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M500IT mSATA NAND Flash SSD

MTFDDAT060MBD, MTFDDAT120MBD, MTFDDAT240MBD, MTFDDAT064MBD, MTFDDAT128MBD, MTFDDAT256MBD

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, 6
- 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 ACS3 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
- Adaptive thermal monitoring
- Power loss protection for data-at-rest
- Performance[1, 2]
  - Sequential 128KB READ: Up to 500 MB/s
  - Sequential 128KB WRITE: Up to 250 MB/s
  - Random 4KB READ: Up to 65,000 IOPS
  - Random 4KB WRITE: Up to 60,000 IOPS
  - READ/WRITE latency: 160µs/40µs (TYP)
- Reliability
  - MTTF: 3.0 million device hours[3]
  - Static and dynamic wear leveling
  - Uncorrectable bit error rate (UBER): <1 sector per 10^{16} bits read
- Low power consumption
  - 150mW TYP[4]
- Endurance: Total bytes written (TBW)
  - Up to 240TB
- Capacity (unformatted): 60GB, 64GB, 120GB, 128GB, 240GB, 256GB
- mSATA form factor
- Secure firmware update with digitally signed firmware image
- Operating temperature
  - Extended range (–40°C to +85°C)[5]

Notes:
1. Typical I/O performance numbers as measured fresh-out-of-the-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. Temperature measured by SMART attribute 194.

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

Part Numbering Information

Micron's M500IT SSD is available in different configurations and densities. The chart below is a comprehensive list of options for the M500IT 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

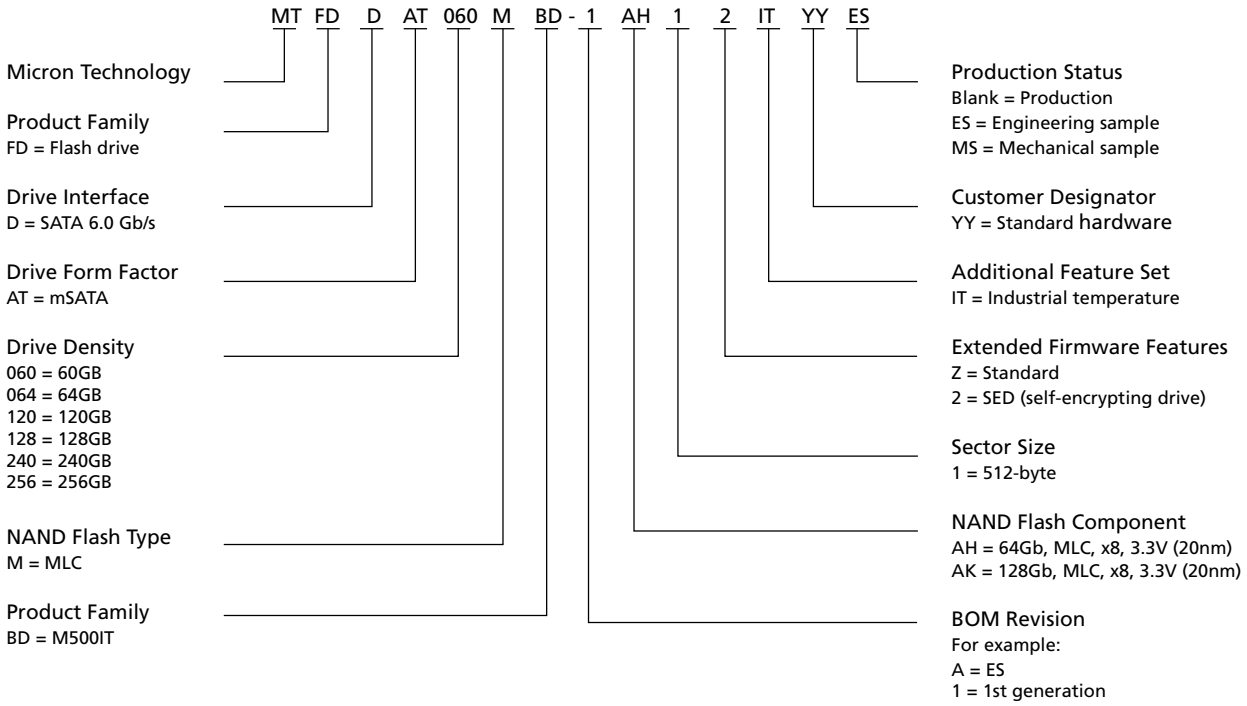


Table 1: Part Ordering Information

Capacity (GB)	Valid Part Number	Description
60	MTFDDAT060MBD-1AH12ITYY	1st generation
120	MTFDDAT120MBD-1AK12ITYY	1st generation
240	MTFDDAT240MBD-1AK12ITYY	1st generation
64	MTFDDAT064MBD-1AH12ITYY	1st generation
128	MTFDDAT128MBD-1AK12ITYY	1st generation
256	MTFDDAT256MBD-1AK12ITYY	1st generation
64	MTFDDAT064MBD-AAH12ITYYES	1st generation
128	MTFDDAT128MBD-AAK12ITYYES	1st generation
256	MTFDDAT256MBD-AAK12ITYYES	1st generation

General Description

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

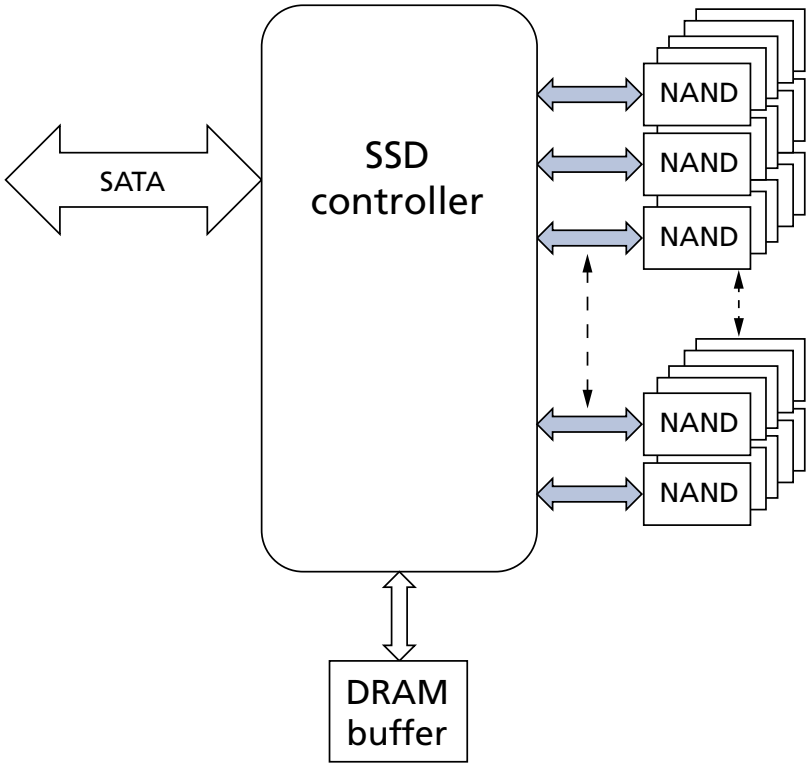
The SSD is designed to use the SATA interface efficiently during both READs and WRITEs while delivering bandwidth-focused performance. SSD technology enables enhanced boot times, faster application load times, reduced power consumption, and extended reliability.

The self-encrypting 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 ATA security 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 ATA security feature sets are enabled.

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 capacity. Standard LBA settings, based on the IDEMA standard (LBA1-03), are shown below.

Table 2: Standard LBA Settings

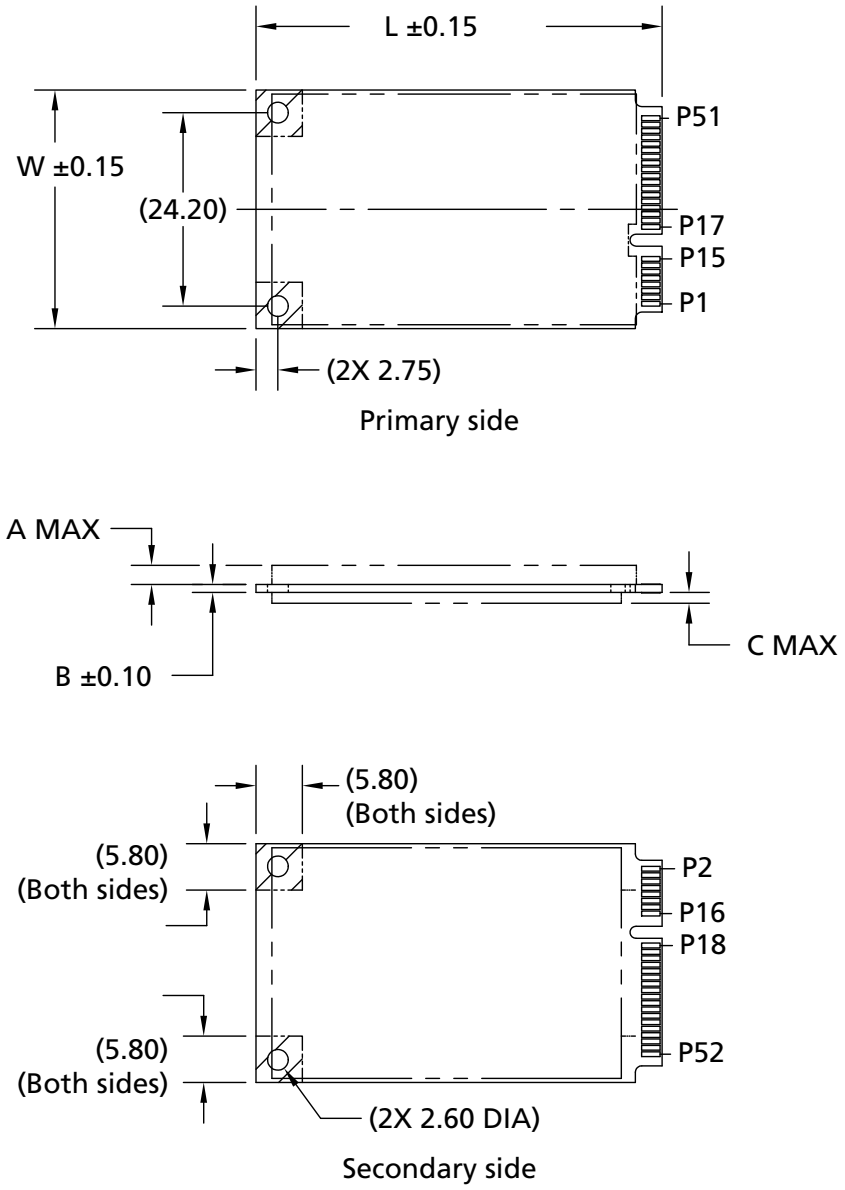
	Total LBA		Max LBA		User Available Bytes
Capacity (GB)	Decimal	Hexadecimal	Decimal	Hexadecimal	(Unformatted)
60	117,231,408	6FCCF30	117,231,407	6FCCF2F	60,022,480,896
120	234,441,648	DF94BB0	234,441,647	DF94BAF	120,034,123,776
240	468,862,128	1BF244B0	468,862,127	1BF244AF	240,057,409,536
64	125,045,424	7740AB0	125,045,423	7740AAF	64,023,257,088
128	250,069,680	EE7C2B0	250,069,679	EE7C2AF	128,035,676,160
256	500,118,192	1DCF32B0	500,118,191	1DCF32AF	256,060,514,304

Physical Configuration

Product mass: 10 grams MAX

Physical dimensions conform to the applicable form factor specifications as listed in the figure below.

Figure 3: mSATA Package



Note: 1. All dimensions are in millimeters.

Table 3: mSATA Package Dimensions

Density (GB)	W	L	A	B	C	Unit
60	29.85	50.80	2.40	1.00	1.35	mm
120						
240						
64						
128						
256						

Note: 1. Dimension values in millimeter per SERIAL ATA Rev. 3.2.

Interface Connectors

Figure 4: SSD Interface Connections

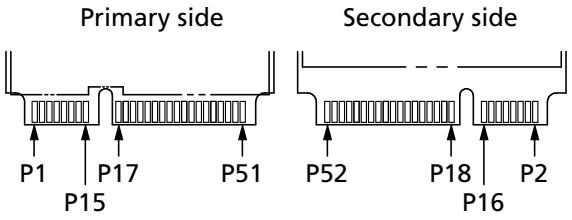


Table 4: Signal Assignments

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

Table 4: Signal Assignments (Continued)

Primary Side			Secondary Side		
Pin #	**Signal Name**	**Description**	**Pin #**	**Signal Name**	**Description**
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

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 industrial market, Micron specifies performance in fresh-out-of-box (FOB) state. Data throughput measured in "steady state" may be lower than FOB state, depending on the nature of the data workload.

For a description of these performance states and of Micron's best practices for performance measurement, refer to Micron's technical marketing brief "Best Practices for SSD Performance Measurement" (www.micron.com/products/solid-state-storage/).

Table 5: Drive Performance

Capacity	60GB	120GB	240GB	64GB	128GB	256GB	
Interface Speed	**6 Gb/s**	**6 Gb/s**	**6 Gb/s**	**6 Gb/s**	**6 Gb/s**	**6 Gb/s**	**Unit**
Sequential read (128KB transfer)	500	500	500	500	500	500	MB/s
Sequential write (128KB transfer)	130	130	250	130	130	250	MB/s
Random read (4KB transfer)	55,000	55,000	65,000	55,000	55,000	65,000	IOPS
Random write (4KB transfer)	35,000	35,000	60,000	35,000	35,000	60,000	IOPS
READ latency (TYP)	160	160	160	160	160	160	µs
WRITE latency (TYP)	40	40	40	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 with a queue depth of 1 are used to measure READ/WRITE latency values with write cache enabled.

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 6: Uncorrectable Bit Error Rate

Uncorrectable Bit Error Rate	Operation
<1 sector per 10^{16} 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 7: MTTF

Capacity (GB)	MTTF (Operating Hours)[1]
60	3.0 million
120	3.0 million
240	3.0 million
64	3.0 million
128	3.0 million
256	3.0 million

Note: 1. The product achieves a mean time to failure (MTTF) of 3.0 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. For each SSD capacity, the table below shows drive lifetime and sequential input based on predefined usage conditions.

Table 8: Drive Lifetime

Capacity (GB)	Drive Lifetime (Total Bytes Written)
60	60TB
120	120TB
240	240TB
64	60TB
128	120TB

Table 8: Drive Lifetime (Continued)

Capacity (GB)	Drive Lifetime (Total Bytes Written)
256	240TB

Notes:
1. Total bytes written validated with the drive 90% full.
2. Access patterns used during reliability testing are 25% sequential and 75% random and consist of the following: 50% are 4 KB; 40% are 64 KB; and 10% are 128 KB.
3. Host workload parameters, including write cache settings, I/O alignment, transfer sizes, randomness, and percent full, that are substantially different than the described notes may result in varied endurance results.
4. GB/day can be calculated by dividing the total bytes written value by (365 × number of years). For example: 100 TB/5 years/365 days = 54 GB/day for 5 years.

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 (GB)	Device Sleep Typical	Idle Average	Active Average	Active Maximum (128KB transfer)	Unit
60	10	100	150	2200	mW
120	10	100	150	2300	mW
240	10	100	150	3500	mW
64	10	100	150	2200	mW
128	10	100	150	2300	mW
256	10	100	150	3500	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 an average power measurement performed using Iometer with 128KB sequential write transfers.

Table 10: Maximum Ratings

Parameter/Condition	Symbol	Min	Max	Unit	Notes
Voltage input	3V3	3.14	3.46	V	
Operating temperature	T_C	–40	85	°C	1
Non-operating temperature		–40	85	°C	
Rate of temperature change		–	20	°C/hour	
Relative humidity (non-condensing)		5	95	%	

Note:
1. Operating temperature is best measured by reading the SSD's on-board temperature sensor, which is recorded in SMART attribute 194 (or 0xC2).

Table 11: Shock and Vibration

Parameter/Condition	Specification
Non-operating shock	1500G/0.5ms (10x shocks per axis)
Non-operating vibration	7 – 2000Hz @ 20 Grms (30 minutes per axis)

Note:
1. Stress qualification tests are not intended for operational or continuous use. Exposure to these conditions may affect reliability.

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 total SSD power consumption by the device controller, as well as the NAND media, by injecting time-based delays between internal processing of media commands when the device temperature reaches 85 °C. The delay times used are bound to the microsecond range, and are based on a proportional and differential control equation of the general form shown here.

Figure 5: Adaptive Thermal Monitoring Control Equation

$$u(t) = Kp \times T_p(t) + Kd \times \frac{dT_d}{dt}$$

The delay-control equation is tuned for a steady-state temperature target, which has been designed as an optimum balance of hardware temperature tolerances and drive performance. Steady-state temperature targets are hardware-configuration dependant, and may range from 85 °C to 90 °C. Temperatures below the intended steady-state target will not produce a proportional component to delay, but may produce a differential component based on the current rate of temperature change according to the control equation. When the feature is active, DRAM refresh rates are also adjusted to improve data integrity and stability while operating outside of temperature specifications.

When the device temperature falls below 85 °C, normal operation will continue without induced delays. If temperature continues to rise above the temperature target and exceeds a hardware-dependant critical threshold, the device will abort host commands to prevent component damage. The critical threshold values have a 6 °C margin on top of target threshold, and range between 95 °C and 101 °C.

Device temperature values used by the adaptive thermal monitoring feature are based on an internal temperature sensor located on the device PCB, and may differ from case or package temperatures as measured by thermocouple. Device temperature is accessible through SMART attribute 194, though usage of the SMART feature is not necessary for adaptive thermal monitoring functionality.

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.

This feature is still under definition, and further details on exact behavior will be provided later.

TCG/Opal Support

Table 12: 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

Table 12: 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	16	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	16	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
MBR Table	128MB	–

Table 12: TCG/Opal Support Parameters (Continued)

Property	Supported?	Comments
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	16 (15 user definable, 1 global range)	Now supporting 15 LBA ranges; range cross read and write allowed if LBA ranges are unlocked
Re-Encryption	Not Supported	–
Key Management		Cryptographic
Crypto Erase Completion Time <1s	Yes	–
Cryptographic Algorithms are Certified by FIPS-197	No	Designed to meet, no plans for certification
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	14	–
Def Session Timeout	Yes	The session timeout length (in milliseconds) used by the TPer by default
IEEE1667		
Probe Silo	Supported	–

Table 12: TCG/Opal Support Parameters (Continued)

Property	Supported?	Comments
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

Device ID

Table 13: 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	X	1b	1 = Not removable device
	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

Table 13: 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	0b	1 = The OVERWRITE EXT command is supported
	13	F	1b	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

Table 13: 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

Table 13: Identify Device (Continued)

See Note 1 for setting definitions

Word	Bit(s)	Setting	Default Value	Description
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	varies	1 = READ BUFFER DMA is supported
	10	F	varies	1 = WRITE BUFFER DMA is supported
	9	F	0b	1 = SET MAX PASSWORD DMA and SET MAX UNLOCK DMA are supported
	8	F	varies	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	varies	1 = Device encrypts all user data
	3	F	1b	1 = Extended number of user addressable sectors is supported
	2–0	F	000b	Reserved
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

Table 13: Identify Device (Continued)

See Note 1 for setting definitions

Word	Bit(s)	Setting	Default Value	Description
76				Serial ATA capabilities
	15	F	1b	1 = Supports READ LOG DMA EXT as equivalent to READ LOG EXT
	14	F	0b	1 = Supports device automatic partial to slumber transitions
	13	F	0b	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	0b	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	1b	Supports RECEIVE FPDMA QUEUED and SEND FPDMA QUEUED commands
	5	F	0b	Supports NCQ Queue Management Command
	4	F	0b	Supports NCQ Streaming
	3–1	V	varies	Coded value indicating current negotiated Serial ATA signal speed
	0	F	0b	Shall be cleared to zero
78				Serial ATA features supported
	15–9	F	0000000b	Reserved
	8	F	1b	1 = Device sleep supported
	7	F	0b	1 = Supports NCQ Autosense
	6	F	1b	1 = Supports software settings preservation
	5	F	1b	1 = HARDWARE FEATURE CONTROL SUPPORTED bit
	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 13: Identify Device (Continued)

See Note 1 for setting definitions

Word	Bit(s)	Setting	Default Value	Description
79				Serial ATA features enabled
	15–9	F	0000000b	Reserved
	8	V	0b	1 = Device sleep enabled
	7	V	1b	1 = Automatic partial to slumber transitions enabled
	6	V	1b	1 = Software settings preservation enabled
	5	F	0b	Reserved
	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	F	0b	Reserved (set to 0)
80				Major revision number
	15–11	F	00000b	Reserved
	10	F	1b	1 = Supports ACS-3
	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	X	1b	1 = Supports ATA/ATAPI-4
	3	X	1b	1 = Supports ATA-3
	2	X	0b	Obsolete
	1	X	0b	Obsolete
	0	F	0b	Reserved
81		F	011Bh	Minor revision number
				011Bh = ACS-3 version 4

Table 13: 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	X	0b	Obsolete
	3	F	1b	1 = Advanced Power Management feature set supported
	2	F	0b	1 = CFA feature set supported
	1	X	0b	Obsolete
	0	F	1b	1 = DOWNLOAD MICROCODE command supported

Table 13: 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	X	00b	Obsolete
	8	F	1b	1 = 64-bit word wide name supported
	7	X	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	X	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	X	0b	Obsolete
	1	V	0b	1 = Security Mode feature set enabled
	0	V	1b	1 = SMART feature set enabled

Table 13: 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	X	0b	Obsolete
	3	V	1b	1 = Advanced Power Management feature set enabled
	2	F	0b	1 = CFA feature set supported
	1	X	0b	Obsolete
	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	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	X	00b	Obsolete
	8	F	1b	1 = 64-bit word wide name supported
	7	X	0b	Obsolete
	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	X	0b	Obsolete
	3	X	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