	B	EN 61000-4-5: 95
Conducted RF immunity	150 kHz to 80 MHz, 3 Vrms, 80% AM with 1 kHz sine	A	EN 61000-4-6: 97
Voltage dips, interrupts	0% open, 5 seconds 0% short, 5 seconds 40%, 0.10 seconds 70%, 0.01 seconds	C C C B	EN 61000-4-11: 94

Notes:
1. **Performance Criteria A** = The device shall continue to operate as intended, i.e., normal unit operation with no degradation of performance.
2. **Performance Criteria B** = The device shall continue to operate as intended after completion of the test. However, during the test, some degradation of performance is allowed as long as there is no data loss operator intervention to restore device function.
3. **Performance Criteria C** = temporary loss of function is allowed. Operator intervention is acceptable to restore device function.
4. Contact electostatic discharge applied to drive enclosure.

3.5 Reliability

Table 12. Reliability Specifications

Parameter	Value
Nonrecoverable read errors	1 sector in 10^{15} bits read, max
Mean Time between Failure (MTBF)	1,200,000 hours
Power On/Off Cycles	50,000 cycles
Minimum Useful Life	5 years

3.5.1 Nonrecoverable Read Errors

The nonrecoverable read error rate will not exceed one sector in the specified number of bits read. In the extremely unlikely event of a nonrecoverable read error, the drive will report it as a read failure to the host; the sector in error is considered corrupt and is not returned to the host.

3.5.2 Mean Time Between Failure

The Mean Time Between Failure (MTBF) is calculated based on a Part Stress Analysis. It assumes nominal voltage, with all other parameters within specified range.

3.5.3 Power On/Off Cycles

Defined as power being removed from the drive, and then restored. Most host systems remove power from the drive when entering suspend and hibernate as well as on a system shutdown.

3.5.4 Minimum Useful Life

The drive will have a minimum of 5 years of useful life under typical client workloads with up to 20 GB of host writes per day.

4.0 Mechanical Information

4.1 1.8″ 5 mm Intel X18-M SATA SSD

The following figure shows the physical package information for the 5 mm deep 1.8″ Intel X18-M SATA SSD.

Figure 2.   Dimensions for Intel X18-M SATA SSD 1.8" 5 mm Form Factor
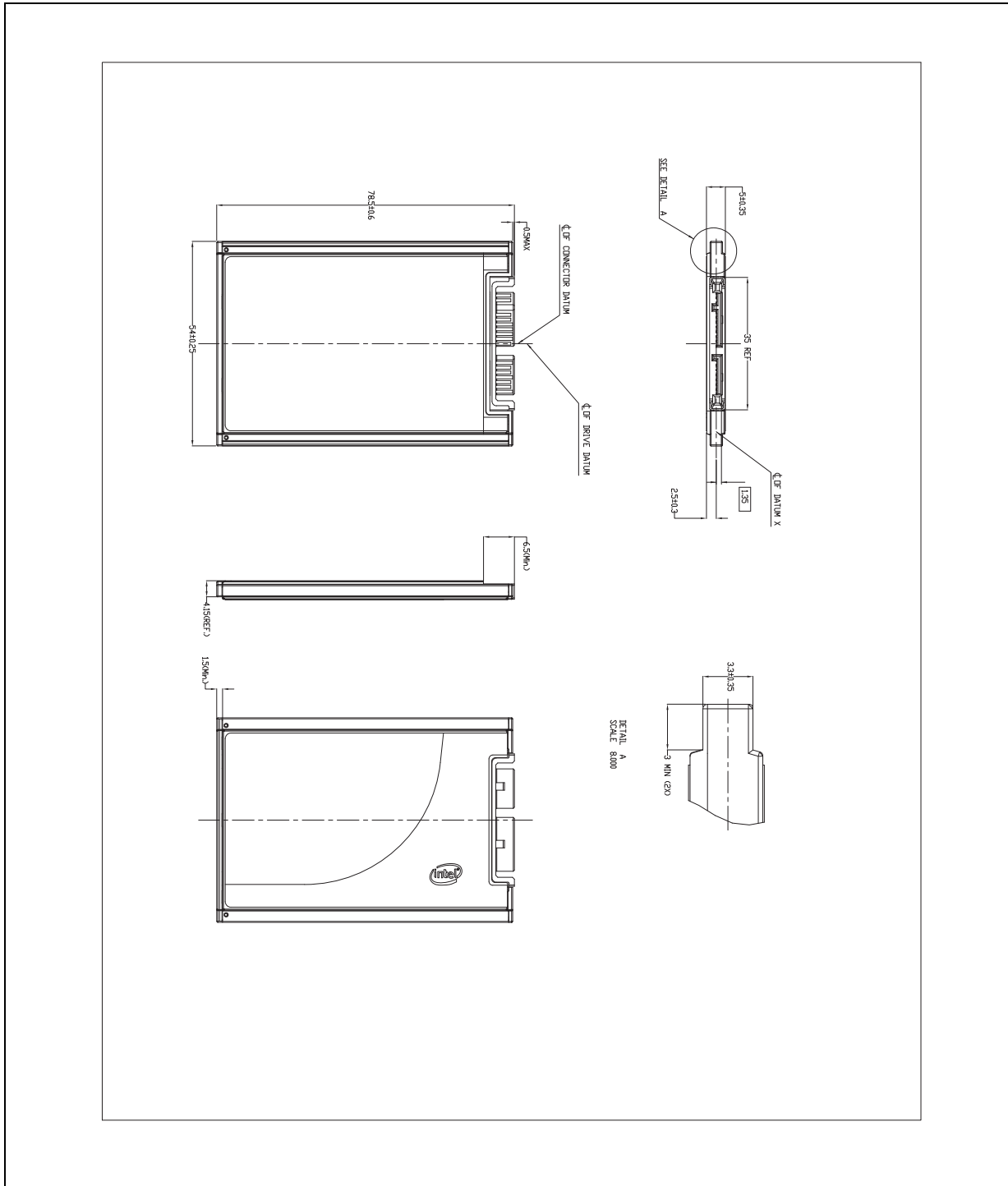
Notes:
1.   Connector Outline: The 1.8" Intel X18-M SATA SSD connector is compliant to the SATA Rev 2.6 specifications.
2.   Connector Location: The 1.8" Intel X18-M SATA SSD connector is compliant to the micro SATA SFF-8144 specification.
3.   All dimensions are in millimeters.

4.2 1.8" 8 mm Intel X18-M SATA SSD

The following figure shows the physical package information for the 8 mm deep 1.8"
Intel X18-M SATA SSD.

Figure 3. Dimensions for Intel X18-M SATA SSD 1.8" 8 mm Form Factor
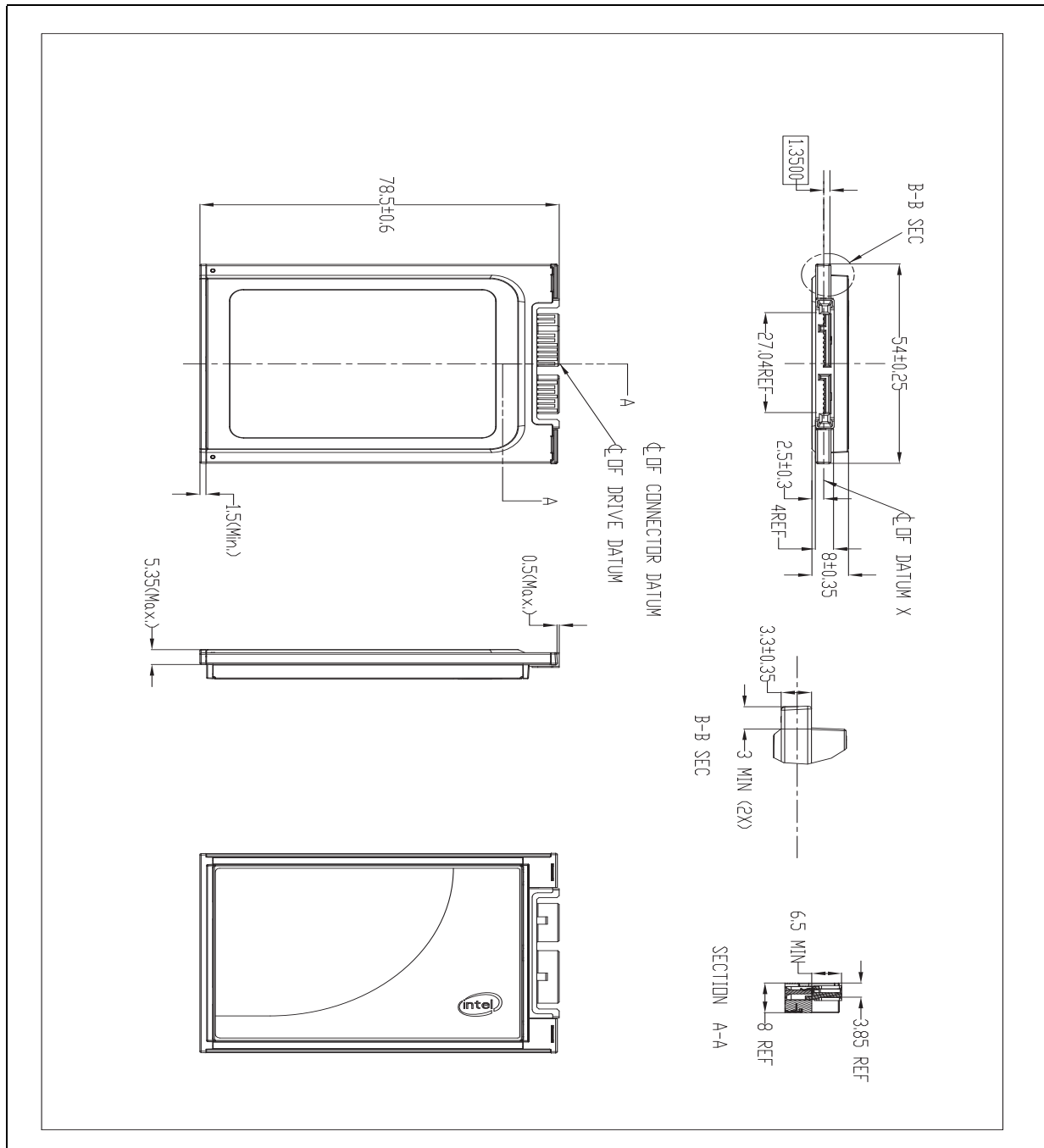
Note: All dimensions are in millimeters.

4.3 2.5″ 7 mm Intel X25-M SATA SSD

The following figure shows the physical package information for the 7 mm deep 2.5″ Intel X25-M SATA SSD.

Figure 4. Dimensions for Intel X25-M SATA SSD 2.5″ 7 mm Form Factor
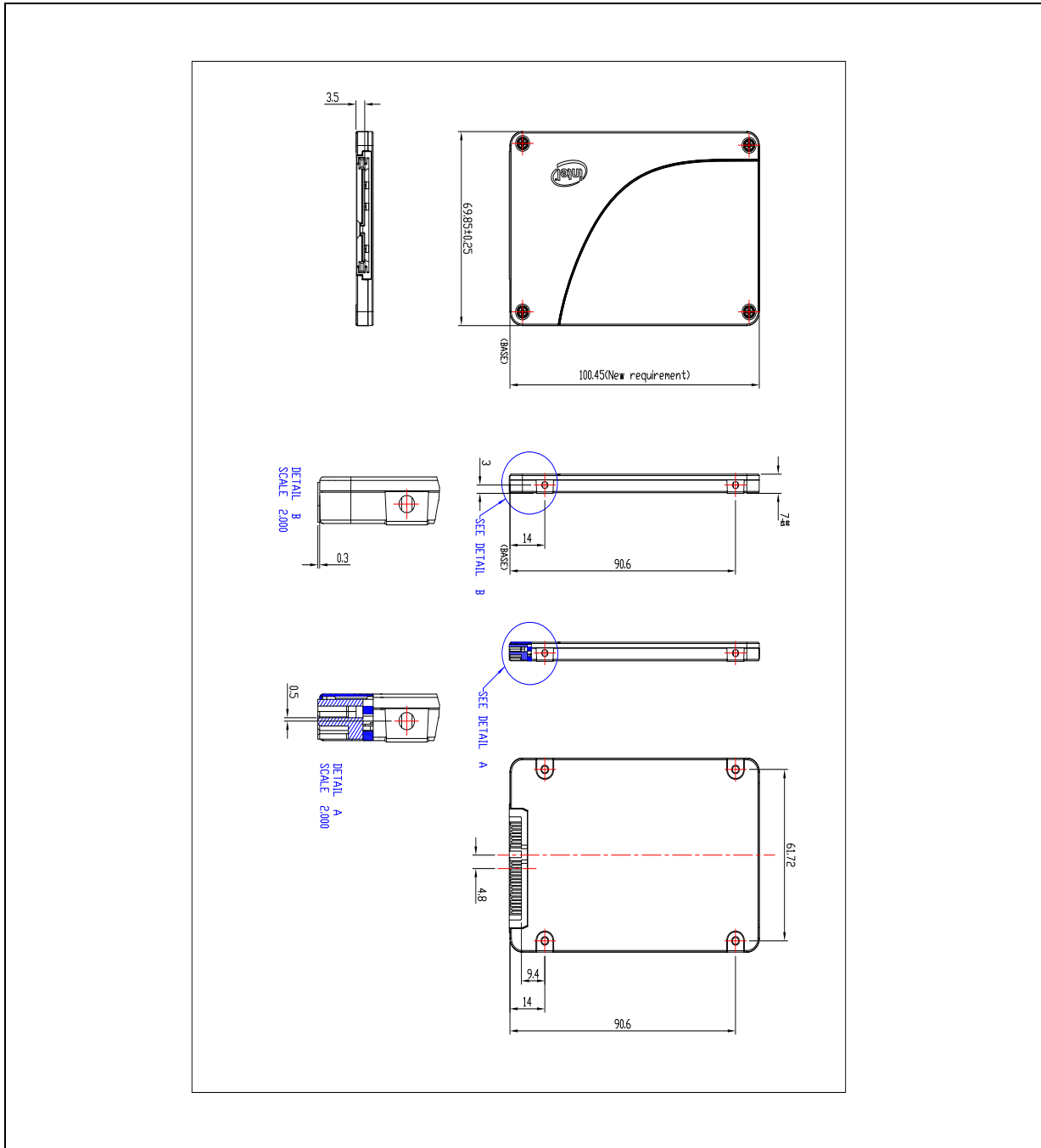
Note: All dimensions are in millimeters.

4.4 2.5″ 9.5 mm Intel X25-M SATA SSD

The following figure shows the physical package information for the 9.5 mm deep 2.5″ Intel X25-M SATA SSD.

Figure 5.   Dimensions for Intel X25-M SATA SSD 2.5″ 9.5 mm Form Factor
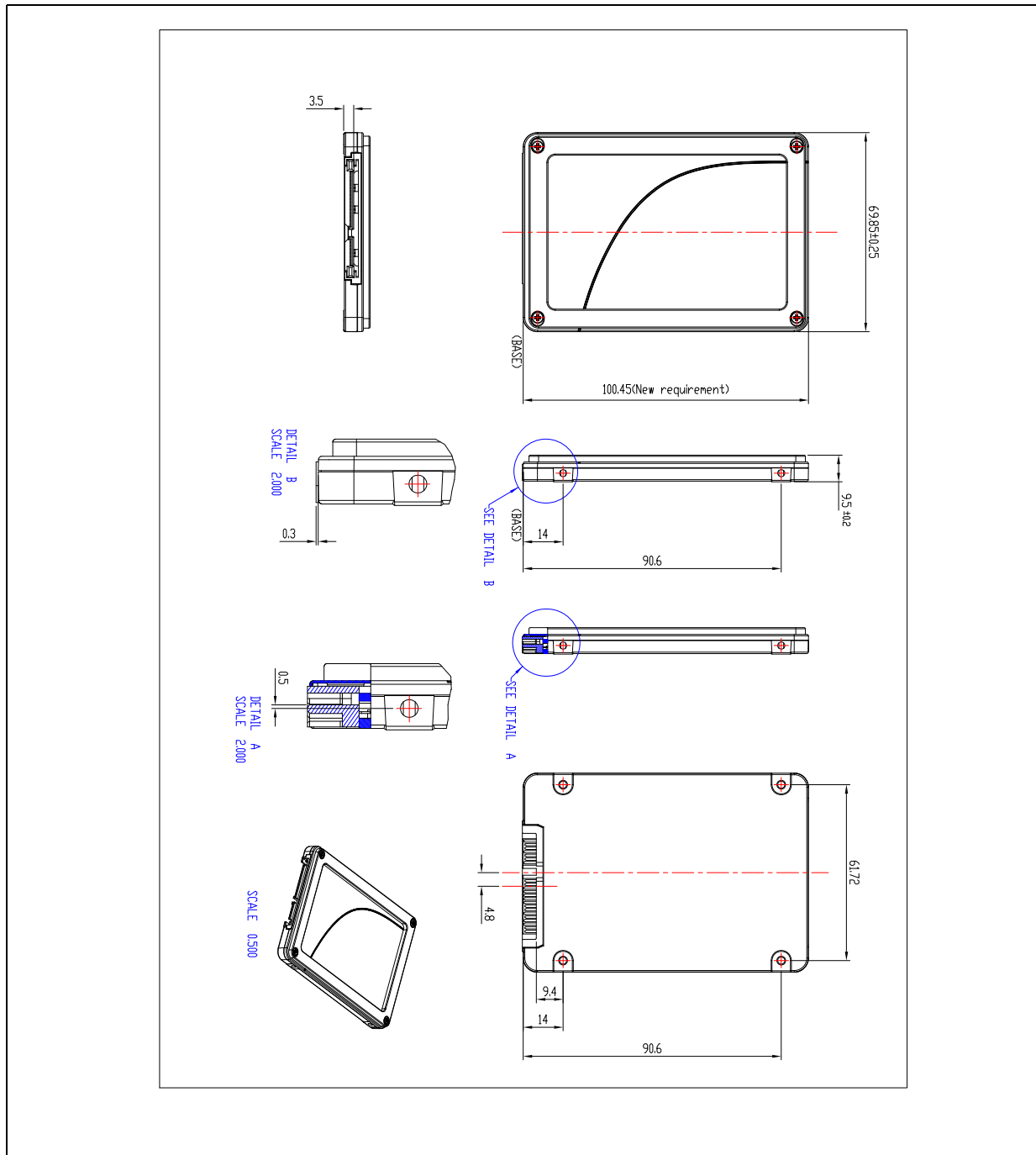
Note: All dimensions are in millimeters.

5.0　Pin and Signal Descriptions

This section identifies the pin locations and signal descriptions of the Intel X18-M/X25-M SATA SSDs.

5.1　Pin Locations

5.1.1　1.8″ Pin Locations

Figure 6.　Layout of Signal and Power Segment Pins

Signal Segment S1　　　Power Segment P1
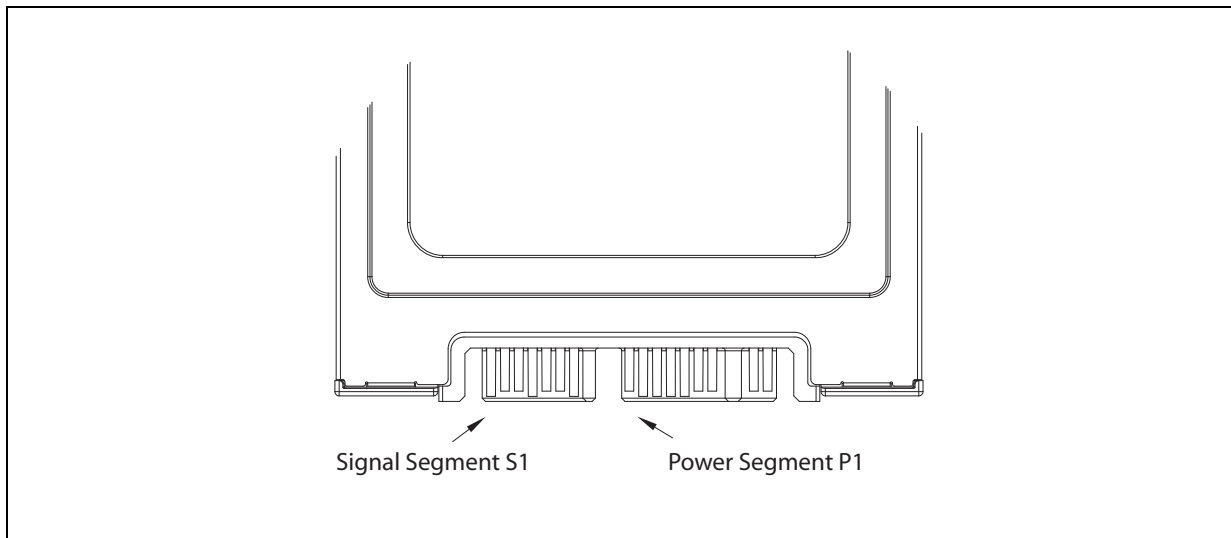
5.1.2   2.5" Pin Locations

Figure 7.   Layout of Signal and Power Segment Pins
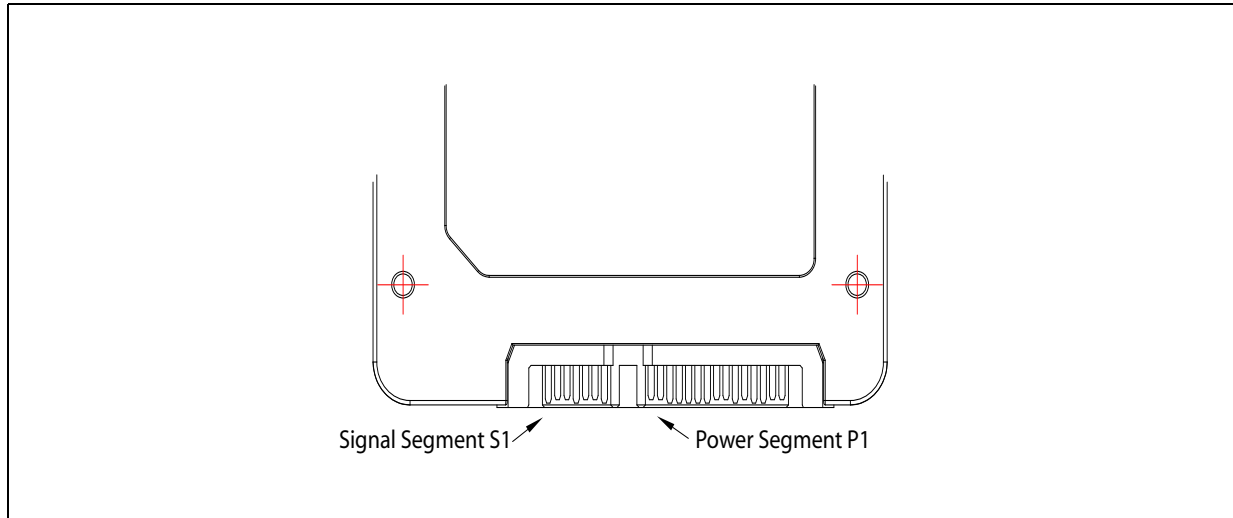
5.2   Signal Description Table

Table 13.   Serial ATA Connector Pin Signal Definitions for 1.8" and 2.5" Form Factors

Pin	Function	Definition
S1	Ground	2nd mate
S2	A+	Differential signal pair A
S3	A-	
S4	Ground	2nd mate
S5	B-	Differential signal pair B
S6	B+	
S7	Ground	2nd mate

Note: Key and spacing separate signal and power segments.

Table 14.   Serial ATA Power Pin Definitions for 1.8" Form Factor

Pin	Function	Definition	Mating Order[1]
P1	V_{33}	3.3 V Power[2]	2nd Mate
P2	V_{33}	3.3 V Power, pre-charge[2]	1st Mate
P3	Ground[3]		1st Mate
P4	Ground[3]		1st Mate
P5	V_5	5 V Power. Not connected[4]	1st Mate

Table 14.   Serial ATA Power Pin Definitions for 1.8" Form Factor (Continued)

Pin	Function	Definition	Mating Order[1]
P6	V_5	5 V Power. Not connected[4]	2nd Mate
P7	DAS	Device Activity Signal[5]	2nd Mate
Key	Key	NC	NC
P8	Optional	Manufacturing Test Pin[6]	2nd Mate
P9	Optional	Manufacturing Test Pin[6]	2nd Mate

Notes:
1. All mate sequences assume zero angular offset between connectors.
2. P1 and P2 are internally connected to one another within the device.
3. Ground connectors P3 and P4 may contact before the other 1st mate pins in both the power and signal connectors to discharge ESD in a suitably configure backplane connector.
4. P5 and P6 are not connected internal to the device. The host may put 5V on these pins.
5. The host may ground P7 if it is not used for Device Activity Signal (DAS).
6. P8 and P9 should not be connected by the host.

Table 15.   Serial ATA Power Pin Definitions for 2.5" Form Factor

Pin[1]	Function	Definition	Mating Order
P1	Not connected[2]	(3.3 V Power)	
P2	Not connected[2]	(3.3 V Power)	
P3	Not connected[2]	(3.3 V Power. pre-charge)	2nd Mate
P4	Ground[3, 4]		1st Mate
P5	Ground[3]		1st Mate
P6	Ground[3]		1st Mate
P7	V_5[3, 5]	5 V Power	1st Mate
P8	V_5[3, 5]	5 V Power	2nd Mate
P9	V_5[3, 5]	5 V Power	2nd Mate
P10	Ground[3]		1st Mate
P11	DAS[6]	Device Activity Signal[6]	2nd Mate
P12	Ground[3, 4]		1st Mate
P13	V_{12}[7]	12 V Power. Not used.	2nd Mate
P14	V_{12}[7]	12 V Power. Not used.	2nd Mate
P15	V_{12}[7]	12 V Power. Not used.	2nd Mate

Notes:
1. All pins are in a single row, with a 1.27 mm (0.050") pitch.
2. Pins P1, P2 and P3 are connected together, although they are not connected internally to the device. The host may put 3.3 V on these pins.
3. The mating sequence are:
   - the ground pins P4-P6, P10, P12 and the 5v power pin P7.
   - the 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 connected together, although they are not connected internally to the device. The host may put 12 V on these pins.

5.3   Hot Plug Support

Hot Plug insertion and removal are supported in the presence of a proper connector and appropriate operating system (OS) support as described in the SATA 2.6 specification. This product supports Asynchronous Signal Recovery and will issue an unsolicited COMINIT when first mated with a powered connector to guarantee reliable detection by a host system without hardware device detection.

6.0   Command Sets

6.1   ATA Commands

The Intel X18-M/X25-M SATA SSDs support all the mandatory ATA commands defined in the ATA/ATAPI-7 specification.

6.1.1   ATA General Feature Command Set

The Intel X18-M/X25-M SATA SSDs support the ATA General Feature command set (non-PACKET), which consists of

- EXECUTE DEVICE DIAGNOSTIC
- FLUSH CACHE
- IDENTIFY DEVICE
- READ DMA
- READ SECTOR(S)
- READ VERIFY SECTOR(S)
- SEEK
- SET FEATURES
- WRITE DMA
- WRITE SECTOR(S)
- READ MULTIPLE
- SET MULTIPLE MODE
- WRITE MULTIPLE

The Intel X18-M/X25-M SATA SSDs also support the following optional commands:

- READ BUFFFER
- WRITE BUFFER
- NOP
- DOWNLOAD MICROCODE

6.1.1.1 IDENTIFY DEVICE Data

The following table details the sector data returned after issuing an IDENTIFY DEVICE command.

Table 16. Returned Sector Data

Word	F = Fixed V = Variable X = Both	Default Value	Description
0	F	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
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	0h	Reserved
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	0101h	Number of sectors transferred per interrupt on MULTIPLE commands
60-61	F	0950F8B0h (80 GB) 0FFFFFFFh (160 GB)	Total number of user addressable sectors
62	X	0h	Obsolete
63	F	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

Table 16.   Returned Sector Data (Continued)

Word	F = Fixed V = Variable X = Both	Default Value	Description
69-70	F	0h	Reserved (for future command overlap and queuing)
71-74	F	0h	Reserved for the IDENTIFY PACKET DEVICE command.
75	F	001Eh	Queue depth
76	F	0106h	Serial ATA capabilities
77	F	0h	Reserved for future Serial ATA definition
78	F	0048h	Serial ATA features supported
79	V	0040h	Serial ATA features enabled
80	F	00FCh	Major Version Number
81	F	001Ah	Minor Version Number
82	F	746Bh	Command set supported.
83	F	7C01h	Command sets supported.
84	F	6123h	Command set/feature supported extension.
85	V	7469h	Command set/feature enabled.
86	V	BC01h	Command set/feature enabled.
87	V	6123h	Command set/feature default.
88	V	407Fh	Ultra DMA Modes
89	F	0001h	Time required for security erase unit completion
90	F	0001h	Time required for Enhanced security erase completion
91	V	0h	Current advanced power management value
92	V	FFFEh	Master Password Revision Code
93	F	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	0950F8B0h (80 GB) 12A19EB0h (160 GB)	Maximum user LBA for 48-bit Address feature set.
104	V	0h	Streaming Transfer Time - PIO
105	F	0h	Reserved
106	F	4000h	Physical sector size / logical sector size
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 world wide 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

Table 16.   Returned Sector Data (Continued)

Word	F = Fixed V = Variable X = Both	Default Value	Description
120	F	401Ch	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
129-159	X	0h	Vendor specific
160	F	0h	CompactFlash Association (CFA) power mode 1
161-175	X	0h	Reserved for assignment by the CFA
176-205	V	0h	Current media serial number
206-216	F	0h	Reserved
217	F	0001h	Non-rotating media device
218-221	F	0h	Reserved
222	F	101F	Reserved
223-233	F	0h	Reserved
234		0001h	Reserved
235		02A0h	Reserved
236-254	F	0h	Reserved
255	X	Varies	Integrity word (Checksum and Signature)

Notes:
1. **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.
2. **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.
3. **X = F or V**. The content of the word may be fixed or variable.

6.1.2   Power Management Command Set

The Intel X18-M/X25-M SATA SSD supports the Power Management command set, which consists of

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

6.1.3 Security Mode Feature Set

The Intel X18-M/X25-M SATA SSD 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

6.1.4 SMART Command Set

The Intel X18-M/X25-M SATA SSDs support the SMART command set, which consists of

- SMART ENABLE OPERATIONS
- SMART DISABLE OPERATIONS
- SMART ENABLE/DISABLE AUTOSAVE
- SMART RETURN STATUS

The Intel X18-M/X25-M SATA SSDs also support the following optional commands:

- SMART EXECUTE OFF-LINE IMMEDIATE
- SMART READ DATA
- SMART READ LOG
- SMART WRITE LOG

6.1.5 Host Protected Area Command Set

The Intel X18-M/X25-M SATA SSDs support 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

The Intel X18-M/X25-M SATA SSDs also support the following optional commands:

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

6.1.6   48-Bit Address Command Set

The Intel X18-M/X25-M SATA SSDs support 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

6.1.7   Device Configuration Overlay Command Set

The Intel X18-M/X25-M SATA SSDs support the Device Configuration Overlay command set, which consists of

- DEVICE CONFIGURATION FREEZE LOCK
- DEVICE CONFIGURATION IDENTITY
- DEVICE CONFIGURATION RESTORE
- DEVICE CONFIGURATION SET

6.1.8   General Purpose Log Command Set

The Intel X18-M/X25-M SATA SSDs support the General Purpose Log command set, which consists of

- READ LOG EXT
- WRITE LOG EXT

6.2   SATA Commands

The SATA 2.6 specification is a super set of the ATA/ATAPI-7 specification with regard to supported commands. The Intel X18-M/X25-M SATA SSDs support the following features that are unique to the SATA specification.

6.2.1   Software Settings Preservation

The Intel X18-M/X25-M SATA SSDs support the SET FEATURES parameter to enable/disable the preservation of software settings.

6.2.2   Native Command Queuing

The Intel X18-M/X25-M SATA SSDs support the Native Command Queuing (NCQ) command set, which includes

- READ FPDMA QUEUED
- WRITE FPDMA QUEUED

Note: With a maximum queue depth equal to 31.

7.0   References

This document references standards defined by a variety of organizations. Use the following list to identify the location of an organization's standards information.

Table 17.   Standards References

Date or Rev. #	Title	Location
Dec 2008	VCCI	http://www.vcci.or.jp/vcci_e/general/join/index.html
July 2007	RoHS	Search for material description datasheet at http://intel.pcnalert.com
July 2007	SFF-8144, 1.8" drive form factor	http://www.sffcommittee.org
June 2007	Intel Matrix Storage Manager	http://support.intel.com/support/chipsets/imsm/
February 2007	Serial ATA Revision 2.6	http://www.sata-io.org
May 2006	SFF-8223, 2.5" Drive w/Serial Attachment Connector	http://www.sffcommittee.org
May 2005	SFF-8201, 2.5" drive form factor	http://www.sffcommittee.org
April 2004	ATA-6 spec	http://www.t13.org/project/d1410r3b-ATA-ATAPI-6.pdf
April 2004	ATA-7 Volume 1	http://www.t13.org/Documents/UploadedDocuments/docs2007/D1532v1r4b-AT_Attachment_with_Packet_Interface_-_7_Volume_1.pdf

1995 1996 1995 1995 1997 1994	International Electrotechnical Commission EN 61000
	    4-2 (Personnel Electrostatic Discharge Immunity)
	    4-3 (Electromagnetic compatibility (EMC))
	    4-4 (Electromagnetic compatibility (EMC))
	    4-5 (Electromagnetic compatibility (EMC))
	    4-6 (Electromagnetic compatibility (EMC))
	    4-11 (Voltage Variations)
		http://www.iec.ch

1995	ENV 50204 (Radiated electromagnetic field from digital radio telephones)	http://www.iec.ch

8.0   Terms and Acronyms

This document incorporates many industry- and device-specific words. Use the following list to define a variety of terms and acronyms.

Table 18.   Glossary of Terms and Acronyms

Term	Definition
ATA	Advanced Technology Attachment
ATAPI	Advanced Technology Attachment Packet Interface
BER	Bit error rate, or percentage of bits that have errors relative to the total number of bits received
BIOS	Basic Input / Output System
Chipset	A term used to define a collection of integrated components required to make a PC function.
Device Initiated Link Power Management (DIPM)	The ability of the device to request SATA link power state changes.
DIPM	Device Initiated Power Management (SATA hard disk drive)
DMA	Direct Memory Access
DRAM	Dynamic Random Access Memory
EXT	Extended
FP	First Party
GB	Giga-byte defined as 1×10^9 bytes
HCI	Host Controller Interface
HCT	Hardware Compatibility Test
HDD	Hard Disk Drive
Host Initiated Link Power Management	The ability of the host to request SATA link power state changes.
Hot Plug	A term used to describe the removal or insertion of a SATA hard drive when the system is powered on.
IOPS	Input output operations per second
iMSM	The Intel Matrix Storage Manager device driver and associated system software.
LBA	Logical Block Address
LPM	Link Power Management: the ability of the SATA link layer to enter one of two lower power consuming states, partial and slumber
MB	Mega-bytes defined as 1×10^6 bytes
MP	Multi-Processor
MTBF	Mean time between failure
Native Command Queuing (NCQ)	The ability of the SATA hard drive to re-order commands in order to maximize the efficiency of gathering data from the platters.
NOP	No Operation
NTFS	NT File System
OEM	Original Equipment Manufacturer
OS	Operating System
Port	The point at which a SATA drive physically connects to the SATA controller.
RAID	Redundant Array of Independent Disks

Table 18.   Glossary of Terms and Acronyms (Continued)

Term	Definition
RMS	Root Mean Squared
RPM	Revolutions Per Minute
RTM	Release To Manufacture
SATA	Serial ATA
SFF	Small Form Factor
SMART	Self-Monitoring, Analysis and Reporting Technology: an open standard for developing hard drives and software systems that automatically monitors a hard drive's health and reports potential problems.
SSD	Solid State Drive
TBD	To Be Determined
WHQL	Microsoft* Windows Hardware Quality Labs
Write Cache	A memory device within a hard drive, which is allocated for the temporary storage of data before that data is copied to its permanent storage location.
VCCI	Voluntary Control Council for Interface

9.0   Revision History

Date	Revision	Description
May 2009	008	Updated feature list on page 1. Updated vibration specification on page 9. Clarified statement on minimum useful life specification on page 11. Added SMART command set on page 23.
May 2009	007	Updated the ordering information on page 2.
February 2009	006	Modified mechanical drawing details on page 12. Added note to sequential performance table on Table 3 on page 7. Added latency specifications on the front page. Clarified statement about NCQ support on page 25.
January 2009	005	Added Random IOPs numbers on page 1 and page 8. Modified Identify Device Info for word 59 and 106 on page 20.
December 2008	004	Modified thickness information on the ordering table on page 2.

Date	Revision	Description
December 2008	003	Included capacity and weight for 160 GB on page 1. Updated ordering information on page 2. Updated User Addressable Sectors for 160 GB on page 7. Added 1.8″ 8mm Intel X18-M SATA SSD mechanical info page 13. Updated identify device information on words 60, 84, 85, 87, 88 and 100 on page 20. Added VCCI certification on page 25.
July 2008	002	Modified Idle Power Number on page 1. Modified Weights for different form factors on page 1. Modified Shock Spec on page 1 and Table 10, Shock and Vibration Specifications. Updated Active and Idle Power number on Table 8, Typical Power Consumption. Corrected Temp Gradient unit on Table 9, Temperature Related Specifications. Updated Identify Device Data on Table 16, Returned Sector Data. Maximum Queue Depth number changed to 31 on 6.2.2. Updated Sustained Read Bandwidth number on page 1 and Table 3 on page 7. Added extra information on altitude in 3.4.2. Updated RoHS reference in Table 17 on page 25.
May 2008	001	Initial Release. Earlier information released as *Intel® High Performance Solid State Drive Advance Product Manual* - 318512-002US.