M500 mSATA NAND Flash SSD

MTFDDAT120MAV, MTFDDAT240MAV, MTFDDAT480MAV

Features

- Micron® 20nm MLC NAND Flash
- RoHS-compliant package
- SATA 6 Gb/s interface
- TCG/Opal 2.0-compliant self-encrypting drive (SED)
- Hardware-based AES-256 encryption engine
- 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
- Device Sleep (DEVSLP), extreme low power mode
- 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
- Sanitize device feature set support
- Self-monitoring, analysis, and reporting technology (SMART) command set
- Windows 8 drive telemetry
- Adaptive thermal monitoring
- Power loss protection for data-at-rest
- Performance[1, 2]
  - PCMark® Vantage (HDD test suite score): up to 80,000
  - Sequential 128KB READ: up to 500 MB/s
  - Sequential 128KB WRITE: up to 400 MB/s
  - Random 4KB READ: up to 80,000 IOPS
  - Random 4KB WRITE: up to 80,000 IOPS
  - READ/WRITE latency: 5ms/25ms (MAX)
- Reliability
  - MTTF: 1.2 million device hours[3]
  - Static and dynamic wear leveling
  - Uncorrectable bit error rate (UBER): <1 sector per 10^{15} bits read
- Low power consumption
  - 150mW TYP[4]
- Endurance: Total bytes written (TBW) – Up to 500TB[5]
- Capacity[6] (unformatted): 120GB, 240GB, 480GB
- Mechanical
  - mSATA connector: 3.3V ±5%
  - Caseless design: 50.80mm x 29.85mm x 3.75mm
  - Weight: 10g (MAX)
- Secure firmware update with digitally signed firmware image
- Operating temperature
  - Commercial (0°C to +70°C)[7]

Notes:
1. Typical I/O performance numbers as measured fresh-out-of-box (FOB) using Iometer with a queue depth of 32 and write cache enabled.
2. 4KB transfers used for READ/WRITE latency values.
3. The product achieves a mean time to failure (MTTF) based on population statistics not relevant to individual units.
4. Active average power measured during execution of MobileMark® with DIPM (device-initiated power management) enabled.
5. Endurance may depend highly on the nature of the data stream from the host computer. See Endurance section for more details.
6. 1GB = 1 billion bytes; formatted capacity is less.
7. Drive onboard temperature sensor.

Warranty: Contact your Micron sales representative for further information regarding the product, including product warranties.

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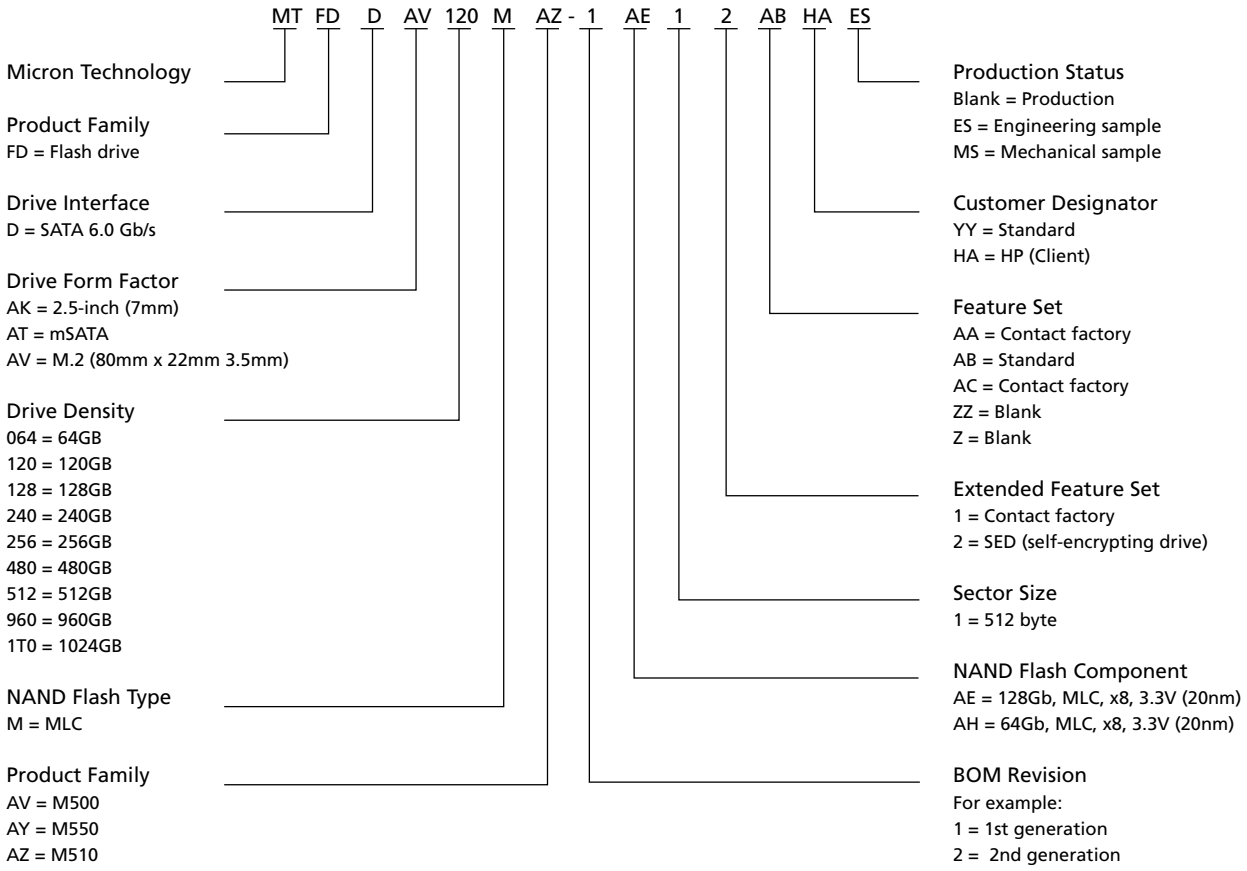
Part Numbering Information

Micron's M500 SSD is available in different configurations and densities. The chart below is a comprehensive list of options for the M500 series devices; not all options listed can be combined to define an offered product. Visit www.micron.com for a list of valid part numbers.

Figure 1: Part Number Chart



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General Description

Micron's solid state drive (SSD) uses a single-chip controller with a SATA interface on the system side and 8-channels of Micron NAND Flash internally. Packaged in an HDD replacement enclosure, the SSD integrates easily in existing storage infrastructures.

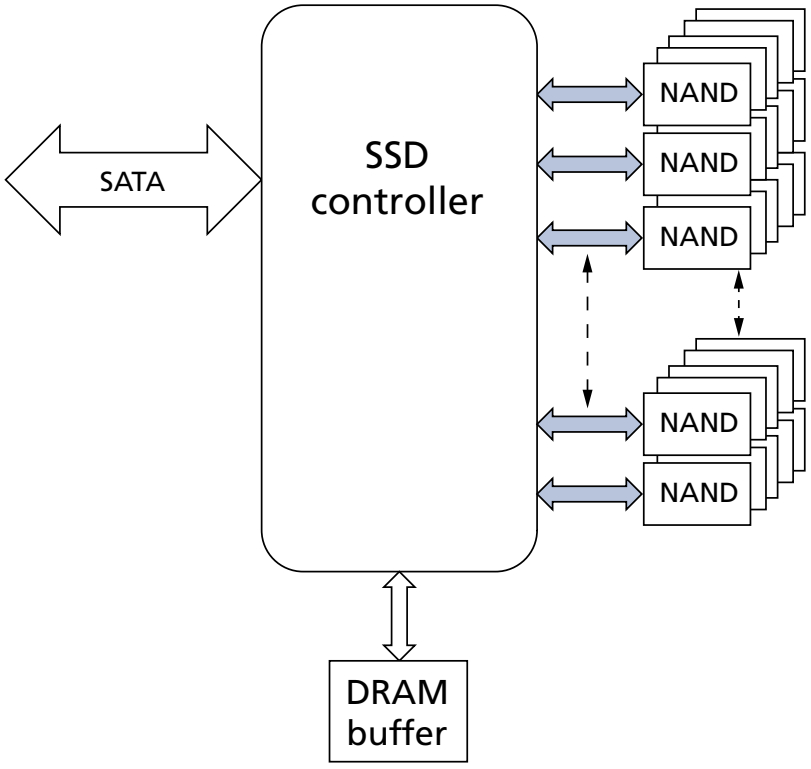
The SSD is designed to use the SATA interface efficiently during both READs and WRITEs while delivering bandwidth-focused performance. SSD technology enables enhanced boot times, faster application load times, reduced power consumption, and extended reliability.

The self-encypting drive (SED) features a FIPS-compliant, AES-256 encryption engine, providing hardware-based, secure data encryption, with no loss of SSD performance. This SED follows the TCG/Opal specification for trusted peripherals.

When TCG/Opal features are not enabled, the device can perform alternate data encryption by invoking the ATA security command-set encryption features, to provide full-disk encryption (FDE) managed in the host system BIOS. TCG/Opal and FDE feature sets cannot be enabled simultaneously.

The data encryption is always running; however, encryption keys are not managed and the data is not secure until either TCG/Opal or FDE feature sets are enabled.

Figure 2: Functional Block Diagram



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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 capacity. Standard LBA settings, based on the IDEMA standard (LBA1-02), are shown below.

Table 1: Standard LBA Settings

Capacity	Total LBA		Max LBA		User Available Bytes
	Decimal	Hexadecimal	Decimal	Hexadecimal	(Unformatted)
120GB	234,441,648	DF94BB0	234,441,647	DF94BAF	120,034,123,776
240GB	468,862,128	1BF244B0	468,862,127	1BF244AF	240,057,409,536
480GB	937,703,088	37E436B0	937,703,087	37E436AF	480,103,981,056

Physical Configuration

Table 2: mSATA Dimensions and Weight

Specification	Value		Unit
	Nom	Max	
Height	–	3.75	mm
Width	29.85	–	mm
Length	50.80	–	mm
Unit weight	–	10	g
Insertion rating	10	–	insert/remove cycles

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Interface Connectors

Figure 3: SSD Interface Connections

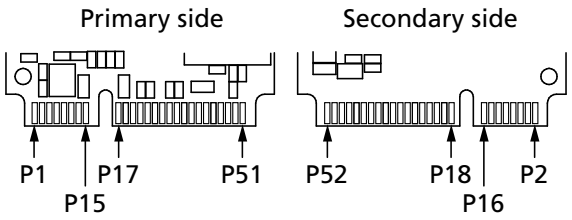

Table 3: Signal Assignments

Primary Side			Secondary Side		
Pin #	**Signal Name**	**Description**	**Pin #**	**Signal Name**	**Description**
1	Reserved	No connect	2	3V3	+3.3V
3	Reserved	No connect	4	GND	Ground
5	Reserved	No connect	6	1V5	No connect
7	Reserved	No connect	8	Reserved	No connect
9	GND	Ground	10	Reserved	No connect
11	Reserved	No connect	12	Reserved	No connect
13	Reserved	No connect	14	Reserved	No connect
15	GND	Ground	16	Reserved	No connect
17	Reserved	No connect	18	GND	Ground
19	Reserved	No connect	20	Reserved	No connect
21	GND	Ground	22	Reserved	No connect
23	+B	Differential signal pair +B and -B	24	3V3	+3.3V
25	-B		26	GND	Ground
27	GND	Ground	28	1V5	No connect
29	GND	Ground	30	TWI	Two-wire interface
31	-A	Differential signal pair +A and -A	32	TWI	
33	+A		34	GND	Ground
35	GND	Ground	36	Reserved	No connect
37	GND	Ground	38	Reserved	No connect
39	3V3	+3.3V	40	GND	Ground
41	3V3	+3.3V	42	Reserved	No connect
43	NC	No connect	44	DEVSLP	Device sleep
45	Optional	No connect	46	Reserved	No connect
47	Optional	No connect	48	1V5	No connect
49	DA/DSS	Drive activity LED	50	GND	Ground
51	Presence	Presence detection	52	3V3	+3.3V

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Performance

Measured performance can vary for a number of reasons. The major factors affecting drive performance are the capacity 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.

For SSDs designed for the client computing market, Micron specifies performance in FOB state.

For a description of these performance states and of Micron's best practices for performance measurement, refer to micron.com/ssd.

Table 4: Drive Performance

Capacity	120GB	240GB	480GB	
Interface Speed	**6 Gb/s**	**6 Gb/s**	**6 Gb/s**	**Unit**
PCMark Vantage	70,000	80,000	80,000	HDD score
Sequential read (128KB transfer)	500	500	500	MB/s
Sequential write (128KB transfer)	130	250	400	MB/s
Random read (4KB transfer)	62,000	72,000	80,000	IOPS
Random write (4KB transfer)	35,000	60,000	80,000	IOPS
READ latency (MAX)	5	5	5	ms
WRITE latency (MAX)	25	25	25	ms
READ latency (TYP)	160	160	160	µs
WRITE latency (TYP)	40	40	40	µs

Notes:
1. Performance numbers are maximum values, except as noted.
2. Typical I/O performance numbers as measured using Iometer with a queue depth of 32 and write cache enabled. Fresh-out-of-box (FOB) state is assumed. For performance measurement purposes, the SSD may be restored to FOB state using the secure erase command.
3. Iometer measurements are performed on an 20GB span of logical block addresses (LBAs).
4. 4KB transfers used to measure READ/WRITE latency values with write cache enabled.
5. System variations will affect measured results. For comparison, PCMark scores are measured with the SSD as a secondary drive in a two-drive system. When measured as an OS drive, system overhead can cause lower scores.

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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 5: Uncorrectable Bit Error Rate

Uncorrectable Bit Error Rate	Operation
<1 sector per 10^{15} bits read	READ

Mean Time To Failure

Mean time to failure (MTTF) 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 6: MTTF

Capacity	MTTF (Operating Hours)[1]
120GB	1.2 million
240GB	1.2 million
480GB	1.2 million

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

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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 tables below show the drive lifetime for each SSD capacity by client computing and sequential input and based on predefined usage conditions.

Table 7: Drive Lifetime – Client Computing

Capacity	Drive Lifetime (Total Bytes Written)
120GB	72TB
240GB	72TB
480GB	72TB

Notes:
1. Total bytes written calculated with the drive 90% full.
2. SSD volatile write cache is enabled.
3. Access patterns used during reliability testing are 25% sequential and 75% random and consist of the following: 50% are 4KiB; 40% are 64KiB; and 10% are 128KiB.
4. Host workload parameters, including write cache settings, IO alignment, transfer sizes, randomness, and percent full, that are substantially different than the described notes, may result in varied endurance results.
5. GB/day can be calculated by dividing the total bytes written value by (365 × number of years). For example: 72TB/5 years/365 days = 40 GB/day for 5 years.

Table 8: Drive Lifetime – Sequential Input

Capacity	Drive Lifetime (Total Bytes Written)
120GB	125TB
240GB	250TB
480GB	500TB

Notes:
1. Endurance of Client SSDs in some data center applications can be maximized by implementing workloads which are sequential when writing, with read-intensive access. Micron recommends no higher than 20% of input/output operations be writes.
2. SSD volatile write cache is enabled.
3. Micron recommends sequential writes in transfer sizes of 128KiB or integer multiples of 128KiB which are 4KiB-aligned. Contact Micron for details.
4. Host workload parameters, including write cache settings, IO alignment, transfer sizes, randomness, and percent full, that are substantially different than the described notes, may result in varied endurance results.

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Electrical Characteristics

Environmental conditions beyond 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 9: SATA Power Consumption

Capacity	Device Sleep Average	Idle Average	Active Average	Active Maximum (128KB transfer)	Unit
120GB	<5	80	150	2100	mW
240GB	<5	95	150	3200	mW
480GB	<10	100	150	3600	mW

Notes:
1. Data taken at 25°C using a 6 Gb/s SATA interface.
2. Active average power measured while running MobileMark Productivity Suite.
3. DIPM (device-initiated power management) enabled. DIPM Slumber supported.
4. Active maximum power is measured using Iometer with 128KB sequential write transfers.

Table 10: Maximum Ratings

Parameter/Condition	Symbol	Min	Max	Unit
Voltage input	3V3	3.14	3.46	V
Operating temperature	T_A	0	70	°C
Non-operating temperature		–40	85	°C
Rate of temperature change		–	20	°C/hour
Relative humidity (non-condensing)		5	95	%

Notes:
1. Temperature rating is for ambient environment. Adequate airflow or heat sink is advised. Temperature at the PCB level is recorded in SMART attribute 194 (or 0xC2), and may differ from ambient temperature.
2. Power-off sequence: When the SSD is shut down, the ATA STANDBY IMMEDIATE (STBI) command should be the last command sent by the host and acknowledged by the SSD. Failure to follow this process might result in a longer than normal time-to-ready (TTR) during the subsequent power-on sequence. TTR is the time from power-on to drive ready to accept SATA commands.

Table 11: Shock and Vibration

Parameter/Condition	Specification
Operating shock	1500G/0.5ms
Operating vibration	5–800Hz @ 3.13G

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Adaptive Thermal Monitoring

The device features adaptive thermal monitoring. While most host computers exhibit operating environments that keep an SSD running in the range of 40°C to 45°C, adaptive thermal monitoring enables the SSD device to operate in a wide variety of environments by helping to prevent the host computer from running at excessive temperatures.

Adaptive thermal monitoring reduces NAND operations by approximately 40% when the SSD's internal measured temperature reaches 75°C. The SSD remains in this lowered performance state until the temperature returns to 65°C; the SSD then returns to normal operating mode. These transition points might occur at points somewhat different from case or ambient temperature because of thermal effects that cause a difference between temperature sensed at the PCB level and temperature at the specified operating environment.

Adaptive thermal monitoring does not change the current negotiated speed of the SATA bus, nor require or cause any new commands to be issued on the SATA bus. Rated-throughput performance is not guaranteed at any point above the maximum specified operating temperature.

The thermal monitoring feature can be disabled using ATA SET FEATURE commands as described below. The default setting is ENABLED.

Note: The SSD will return to the default setting after each power cycle or COMRESET command. Arrangements should be made to re-issue the DISABLE command after each power cycle or COMRESET.

DISABLE THERMAL MONITORING Command

- Command set feature
- Sub-command enable SATA feature
- Specific feature hardware feature control
- LBA FFFFh
- IDFY word 78, bit 5 will be set to indicate SATA hardware feature control is active

Table 12: Disable Thermal Monitoring Command Set Register

	Register							
Feature Set	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Feature	10h							
Sector count	08h							
Sector number	FFh							
Cylinder low	FFh							
Cylinder high	xx							
Drive head	xx							
Command	EFh							

ENABLE THERMAL MONITORING Command

- Command set feature
- Sub-command disable SATA feature

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- Specific feature hardware feature Control
- LBA FFFFh
- IDFY word 78, bit 5 will be set to indicate SATA hardware feature control is inactive

Table 13: Enable Thermal Monitoring Command Set Register

	Register							
Feature Set	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Feature	0x90h							
Sector count	0x8h							
Sector number	0xFFh							
Cylinder low	0xFFh							
Cylinder high	xx							
Drive head	xx							
Command	0xEFh							

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TCG/Opal Support

Table 14: TCG/Opal Support Parameters

Property	Supported?	Comments
TCG Storage Specifications		
OPAL: TCG Storage Security SubSystem Class	Specification 2.00	Revision 1.00, Feb 24, 2012
TCG Core Specification	Specification 2.00	Revision 2.00, Nov 4, 2011
TCG Storage Interface Interactions Specification	TCG Reference Specification	Specification Version 1.02 Revision 1.00 30 December, 2011
OPAL SSC 1.00 (backward compatibility)	Not supported	–
OPAL SSC Additional Feature Set Specification		
Additional DataStore Table	Supported	Specification 1.00 Revision 1.00, Feb 24, 2012
Single User Mode	Supported	Specification 1.00 Revision 1.00, Feb 24, 2012
TCG Storage Protection Mechanisms for Secrets	Supported	Specification Version 1.00 Revision 1.07 17 August, 2011
PSID – Physical Presence SID	Supported	Specification Version 1.00 Committee Draft Revision 1.05 February 9, 2011
GUDID (Globally Unique Serial Number)	Supported	Mandatory GUDID Proposal 11/03/2011 (Microsoft)
SID Authority Disable	Supported	SID Authority Disable Proposal 9/26/2011 (Microsoft)
Modifiable CommonName Columns	Supported	Modifiable CommonName Columns Proposal 7/22/2010 (Microsoft)
OPAL SSC Feature Set – Specific List		
ALL OPAL Mandatory Features	Supported	–
Close Session (optional)	Supported	Allows Tper to notify the host it has aborted a session
Restricted Command & Table (optional)	Not Supported	The interface control template enables TPer control over selected interface commands; the benefit is the reduction of undesired side effects
Type Table (not required)	Not Supported	–
Activate Method	Supported	–
Revert Method	Supported	–
Revert SP Method	Supported	–
Activate Method Within Transactions	Not Supported	As per OPAL, this behavior is out of the scope
Revert Method within Transactions	Not Supported	As per OPAL, this behavior is out of the scope
Revert SP Method within Transactions	Not Supported	As per OPAL, this behavior is out of the scope
Creation/Deletion of Tables/Rows after Manufacturing	Not Supported	As per OPAL, this behavior is out of the scope
Tper Feature		
COM ID Management Support	Not Supported	Dynamic COM ID allocation & management not supported
Buffer Management Support	Not Supported	Flow control

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Table 14: TCG/Opal Support Parameters (Continued)

Property	Supported?	Comments
ACK/NACK Support	Not Supported	Session reliability
Async Support	Not Supported	Asynchronous protocol support with multiple commands per session
Geometry Reporting Feature		
ALIGN	Supported	OPAL 2.0 (only)
Logical Block Size	512 bytes	Logical block size = 512 Bytes
Alignment Granularity	4096 Bytes	Page or Descriptor size <<Minimum AES LU size>>
Lowest Aligned LBA	0	–
OPAL SSC V2.00 Feature Descriptor		
Base COM ID	0x1000	0x1000-0xFFFF defined for COM ID management
Number of COM IDs	1	–
Range Crossing Behavior	0	If drive receives a READ or WRITE command that spans multiple LBA ranges and the LBA ranges are not locked, then: 1. Process the data transfer, if Range Crossing = 0 2. Terminate the command with "Other Invalid Command Parameter" if Range Crossing = 1
Number of Locking SP Admin Authorities Supported	4	As per OPAL 2.0, drive should support at least 4 admin
Number of Locking SP User Authorities Supported	9	As per OPAL 2.0, drive should support at least 8 users
Initial C_PIN_SID PIN Indicator	0x00	0x00 = The initial C_PIN_SID PIN value is equal to the C_PIN_MSID PIN value 0xFF = The initial C_PIN_SID PIN value is VU, and MAY not be equal to the C_PIN_MSID PIN value OPAL 2.0 (only) Customer-specific SID – Configurable
Behavior of C_PIN_SID PIN upon Ter Revert	0x00	0x00 = The C_PIN_SID PIN value becomes the value of the C_PIN_MSID PIN column after successful invocation of revert on the admin SP's object in the SP table 0xFF = The C_PIN_SID PIN value changes to a VU value after successful invocation of revert on the admin SP's object in the SP table and MAY not be equal to the C_PIN_MSID PIN value OPAL 2.0 (only)
DataStore Table Feature		
Maximum number of DataStore Tables	9	The maximum number of the DataStore tables that the TPer supports, including the DataStore table defined in OPAL SSC 2.0
Maximum total size of DataStore Tables	90MB	Specifies the maximum total size in bytes of all of the DataStore tables that TPer supports, including the DataStore table defined in OPAL SSC 2.0
DataStore Table Size Alignment	10MB	–

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Table 14: TCG/Opal Support Parameters (Continued)

Property	Supported?	Comments
MBR Table	128MB	–
Byte Table Access Granularity		
Mandatory Write Granularity	1	TPer enforces when the host invokes the set method on byte tables; it should be less than or equal to 8192; it should be less than or equal to Recommended Access Granularity, OPAL 2.0 (only)
Recommended Access Granularity	8192	Tper recommends when the host invokes the set or get method on byte tables; it should be less than or equal to 8192
Cryptographic Features		
AES Key Size	256 Bits	AES key is generated by using CTR DRBG algorithm (FIPS Compliant)
AES Mode	CBC	IV swapped
Number of Ranges/Band Supported	9 (8 user definable, 1 global range)	Now supporting 8 LBA ranges; range cross read and write allowed if LBA ranges are unlocked
Re-Encryption	Not Supported	–
Key Management		Authentication data required. Conforms to TCG Storage Protection Mechanisms for Secrets; Specification version 1.00, Revision 1.00, 05 March 2012
Crypto Erase Completion Time <1s	Yes	–
Cryptographic Algorithms are Certified by FIPS-197	Pending	–
AES 256-Bit CBC/ECB Mode	Supported	ECB mode used only for generating the random key by CTR DRBG
CTR DRBG	Supported	–
SHA 256	Supported	–
RSA 2048 Signature Verification	Supported	–
TPer Communication Properties		
Max ComPacket Size	131072	256 sectors (128K)
Max Response ComPacket Size	131072	256 sectors (128K)
Max Packet Size	128512	–
Max Individual Token Size	123904	–
Max Packets	1	–
Max SubPackets	1	–
Max Sessions	1	Each session requires a set of buffers and variables
Max Transaction Limit	1	Transaction are inside sessions
Max Methods	1	Methods are contained in a transaction
Max Authentications	2	–

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Table 14: TCG/Opal Support Parameters (Continued)

Property	Supported?	Comments
Def Session Timeout	Yes	The session timeout length (in milliseconds) used by the TPer by default
IEEE1667		
Probe Silo	Supported	–
TCG Storage Silo	Supported	–
Other than Probe and TCG Storage Silo	Not Supported	–
IEEE1667 Major Version	TBD	As per current draft specification, major and minor versions are not yet decided
IEEE1667 Minor Version	TBD	–
Maximum P_OUT Transfer Size	131072	256 sectors (128K)
Others		
FDE (ATA Security with Key Management)	Yes	–
Secure Firmware Download	Supported	Firmware image is validated by using SHA256 and RSA2048 algorithm (FIPS-compliant; certification pending)

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Device ID

Table 15: Identify 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	1 = Fixed disk HDD
	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	0000000000000b	Reserved for the Trusted Computing Group
	0	F	1b	1=Trusted Computing feature set is support

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Table 15: Identify 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	0000000000000b	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	1b	1 = The BLOCK ERASE EXT command is supported
	14	F	1b	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	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
60–61		M(F)	Varies by capacity	Total number of user addressable logical sectors

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Table 15: Identify 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	0	Reserved
	7–0	F	00000011b	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	1b	Reserved for IEEE-1667
	6	F	0b	1 = Optional ATA device 28-bit commands supported
	5	F	1b	1 = Read zero after Trim is supported
	4	F	1b	1 = Device encrypts all user data
	3–0	F	0000b	Reserved

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Table 15: Identify Device (Continued)

See Note 1 for setting definitions

Word	Bit(s)	Setting	Default Value	Description
70		F	0000h	Reserved
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	F	0b	1 = Supports READ LOG DMA EXT as equivalent to READ LOG EXT
	14	F	1b	1 = Supports device automatic partial to slumber transitions
	13	F	1b	1 = Supports host automatic partial to slumber transitions
	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
	15–8	F	00000000b	Reserved for future Serial ATA definition
	7	F	1b	1 = Supports DEVSLP_to_ReducedPwrState
	6	F	0b	Reserved
	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

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Table 15: Identify Device (Continued)

See Note 1 for setting definitions

Word	Bit(s)	Setting	Default Value	Description
78				Serial ATA features supported
	15–8	F	000000000b	Reserved
	7	F	1b	1 = Supports NCQ Autosense
	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)
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

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Table 15: Identify 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

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Table 15: Identify 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	1b	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

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Table 15: Identify 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

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Table 15: Identify 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		1b	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

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Table 15: Identify 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		00b	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		0b	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

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Table 15: Identify 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	1b	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	0011b	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 12- bit word-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

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Table 15: Identify 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
	13–8	F	00000001b	Reserved
	7	F	0b	1 = Extended Power Conditions feature set is supported
	6	F	0b	1 = Extended Status Reporting feature set is supported
	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 = Disable Data Transfer After Error Detection feature set 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

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Table 15: Identify 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
129–159		( )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	5h	Device Nominal Form Factor
169				DATA SET MANAGEMENT command support
	15–1	F	000000000000000b	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)

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Table 15: Identify 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	0b	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)
218		(O)V	0000h	Reserved
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

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Table 15: Identify 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)
	11–7		000000b	Reserved Reserved
	6		1b	Supports SATA Rev 3.1
	5		1b	Supports SATA Rev 3.0
	4		1b	Supports SATA Rev 2.6
	3		1b	Supports SATA Rev 2.5
	2		1b	Supports SATA II: Extensions
	1		1b	Supports SATA 1.0a
	0		1b	Supports ATA8-APT ATA8-AST
223		(M)F	0000h	Transport Minor revision number
224		( )F	0000h 0000h 0000h 0000h 0000h 0000h 0000h 0000h	Reserved for CE-ATA
234		(O)F	0001h	Minimum number of 512 byte units per DOWNLOAD MICROCODE command for mode 3
235			00FFh	Maximum number of 512 byte units per DOWNLOAD MICROCODE command for mode 3
236			0000h 0000h 0000h 0000h 0000h 0000h 0000h 0000h	Reserved
243			4000h	Bit 14 = 1; Supports FDE security features
244			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.

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Commands

Table 16: 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
RECEIVE FPDMA QUEUED	65h
SANITIZE DEVICE	B4h
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

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Table 16: Supported ATA Command Set (Continued)

See ATA-8 standard for command details

Command Name	Command Code (hex)
SCT SET FEATURE CONTROL	04h/01h
SCT RETURN FEATURE CONTROL	04h/02h
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
SEND FPDMA QUEUED	64h
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
TRUSTED NON-DATA	5Bh
TRUSTED RECEIVE	5Ch
TRUSTED RECEIVE DMA	5Dh
TRUSTED SEND	5Eh
TRUSTED SEND DMA	5Fh
WRITE BUFFER	E8h

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Table 16: Supported ATA Command Set (Continued)

See ATA-8 standard for command details

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

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Compliance

Micron SSDs comply with the following:

- RoHS “green”
- 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}
- 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 B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

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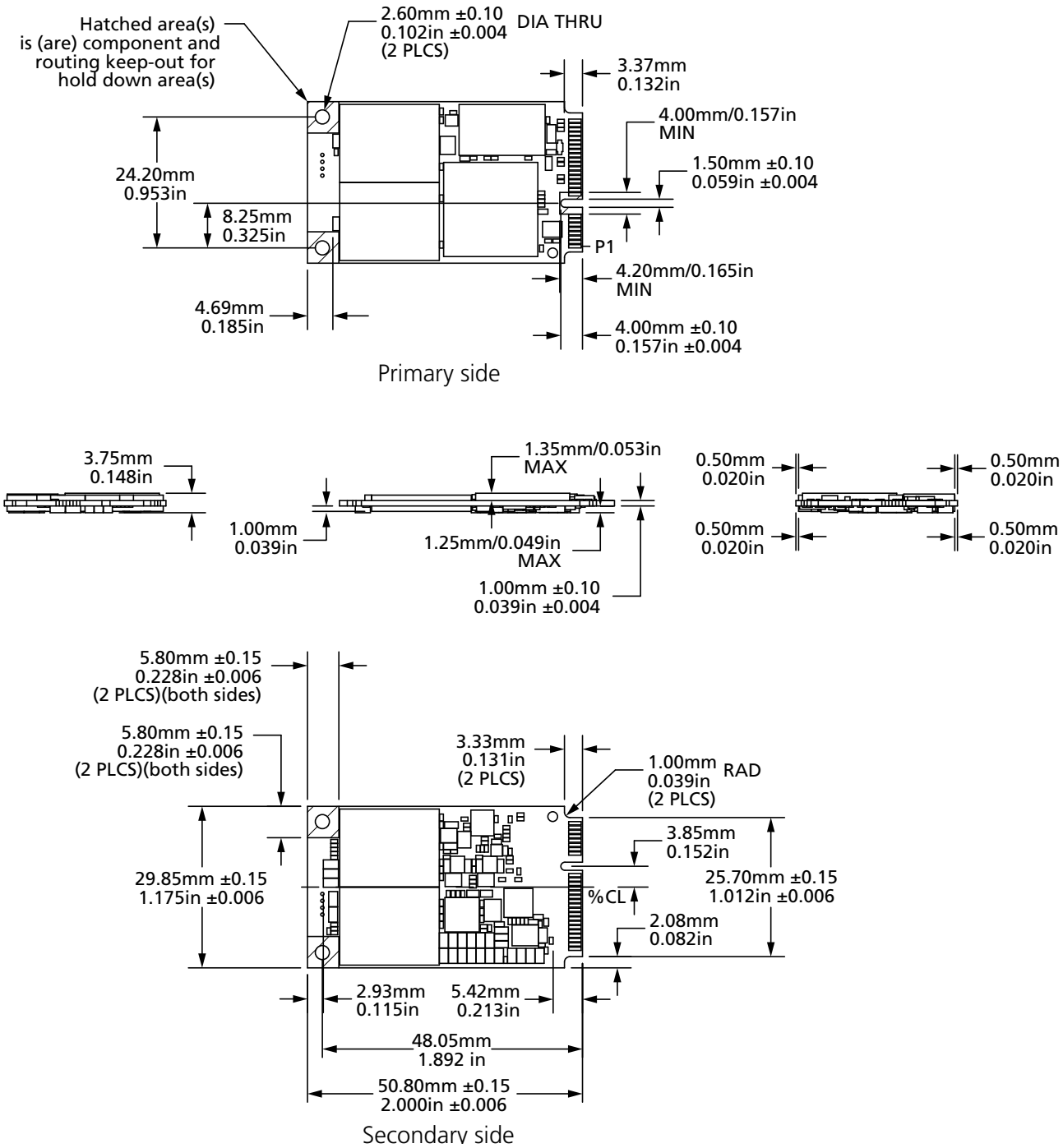
Package Dimensions

Figure 4: mSATA Package



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References

- Serial ATA: High-speed serialized AT attachment, Serial ATA working group, available at www.sata-io.org
- SATA 3.1 GOLD, and the following:
  - DEVSLP, SATA31_TPR_C108 rev. 1.0a 10/24/2011
  - SATA TP #37, Standard SATA Connector 3.3V Power Pin Assignments, Rev. 1.1 10/12/2011
  - SATA TP #39, DEVSLP Assignment on Standard SATA Connector, Rev. 01 01/02/12
- ATA-8 ACS2 (T13/2015-D, Revision 4), and the following:
  - Device Internal Logs (supports SSD Telemetry)
  - IDFY Device Data Logs (supports DEVSLP)
- TCG Storage Security Subsystem Class Opal; Specification 2.00 Revision 1.00, Feb 24, 2012
- TCG Core Specification; Specification 2.00 Revision 2.00, Nov 4, 2011
- TCG Storage Interface Interactions: Specification Version 1.02 Revision 1.00 30 December, 2011
- IEEE-1667: "Standard Protocol for Authentication in Host Attachments of Transient Storage Devices"

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Revision History

Rev. G – 8/14

- Added note 2 and note 4 to Table 7: Drive Lifetime – Client Computing
- Added note 2 and note 4 to Table 8: Drive Lifetime – Sequential Input

Rev. F – 6/14

- Removed the AW = 2.5-inch (5mm) drive form factor from the Part Number Chart

Rev. E – 10/13

- Added heat sink information to maximum ratings note
- Corrected part number chart: 064 = 64GB

Rev. D– 9/13

- Added a power cycle note to thermal monitoring

Rev. C– 5/13

- Changed endurance data and added an endurance footnote on cover page
- Revised part number chart
- Revised and divided the drive lifetime table into two tables, a client computing table and a sequential input table, with new data for these table categories.

Rev. B – 2/13

- Status changed from Preliminary to Production
- Updated Physical Configuration section
- Updated Electrical Characteristics section
- Updated package drawing

Rev. A – 1/13

- Initial release

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