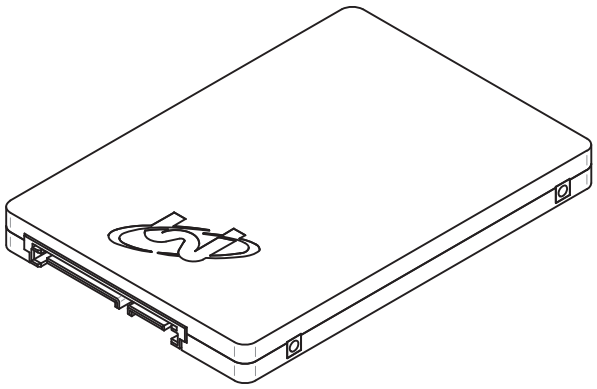
RealSSD™ 2.5-Inch SATA NAND Flash Solid State Drive (SSD)

MTFDAAC008SAA, MTFDAAC016SAA, MTFDAAC032SAA, MTFDAAC064SAA

Features

- Micron® NAND Flash
- RoHS-compliant "green" package
- Interface: Serial advanced technology attachment (SATA), 1.5 Gb/s
- ATA modes supported
  - PIO mode 0, 1, 2, 3, 4
  - DMA mode 0, 1, 2
  - Ultra DMA mode 0, 1, 2, 3, 4, 5, 6
- READ performance
  - Sequential READ: 65 MB/sec[1]
- WRITE performance
  - Sequential WRITE: 35 MB/sec[1]
  - Random access time (MAX): 0.1ms
- Secure erasure (clear, sanitize)
- Reliability: 2 million operating hours mean time between failures (MTBF)
- Endurance: 5 years at 400GB per day based on a 32GB drive under normal operating conditions
- Static and dynamic wear-leveling
- Field-upgradable firmware
- Active power consumption: 2.2W
- Bit error rate: <1 uncorrectable error per 10^{15} bits
- Self-monitoring analysis and reporting technology (S.M.A.R.T.)
- Standard SATA connector
- Password protection
- Data security

Figure 1: RealSSD™ Solid State Drive



Options

- Capacity (unformatted): 8GB, 16GB, 32GB, 64GB[2]
- Form factor
  - 2.5-inch drive package (100.45mm x 69.85mm x 9.5mm)
- Weight: 70g maximum
- Voltage: 5V ±5 percent
- Operating temperature
  - Commercial (0°C to +70°C)
  - Industrial (–40°C to +85°C)

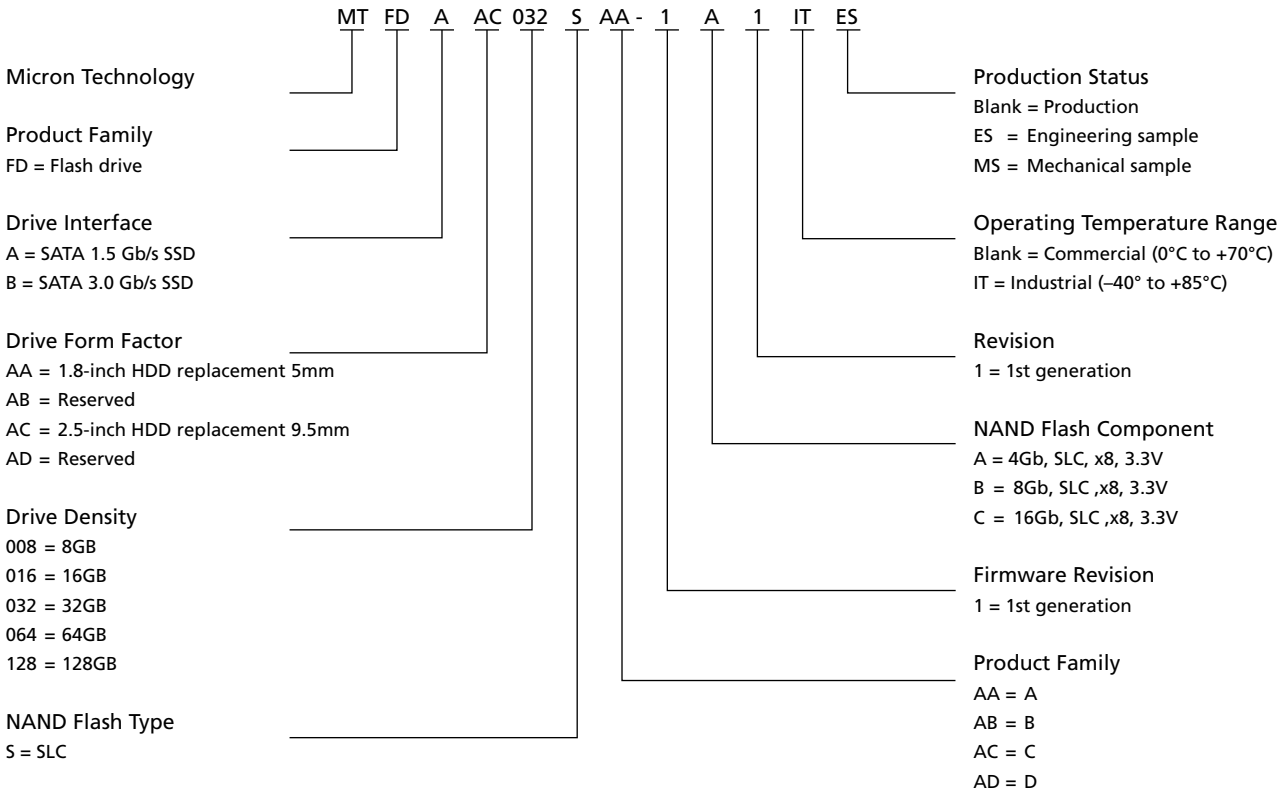
Notes: 1. Typical transfer rate measured with H2BENCH 3.6.

2. 1GB = 1 billion bytes; formatted capacity is less.

Part Numbering Information

Micron Real*SSD*s are available in several configurations and densities. Visit micron.com for a list of valid part numbers.

Figure 2: Part Number Chart



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General Description

Micron Real*SSD* solid state drives (SSDs) provide 8GB, 16GB, 32GB, or 64GB of mass memory storage. They support faster boot and application start-up times and they offer increased reliability, lower power consumption, and weigh less than standard hard disk drives (HDDs). They are suitable for a variety of applications, from portable devices, such as notebook and mobile computers, PDAs, and camcorders, to enterprise solutions, such as servers and workstations.

Micron's SSDs are compatible with the SATA 1.5 Gb/s standard. Because the drives are Flash-based, they have no moving parts. The absence of moving parts eliminates many of the inherent drawbacks of traditional HDDs, enabling the SSD to withstand higher levels of vibration, shock, temperature, humidity, and altitude.

Micron's SSD SATA controller provides the SATA 1.5 Gb/s bus interface to the host controller while managing all wear-leveling and bad-block mapping of the NAND Flash storage element. These SSDs operate at 5V ± 5 percent and are drop-in replacements for SATA 2.5-inch HDDs. Firmware for the SSD is field-upgradable.

Figure 3: Functional Block Diagram

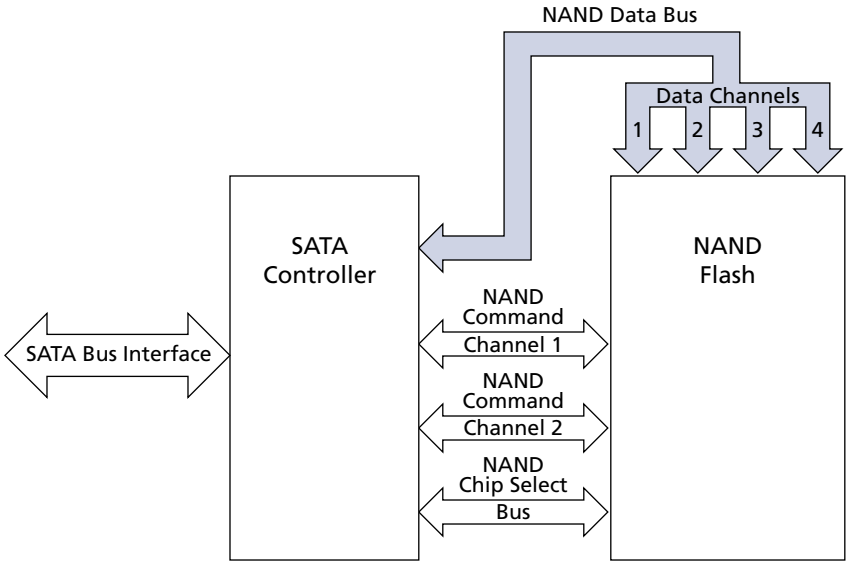


Table 1: 2.5-Inch SATA Densities

Unformatted Disk Density	Total Number of User-Addressable Sectors in Logical Block Addressing (LBA) Mode	Number of Logical Sectors per Track	Number of Logical Heads	Number of Logical Cylinders	Current Cylinder-Head-Sector (Sectors)
	Words 60 and 61 of IDENTIFY information	Words 6 and 56 of IDENTIFY information after power-on	Words 3 and 55 of IDENTIFY information after power-on	Words 1 and 54 of IDENTIFY information after power-on	Words 57 and 58 of IDENTIFY information after power-on
8GB	16,074,752	63	16	16,383	16,514,604
16GB	32,149,504	63	16	16,383	16,514,064
32GB	64,360,448	63	16	16,383	16,514,064
64GB	128,786,432	63	16	16,383	16,514,064

Table 2: Real*SSD* 2.5-Inch Nominal Dimensions, Density, and Weight

	Value	Unit
Height	9.5	mm
Width	69.85	mm
Length	100.45	mm
Density	8, 16, 32, 64	GB
Maximum unit weight	70	g

Table 3: Serial ATA 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

Note: All pins are in a single row with a 1.27mm (0.050in) pitch.

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, pre-charge
P8	V5	5V power
P9	V5	5V power

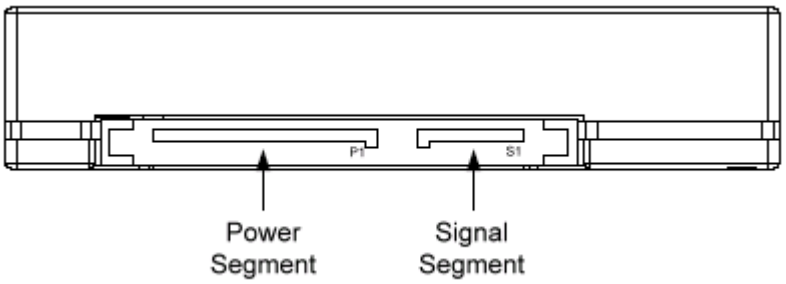
Table 4: 2.5-Inch SATA Power Segment Pin Assignments (continued)

Pin#	Signal Name	Description
P10	GND	Ground
P11	Reserved	No connect
P12	GND	Ground
P13	V12	No connect
P14	V12	No connect
P15	V12	No connect

Interface Connectors

The SATA signal segment interface cable has four conductors and three ground connections. As shown in Figure 3, 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.

Figure 4: Interface Connections



Command Definitions

This section describes the commands available on Micron Real*SSD* drives.

Table 5: Supported ATA Command Set
See ATA-8 standard for command details.

Command Name	Command Code (hex)
CHECK POWER MODE	98h-E5h
DOWNLOAD MICROCODE	92h
EXECUTE DEVICE DIAGNOSTIC	90h
FLUSH CACHE	E7h
IDENTIFY DEVICE	ECh
IDLE	E3h
IDLE IMMEDIATE	E1h
INITIALIZE DEVICE PARAMETERS	91h
NOP	00h
READ BUFFER	E4h
READ DMA (with retry)	C8h
READ DMA (without retry)	C9h
READ MULTIPLE	C4h
READ SECTOR(S) (with retry)	20h
READ SECTOR(S) (without retry)	21h
READ VERIFY SECTOR(S) (with retry)	40h
READ VERIFY SECTOR(S) (without retry)	41h
RECALIBRATE	10h
SECURITY DISABLE PASSWORD	F6h
SECURITY ERASE PREPARE	F3h
SECURITY ERASE UNIT	F4h
SECURITY FREEZE	F5h
SECURITY SET PASSWORD	F1h
SECURITY UNLOCK	F2h
SEEK	70h
SET FEATURES	EFh
SET MULTIPLE MODE	C6h
SLEEP	E6h
SMART DISABLE OPERATIONS	B0h-D9h
SMART ENABLE OPERATIONS	B0h-D8h
SMART ENABLE/DISABLE AUTOSAVE	B0h-D2h
SMART READ DATA	B0h-D0h
SMART RETURN STATUS	B0h-DAh
STANDBY	E2h
STANDBY IMMEDIATE	E0h
WRITE BUFFER	E8h
WRITE DMA (with retry)	CAh
WRITE DMA (without retry)	CBh
WRITE MULTIPLE	C5h
WRITE SECTOR(S) (with retry)	30h
WRITE SECTOR(S) (without retry)	31h

Command Descriptions

For detail on the low-level operations of the following commands, refer to the S ATA standard, available at www.sata-io.org.

CHECK POWER MODE 98h-E5h

The CHECK POWER MODE (98h-E5h) command generates a response with the current power mode in which the SSD is operating.

DOWNLOAD MICROCODE 92h

The DOWNLOAD MICROCODE (92h) command enables the host controller to change the device's microcode. All data transferred while using the DOWNLOAD MICROCODE command is vendor specific. This command requires the segment transfer size to be a multiple of 512-byte data blocks; all microcode segments are issued in sequence.

The new microcode becomes effective immediately after the transfer of the last data segment has completed.

EXECUTE DEVICE DIAGNOSTIC 90h

The EXECUTE DEVICE DIAGNOSTIC (90h) command executes and reports device diagnostics. The SSD responds with either a "pass" or a "fail" status, reflected in the frame information structure (FIS) register. When the FIS register data has been transmitted to the host, the SSD returns to the idle state.

FLUSH CACHE E7h

The FLUSH CACHE (E7) command is issued to request a flush of the write cache. This causes all data in the write cache to be written to the SSD. The FLUSH CACHE command then reports whether the data was written successfully or with errors.

IDENTIFY DEVICE ECh

The IDENTIFY DEVICE (ECh) command returns 512 bytes of identifier codes that are programmed into the SSD. The IDENTIFY DEVICE command reads a table that includes the manufacturer ID, device configuration, and other part-specific information.

IDLE E3h

The IDLE (E3h) command places the SSD in idle mode at the completion of the last SSD access.

IDLE IMMEDIATE E1h

The IDLE IMMEDIATE (E1h) command places the device in idle mode without waiting for completion of the last command issued to the SSD.

INITIALIZE DEVICE PARAMETERS 91h

The INITIALIZE DEVICE PARAMETERS (91h) command sets the number of sectors per track for the SSD.

NOP 00h

The NOP (00h) command instructs the SATA interface not to issue any command instructions during the execution cycle in which the NOP command is issued, and then reports the status of the SSD. After receiving the NOP command, the SSD also reports back an aborted error.

READ BUFFER E4h

The READ BUFFER (E4h) command transfers a sector of data (512 bytes) from the SSD to the host. When the READ BUFFER E4h command is issued to the SSD, the SSD sets bit BSY in the status register, sets DRQ, resets the BSY bit, and then generates an interrupt when the READ operation is complete. After the interrupt is issued from the SSD, the host can read the sector of data.

READ DMA C8h and C9h

The READ DMA (C8h and C9h) commands are similar to READ VERIFY SECTOR(S) (40h) commands, except that the DMA channel is initialized before the command is executed on the SSD. At the completion of the READ DMA, following the data transfer, the SSD issues an interrupt to report its status.

READ MULTIPLE C4h

The READ MULTIPLE (C4h) command is the same as the READ VERIFY SECTOR(S) (40h) command except that the SSD does not issue interrupts on each sector read. Instead, the SSD issues interrupts on each block transferred that has a defined number of sectors set by the SET MULTIPLE MODE (C6h) command.

READ SECTOR(S) 20h and 21h

The READ SECTOR(S) (20h and 21h) commands read the sectors specified in the sector count register. The transfer of data starts in the logical block addressing (LBA) of the sector listed in the LBA registers.

READ VERIFY SECTOR(S) (with and without retry) 40h and 41h

The READ VERIFY SECTOR(S) (40h and 41h) commanda are identical to READ SECTOR(S) (20h and 21h) commands, except that no data is transferred from the SSD to the host. The SSD reads the data from the media and verifies that there are no errors.

RECALIBRATE 10h

The RECALIBRATE (10h) command is a non-data protocol command. When the host issues a 10h command, the SSD sets the BSY bit in the read status register (RSR) until the RECALIBRATE command execution is complete. When the 10h command is complete, the SSD clears the BSY bit in the RSR and sends an INTRQ interrupt to the host. The host then reads the RSR in response to the INTRQ interrupt, and the SSD clears the INTRQ bit in the RSR.

SECURITY DISABLE PASSWORD F6h

The SECURITY DISABLE PASSWORD (F6h) command transfers one sector of data from the host, as shown in Table 6. The SSD compares the password selected by word 0 to the previously saved user and master passwords. If the password selected by word 0 matches either of the stored passwords, the SSD disables the lock mode. If the password transferred from the host does not match either stored password, the SSD issues an aborted command error and does not execute the F6h command.

Table 6: SECURITY DISABLE Data

Word	Details	
0	Control word	
	Bits [15:1]	Reserved
	Bit 0	Identifier: 0 = Compare user password 1 = Compare master password
1–16	Password from host (16 words)	
17–255	Reserved	

The F6h command can be performed only when the SSD is in unlock mode. If the SSD is in lock mode when the F6h command is issued, the SSD issues an aborted command error and does not execute the command.

SECURITY ERASE PREPARE F3h

The SECURITY ERASE PREPARE (F3h) command is used to prevent accidental erasure of the SSD. The F3h command must be executed immediately prior to a SECURITY ERASE UNIT (F4h) command.

SECURITY ERASE UNIT F4h

The SECURITY ERASE UNIT (F4h) command must be executed immediately after a SECURITY ERASE PREPARE (F3h) command. If the F4h command is issued at any time other than immediately following an F3h command, the SSD will respond with an aborted command error and will not execute the F4h command.

The F4h command transfers a sector of data from the host, as shown in Table 7. The SSD compares the password selected by word 0 to the previously saved user and master passwords. If the password selected by word 0 matches either of the stored passwords, the SSD proceeds with the F4h command. If the password transferred from the host does not match either stored password, the SSD issues an aborted command error and does not execute the F4h command.

Table 7: SECURITY ERASE UNIT Data

Word	Details	
0	Control word	
	Bits [15:1]	Reserved
	Bit 0	Identifier: 0 = Compare user password 1 = Compare master password
1–16	Password from host (16 words)	
17–255	Reserved	

The F4h command erases all the user data in the SSD. This command also disables the SSD lock function.

SECURITY FREEZE F5h

The SECURITY FREEZE (F5h) command puts the SSD into frozen mode. After the SSD completes the F5h command, it will not execute any subsequent commands that alter SSD lock functions, including SECURITY DISABLE PASSWORD (F6h), SECURITY ERASE PREPARE (F3h), SECURITY ERASE UNIT (F4h), SECURITY SET PASSWORD (F1h), and SECURITY UNLOCK (F2h).

Either a power-on or a reset event can bring the SSD out of frozen mode. If the SSD is in frozen mode when an F5h command is issued, the SSD will execute the command and remain in frozen mode.

SECURITY SET PASSWORD F1h

The SECURITY SET PASSWORD (F1h) command transfers a sector of data from the host, as shown in Table 8, to set either the user or the master password.

Table 8: SECURITY SET PASSWORD Data

Word	Details	
0	Control word	
	Bits [15:9]	Reserved
	Bit 8	Level of security: 0 = High 1 = Maximum
	Bits [7:1]	Reserved
	Bit 0	Identifier: 0 = Set user password 1 = Set master password
1–16	Password from host (16 words)	
17–255	Reserved	

Further definitions for the level of security and the identifier bits in Table 8 are provided in Table 9 on page 13.

Table 9: SECURITY SET PASSWORD BIT DEFINITIONS

Identifier	Level of Security	Result
Set user password	High	The password transferred by the host during the SECURITY SET PASSWORD (F1h) command immediately becomes the user password. SSD lock functionality becomes available after the next power-on event. If the SSD is locked, it can immediately be unlocked with either the user password or the master password.
Set master password	High	The password transferred by the host during the SECURITY SET PASSWORD (F1h) command is immediately used as the master password. SSD lock functionality is disabled for all other security commands at subsequent power-up operations.
Set user password	Maximum	The password transferred by the host during the SECURITY SET PASSWORD (F1h) command immediately becomes the user password. SSD lock functionality becomes available after the next power-on event. If the SSD is locked, it can immediately be unlocked with only the user password. The master password can no longer be used to lock the SSD.
Set master password	Maximum	The password transferred by the host during the SECURITY SET PASSWORD (F1h) command immediately becomes the master password. SSD lock functionality is disabled for all other security commands at subsequent power-up operations.

SECURITY UNLOCK F2h

The SECURITY UNLOCK (F2h) command transfers a sector of data from the host to the SSD, as shown in Table 10.

Table 10: SECURITY UNLOCK Data

Word	Details	
0	Control word	
	Bits [15:1]	Reserved
	Bit 0	Identifier 0 = Compare user password 1 = Compare master password
1–16	Password from host (16 words)	
17–255	Reserved	

If the identifier bit is set to compare the master password and the SSD security level is set at high, then the master password supplied by the host during the F2h command will be compared with the master password stored in the SSD.

If the identifier bit is set to compare the master password and the SSD security level is set at maximum, then the SSD will reject the F2h command.

If the identifier bit is set to compare the user password, then the user password that is supplied by the host during the F2h command will be compared with the current user password stored in the SSD.

If a comparison fails, then the SSD returns an abort error to the host and decrements the internal unlock counter. By default, the unlock counter in the SSD is set to "5." If the counter reaches "0," then the SECURITY UNLOCK (F2h) and SECURITY ERASE UNIT (F4h) commands will be aborted until a power-on or hard reset event resets the counter.

When the SSD is in unlock mode, an F2h command will not cause any decrements to the unlock counter.

SEEK 70h

The SEEK (70h) command is a non-data command. When the host sends a 70h command to the SSD, the SSD sets the BSY bit in the RSR and completes the 70h command. The SSD then clears the BSY bit and sends an INTRQ interrupt to the host. Upon receipt of the interrupt, the host reads the RSR. The SSD then clears the INTRQ bit in the register.

SET FEATURES EFh

The SET FEATURES (EFh) command is used by the host to inform the SSD of its capabilities and to establish the features of the SSD that will be enabled and disabled.

SET MULTIPLE MODE C6h

The SET MULTIPLE MODE (C6h) command enables the SSD to perform READ MULTIPLE (C4h) and WRITE MULTIPLE (C5h) operations and configures the block count number for those operations.

After receiving the C6h command, the SSD sets the BSY bit to "1" in the status register and reads the contents of the sector count register to determine the set number of sectors per block. If the sector count register contains valid data, that register value is used as the number of sectors per block for all subsequent C4h and C5h commands. C4h and C5h commands are enabled and can be used.

If invalid data is transferred with the C6h command for a block count, the C6h command will not be executed and an aborted command error will be issued to the host. Subsequent C4h and C5h commands will be disabled until a new C6h command is sent. C4h and C5h commands will also be disabled if the sector count register = 0 when the C6h command is issued.

SLEEP E6h

The SLEEP (E6h) command places the SSD immediately into sleep mode. When the SSD enters sleep mode, it sends an interrupt to the host to confirm that the E6h command has been completed. The host can move the SSD out of sleep mode and into standby mode by issuing a reset.

STANDBY E2h

The STANDBY (E2h) command puts the SSD in standby mode.

STANDBY IMMEDIATE E0h

The STANDBY IMMEDIATE (E0h) command places the SSD into standby mode without waiting for the previously executed command to terminate.

WRITE BUFFER E8h

The WRITE BUFFER (E8h) command transfers a sector of data (512 bytes) from the host to the SSD. When the E8h command is issued to the SSD, the SSD prepares its buffer for a WRITE operation and sets DRQ in the status register. The host may then write a sector of data to the SSD buffer.

WRITE DMA CAh and CBh

The WRITE DMA (CAh and CBh) commands are similar to the WRITE SECTOR(S) (30h) command, except that the DMA channel is initialized before the command is executed on the SSD. While the DMA data transfer is in progress, the BSY bit or the DRQ bit is set to "1" in the status register. After the WRITE DMA is complete, the cylinder (CY), head (HD), and sector number (SN) registers will contain the last sector transferred.

WRITE MULTIPLE C5h

The WRITE MULTIPLE (C5h) command performs the same function as the WRITE SECTOR(S) 30h command, except that the SSD does not issue an interrupt on a sector write. Instead, the SSD issues interrupts on the transfer of each block that has a predefined number of sectors, as specified in the sector count register (SCR).

WRITE SECTOR(S) 30h and 31h

The WRITE SECTORS (30h and 31h) commands write the sectors specified in the sector count register. A sector count of 0 requests 256 sectors.

Vendor-Specific Commands

S.M.A.R.T. Commands

Disk drive manufacturers have incorporated self-monitoring analysis and reporting technology (S.M.A.R.T.) into their drives to check various performance attributes and to predict drive failure in time for a system administrator to protect the data on the drive. With mechanical HDDs, the S.M.A.R.T. system typically monitors, like head flying height and spin-up time. With SSDs, the S.M.A.R.T. system is used instead to check the number of bad blocks against the number of remaining spare blocks.

When a Flash block fails, the device automatically transfers the data from the failed block to a spare block and marks the failed block as bad. When the Flash device leaves the factory, a small percentage of the total density is reserved as spare blocks. When the S.M.A.R.T. status is checked by the host on the SSD, the SSD calculates the original number of spare blocks and the current number of spare blocks. The subcommand RETURN STATUS returns a status of “passed” if at least 5 percent of the original spare blocks are still available; otherwise, it returns a “failed” status.

FORMAT UNIT Command

The SSD is shipped from the factory in a low-level format. The FORMAT UNIT (F7h) command can be used to initiate a new low-level format.

Table 11: FORMAT UNIT Command

Register	7	6	5	4	3	2	1	0
Features								
Sector count								
Sector number								
Cylinder low								
Cylinder high								
Device/head					D	1		1
Command	F7h							

Error Management

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. See Table 12 for the uncorrectable bit error rate for the SSD.

Table 12: Uncorrectable Bit Error Rate

Uncorrectable Bit-Error Rate	Operation
<1 bit error in 10^{15} bits	READ

Mean Time Between Failures

Mean time between failures (MTBF) 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 10 shows the MTBF for each SSD density.

Table 13: Mean Time Between Failures

Density	MTBF (Operating Hours)
8GB	2.5 million
16GB	2.5 million
32GB	2.5 million
64GB	1.7 million

Electrical Characteristics

Table 14: RealSSD SATA Typical Power Consumption

Density	Sleep	Standby	Read[1]	Write[1]	Unit
8GB	1.5	1.6	2	2.2	W
16GB	1.5	1.6	2	2.2	W
32GB	1.5	1.6	2	2.2	W
64GB	1.5	1.6	2	2.2	W

Notes: 1. Data taken at MAX transfer rate (256-sector transfer size).

Table 15: Absolute Maximum Ratings

Parameter/Condition		Symbol	Min	Max	Unit
Voltage input		V5	4.75	5.25	V
Operating temperature	Commercial	T_A	0	+70	°C
	Industrial		–40	+85	°C
Rate of temperature change			–	5	°C/minute
Altitude			–	80,000	feet
Relative humidity (noncondensing)			5	95	%

Stresses greater than those listed in Table 15 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 16: Shock and Vibration

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

Table 17: Recommended Operating Conditions

Parameter/Condition	Symbol	Min	Typ	Max	Unit
Power supply voltage	V5	4.75	5.00	5.25	V
Ground supply voltage	GND	0	0	0	V
Input signal voltage	A, A#, B, B#	1.65	1.8	1.95	V

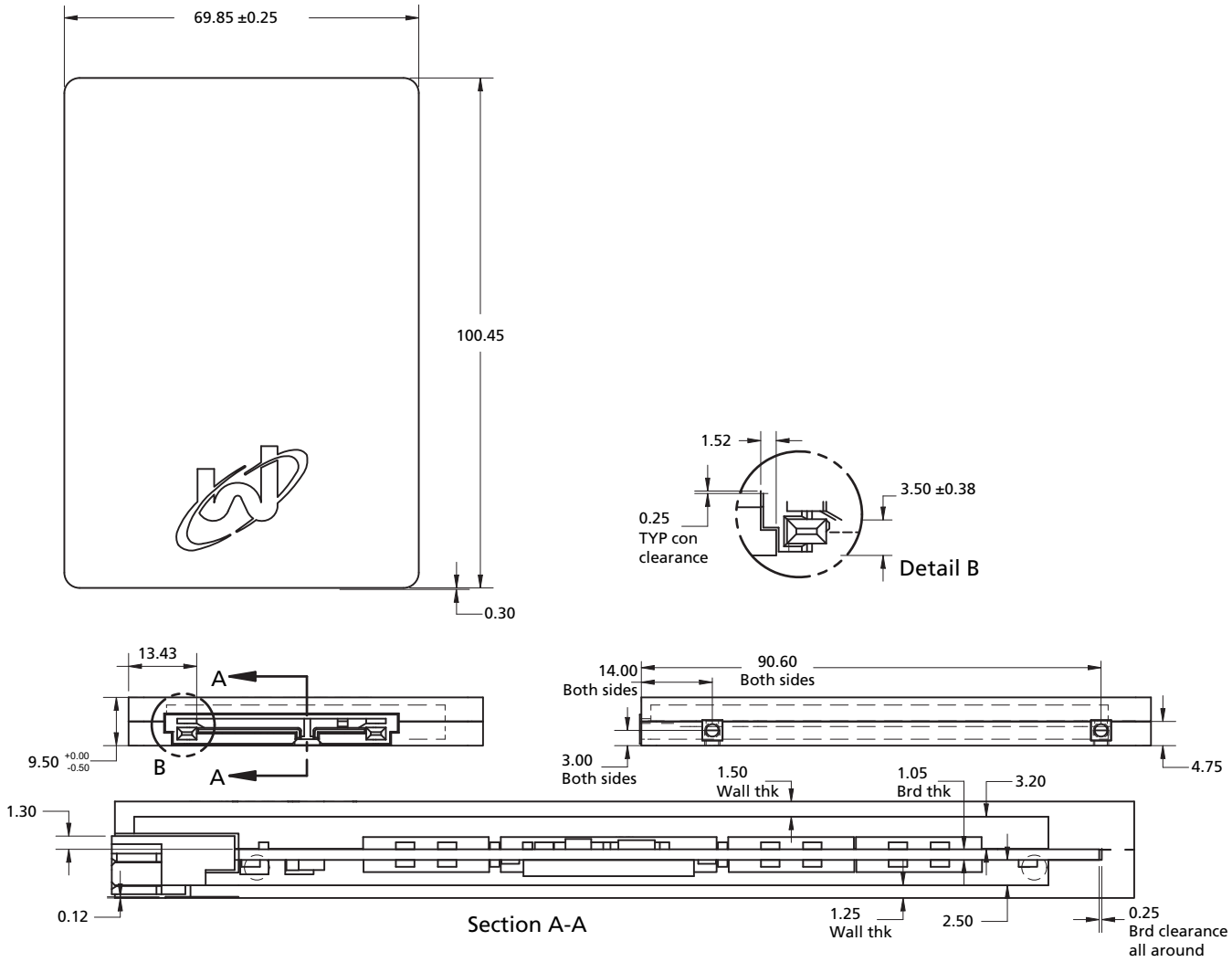
Compliance

Micron's 2.5-inch SSDs comply with the following requirements:

- RoHS "green" package
- CE (Europe): EN55022, 1998 and EN55024, 1998
- FCC: 47CFR Part 15 Class B
- C-TICK (Australia, New Zealand): Approval to AS/NZS CISPR22
- BSMI (Taiwan): Appproval to CNS 13438
- MIC RRL (South Korea): Approval to MIC 2001-115, MIC 2001-116
- CSA (Canada): CSA 22.2 60950
- TUV/GS (Germany): Approval to IEC60950 / EN6095
- UL (US): Approval to UL-60950

Package Dimensions

Figure 5: 2.5-Inch Package



Note: All dimensions are in millimeters.

References

The following references were used to prepare this data sheet:

- Serial ATA: High-speed serialized AT attachment, Serial ATA working group, available at www.sata-io.org/
- Small Form Factor Specification SFF-8201, SFF-8223.
- Electronic Industries Association Standard, EIA-720
- Serial ATA: High-speed serialized AT attachment, Serial ATA working group
- SFF documents
- EIA-720 document

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Revision History

Rev. B, Advance 5/08

- Page 1: Updated part numbers.
- "Features" on page 1: Updated the SATA interface value; deleted Random READ; deleted Random WRITE; updated Endurance; updated Active power consumption.
- Figure 2: Part Number Chart on page 2: Updated figure.
- "General Description" on page 6: Updated description.
- Table 5: Supported ATA Command Set on page 9: Deleted commands and associated descriptions (S.M.A.R.T. description remains, as it applies universally):
  - FLUSH CACHE EXT
  - IDLE/UNLOAD IMMEDIATE
  - READ DMA EXT
  - READ FPDMA QUEUED
  - READ LOG EXT, READ LONG (with retry)
  - READ LONG (without retry)
  - READ NATIVE MAX ADDRESS
  - READ NATIVE MAX ADDRESS EXT
  - READ SECTOR EXT
  - READ VERIFY SECTOR EXT
  - SET MAX ADDRESS
  - SET MAX ADDRESS EXT
  - SMART EXECUTE OFF-LINE IMMEDIATE
  - SMART READ LOG SECTOR
  - SMART WRITE LOGS SECTOR
  - WRITE DMA EXT
  - WRITE DMA FUA EXT
  - WRITE FPDMA QUEUED
  - WRITE LOG EXT
  - WRITE LONG (with retry)
  - WRITE LONG (without retry)
- Table 14: RealSSD SATA Typical Power Consumption on page 18: Updated table.

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- Initial release.