

# P300 2.5-Inch SATA NAND Flash SSD

## MTFDDACxxxSAL1x1

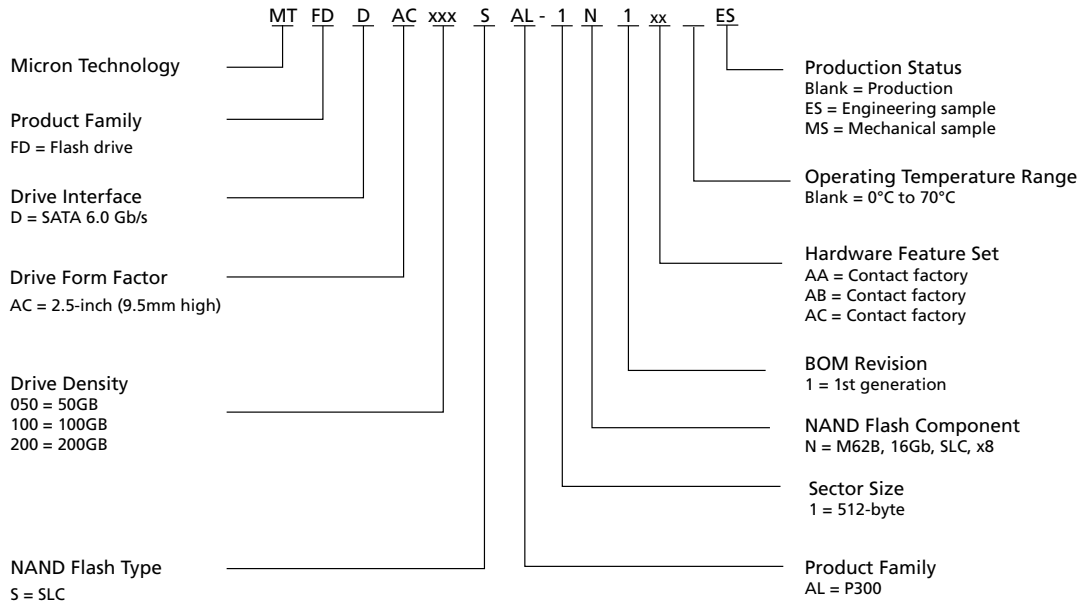
### Features

- Micron® SLC NAND Flash
  - RoHS-compliant package
  - SATA 6 Gb/s interface
  - ATA modes supported
    - PIO modes 3 and 4
    - Multiword DMA modes 0, 1, 2
    - Ultra DMA modes 0, 1, 2, 3, 4, 5, 6
  - Industry-standard, 512-byte sector size support
  - Hot-plug capable
  - Native command queuing support with 32 command slot support
  - ATA8-ACS2 command set support
  - Secure erase (data page) command set
  - Self-monitoring, analysis, and reporting technology (SMART) command set
  - Performance (empty/steady state)<sup>1, 2, 3, 4</sup>
    - Sequential READ: up to 360/360 MB/s
    - Sequential WRITE: up to 275/255 MB/s
    - Random READ: up to 60,000/44,000 IOPs
    - Random WRITE: up to 45,200/16,000 IOPs
    - READ latency: 0.153/0.154ms (TYP)
    - WRITE latency: 0.118/0.424ms (TYP)
  - Reliability
    - MTBF: 2 million hours
    - 3-year warranty
    - Static and dynamic wear leveling
    - Field-upgradable firmware
    - Uncorrectable bit error rate (UBER): <1 sector per 10<sup>16</sup> bits read
    - Low power consumption: <7W (AVG)
  - Endurance: Total bytes written (TBW) – 50GB (0.875PB); 100GB (1.75PB); 200GB (3.5PB)
  - Mechanical/electrical
    - Standard SATA connector
    - 5V power (±10%)
    - Dimensions: 100.45mm x 69.85mm x 9.5mm
    - Weight: 100g
  - Operating temperature: 0°C to 70°C
  - Humidity (operating): 5% to 95% RH
  - Shock and vibration
    - 1500G/0.5ms
    - 5–500Hz at 3.1G
  - Capacity<sup>5</sup>: 50GB, 100GB, 200GB
- Notes:
1. 128K transfers used for sequential READ/WRITE values.
  2. 4K transfers used for random READ/WRITE latency values.
  3. I/O performance numbers as measured using Iometer with a queue depth of 32 and write cache disabled.
  4. Performance values apply to all drive capacities.
  5. 1GB = 1 billion bytes; formatted capacity is less.

## Part Numbering Information

The Micron® RealSSD™ P300 SSD is available in different configurations and densities. Visit [www.micron.com](http://www.micron.com) for a list of valid part numbers.

**Figure 1: Part Number Chart**



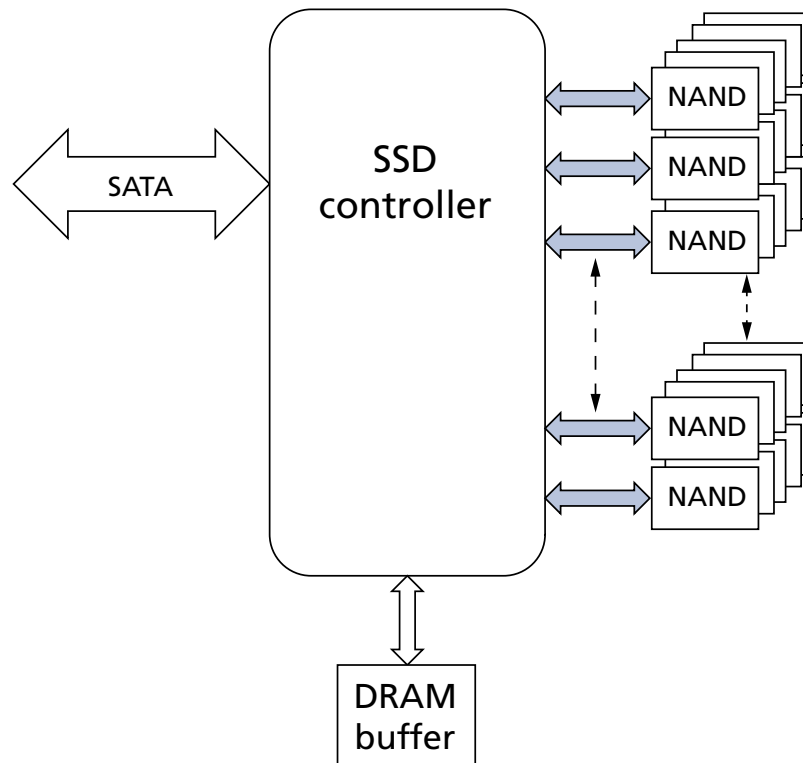
**Warranty:** Micron makes no warranties, expressed or implied, including, but not limited to, any implied warranties of merchantability, fitness for a particular purpose, other warranties that might arise from course of dealing or custom of trade other than that Micron warrants only that the product complies with Micron's specification sheet for the product at the time of delivery, provided that deviations from specifications which do not materially affect performance of such product in the system and configuration in or for which it is initially installed or qualified by customer shall not be deemed to constitute failure to comply with such specifications. Any claim against Micron must be made within **three (3) years** from the date of shipment by Micron and Micron has no liability thereafter. Micron's liability is limited to repair or replacement of the defective product or credit or refund of the purchase price of the defective product, provided that Micron may elect refund in lieu of credit, replacement or repair.

## General Description

The Micron® RealSSD™ P300 solid state drive (SSD) uses a single-chip controller with a SATA interface on the system side and n-channels of Micron NAND Flash internally. Packaged in an industry standard 2.5-inch drive enclosure, the SSD integrates easily in existing storage infrastructures.

The Micron® RealSSD™ P300 SSD is targeted at applications that require a high percentage of random READ/WRITE operations; high performance in terms of IOPs or latency, high endurance, high data retention; or applications that are deployed in harsh environments.

**Figure 2: Functional Block Diagram**



## Architecture

The P300 SSD is a NAND Flash storage device. A SATA 6 Gb/s interface connects to the SSD externally and communicates with the controller. The controller manages data transfers to and from the NAND Flash array.

**Table 1: P300 Configurations**

Unformatted Disk Density	NAND Flash Process	NAND Flash Density	Package Count	Die per BGA Package
50GB	34nm	16Gb	16	2
100GB	34nm	16Gb	16	4
200GB	34nm	16Gb	16	8

Note: 1. Density is shown as user capacity (unformatted).

## Logical Block Address Configuration

The drive is set to report the number of logical block addresses (LBA) that will ensure sufficient storage space for the specified density. Standard LBA settings, based on the IDEMA standard (LBA1-02), are shown below.

**Table 2: Standard LBA Settings**

Drive Size <sup>1</sup>	Total LBAs		Max LBA		User Available Bytes
	Decimal	Hexadecimal	Decimal	Hexadecimal	(Unformatted)
50GB	97,696,368	5D2BA70	97,696,367	5D2BA6F	50,020,549,632
100GB	195,371,568	BA52230	195,371,567	BA5222F	100,030,242,816
200GB	390,721,968	1749F1B0	390,721,967	1749F1AF	200,049,647,616

Note: 1. 1GB = 1,000,000,000 bytes.

**Table 3: 2.5-Inch Nominal Dimensions and Weight**

	Value	Unit
Height	9.5	mm
Width	69.85	mm
Length	100.50	mm
Unit weight	<100	g

## Interface Connectors

The SATA signal segment interface cable has four conductors and three ground connections. As shown in Package Dimensions, the cable includes a 7-pin signal segment and a 9-pin power segment arranged in a single row with a 1.27mm (0.050in) pitch.

**Table 4: SATA Signal Segment Pin Assignments**

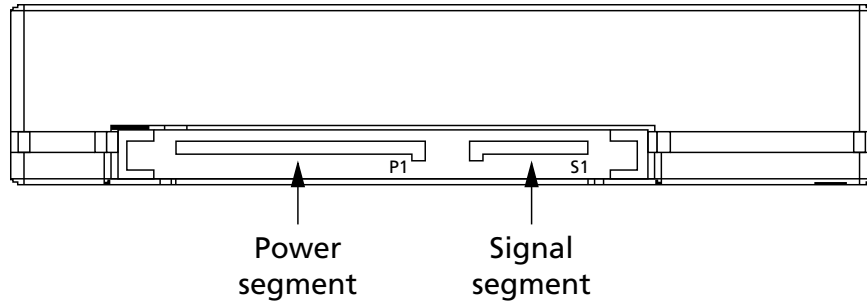
Signal Name	Type	Description
S1	GND	Ground
S2	A	Differential signal pair A and A#
S3	A#	
S4	GND	Ground
S5	B#	Differential signal pair B and B#
S6	B	
S7	GND	Ground

**Table 5: 2.5-Inch SATA Power Segment Pin Assignments**

Pin#	Signal Name	Description
P1	V33	No connect
P2	V33	No connect
P3	V33	No connect
P4	GND	Ground
P5	GND	Ground
P6	GND	Ground
P7	V5	5V power, precharge
P8	V5	5V power
P9	V5	5V power
P10	GND	Ground
P11	DAS <sup>1</sup>	Device activity signal
P12	GND	Ground
P13	V12	No connect
P14	V12	No connect
P15	V12	No connect

Note: 1. Pin 11 (DAS) may be optionally connected to GND.

**Figure 3: SSD Interface Connections**



## Device ID

**Table 6: IDENTIFY Device ID**

- F = The content of the word is fixed and does not change
- V = The content of the word is variable and may change depending on the state of the device or the commands executed by the device
- X = The fixed or variable type of this field is not defined in the governing standard
- R = The content of the word is reserved and shall be zero

Word	Bit(s)	Setting	Default Value	Description
00	15	F	0b	0 = ATA device
	14–8	X	1000100b	Retired
	7–6	F	01b	Obsolete
	5–3	X	000b	Retired
	2	V	0b	Response incomplete
	1	X	0b	Retired
	0			0b
01		X	3FFFh	Obsolete
02		V	C837h	Specific configuration
03		X	0010h	Obsolete
04		X	0000h 0000h	Retired
06		X	003Fh	Obsolete
07			0000h 0000h	Reserved for the CompactFlash® Association (CFA)
09		X	0000h	Retired
10		F	Varies	Serial number (20 ASCII characters)
20		X	0000h 0000h 0000h	Retired/Obsolete
23		F	Varies	Firmware revision (8 ASCII characters)
27		F	Varies	Model number (40 ASCII characters)
47	15–8	F	80h	80h
	7–0	F	10h	00h = Reserved 01h-FFh = Maximum number of logical sectors that shall be transferred per DRQ data block on READ/WRITE MULTIPLE commands
48	15	F	0b	Shall be cleared to 0
	14	F	1b	Shall be set to 1
	13–1		000000000000b	Reserved for the trusted computing group
	0	F	0b	1 = Trusted computing feature set is supported

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Word	Bit(s)	Setting	Default Value	Description
49	15–14		00b	Reserved for IDENTIFY PACKET DEVICE command
	13	F	1b	1 = Standby timer values as specified in ATA-8 ACS-2 are supported 0 = Standby timer values shall be managed by the device
	12		0b	Reserved for IDENTIFY PACKET DEVICE command
	11	F	1b	1 = IORDY supported 0 = IORDY may be supported
	10	F	1b	1 = IORDY may be disabled
	9	F	1b	1 = Shall be set to 1 to indicate that LBA is supported
	8	F	1b	1 = DMA support
	7–2	X	00000000b	Reserved
	1–0		00b	Current long physical sector alignment setting
50	15	F	0b	Shall be cleared to 0
	14	F	1b	Shall be set to 1
	13–2		00000000b	Reserved
	1	X	0b	Obsolete
	0	F	1b	Shall be set to 1 to indicate vendor-specific standby timer value minimum
51		X	0000h 0000h	Obsolete
53	15–8	F	00000000b	Free-fall control sensitivity 00h = Vendor's recommended setting 01h-FFh = Sensitivity level; a larger number is a more sensitive setting
	7–3		00000b	Reserved
	2	F	1b	1 = The fields reported in word 88 are valid 0 = The fields reported in word 88 are not valid
	1	F	1b	1 = The fields reported in words (70:64) are valid 0 = The fields reported in words (70:64) are not valid
	0	X	1b	Obsolete
54		X	3FFh 0010h 003Fh FC10h 00FBh	Obsolete



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Word	Bit(s)	Setting	Default Value	Description
59	15	F	1b	1 = The BLOCK ERASE EXT command is supported
	14	F	0b	1 = The OVERWRITE EXT command is supported
	13	F	0b	1 = The CRYPTO SCRAMBLE EXT command is supported
	12	F	1b	1 = The sanitize feature set is supported
	11–9		000b	Reserved
	8	V	1b	1 = Multiple sector setting is valid
	7–0	V	00000001b	Current setting for number of logical sectors that shall be transferred per DRQ data block on READ/WRITE MULTIPLE commands
60		F	Sect	Total number of user addressable logical sectors for 28-bit commands
62		X	0000h	Obsolete
63	15–11		00000b	Reserved
	10	V	0b	1 = Multiword DMA mode 2 is selected 0 = Multiword DMA mode 2 is not selected
	9	V	0b	1 = Multiword DMA mode 1 is selected 0 = Multiword DMA mode 1 is not selected
	8	V	0b	1 = Multiword DMA mode 0 is selected 0 = Multiword DMA mode 0 is not selected
	7–3		0000b	Reserved
	2	F	1b	1 = Multiword DMA mode 2 and below is supported
	1	F	1b	1 = Multiword DMA mode 1 and below is supported
	0	F	1b	1 = Multiword DMA mode 0 is supported
64	15–8		00	Reserved
	7–0	F	03h	PIO modes support
65		F	0078h	Minimum multiword DMA transfer cycle time per word in nanoseconds (cycle time)
66		F	0078h	MFR's recommended multiword DMA transfer cycle time per word in nanoseconds (cycle time)
67		F	0078h	Minimum PIO transfer cycle time without flow control in nanoseconds (cycle time)
68	15–0	F	0078h	Minimum PIO transfer cycle time with IORDY flow control in nanoseconds (cycle time)

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Word	Bit(s)	Setting	Default Value	Description	
69	15	F	0b	1 = CFast™ specification support	
	14	F	0b	1 = Deterministic read after trim is supported	
	13	F	0b	1 = Long physical sector alignment error reporting control is supported	
	12	F	0b	1 = DEVICE CONFIGURATION IDENTIFY DMA and DEVICE CONFIGURATION SET DMA are supported	
	11	F	0b	1 = READ BUFFER DMA is supported	
	10	F	0b	1 = WRITE BUFFER DMA is supported	
	9	F	0b	1 = SET MAX PASSWORD DMA and SET MAX UNLOCK DMA are supported	
	8	F	0b	1 = DOWNLOAD MICROCODE DMA is supported	
	7	F	0b	Reserved for IEEE-1667	
	6	F	0b	1 = Optional ATA device 28-bit commands supported	
	5	F	0b	1 = Read zero after trim is supported	
	4-0		00000b	Reserved	
70			0000h	Reserved	
71			0000h 0000h 0000h 0000h	Reserved for the IDENTIFY PACKET DEVICE command	
75	15-5		00000000000b	Reserved	
	4-0	F	11111b	Maximum queue depth - 1	
76	15-13		000b	Reserved for SATA	
	12	F	1b	1 = Supports NCQueue priority information	
	11	F	0b	1 - Supports unload while NCQ commands outstanding	
	10	F	1b	1 = Supports PHY event counters	
	9	F	1b	1 = Supports receipt of host-initiated partial interface power management	
	8	F	1b	1 = Supports NCQ feature set	
		7-3		0000b	Reserved for SATA
		2	F	1b	1 = Supports SATA Gen-2 signaling speed (3.0 Gb/s)
		1	F	1b	1 = Supports SATA Gen-1 signaling speed (1.5 Gb/s)
		0	F	0b	Shall be cleared to 0
77		V	0004h	Reserved for SATA	

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Word	Bit(s)	Setting	Default Value	Description
78	15–7		00000000b	Reserved for SATA
	6	F	1b	1 = Supports software settings preservation
	5		0b	Reserved for SATA
	4	F	0b	1 = Supports in-order data delivery
	3	F	1b	1 = Device supports initiating interface power management (DIPM)
	2	F	1b	1 = Supports DMA setup auto activation
	1	F	0b	1 = Supports nonzero buffer offsets
	0	F	0b	Shall be cleared to 0
79	15–7		00000000b	Reserved for SATA
	6	V	1b	1 = Software settings preservation enabled
	5		0b	Reserved for SATA
	4	V	0b	1 = In-order data delivery enabled
	3	V	0b	1 = Device initiated power management enabled
	2	V	0b	1 = DMA setup auto-activation enabled
	1	V	0b	1 = Nonzero buffer offsets enabled
	0	F	0b	Shall be cleared to 0
80	15–10		000000b	Reserved
	9	F	1b	1 = Supports ATA8-ACS2
	8	F	1b	1 = Supports ATA-8-ACS
	7	F	1b	1 = Supports ATA/ATAPI-7
	6	F	1b	1 = Supports ATA/ATAPI-6
	5	F	1b	1 = Supports ATA/ATAPI-5
	4	F	1b	1 = Supports ATA/ATAPI-4
	3	X	0b	Obsolete
	2	X	0b	Obsolete
	1	X	0b	Obsolete
	0			Reserved
81				Minor version number
		F	0028h	0028h = ATA8-ACS version 6

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Word	Bit(s)	Setting	Default Value	Description
82	15	X	0b	Obsolete
	14	F	1b	1 = NOP command support
	13	F	1b	1 = READ BUFFER command support
	12	F	1b	1 = WRITE BUFFER command support
	11	X	0b	Obsolete
	10	F	1b	1 = Host-protected area feature set support
	9	F	0b	Shall be cleared to 0 to indicate that the DEVICE RESET command is not supported
	8	F	0b	1 = Service interrupt support
	7	F	0b	1 = Release interrupt support
	6	F	1b	1 = READ look-ahead support
	5	F	1b	1 = Volatile write cache support
	4	F	0b	Shall be cleared to 0 to indicate that the PACKET feature set is not supported
	3	F	1b	Shall be set to 1 to indicate that mandatory power management feature set is supported
	2	X	0b	Obsolete
	1	F	1b	1 = Security feature set support
0	F	1b	1 = SMART feature set support	

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Word	Bit(s)	Setting	Default Value	Description
83	15	F	0b	Shall be cleared to 0
	14	F	1b	Shall be set to 1
	13	F	1b	1 = FLUSH CACHE EXT command support
	12	F	1b	Shall be set to 1 to indicate that the mandatory FLUSH CACHE command is supported
	11	F	1b	1 = Device configuration overlay feature set support
	10	F	1b	1 = 48-bit address feature set support
	9	F	0b	1 = Automatic acoustic management feature set support
	8	F	1b	1 = SET MAX security extension support
	7		0b	Reserved for address offset reserved area boot method
	6	F	0b	1 = SET FEATURES subcommand required to spin up after power up
	5	F	0b	1 = Power-up in standby feature set support
	4	X	0b	Obsolete
	3	F	1b	1 = Advanced power management feature set support
	2	F	0b	1 = CFA feature set support
	1	X	0b	Obsolete
0	F	1b	1 = DOWNLOAD MICROCODE command support	
84	15	F	0b	Shall be cleared to 0
	14	F	1b	Shall be set to 1
	13	F	1b	1 = The IDLE IMMEDIATE command with unload feature is supported
	12		0b	Reserved for TLC
	11		0b	Reserved for TLC
	10–9	X	00b	Obsolete
	8	F	1b	1 = 64-bit worldwide name support
	7	X	0b	Obsolete
	6	F	1b	1 = WRITE DMA FUA EXT (and) WRITE MULTIPLE FUA EXT commands are supported
	5	F	1b	1 = General purpose logging feature set support
	4	F	0b	1 = Streaming feature set support
	3	F	0b	1 = Media card passthrough command feature set support
	2	F	0b	1 = Media serial number support
	1	F	1b	1 = SMART self-test support
0	F	1b	1 = SMART error logging support	

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Word	Bit(s)	Setting	Default Value	Description
85	15	X	0b	Obsolete
	14	F	1b	1 = NOP command support
	13	F	1b	1 = READ BUFFER command support
	12	F	1b	1 = WRITE BUFFER command support
	11	X	0b	Obsolete
	10	V	1b	1 = Host-protected area feature set support
	9	F	0b	1 = DEVICE RESET command support
	8	V	0b	1 = Service interrupt enabled
	7	V	0b	1 = Release interrupt enabled
	6	V	1b	1 = Read look-ahead enabled
	5	V	1b	1 = Volatile write cache enabled
	4	F	0b	0 = Packet feature set is not supported
	3	F	1b	1 = Power management feature set is enabled
	2	X	0b	Obsolete
	1	V	0b	1 = Security feature set enabled
0	V	1b	1 = SMART feature set enabled	
86	15	F	1b	1 = Words 120 and 119 are valid
	14		0b	1 = Reserved
	13	F	1b	1 = FLUSH CACHE EXT command supported
	12	F	1b	1 = FLUSH CACHE command supported
	11	F	1b	1 = Device configuration overlay (DCO) feature set supported
	10	F	1b	1 = 48-bit address feature set support
	9	V	0b	1 = Automatic acoustic management feature set enabled
	8	F	0b	1 = SET MAX security extension enabled by SET MAX SET PASSWORD
	7		0b	Reserved for address offset reserved area boot method
	6	F	0b	1 = SET FEATURES subcommand required to spin up after power up
	5	V	0b	1 = Power-up in standby feature set enabled
	4	X	0b	Obsolete
	3	V	1b	1 = Advanced power management feature set enabled
	2	F	0b	1 = CFA feature set enabled
	1	X	0b	Obsolete
0	F	1b	1 = DOWNLOAD MICROCODE command support	

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Word	Bit(s)	Setting	Default Value	Description
87	15	F	0b	Shall be cleared to 0
	14	F	1b	Shall be set to 1
	13	F	1b	1 = IDLE IMMEDIATE command with unload feature support
	12		0b	Reserved for TLC
	11		0b	Reserved for TLC
	10–9	X	00b	Obsolete
	8	F	1b	1 = 64-bit worldwide name support
	7	X	0b	Obsolete
	6	F	1b	1 = WRITE DMA FUA EXT (and) WRITE MULTIPLE FUA EXT commands are supported
	5	F	1b	1 = General purpose logging feature set support
	4	X	0b	Obsolete
	3	V	0b	1 = Media card passthrough command feature set support
	2	V	0b	1 = Media serial number is valid
	1	F	1b	1 = SMART self-test support
0	F	1b	1 = SMART error logging support	

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Word	Bit(s)	Setting	Default Value	Description
88	15		0b	Reserved
	14	V	0b	1 = Ultra DMA mode 6 is selected 0 = Ultra DMA mode 6 is not selected
	13	V	0b	1 = Ultra DMA mode 5 is selected 0 = Ultra DMA mode 5 is not selected
	12	V	0b	1 = Ultra DMA mode 4 is selected 0 = Ultra DMA mode 4 is not selected
	11	V	0b	1 = Ultra DMA mode 3 is selected 0 = Ultra DMA mode 3 is not selected
	10	V	0b	1 = Ultra DMA mode 2 is selected 0 = Ultra DMA mode 2 is not selected
	9	V	0b	1 = Ultra DMA mode 1 is selected 0 = Ultra DMA mode 1 is not selected
	8	V	0b	1 = Ultra DMA mode 0 is selected 0 = Ultra DMA mode 0 is not selected
	7		0b	Reserved
	6	F	1b	1 = Ultra DMA mode 6 and below supported
	5	F	1b	1 = Ultra DMA mode 5 and below supported
	4	F	1b	1 = Ultra DMA mode 4 and below supported
	3	F	1b	1 = Ultra DMA mode 3 and below supported
	2	F	1b	1 = Ultra DMA mode 2 and below supported
	1	F	1b	1 = Ultra DMA mode 1 and below supported
	0	F	1b	1 = Ultra DMA mode 0 support
89	15–8		00h	Reserved
	7–0	F	01h	Time required for normal erase mode SECURITY ERASE UNIT command
90	15–8		00h	Reserved
	7–0	F	01h	Time required for enhanced erase mode SECURITY ERASE UNIT command
91		V	00FEh	Current advanced power management value
92		V	0000h	Master password identifier



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Word	Bit(s)	Setting	Default Value	Description
93	15	F	0b	Shall be cleared to 0
	14	F	0b	Shall be set to 1
	13	V	0b	1 = Device detected CBLID above ViH 0 = Device detected CBLID below ViL
	12		0b	Reserved
	11	V	0b	0 = Device 1 did not assert PDIAG 1 = Device asserted PDIAG
	10–9	V	00b	These bits indicate how device 1 determined the device number: 00 = Reserved 01 = Jumper used 10 = CSEL signal used 11 = Other method used or method used unknown
	8		0b	Shall be set to 1
	7	F	0b	Reserved
	6	F	0b	0 = Device 0 does not respond when device 1 is selected 1 = Device 0 responds when device 1 is selected
	5	V	0b	0 = Device 0 did not detect the assertion of DASP 1 = Device 0 detected the assertion of DASP
	4	V	0b	0 = Device 0 does not detect the assertion of PDIAG 1 = Device 0 detected the assertion of PDIAG
	3	V	0b	0 = Device 0 failed diagnostics 1 = Device 0 passed diagnostics
	2–1	V	00b	These bits indicate how device 0 determined the device number: 00 = Reserved 01 = Jumper used 10 = CSEL signal used 11 = Other method used or method used unknown
	0	F	0b	Shall be set to 1
94	15–8	F	00h	Vendor's recommended auto acoustic management (AAM) value
	7–0	V	00h	Current auto acoustic management (AAM) value
95		F	0000h	Stream minimum request size
96		F	0000h	Streaming transfer time – DMA
97		F	0000h	Streaming access latency – DMA and PIO
98		F	0000h 0000h	Streaming performance granularity

**Table 6: IDENTIFY Device ID (Continued)**

- F = The content of the word is fixed and does not change
- V = The content of the word is variable and may change depending on the state of the device or the commands executed by the device
- X = The fixed or variable type of this field is not defined in the governing standard
- R = The content of the word is reserved and shall be zero

Word	Bit(s)	Setting	Default Value	Description
100		F	LBA	Maximum user LBA for 48-bit address feature set
104		F	0000h	Streaming transfer time – PIO
105		F	0008h	Maximum number of 512-byte blocks of LBA range entries per DATA SET MANAGEMENT command
106	15	F	0b	Shall be cleared to 0
	14	F	1b	Shall be set to 1
	13	F	0b	1 = Device has multiple logical sectors per physical sector
	12	F	0b	1 = Device logical sector size > 256 words
	11–4	F	00000000b	Reserved
	3–0	F	0000b	2 <sup>x</sup> P logical sectors per physical sector
107		F	0000h	Interseek delay for ISO-7779 standard acoustic testing
108	15–12	F	0101b	NAA (3–0)
	11–0	F	000000001010b	IEEE OUI (23–12)
109	15–4	F	Varies	IEEE OUI (11–0)
	3–0		Varies	Unique ID (35–32)
110		F	Varies	5–0 Unique ID (31–16)
111		F	Varies	Unique ID (15–0)
112			0000h 0000h 0000h 0000h	Reserved
116			0000h	Reserved for TLC
117		F	0000h 0000h	Logical sector size
119	15	F	0b	Shall be cleared to 0
	14	F	1b	Shall be set to 1
	13–8		000000b	Reserved
	7	F	0b	1 = Extended power conditions feature set supported
	6	F	1b	1 = Extended sense data reporting feature set supported
	5	F	1b	1 = Free-fall control feature set supported
	4	F	1b	1 = DOWNLOAD MICROCODE command with mode 3 supported
	3	F	1b	1 = READ LOG DMA EXT (and) WRITE LOG DMA EXT command support
	2	F	1b	1 = WRITE UNCORRECTABLE EXT support
	1	F	0b	1 = Write-read-verify feature set support
0	F	0b	Reserved for DDT	

**Table 6: IDENTIFY Device ID (Continued)**

- F = The content of the word is fixed and does not change
- V = The content of the word is variable and may change depending on the state of the device or the commands executed by the device
- X = The fixed or variable type of this field is not defined in the governing standard
- R = The content of the word is reserved and shall be zero

Word	Bit(s)	Setting	Default Value	Description
120	15	F	0b	Shall be cleared to 0
	14	F	1b	Shall be set to 1
	13–8		000000b	Reserved
	7	V	0b	1 = At least one extended power conditions idle timer is enabled
	6	V	0b	1 = Extended sense data reporting feature set enabled
	5	V	0b	1 = Free-fall control feature set enabled
	4	F	1b	1 = DOWNLOAD MICROCODE command with mode 3 supported
	3	F	1b	1 = READ LOG DMA EXT (and) WRITE LOG DMA EXT command support
	2	F	0b	1 = WRITE UNCORRECTABLE EXT support
	1	V	0b	1 = Write-read-verify feature set enabled
0			0b	Reserved for DDT
121			0000h 0000h 0000h 0000h 0000h 0000h	Reserved for expanded support and enabled settings
127		X	0000h	Obsolete
128	15–9		0000000b	Reserved
	8	V	0b	Master password capability: 0 = High, 1 = Maximum
	7–6		00b	Reserved
	5	F	1b	1 = Enhanced security erase support
	4	V	0b	1 = Security count expired
	3	V	0b	1 = Security frozen
	2	V	0b	1 = Security locked
	1	V	0b	1 = Security enabled
0	F		1b	1 = Security supported
129		X	Varies	Vendor specific
160	15	F	0b	CFA power mode
	14		0b	Word 160 supported
	13	F	0b	CFA power mode 1 is required for one or more commands implemented by the device
	12	V	0b	CFA power mode 1 disabled
	11–0	F	00000000000b	Maximum current in ma

**Table 6: IDENTIFY Device ID (Continued)**

- F = The content of the word is fixed and does not change
- V = The content of the word is variable and may change depending on the state of the device or the commands executed by the device
- X = The fixed or variable type of this field is not defined in the governing standard
- R = The content of the word is reserved and shall be zero

Word	Bit(s)	Setting	Default Value	Description
161		F	0000h 0000h 0000h 0000h 0000h 0000h 0000h	Reserved for assignment by the CFA
168	15–4		000h	Reserved
	3–0	F	3h	Device nominal form factor (DNFF)
169	15–1	F	000000000000000b	Reserved
	0	F	1b	1 = Trim bit of the DATA SET MANAGEMENT command supported
170		F	0000h 0000h 0000h 0000h	Additional product identifier
174			0000h 0000h	Reserved
176		F	Varies	Current media serial number (60 ASCII characters; not supported)
206	15–12	X	0000b	Vendor specific
	11–6		000000b	Reserved
	5	F	1b	SCT data tables command support
	4	F	1b	SCT FEATURES CONTROL command support
	3	F	1b	SCT ERROR RECOVERY CONTROL command support
	2	F	1b	SCT WRITE SAME command support
	1	F	0b	Obsolete
	0	F	1b	SCT command transport support
207		F	0000h 0000h	Reserved FOR CE-ATA
209	15	F	0b	Shall be cleared to 0
	14	F	1b	Shall be set to 1
	13–0	F	00000000000000b	Logical sector offset within the first physical sector where the first logical sector is placed
210		V	0000h 0000h	Write-read-verify sector count mode 3
212		F	0000h 0001h	Write-read-verify sector count mode 2
214	15–12	F	0000b	NV cache feature set version
	11–8	F	0000b	NV cache power mode feature set version
	7–5		000b	Reserved
	4	V	0b	1 = NV cache feature set enabled
	3–2		00b	Reserved
	1	V	0b	1 = NV cache power mode feature set enabled
	0	F	0b	1 = NV cache power mode feature set support

**Table 6: IDENTIFY Device ID (Continued)**

- F = The content of the word is fixed and does not change
- V = The content of the word is variable and may change depending on the state of the device or the commands executed by the device
- X = The fixed or variable type of this field is not defined in the governing standard
- R = The content of the word is reserved and shall be zero

Word	Bit(s)	Setting	Default Value	Description
215		V	0000h	NV cache size in logical blocks (LSW)
216		V	0000h	NV cache size in logical blocks (MSW)
217		F	0001h	Nominal media rotation rate
218			0000h	Reserved
219	15–8		00h	Reserved
	7–0	F	00h	Device estimated time to spin up in seconds
220	15–8		00h	Reserved
	7–0	V	00h	Write-read-verify feature set current mode
221			0000h	Reserved
222	15–12	F	0001b	Transport type: 0 = Parallel; 1 = SATA; 2–15 = Reserved
	11–6		000000b	0 = Reserved 1 = Reserved
	5	F	1b	0 = Reserved 1 = SATA Rev. 3.0
	4	F	1b	0 = Reserved 1 = SATA Rev. 2.6
	3	F	1b	0 = Reserved 1 = SATA Rev. 2.5
	2	F	1b	0 = Reserved 1 = SATA II: extensions
	1	F	1b	0 = ATA/ATAPI-7 1 = SATA 1.0a
	0	F	1b	0 = ATA8-APT 1 = ATA8-AST
223		F	0000h	Transport minor revision number
224			0000h 0000h 0000h 0000h 0000h 0000h 0000h 0000h 0000h 0000h	Reserved
234		F	0001h	Minimum number of 512-byte units per DOWNLOAD MICROCODE command mode 3
235		F	00FFh	Maximum number of 512-byte units per DOWNLOAD MICROCODE command mode 3

**Table 6: IDENTIFY Device ID (Continued)**

- F = The content of the word is fixed and does not change
- V = The content of the word is variable and may change depending on the state of the device or the commands executed by the device
- X = The fixed or variable type of this field is not defined in the governing standard
- R = The content of the word is reserved and shall be zero

Word	Bit(s)	Setting	Default Value	Description
236			0000h 0000h 0000h 0000h 0000h 0000h 0000h 0000h 0000h 0000h 0000h 0000h 0000h 0000h 0000h 0000h 0000h 0000h 0000h	Reserved
255	15–8	F	Varies	Checksum
	7–0	F	A5h	Signature

## Commands

**Table 7: Supported ATA Command Set**

See ATA8-ACS2 standard for command details

Command Name	Command Code (Hex)
CHECK POWER MODE	98h
CHECK POWER MODE	E5h
DEVICE CONFIGURATION	B1h
DOWNLOAD MICROCODE	92h
FLUSH CACHE	E7h
FLUSH CACHE EXT	EAh
IDLE	E3h
IDLE	97h
IDLE IMMEDIATE	95h
IDLE IMMEDIATE	E1h
NOP	00h
READ BUFFER	E4h
READ BUFFER DMA	E9h
READ DMA	C8h
READ DMA EXT	25h
READ DMA (without retries)	C9h
READ FPDMA QUEUED	60h
READ LOG DMA EXT	47h
READ LOG EXT	2Fh
READ MULTIPLE	C4h
READ MULTIPLE EXT	29h
READ NATIVE MAX ADDRESS	F8h
READ NATIVE MAX ADDRESS EXT	27h
READ SECTORS	20h
READ SECTORS EXT	24h
READ SECTORS (without retry)	21h
READ VERIFY SECTORS	40h
READ VERIFY SECTORS EXT	42h
READ VERIFY SECTORS (without retry)	41h
RECALIBRATE	10h
REQUEST SENSE DATA EXT	0Bh
SECURITY DISABLE PASSWORD	F6h
SECURITY ERASE PREPARE	F3h
SECURITY ERASE UNIT	F4h
SECURITY FREEZE LOCK	F5h
SECURITY SET PASSWORD	F1h

**Table 7: Supported ATA Command Set (Continued)**

See ATA8-ACS2 standard for command details

<b>Command Name</b>	<b>Command Code (Hex)</b>
SECURITY UNLOCK	F2h
SEEK	70h
SET FEATURES	EFh
SET MAX ADDRESS	F9h
SET MULTIPLE MODE	C6h
SET NATIVE MAX ADDRESS EXT	37h
SLEEP	99h
SLEEP	E6h
SMART	B0h
STANDBY	E2h
STANDBY	96h
STANDBY IMMEDIATE	94h
STANDBY IMMEDIATE	E0h
WRITE BUFFER	E8h
WRITE BUFFER DMA	EBh
WRITE DMA	CAh
WRITE DMA EXT	35h
WRITE DMA FUA EXT	3Dh
WRITE DMA (without retries)	CBh
WRITE FPDMA QUEUED	61h
WRITE LOG DMA EXT	57h
WRITE LOG EXT	3Fh
WRITE MULTIPLE	C5h
WRITE MULTIPLE EXT	39h
WRITE MULTIPLE FUA EXT	CEh
WRITE SECTORS	30h
WRITE SECTORS EXT	34h
WRITE SECTORS (without retry)	31h



## Reliability

Micron SSDs incorporate advanced technology for defect and error management. Micron uses various combinations of hardware-based error correction algorithms and firmware-based static and dynamic wear-leveling algorithms.

Over the life of the SSD, uncorrectable errors may occur. An uncorrectable error is defined as data that is reported as successfully programmed to the SSD but when it is read out of the SSD, the data differs from what was programmed.

**Table 8: Uncorrectable Bit Error Rate**

Uncorrectable Bit Error Rate	Operation
<1 sector per 10 <sup>16</sup> bits read	READ

## Mean Time Between Failures

Mean time between failures (MTBFs) for the SSD can be predicted based on the component reliability data using the methods referenced in the Telcordia SR-332 reliability prediction procedures for electronic equipment.

**Table 9: MTBFs**

Density	MTBF (Operating Hours) <sup>1</sup>
50GB	2 million
100GB	2 million
200GB	2 million

Note: 1. The product achieves a mean time between failure (MTBF) of 2 million hours, based on population statistics not relevant to individual units.

## Endurance

Endurance for the SSD can be predicted based on the usage conditions applied to the device, the internal NAND component cycles, the write amplification factor, and the wear-leveling efficiency of the drive. The table below shows the drive lifetime for each SSD density based on predefined usage conditions.

**Table 10: Drive Lifetime**

Density	Drive Lifetime (Total Bytes Written)
50GB	.875PB
100GB	1.75PB
200GB	3.5PB

Notes: 1. Total bytes written calculated with the drive 100% full.  
2. Access patterns are 50% sequential and 50% random. Random accesses: 10% are 512B; 50% are 4K; 15% are 32K; 15% are 64K; and 10% are 128K. Sequential accesses: 100% are 128K.

## **Data Retention**

Micron SSD data retention at beginning of life: 10 years at 25°C

Micron SSD data retention at end of life: 1 year at 25°C

## Electrical Characteristics

**Table 11: SATA Typical Power Consumption**

Density	Idle/Standby/Sleep	Secure Erase	SEQ Write/Read (128K XFR)	RND Write/Read (4K XFR)	Unit
50GB	125	1000	2500/1800	1900/1500	mW
100B	125	1200	3000/2000	2200/1700	mW
200GB	125	1400	3500/2200	2500/1900	mW

**Table 12: Maximum Ratings**

Parameter/Condition	Symbol	Min	Max	Unit
Voltage input	V <sub>5</sub>	4.5	5.5	V
Operating temperature	T <sub>A</sub>	0	70	°C
Non-operating temperature		-40	85	°C
Rate of temperature change		-	20	°C/hour
Relative humidity (noncondensing)		5	95	%

Stresses greater than those listed may cause permanent damage to the device. This is a stress rating only, and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

**Table 13: Shock and Vibration**

Parameter/Condition	Specification
Operating shock	1500G/0.5ms
Operating vibration	5–500Hz at 3.1G

## Compliance

Micron SSDs comply with the following:

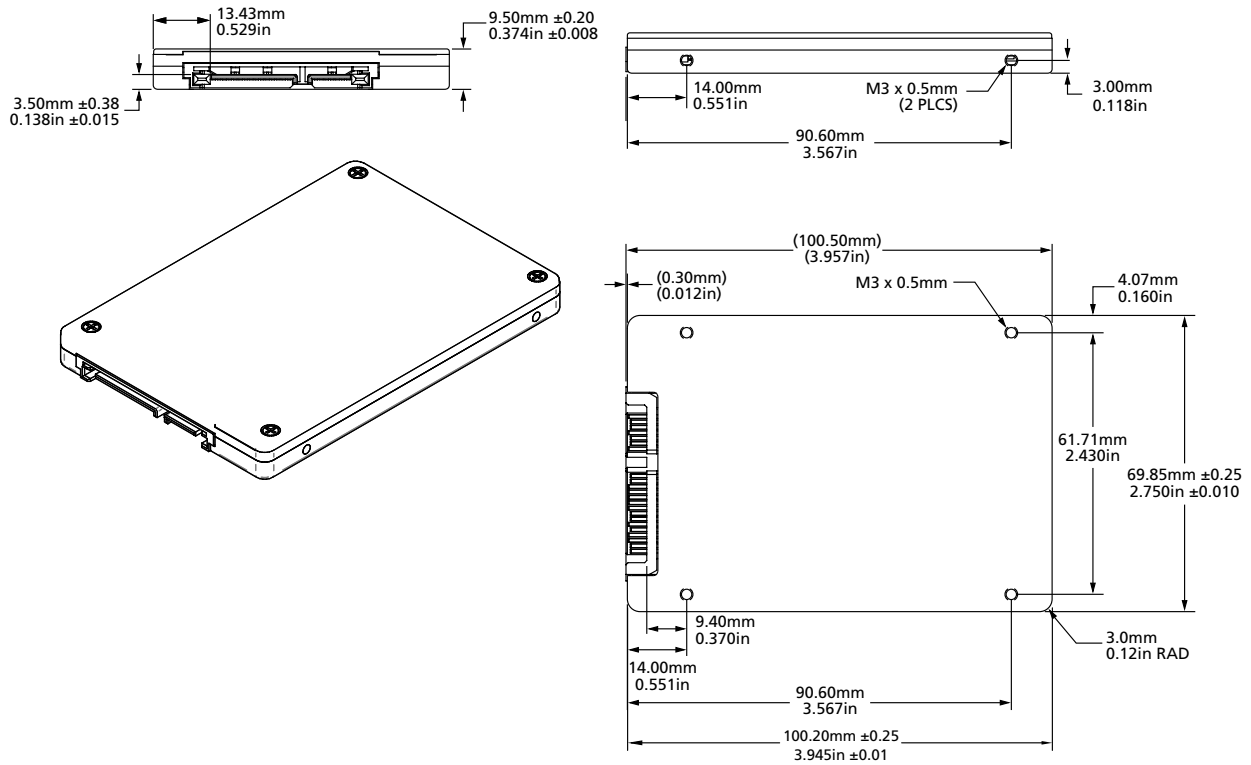
- RoHS compliant
- Halogen free
- SATA-IO
- WHQL
- CE (Europe): EN55022, 2006 Class B and EN55024, 1998 + A1: 2001 + A2:2003
- FCC: CFR Title 47, Part 15, ICES-003, all Class B
- UL (US): approval to UL-60950-1, 2nd Edition, 2007-03-27, IEC 60950-1:2005, 2nd Edition
- BSMI (Taiwan): approval to CNS 13438
- C-TICK (Australia, New Zealand): approval to AS/NZS CISPR22
- KCC RRL (Korea): approval to KCC MU2-C30025, KCC MU2-C30018 Class B
- W.E.E.E.: Compliance with EU WEEE directive 2002/96/EC. Additional obligations may apply to customers who place these products in the markets where WEEE is enforced.
- TUV (Germany): approval to IEC60950/EN60950
- $V_{CCI}$

## FCC Rules

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

## Package Dimensions

Figure 4: 2.5-Inch Package



- Notes: 1. Maximum mounting screw length: Bottom = M3 x 0.5 x 3; Side = M3 x 0.5 x 4  
 2. Maximum torque: 4.5 in-lb

## References

- Serial ATA: High-speed serialized AT attachment, Serial ATA working group, available at [www.sata-io.org](http://www.sata-io.org)
- Small Form Factor Specification SFF-8201, SFF-8223
- Electronic Industries Association Standard, EIA-720
- Telcordia SR-332 reliability prediction procedures for electronic equipment
- IDEMA Document LBA1-02

## Revision History

### Rev. J – 4/12

- Added notes to package dimension graphic.

### Rev. I – 10/11

- Added FCC rules to Compliance.

### Rev. H – 5/11

- Added DOWNLOAD MICROCODE command to Table 7: Supported ATA Command Set; changed hex format of command codes.

### Rev. G – 5/11

- Changed overall length of the enclosure + connector from absolute maximums to reference dimensions in packaging figure.

### Rev. F – 4/11

- Removed references to altitude from Features section.

### Rev. E – 4/11

- Removed references to green from Compliance section.

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This data sheet contains minimum and maximum limits specified over the power supply and temperature range set forth herein. Although considered final, these specifications are subject to change, as further product development and data characterization sometimes occur.

# P400e 2.5-Inch SATA NAND Flash SSD

**MTFDDAK050MAR, MTFDDAK100MAR,  
MTFDDAK200MAR, MTFDDAK400MAR**

## Features

- Micron® 25nm MLC NAND Flash
- RoHS-compliant package
- SATA 6 Gb/s interface
- ATA modes supported
  - PIO mode 3, 4
  - Multiword DMA mode 0, 1, 2
  - Ultra DMA mode 0, 1, 2, 3, 4, 5
- Industry-standard, 512-byte sector size support
- Hot-plug capable
- Native command queuing support with 32-command slot support
- ATA-8 ACS2 command set compliant
- ATA security feature command set and password login support
- Secure erase (data page) command set: fast and secure erase
- Self-monitoring, analysis, and reporting technology (SMART) command set
- 50GB Performance (steady state) <sup>1,2</sup>
  - Sequential 64K Read: 350 MB/s
  - Sequential 64K Write: 100 MB/s
  - Random 4K Read: 50K IOPs
  - Random 4K Write: 7K IOPs
  - READ Latency: 0.5ms (TYP)
  - WRITE Latency: 3.5ms (TYP)
- 100GB, 200GB, 400GB Performance (steady state) <sup>1,2</sup>
  - Sequential 64K Read: 350 MB/s
  - Sequential 64K Write: 140 MB/s
  - Random 4K Read: 50K IOPs
  - Random 4K Write: 7.5K IOPs
- Reliability
  - MTBF: 1.2 million device hours<sup>3</sup>
  - Static and dynamic wear leveling
  - Field-upgradeable firmware
  - Uncorrectable bit error rate (UBER): <1 sector per 10<sup>15</sup> bits read
  - Low power consumption
- Endurance: Total bytes written (TBW)
  - 50GB: 87.5TB
  - 100–400GB: 175TB
- Capacity<sup>4</sup> (unformatted): 50GB, 100GB, 200GB, 400GB
- Mechanical – 7.0mm height
  - SATA connector: 5V ±5%
  - 2.5-inch drive: 100.5mm x 69.85mm x 7.0mm
- Field-updateable firmware
- Operating temperature
  - Commercial (0°C to +70°C)<sup>5</sup>

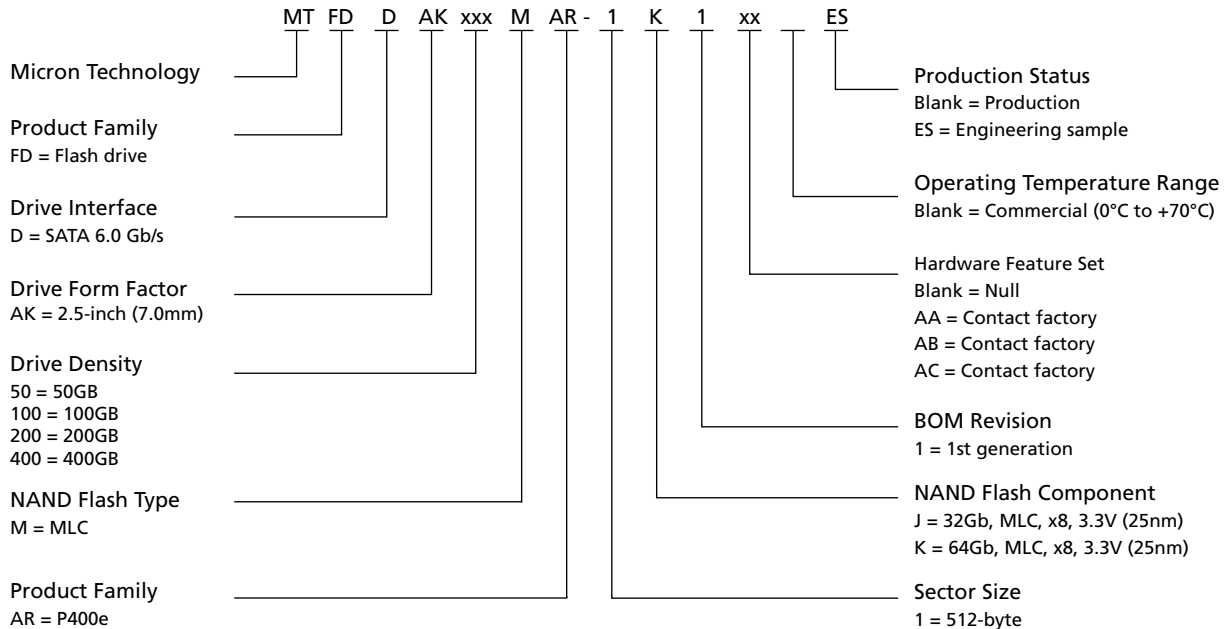
- Notes:
1. Typical I/O performance numbers as measured using Iometer with a queue depth of 32 and write cache disabled.
  2. 4K transfers used for READ/WRITE latency values.
  3. The product achieves a mean time between failure (MTBF) based on population statistics not relevant to individual units.
  4. 1GB = 1 billion bytes; formatted capacity is less.
  5. Drive case temperature.



## Part Numbering Information

Micron's RealSSD™ P400e SSD is available in different configurations and densities. Visit [www.micron.com](http://www.micron.com) for a list of valid part numbers.

**Figure 1: Part Number Chart**



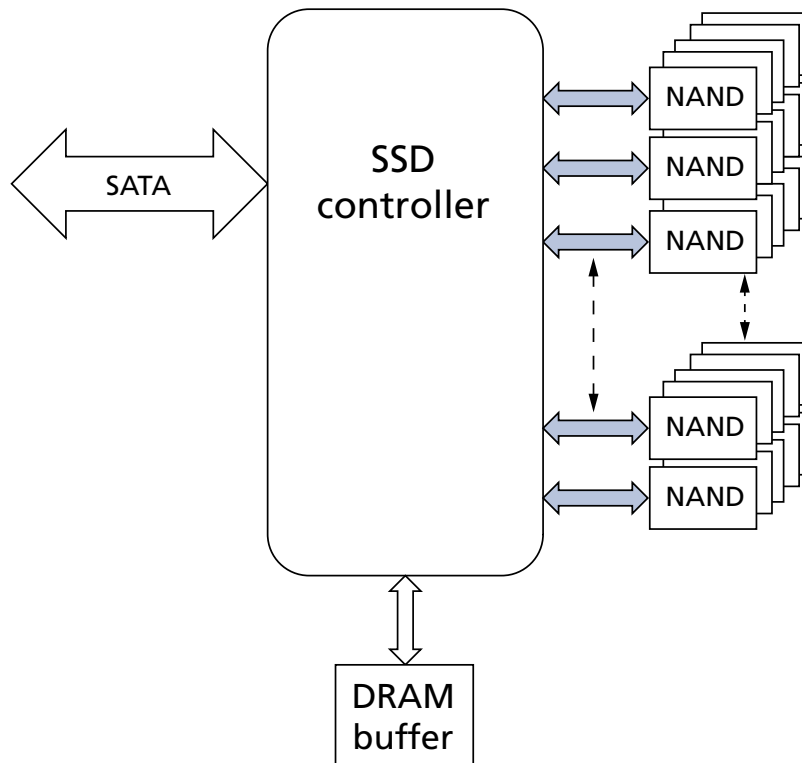
**Warranty:** Micron makes no warranties, expressed or implied, including, but not limited to, any implied warranties of merchantability, fitness for a particular purpose, other warranties that might arise from course of dealing or custom of trade other than that Micron warrants only that the product complies with Micron's specification sheet for the product at the time of delivery, provided that deviations from specifications which do not materially affect performance of such product in the system and configuration in or for which it is initially installed or qualified by customer shall not be deemed to constitute failure to comply with such specifications. Any claim against Micron must be made within three (3) years from the date of shipment by Micron and Micron has no liability thereafter. Micron's liability is limited to repair or replacement of the defective product or credit or refund of the purchase price of the defective product, provided that Micron may elect refund in lieu of credit, replacement or repair.

## General Description

Micron’s RealSSD P400e solid state drive (SSD) uses a single-chip controller with a SATA interface on the system side and n-channels of Micron NAND Flash internally. Packaged in an HDD replacement enclosure, the SSD integrates easily in existing storage infrastructures.

The P400e SSD device is targeted at applications that require enterprise performance in high random READ operations; high performance in terms of IOPs or latency; high endurance; high data retention; or applications that are deployed in cost-sensitive environments that do not have significant WRITE operation constraints.

**Figure 2: Functional Block Diagram**





## Logical Block Address Configuration

The drive is set to report the number of logical block addresses (LBA) that will ensure sufficient storage space for the specified density. Standard LBA settings, based on the IDEMA standard (LBA1-02), are shown below.

**Table 1: Standard LBA Settings**

Drive Size	Total LBA		Max LBA		User Available Bytes
	Decimal	Hexadecimal	Decimal	Hexadecimal	(Unformatted)
50GB	97,696,368	5D2BA70	97,696,367	5D2BA6F	50,020,540,416
100GB	195,371,568	BA52230	195,371,567	BA5222F	100,030,242,816
200GB	390,721,968	1749F1B0	390,721,967	1749F1AF	200,049,647,616
400GB	781,422,768	2E9390B0	781,422,767	2E9390AF	400,088,457,216

## Physical Configuration

**Table 2: 2.5-Inch Dimensions and Weight**

Dimensions	Height	Unit
	7.0mm	
Width	69.85	mm (NOM)
Length	100.50	mm (NOM)

## Interface Connectors

The SATA signal segment interface cable has four conductors and three ground connections. As shown in Package Dimensions, the cable includes a 7-pin signal segment and a 15-pin power segment arranged in a single row with a 1.27mm (0.050in) pitch.

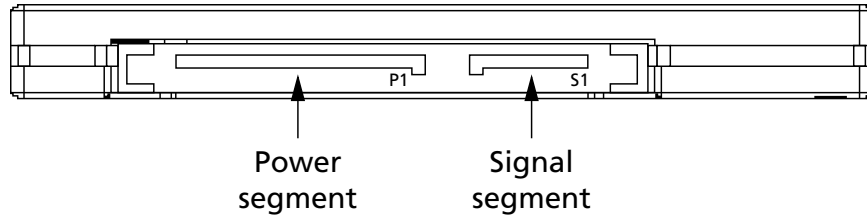
**Table 3: SATA Signal Segment Pin Assignments**

Signal Name	Type	Description
S1	GND	Ground
S2	A	Differential signal pair A and A#
S3	A#	
S4	GND	Ground
S5	B#	Differential signal pair B and B#
S6	B	
S7	GND	Ground

**Table 4: 2.5-Inch SATA Power Segment Pin Assignments**

Pin#	Signal Name	Description
P1	V33	No connect
P2	V33	No connect
P3	V33	No connect
P4	GND	Ground
P5	GND	Ground
P6	GND	Ground
P7	V5	5V power, precharge
P8	V5	5V power
P9	V5	5V power
P10	GND	Ground
P11	DAS	Device activity signal
P12	GND	Ground
P13	V12	No connect
P14	V12	No connect
P15	V12	No connect

**Figure 3: SSD Interface Connections**



## Device ID

**Table 5: Identity Device**

See Note 1 for setting definitions

Word	Bit(s)	Setting	Default Value	Description
0				General configuration bit-significant information
	15	F	0b	0 = ATA device
	14–8	X	0000100b	Retired
	7	F	0b	1 = removable media device
	6	F	1b	Obsolete
	5–3	X	000b	Retired
	2	V	0b	Response incomplete
	1	X	0b	Retired
	0	F	0b	Reserved
1			3FFFh	Obsolete
2		F	C837h	Specific configuration
3		F	0010h	Obsolete
4		F	0000h 0000h	Retired
6		F	003Fh	Obsolete
7		(O)V	0000h 0000h	Reserved for assignment by the CompactFlash™ Association
9		( )X	0000h	Retired
10		(M)F	varies	Serial number (20 ASCII characters)
20		( )X	0000h 0000h 0000h	Retired/Obsolete
23		(M)F	varies	Firmware revision (8 ASCII characters)
27		(M)F	varies	Model number (40 ASCII characters)
47	15–8	F	80h	80h
	7–0	F	10h	00h = Reserved 01h-FFh = Maximum number of logical sectors that shall be transferred per DRQ data block on READ/WRITE MULTIPLE commands
48				Trusted Computing feature set options
	15	F	0b	Shall be cleared to zero
	14	F	1b	Shall be set to one
	13–1	F	000000000000b	Reserved for the Trusted Computing Group
	0	F	0b	1 = Trusted Computing feature set is support

**Table 5: Identity Device (Continued)**

See Note 1 for setting definitions

Word	Bit(s)	Setting	Default Value	Description
49				Capabilities
	15–14	F	00b	Reserved for the IDENTIFY PACKET DEVICE command.
	13	F	1b	1 = Standby timer values as specified in this standard are supported
				0 = Standby timer values shall be managed by the device
	12	F	0b	Reserved for the IDENTIFY PACKET DEVICE command.
	11	F	1b	1 = IORDY supported
				0 = IORDY may be supported
	10	F	1b	1 = IORDY may be disabled
	9		1b	1 = LBA supported
	8	F	1b	1 = DMA supported.
7–0	F	00000000b	Retired	
50				Capabilities
	15	F	0b	Shall be cleared to zero
	14	F	1b	Shall be set to one
	13–2	F	000000000000b	Reserved
	1	X	0b	Obsolete
	0	F	1b	Shall be set to one to indicate a vendor specific standby timer value minimum.
51		( )X	0000h 0000h	Obsolete
53	15–3	F	000000000000b	Reserved
	2	F	1b	1 = The fields reported in word 88 are valid 0 = the fields reported in word 88 are not valid
	1	F	1b	1 = The fields reported in words (70:64) are valid 0 = the fields reported in words (70:64) are not valid
	0	X	1b	Obsolete
54		( )X	3FFFh 0010h 003Fh FC10h 00FBh	Obsolete
59	15	F	0b	1 = The BLOCK ERASE EXT command is supported
	14	F	0b	1 = The OVERWRITE EXT command is supported
	13	F	0b	1 = The CRYPTO SCRAMBLE EXT command is supported
	12	F	0b	1 = The Sanitize feature set is supported
	11–9	F	000b	Reserved
	8	V	1b	1 = Multiple sector setting is valid
	7–0	V	00010000b	xxh = Current setting for number of logical sectors that shall be transferred per DRQ data block on READ/WRITE MULTIPLE commands
60		M(F)	Varies by capacity	Total number of user addressable logical sectors

**Table 5: Identity Device (Continued)**

See Note 1 for setting definitions

Word	Bit(s)	Setting	Default Value	Description
62		()X	0000h	Obsolete
63	15–11	F	00000b	Reserved
	10	V	0b	1 = Multiword DMA mode 2 is selected 0 = Multiword DMA mode 2 is not selected
	9	V	0b	1 = Multiword DMA mode 1 is selected 0 = Multiword DMA mode 1 is not selected
	8	V	0b	1 = Multiword DMA mode 0 is selected 0 = Multiword DMA mode 0 is not selected
	7–3	F	0000b	Reserved
	2	F	1b	1 = Multiword DMA mode 2 and below are supported
	1	F	1b	1 = Multiword DMA mode 1 and below are supported
	0	F	1b	1 = Multiword DMA mode 0 is supported
64	15–8	F	00h	Reserved
	7–0	F	03h	PIO modes supported
65		F	0078h	Minimum Multiword DMA transfer cycle time per word Cycle time in nanoseconds
66		F	0078h	Manufacturer's recommended Multiword DMA transfer cycle time Cycle time in nanoseconds
67		F	0078h	Minimum PIO transfer cycle time without flow control Cycle time in nanoseconds
68		F	0078h	Minimum PIO transfer cycle time with IORDY flow control Cycle time in nanoseconds
69		F		Additional Supported
	15	F	0b	1 = CFast Specification Support
	14	F	1b	1 = Deterministic read after Trim is supported
	13	F	0b	1 = Long Physical Sector Alignment Error Reporting Control is supported
	12	F	0b	1 = DEVICE CONFIGURATION IDENTIFY DMA and DEVICE CONFIGURATION SET DMA are supported
	11	F	0b	1 = READ BUFFER DMA is supported
	10	F	0b	1 = WRITE BUFFER DMA is supported
	9	F	0b	1 = SET MAX PASSWORD DMA and SET MAX UNLOCK DMA are supported
	8	F	0b	1 = DOWNLOAD MICROCODE DMA is supported
	7	F	0b	Reserved for IEEE-1667
	6	F	0b	1 = Optional ATA device 28-bit commands supported
	5	F	0b	1 = Read zero after Trim is supported
4–0	F	00000b	Reserved	
70		F	0000h	Reserved



**Table 5: Identity Device (Continued)**

See Note 1 for setting definitions

Word	Bit(s)	Setting	Default Value	Description
71		F	0000h 0000h 0000h 0000h	Reserved for the IDENTIFY PACKET DEVICE command
75				Queue depth
	15–5	F	00000000000b	Reserved
	4–0	F	11111b	Maximum queue depth - 1
76				Serial ATA Capabilities
	15–13	F	000b	Reserved
	12	F	1b	Supports Native Command Queuing priority information
	11	F	0b	Supports Unload while NCQ commands outstanding
	10	F	1b	Supports Phy event counters
	9	F	1b	Supports receipt of host initiated interface power management requests
	8	F	1b	Supports native Command Queueing
	7–4	F	0000b	Reserved for future Serial ATA signaling speed grades
	3	F	1b	1 = Supports Serial ATA Gen-3 speed (6.0 Gb/s)
	2	F	1b	1 = Supports Serial ATA Gen-2 speed (3.0 Gb/s)
	1	F	1b	1 = Supports Serial ATA Gen-1 speed (1.5 Gb/s)
	0	F	0b	Reserved (set to 0)
77				Serial ATA Additional capabilities
	15–6	F	0000000000b	Reserved for future Serial ATA definition
	5	F	0b	Supports NCQ Queue Management Command
	4	F	0b	Supports NCQ Streaming
	3–1	V	010b	Coded value indicating current negotiated Serial ATA signal speed
	0	F	0b	Shall be cleared to zero
78				Serial ATA features Supported
	15–7	F	000000000b	Reserved
	6	F	1b	1 = Supports software settings preservation
	5	F	0b	Reserved
	4	F	0b	1 = Supports in-order data delivery
	3	F	1b	1 = Supports dev initiate interface power management
	2	F	1b	1 = Supports DMA Setup Auto-Activate optimization
	1	F	0b	1 = Supports non-zero buffer offsets in DMA Setup FIS
	0	F	0b	Reserved (set to 0)

**Table 5: Identity Device (Continued)**

See Note 1 for setting definitions

Word	Bit(s)	Setting	Default Value	Description
79				Serial ATA features Enabled
	15–7	V	000000000b	Reserved
	6	V	1b	1 = Software settings preservation enabled
	5	V	0b	1 = Asynchronous notification enabled
	4	V	0b	1 = In-order data delivery enabled
	3	V	0b	1 = Device initiating interface power management enabled
	2	V	0b	1 = DMA Setup Auto-Activate optimization enabled
	1	V	0b	1 = Non-zero buffer offsets in DMA Setup FIS enabled
	0	V	0b	Reserved (set to 0)
80				Major revision number
	15–10	F	000000b	Reserved
	9	F	1b	1 = Supports ATA8-ACS2
	8	F	1b	1 = Supports ATA8-ACS
	7	F	1b	1 = Supports ATA/ATAPI-7
	6	F	1b	1 = Supports ATA/ATAPI-6
	5	F	1b	1 = Supports ATA/ATAPI-5
	4	F	1b	1 = Supports ATA/ATAPI-4
	3	F	1b	Obsolete
	2	S	0b	Obsolete
	1	S	0b	Obsolete
0	F	0b	Reserved	
81		F	0028h	Minor revision number
				0028h = ATA8-ACS version 6

**Table 5: Identity Device (Continued)**

See Note 1 for setting definitions

Word	Bit(s)	Setting	Default Value	Description
82				Command set supported
	15	X	0b	Obsolete
	14	F	1b	1 = NOP command supported
	13	F	1b	1 = READ BUFFER command supported
	12	F	1b	1 = WRITE BUFFER command supported
	11	X	0b	Obsolete
	10	F	1b	1 = Host Protected Area feature set supported
	9	F	0b	1 = DEVICE RESET command supported
	8	F	0b	1 = SERVICE interrupt supported
	7	F	0b	1 = Release interrupt supported
	6	F	1b	1 = Read look-ahead supported
	5	F	1b	1 = Write cache supported
	4	F	0b	Shall be cleared to zero to indicate that the PACKET feature set is not supported.
	3	F	1b	1 = Mandatory Power Management feature set supported
	2	F	0b	Obsolete
1	F	1b	1 = Security feature set supported	
0	F	1b	1 = SMART feature set supported	
83				Command set supported
	15	F	0b	Shall be cleared to zero
	14	F	1b	Shall be set to one
	13	F	1b	1 = FLUSH CACHE EXT command supported
	12	F	1b	1 = mandatory FLUSH CACHE command supported
	11	F	1b	1 = Device Configuration Overlay feature set supported
	10	F	1b	1 = 48-bit Address feature set supported
	9	F	0b	1 = Automatic Acoustic Management feature set supported
	8	F	1b	1 = SET MAX security extension supported
	7	F	0b	See Address Offset Reserved Area Boot INCITS TR27:2001
	6	F	0b	1 = SET FEATURES subcommand required to spin-up after power-up
	5	F	0b	1 = Power-Up In Standby feature set supported
	4	F	0b	Obsolete
	3	F	1b	1 = Advanced Power Management feature set supported
	2	F	0b	1 = CFA feature set supported
1	F	0b	1 = READ/WRITE DMA QUEUED supported	
0	F	1b	1 = DOWNLOAD MICROCODE command supported	

**Table 5: Identity Device (Continued)**

See Note 1 for setting definitions

Word	Bit(s)	Setting	Default Value	Description
84				Command set/feature supported extension
	15	F	0b	Shall be cleared to zero
	14	F	1b	Shall be set to one
	13	F	1b	1 = IDLE IMMEDIATE with UNLOAD FEATURE supported
	12	F	0b	Reserved for technical report INCITS TR-37-2004 (TLC)
	11	F	0b	Reserved for technical report INCITS TR-37-2004 (TLC)
	10–9	F	00b	Obsolete
	8	F	1b	1 = 64-bit Word wide name supported
	7	F	0b	1 = WRITE DMA QUEUED FUA EXT command supported
	6	F	1b	1 = WRITE DMA FUA EXT and WRITE MULTIPLE FUA EXT commands supported
	5	F	1b	1 = General Purpose Logging feature set supported
	4	F	0b	1 = Streaming feature set supported
	3	F	0b	1 = Media Card Pass Through Command feature set supported
	2	F	0b	1 = Media serial number supported
	1	F	1b	1 = SMART self-test supported
0	F	1b	1 = SMART error logging supported	
85				Command set/feature enabled.
	15	X	0b	Obsolete
	14	F	1b	1 = NOP command supported
	13	F	1b	1 = READ BUFFER command supported
	12	F	1b	1 = WRITE BUFFER command supported
	11	X	0b	Obsolete
	10	V	1b	1 = Host Protected Area feature set enabled
	9	F	0b	1 = DEVICE RESET command supported
	8	V	0b	1 = SERVICE interrupt enabled
	7	V	0b	1 = release interrupt enabled
	6	V	1b	1 = look-ahead enabled
	5	V	0b	1 = write cache enabled
	4	F	0b	Shall be cleared to zero to indicate that the PACKET feature set is not supported.
	3	F	1b	Power Management feature set is enabled
	2	F	0b	Obsolete
1	V	0b	1 = Security Mode feature set enabled	
0	V	1b	1 = SMART feature set enabled	

**Table 5: Identity Device (Continued)**

See Note 1 for setting definitions

Word	Bit(s)	Setting	Default Value	Description
86				Command set/feature enabled.
	15		1b	1 = Words 120-119 are valid
	14	F	0b	1 = Reserved
	13	F	1b	1 = FLUSH CACHE EXT command supported
	12	F	1b	1 = FLUSH CACHE command supported
	11	F	1b	1 = Device Configuration Overlay supported
	10	F	1b	1 = 48-bit Address features set supported
	9	V	0b	1 = Automatic Acoustic Management feature set enabled
	8	F	0b	1 = SET MAX security enabled by SET MAX SET PASSWORD
	7	F	0b	Reserved for address Offset Reserved Area Boot, INCITS TR27:2001
	6	F	0b	1 = SET FEATURES subcommand required to spin-up after power-up
	5	V	0b	1 = Power-Up In Standby feature set enabled
	4	V	0b	Obsolete
	3	V	1b	1 = Advanced Power Management feature set enabled
	2	F	0b	1 = CFA feature set supported
1	F	0b	1 = READ/WRITE DMA QUEUED command supported	
0	F	1b	1 = DOWNLOAD MICROCODE command supported	
87				Command set/feature enabled/supported
	15	F	0b	Shall be cleared to zero
	14	F	1b	Shall be set to one
	13	F	1b	1 = IDLE IMMEDIATE with UNLOAD FEATURE supported
	12	V	0b	Reserved for technical report- INCITS tr-37-2004 (TLC)
	11	V	0b	Reserved for technical report- INCITS TR-37-2004 (TLC)
	10-9	F	00b	Obsolete
	8	F	1b	1 = 64-bit Word wide name supported
	7	F	0b	1 = WRITE DMA QUEUED FUA EXT command supported
	6	F	1b	1 = WRITE DMA FUA EXT and WRITE MULTIPLE FUA EXT commands supported
	5	F	1b	1 = General Purpose Logging feature set supported
	4	V	0b	Obsolete
	3	V	0b	1 = Media Card Pass Through Command feature set supported
	2	V	0b	1 = Media serial number is valid
	1	F	1b	1 = SMART self-test supported
0	F	1b	1 = SMART error logging supported	

**Table 5: Identity Device (Continued)**

See Note 1 for setting definitions

Word	Bit(s)	Setting	Default Value	Description
88			0b	Ultra DMA modes
	15		0b	Reserved
	14		0b	1 = Ultra DMA mode 6 is selected 0 = Ultra DMA mode 6 is not selected
	13		0b	1 = Ultra DMA mode 5 is selected 0 = Ultra DMA mode 5 is not selected
	12		0b	1 = Ultra DMA mode 4 is selected 0 = Ultra DMA mode 4 is not selected
	11		0b	1 = Ultra DMA mode 3 is selected 0 = Ultra DMA mode 3 is not selected
	10		0b	1 = Ultra DMA mode 2 is selected 0 = Ultra DMA mode 2 is not selected
	9		0b	1 = Ultra DMA mode 1 is selected 0 = Ultra DMA mode 1 is not selected
	8		0b	1 = Ultra DMA mode 0 is selected 0 = Ultra DMA mode 0 is not selected
	7		0b	Reserved
	6		0b	1 = Ultra DMA mode 6 and below are supported
	5		1b	1 = Ultra DMA mode 5 and below are supported
	4		1b	1 = Ultra DMA mode 4 and below are supported
	3		1b	1 = Ultra DMA mode 3 and below are supported
	2		1b	1 = Ultra DMA mode 2 and below are supported
	1		1b	1 = Ultra DMA mode 1 and below are supported
	0		1b	1 = Ultra DMA mode 0 IS supported
89		(O)F	0001h	Time required for security erase unit completion
90		(O)F	0001h	Time required for Enhanced security erase completion
91		(O)V	00FEh	Current advanced power management value
92		(O)V	FFFEh	Master Password Revision Code

**Table 5: Identity Device (Continued)**

See Note 1 for setting definitions

Word	Bit(s)	Setting	Default Value	Description
93				Shall be 0000h for SATA devices
	15		0b	Shall be cleared to zero
	14		0b	Shall be set to one
	13		0b	1 = Device detected CBLID-above $V_{IH}$ 0 = device detected CBLID-below $V_{IL}$
				Device 1 hardware reset result Device 0 shall clear these bits to zero Device 1 shall set these bits as follows:
	12		0b	Reserved
	11		0b	0 = Device 1 did not assert PDIAG- 1 = Device 1 asserted PDIAG-
	10–9			These bits indicate how Device 1 determined the device number: 00 = Reserved 01 = a jumper was used 10 = the CSEL signal was used 11 = some other method was used or the method is unknown
	8		0b	Shall be set to one
				Device 0 hardware reset result. Device 1 shall clear these bits to zero. Device 0 shall set these bits as follows:
	7		0b	Reserved
	6		0b	0 = Device 0 does not respond when Device 1 is selected. 1 = Device 0 responds when Device 1 is selected.
	5		0b	0 = Device 0 did not detect the assertion of DASP- 1 = Device 0 detected the assertion of DASP-
	4		0b	0 = Device 0 did not detect the assertion of PDIAG- 1 = Device 0 detected the assertion of PDIAG-
	3		0b	0 = Device 0 failed diagnostics. 1 = Device 0 passed diagnostics.
2–1			These bits indicate how Device 0 determined the device number: 00 = Reserved 01 = a jumper was used 10 = the CSEL signal was used 11 = some other method was used or the method is unknown	
0			00b	Shall be set to one
94	15–8	F	00h	Vendor's recommended acoustic management value
	7–0	V	00h	Current automatic acoustic management value
95		(O)V	0000h	Stream Minimum Request Size

**Table 5: Identity Device (Continued)**

See Note 1 for setting definitions

Word	Bit(s)	Setting	Default Value	Description
96		(O)V	0000h	Streaming Transfer Time - DMA
97		(O)V	0000h	Streaming Access Latency - DMA and PIO
98		(O)F	0000h 0000h	Streaming Performance Granularity(98-99)
100		V	Varies by capacity	Maximum user LBA for 48-bit Address feature set
104		(O)V	0000h	Streaming Transfer Time - PIO
105		( )F	0008h	Maximum number of 512-byte blocks of LBA Range Entries per DATA SET MANAGEMENT command
106				Physical sector size / Logical Sector Size
	15	F	0b	Shall be cleared to zero
	14	F	1b	Shall be set to one
	13	F	0b	1 = Device has multiple logical sectors per physical sector
	12	F	0b	1 = Device Logical Sector Longer than 256 Words
	11-4	F	00000000b	Reserved
	3-0	F	0000b	2^x logical sectors per physical sector
107		(O)F	0000h	Inter-seek delay for ISO-7779 acoustic testing in microseconds
108	15-12	F	0101b	NAA (3-0)
	11-0		000000001010b	IEEE OUI (23-12)
109	15-4	F	000001110101b	IEEE OUI (11-0)
	3-0		Varies	Unique ID (35-32)
110		(M)F	Varies	5-0 Unique ID (31-16)
111		(M)F	Varies	Unique ID (15-0)
112		(O)F	0000h 0000h 0000h 0000h	Reserved for 128 bit world wide name extension to 128 bits
116		(O)V	0000h	Reserved for INCITS TR-37-2004
117		(O)F	0000h 0000h	Words per Logical Sector



**Table 5: Identity Device (Continued)**

See Note 1 for setting definitions

Word	Bit(s)	Setting	Default Value	Description
119				Commands and feature sets supported (Continued from words 84-82)
	15	F	0b	Shall be cleared to zero
	14	F	1b	Shall be set to one
	13-6	F	00000001b	Reserved
	5	F	0b	1 = Free-fall Control feature set is supported
	4	F	1b	1 = The DOWNLOAD MICROCODE command with mode 3 is supported
	3	F	1b	1 = READ LOG DMA EXT and WRITE LOG DMA EXT commands are supported
	2	F	1b	1 = The Write-Read-Verify feature set is supported
	1	F	1b	1 = Feature set "Disable Data Transfer After Error Detection" is supported
	0	F	0b	Reserved for DDT
120				Commands and feature sets supported or enabled (Continued from words 87-85)
	15		0b	Shall be cleared to zero
	14		1b	Shall be set to one
	13-6		00000000b	Reserved
	5		0b	1 = Free-fall Control feature set is enabled
	4		1b	1 = The DOWNLOAD MICROCODE command with mode 3 is supported
	3		1b	1 = The READ LOG DMA EXT and WRITE LOG DMA EXT commands are supported
	2		1b	1 = The WRITE UNCORRECTABLE EXT command is supported
	1		0b	1 = The Write-Read-Verify feature set is enabled
	0		0b	1 = Feature set "Disable Data Transfer After Error Detection" is enabled 0 = Feature set "Disable Data Transfer After Error Detection" is disabled
121		F	0000h 0000h 0000h 0000h 0000h 0000h	Reserved for expanded supported and enabled settings
127		(O)	0000h	Obsolete

**Table 5: Identity Device (Continued)**

See Note 1 for setting definitions

Word	Bit(s)	Setting	Default Value	Description
128				Security status
	15-9	F	0000000b	Reserved
	8	V	0b	Security level 0 = High, 1 = Maximum
	7-6	F	00b	Reserved
	5	F	1b	1 = Enhanced security erase supported
	4	V	0b	1 = Security count expired
	3	V	0b	1 = Security frozen
	2	V	0b	1 = Security locked
	1	V	0b	1 = Security enabled
0	F	1b	1 = Security supported	
129		( )X	Vendor specific data	Vendor specific
160				CFA power mode 1
	15	F	0b	Word 160 supported
	14	F	0b	Reserved
	13	F	0b	CFA power mode 1 is required for one or more commands implemented by the device
	12	V	0b	CFA power mode 1 disabled
	11-0	F	000000000000b	Maximum current in ma
161		X	0000h 0000h 0000h 0000h 0000h 0000h 0000h	Reserved for assignment by the CompactFlash Association
168	15-4	F	000h	Reserved
	3-0	F	3h	Device Nominal Form Factor
169				DATA SET MANAGEMENT command support
	15-1	F	0000000000000000b	Reserved
	0	F	1b	1 = the Trim bit in the DATA SET MANAGEMENT command is supported
170		F	0000h 0000h 0000h 0000h	Additional Product Identifier
174		F	0000h 0000h	Reserved
176		(O)V	Varies	Current media serial number (60 ASCII characters)

**Table 5: Identity Device (Continued)**

See Note 1 for setting definitions

Word	Bit(s)	Setting	Default Value	Description
206				SCT Command Transport
	15-12	X	0000b	Vendor Specific
	11-6	F	000000b	Reserved
	5	F	1b	SCT Command Transport Data Tables supported
	4	F	1b	CT Command Transport Features Control supported
	3	F	1b	SCT Command Transport Error Recovery Control supported
	2	F	1b	SCT Command Transport Write Same supported
	1	F	0b	SCT Command Transport Long Sector Access supported
0	F	1b	SCT Command Transport supported	
207		( )F	0000h 0000h	Reserved for CE-ATA
209		(O)		Alignment of logical blocks within a larger physical block
	15	F	0b	Shall be cleared to zero
	14	F	1b	Shall be set to one
	13-0	F	00000000000000b	"Logical sector" offset within the first physical sector where the first logical sector is placed.
210		(O)V	0000h 0000h	Write-Read-Verify Sector Count Mode 3 Only
212		(O)F	0000h 0001h	Verify Sector Count Mode 2 Only
214		(O)		NV Cache Capabilities
	15-12	F	0000b	NV Cache feature set version
	11-8	F	0000b	NV Cache Power Mode feature set version
	7-5	F	000b	Reserved
	4	V	0b	1 = NV Cache feature set enabled
	3-2	F	00b	Reserved
	1	V	0b	1 = NV Cache Power Mode feature set enabled
0	F	0b	1 = NV Cache Power Mode feature set supported	
215		(O)V	0000h	NV Cache Size in Logical Blocks (LSW)
216		(O)V	0000h	NV Cache Size in Logical Blocks (MSW)
217		(M)F	0001h	Nominal media rotation rate (ATA8-ACS 1699-D Revision 6)
				NV Cache Read Transfer Speed in MB/s (ATA8-ACS 1699-D Revision 3f)
218		(O)V	0000h	NV Cache Write Transfer Speed in MB/s
219				NV Cache Options
	15-8	F	00h	Reserved
	7-0	F	00h	Device Estimated Time to Spin Up in Seconds
220	15-8	F	00h	Reserved
	7-0	V	00h	Write-Read-Verify feature set current mode
221			0000h	Reserved

**Table 5: Identity Device (Continued)**

See Note 1 for setting definitions

Word	Bit(s)	Setting	Default Value	Description
222				Transport Major revision number. 0000h or FFFFh = device does not report version
	15–12		0001b	Transport Type - 0 = Parallel, 1 = Serial, 2-15 = Reserved Parallel (Type = 0) Serial (Type = 1)
	11–6		000000b	Reserved Reserved
	5		1b	Reserved SATA Rev 3.0
	4		1b	Reserved SATA Rev 2.6
	3		1b	Reserved SATA Rev 2.5
	2		1b	Reserved SATA II: Extensions
	1		1b	Reserved SATA 1.0a
	0		1b	ATA8-APT ATA8-AST
223		(M)F	0000h	Transport Minor revision number
224		( )F	0000h 0000h 0000h 0000h 0000h 0000h 0000h 0000h 0000h 0000h	Reserved for CE-ATA
234		(O)F	0001h	Minimum number of 512 byte units per DOWNLOAD MI-CROCODE command for mode 3
235			00FFh	Maximum number of 512 byte units per DOWNLOAD MI-CROCODE command for mode 3
236			0000h 0000h 0000h 0000h 0000h 0000h 0000h 0000h 0000h 0000h 0000h 0000h 0000h 0000h 0000h 0000h 0000h 0000h 0000h	Reserved
255		(M)F		Integrity word
	15–8		varies	Checksum
	7–0		A5h	Signature

Note: 1. F = The content of the word is fixed and does not change.  
V = The content of the word is variable and may change depending on the state of the device or the commands executed by the device.  
X = The content of the word may be fixed or variable.  
R = The content of the word is reserved and will be zero.

## Commands

**Table 6: Supported ATA Command Set**

See ATA-8 standard for command details

Command Name	Command Code (hex)
CHECK POWER MODE	98h or E5h
DEVICE CONFIGURATION RESTORE	B1h/C1h
DEVICE CONFIGURATION FREEZE LOCK	B1h/C3h
DEVICE CONFIGURATION IDENTIFY	B1h/C1h
DEVICE CONFIGURATION SET	B1h/C3h
DOWNLOAD MICROCODE	92h
EXECUTE DEVICE DIAGNOSTIC	90h
FLUSH CACHE	E7h
FLUSH CACHE EXT	EAh
IDENTIFY DEVICE	ECh
IDLE	E3h or 97h
IDLE IMMEDIATE	E1h or 95h
INITIALIZE DEVICE PARAMETERS	91h
NOP	00h
READ BUFFER	E4h
READ DMA (with retry)	C8h
READ DMA (without retry)	C9h
READ DMA EXT	25h
READ FPDMA QUEUED	60h
READ LOG EXT	2Fh
READ MULTIPLE	C4h
READ MULTIPLE EXT	29h
READ NATIVE MAX ADDRESS	F8h
READ NATIVE MAX ADDRESS EXT	27h
READ SECTOR(S) EXT	24h
READ SECTOR(S) (with retry)	20h
READ SECTOR(S) (without retry)	21h
READ VERIFY SECTOR EXT	42h
READ VERIFY SECTOR(S) (with retry)	40h
SCT WRITE SAME	02h/0001h 02h/0002h 02h/0101h 02h/0102h
SCT RETURN ERROR RECOVERY CONTROL	030h/01h
SCT SET ERROR RECOVERY CONTROL	03h/01h
SCT SET FEATURE CONTROL	04h/01h
SCT RETURN FEATURE CONTROL	04h/02h

**Table 6: Supported ATA Command Set (Continued)**

See ATA-8 standard for command details

<b>Command Name</b>	<b>Command Code (hex)</b>
SCT RETURN FEATURE OPTION FLAG	04h/03h
SCT RETURN SCT DATA TABLE	05h/01h
SECURITY DISABLE PASSWORD	F6h
SECURITY ERASE PREPARE	F3h
SECURITY ERASE UNIT	F4h
SECURITY FREEZE LOCK	F5h
SECURITY SET PASSWORD	F1h
SECURITY UNLOCK	F2h
SEEK	7xh
SET FEATURES	EFh
SET MAX ADDRESS	F9h
SET MAX – FREEZE LOCK	F9h/04h
SET MAX – LOCK	F9h/02h
SET MAX ADDRESS EXT	37h
SET MULTIPLE MODE	C6h
SET MAX – SET PASSWORD	F9h/01h
SET MAX – UNLOCK	F9h/03h
SLEEP	E6h or 99h
SMART DISABLE OPERATIONS	B0h/D9h
SMART ENABLE OPERATIONS	B0h/D8h
SMART ENABLE/DISABLE AUTOSAVE	B0h/D2h
SMART EXECUTE OFF-LINE IMMEDIATE	B0h/D4h
SMART READ DATA	B0h/D0h
SMART READ LOG SECTOR	B0h/D5h
SMART RETURN STATUS	B0h/DAh
SMART WRITE LOG	B0h/D6h
STANDBY	E2h or 96h
STANDBY IMMEDIATE	E0h or 94h
WRITE BUFFER	E8h
WRITE DMA (with retry)	CAh
WRITE DMA (without retry)	CBh
WRITE DMA EXT	35h
WRITE DMA FUA EXT	3Dh
WRITE FPDMA QUEUED	61h
WRITE LOG EXT	3Fh
WRITE MULTIPLE	C5h
WRITE MULTIPLE EXT	39h

**Table 6: Supported ATA Command Set (Continued)**

See ATA-8 standard for command details

<b>Command Name</b>	<b>Command Code (hex)</b>
WRITE MULTIPLE FUA EXT	CEh
WRITE SECTOR(S) (with retry)	30h
WRITE SECTOR(S) EXT	34h
WRITE UNCORRECTABLE EXT	45h

## Performance

Measured performance can vary for a number of reasons. The major factors affecting drive performance are the density of the drive and the interface of the host. Additionally, overall system performance can affect the measured drive performance. When comparing drives, it is recommended that all system variables are the same, and only the drive being tested varies.

Performance numbers will vary depending on the host system configuration.

**Table 7: Drive Performance**

Density	50GB	100–400GB	Unit
Sequential read (64k transfer)	350	350	MB/s
Sequential write (64k transfer)	100	140	MB/s
Random read (4k transfer)	50,000	50,000	IOPs
Random write (4k transfer)	7000	7500	IOPs
Read latency	0.5	0.5	ms
Write latency	3.5	3.5	ms

- Notes:
1. Typical I/O performance numbers as measured using IOMeter with a queue depth of 32 and write cache disabled.
  2. IOMeter measurements are performed in the steady state region.
  3. 4k transfers used for READ/WRITE latency values.
  4. System variations may affect measured results.



## Reliability

Micron’s SSDs incorporate advanced technology for defect and error management. They use various combinations of hardware-based error correction algorithms and firmware-based static and dynamic wear-leveling algorithms.

Over the life of the SSD, uncorrectable errors may occur. An uncorrectable error is defined as data that is reported as successfully programmed to the SSD but when it is read out of the SSD, the data differs from what was programmed.

**Table 8: Uncorrectable Bit Error Rate**

Uncorrectable Bit Error Rate	Operation
<1 sector per 10 <sup>15</sup> bits	READ

## Mean Time Between Failures

Mean time between failures (MTBFs) for the SSD can be predicted based on the component reliability data using the methods referenced in the Telcordia SR-332 reliability prediction procedures for electronic equipment.

**Table 9: MTBFs**

Density	MTBF (Operating Hours) <sup>1</sup>
50GB	1.2 million
100GB	1.2 million
200GB	1.2 million
400GB	1.2 million

Note: 1. The product achieves a mean time between failure (MTBF) of 1.2 million hours, based on population statistics not relevant to individual units.

## Endurance

Endurance for the SSD can be predicted based on the usage conditions applied to the device, the internal NAND component cycles, the write amplification factor, and the wear-leveling efficiency of the drive. Total bytes written measured with 55°C case temperature within the total bytes written values listed in this document. The table below shows the drive lifetime for each SSD density based on predefined usage conditions.

**Table 10: Drive Lifetime**

Density	Drive Lifetime (Total Bytes Written)
50GB	87.5TB
100GB	175TB
200GB	175TB
400GB	175TB

Notes: 1. Total bytes written calculated with the drive 90% full.  
2. Access patterns are 50% sequential and 50% random and consist of the following: 5% are 4k; 5% are 8k; 10% are 16k; 10% are 32k; 35% are 64K; and 35% are 128k.

## Electrical Characteristics

Stresses greater than those listed may cause permanent damage to the device. This is a stress rating only, and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

**Table 11: SATA Power Consumption**

Density	Idle Average	Random Write/Read Maximum (4k transfer)		Sequential Write/Read Maximum (128k transfer)		Unit
50GB	59	2708	2245	2744	2690	mW
100GB	132	4272	2790	4112	3355	mW
200GB	157	4959	3078	4926	2887	mW
400GB	162	6793	3532	6831	3912	mW

- Notes: 1. Data taken at 25°C using a 6 Gb/s SATA interface.  
2. Sequential power measured in IOMETER MAX with 128KB transfer size.

**Table 12: Maximum Ratings**

Parameter/Condition	Symbol	Min	Max	Unit
Voltage input	V <sub>5</sub>	4.5	5.5	V
Operating temperature	T <sub>A</sub>	0	70	°C
Non-operating temperature		-40	85	°C
Rate of temperature change		-	20	°C/hour
Relative humidity (non-condensing)		5	95	%

**Table 13: Shock and Vibration**

Parameter/Condition	Specification
Operating shock	1500 G/1.0ms
Operating vibration	2–500Hz at 3.1G

## Compliance

Micron SSDs comply with the following:

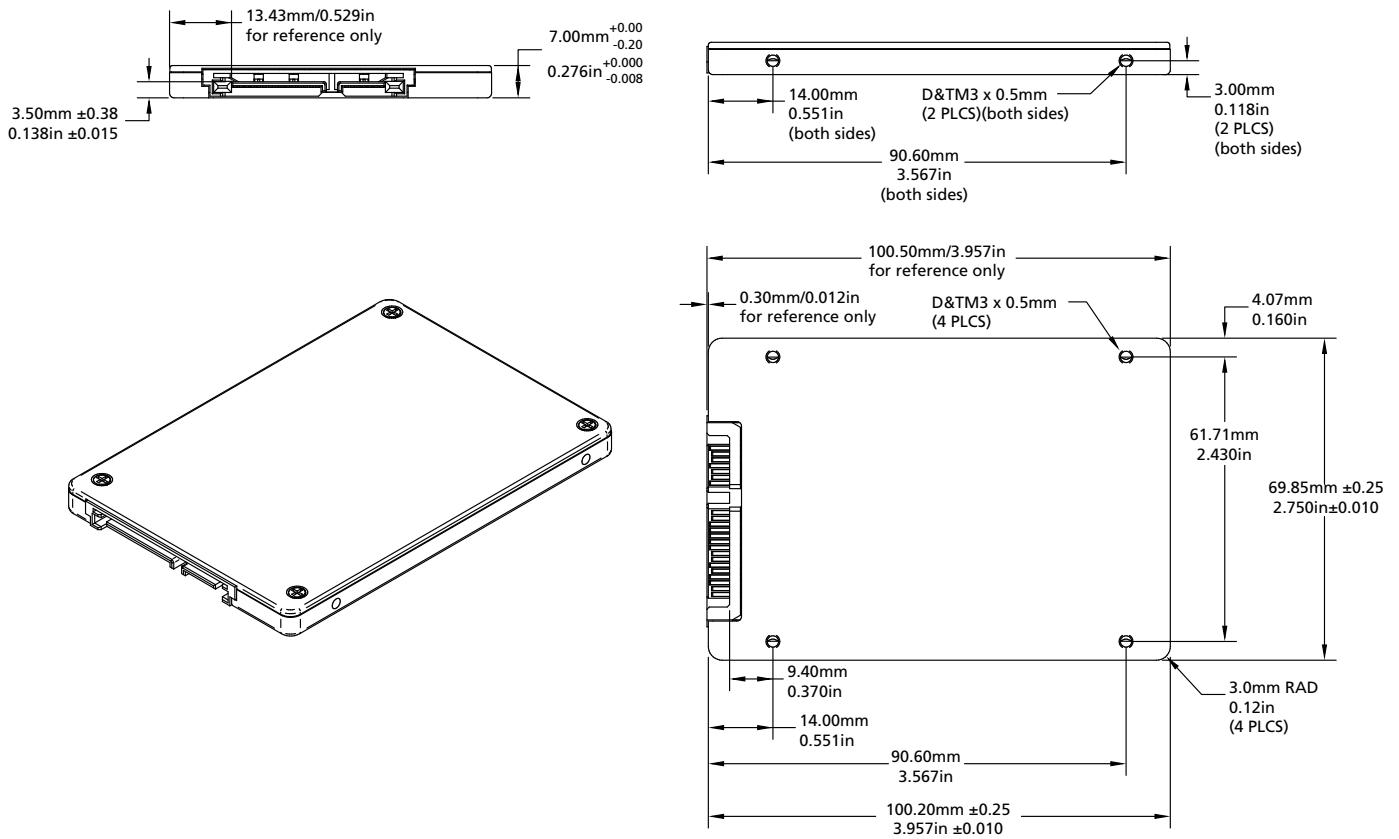
- RoHS
- CE (Europe): EN55022, 2006 Class B and EN55024, 1998 + A1: 2001 + A2:2003
- FCC: CFR Title 47, Part 15, ICES-003, all Class B
- UL (US): approval to UL-60950-1, 2nd Edition, 2007-03-27, IEC 60950-1:2005, 2nd Edition
- BSMI (Taiwan): approval to CNS 13438
- C-TICK (Australia, New Zealand): approval to AS/NZS CISPR22
- KCC RRL (Korea): approval to KCC MU2-C30025, KCC MU2-C30018 Class B
- W.E.E.E.: Compliance with EU WEEE directive 2002/96/EC. Additional obligations may apply to customers who place these products in the markets where WEEE is enforced
- TUV (Germany): approval to IEC60950/EN60950
- V<sub>CCI</sub>
- IC (Canada):
  - This Class B digital apparatus complies with Canadian ICES-003.
  - Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada

## FCC Rules

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

## Package Dimensions

**Figure 4: 2.5-Inch Package – 7mm**



- Notes: 1. Maximum mounting screw length: Bottom = M3 x 0.5 x 3; Side = M3 x 0.5 x 4  
2. Maximum torque: 4.5 in-lb

## References

- Serial ATA: High-speed serialized AT attachment, Serial ATA working group, available at [www.sata-io.org](http://www.sata-io.org)
- SATA 3.0 GOLD
- ATA-8 ACS2

## **Revision History**

### **Rev. C – 04/12**

- Added notes to package dimension graphic

### **Rev. B – 10/11**

- Deleted TBD line item under reliability and corresponding footnote from Features
- Added FCC rules to Compliance

### **Rev. A – 09/11**

- Initial release

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This data sheet contains minimum and maximum limits specified over the power supply and temperature range set forth herein. Although considered final, these specifications are subject to change, as further product development and data characterization sometimes occur.