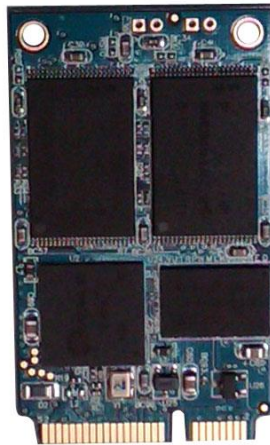


DELKIN DEVICES®

mSATA Solid State Drive Mini-SATA Embedded Flash Module Engineering Specification

Document Number: L50023

Revision D



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Table of Contents

- 1 General Specifications3**
 - 1.1 Interfaces.....4
 - 1.1.1 Electrical / Physical Interfaces5
 - 1.1.2 Controller Features5
 - 1.2 Part Number Availability6
 - 1.3 Reliability7
- 2 Electrical Specifications8**
 - 2.1 Pin and Signal Assignments8
 - 2.2 Supply Voltage10
 - 2.3 Power Consumption10
- 3 Command Descriptions11**
 - 3.1 Supported ATA Commands11
 - 3.2 Identity Device Data12
- 4 SMART Capabilities16**
 - 4.1 SMART Command Set.....16
 - 4.2 SMART Data Structure.....17
 - 4.3 SMART Attributes.....18
 - 4.4 SMART Read Attribute Threshold (D1h).....20
 - 4.5 SMART Enable / Disable Attribute Auto-Save (D2h)21
 - 4.6 SMART Save Attribute Values (D3h)21
 - 4.7 SMART Enable Operations (D8h).....22
 - 4.8 SMART Disable Operations (D9h)22
 - 4.9 SMART Return Status (DAh)22
- 5 Mechanical Specifications23**
 - 5.1 Mechanical Form Factor.....23
 - 5.2 Physical Dimensions24

List of Figures

- Figure 1. mSATA Flash Controller Block Diagram4
- Figure 2. Delkin mSATA SSD block diagram with DDR cache buffer5
- Figure 3. mSATA Embedded Module Mechanical Description23

List of Tables

- Table 1. Specification Summary3
- Table 2. Delkin mSATA SSD Capacities and Part Numbers6
- Table 3. Power and signal pin-out8
- Table 4. Supply voltage10
- Table 5. Power Consumption10
- Table 6. Supported ATA Commands.....11
- Table 7. Device Sector Data.....12
- Table 8. SMART Command Set16
- Table 9. SMART Data Structure.....17
- Table 10. SMART Attributes.....18
- Table 11. mSATA SSD Physical Dimensions24

1 General Specifications

Delkin's mSATA SSD drive combines solid state reliability with SATA connectivity for significant performance advantages over traditional hard disk drives. Manufactured to JEDEC MO-300B form factor specifications, the mSATA SSD is suited to embedded industrial applications where space is restricted. Its shock, vibration, and temperature ratings permit application in extreme environments. The drives can achieve sustained read/write rates of up to 120/90 MB/s and feature storage capacities from 4GB to 128GB.

Table 1. Specification Summary

Specification	Value
Model number	See Table 2
Capacity	MLC: 8GB – 128GB SLC: 4GB – 64GB
Form factor	50.8 x 29.85 x 4.0mm (L x W x H)
Interface	SATA revision 2.6, compatible with SATA 1.5Gb/s and 3.0Gb/s interface rates. Flash I/O: 3.3V for Asynchronous Flash
Interface connector	miniPCIe 52-pin
Hot swappable	Yes
Environmental certifications	RoHS, ESD, and CE/FCC
Performance	
Interface burst speed	1.5 or 3.0 Gb/s
Sustained read (512 byte)	Up to 145 MB/s (varies by configuration)
Sustained write (512 byte)	Up to 130 MB/s (varies by configuration)
Reliability/Data Integrity	
MTBF (temperature dependent)	Up to 2,000,000 power on hours
Data reliability	1 in 10 ¹⁴ bits, read
Endurance	Refer to Table 3 on page 7
Power	
Supply voltage (allowable)	3.3V ±10%
Typical current:	
Idle	190 mA
Read	250 mA
Write	350 mA
Environmental	
Storage temperature (°C)	-50 ~ 100°C
Operating temperature (°C)	-40 ~ 85°C
Relative humidity (non-condensing)	95% under 55°C
Vibration (operating/non-operating)	20G (80 – 2000 Hz)
Shock (operating/non-operating)	1,500G/0.5 ms
Acoustic noise	0 dB
Altitude	80,000 feet max.

Physical Dimensions	
Height	4 mm
Width	29.85 mm
Length	50.8 mm

1.1 Interfaces

Figure 1 below provides a functional block diagram showing the interaction of mSATA SSD components.

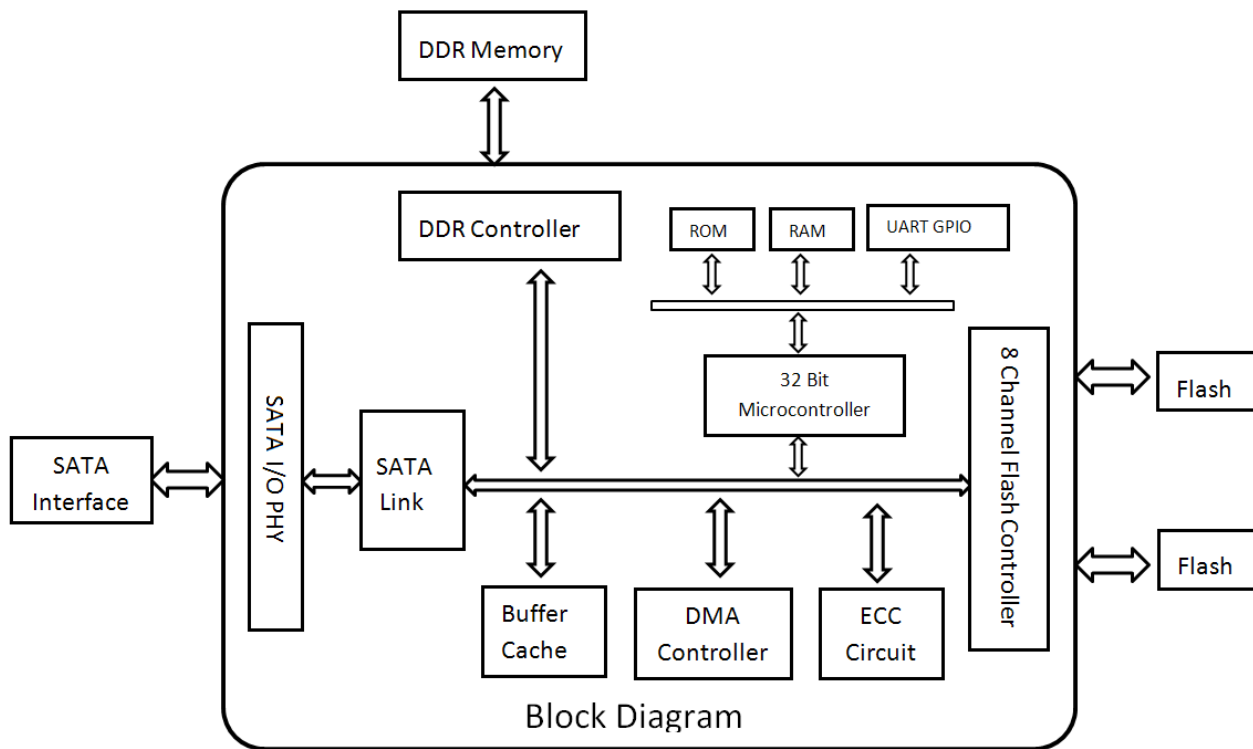


Figure 1. mSATA Flash Controller Block Diagram

1.1.1 Electrical / Physical Interfaces

- SATA Interface—supports SATA 1.5Gbps and 3Gbps interface
- DDR1 IO—supports DDR1 I/O interface to onboard SDRAM cache
- Flash IO—Asynchronous Flash (3.3V)

1.1.2 Controller Features

- **SATA II**
 - SATA Revision 2.6 compliant
 - Compatible with SATA 1.5Gbps and 3Gbps interface
 - Power management supported
 - Support expanded register for SATA protocol 48 bits addressing mode
 - Supports TRIM commands based on ATA-8
 - Supports Native Command Queuing (NCQ) up to 32 commands
 - Supports partial and slumber mode
- **NAND flash interface**
 - Built-in hardware ECC circuit (up to 40bit/1KB)
 - Supports SLC and MLC 2KB, 4KB, 8KB page NAND Flash
 - Global wear leveling

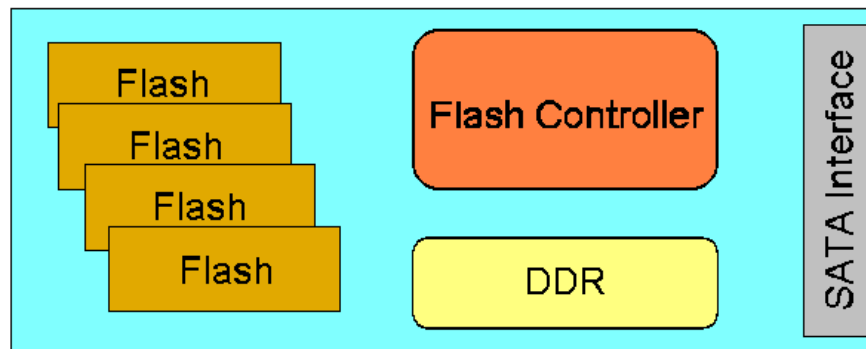


Figure 2. Delkin mSATA SSD block diagram with DDR cache buffer

1.2 Part Number Availability

Delkin mSATA Solid State Drives are available in the product grades and capacities shown in the table below. Drives are also available with optional conformal coating for greater protection in extreme environments.

Table 2. Delkin mSATA SSD Capacities and Part Numbers

Capacity*	Product Grade	Delkin Part Number
8GB	MLC Industrial (-40 to +85C)	ME08NHURB-XN000-D
16GB	MLC Industrial (-40 to +85C)	ME16NGTRB-XN000-D
32GB	MLC Industrial (-40 to +85C)	ME32NKBRB-XN000-D
64GB	MLC Industrial (-40 to +85C)	ME64NKORB-XN000-D
128GB	MLC Industrial (-40 to +85C)	ME1HNKCRB-XN000-D
2GB	SLC Industrial (-40 to +85C)	ME02TFHRB-XN000-D
4GB	SLC Industrial (-40 to +85C)	ME04TFNRB-XN000-D
8GB	SLC Industrial (-40 to +85C)	ME08TFNRB-XN000-D
16GB	SLC Industrial (-40 to +85C)	ME16TFPRB-XN000-D or ME16TGPRB-XN000-D
32GB	SLC Industrial (-40 to +85C)	ME32MGGRB-XN000-D
64GB	SLC Industrial (-40 to +85C)	ME64MGMRB-XN000-D

* Note: Usable capacities are within 10% of the gross capacity figures shown above, which is typical with all NAND flash devices, as a small portion of the total is needed for controller firmware and spare block reserves.

1.3 Reliability

Endurance

The table below provides estimates of drive endurance (expressed as Terabytes Written or TBW, or Gigabytes Written or GBW) based on specific workload scenarios, using a theoretical model that takes into account the specific flash specifications in each drive configuration. Contact Delkin for endurance estimates for other specific workload scenarios.

Table 3. Delkin mSATA Endurance Estimates by Part Number

Part Number(s)	Description	Sequential Write Size, 24/7 Operation	
		1000 Bytes/Sec	5000 Bytes/Sec
ME08NHURB-XN000-D	8GB MLC Industrial	852 GBW	1 TBW
ME16NGTRB-XN000-D	16GB MLC Industrial	928 GBW	2 TBW
ME32NKBRB-XN000-D	32GB MLC Industrial	992 GBW	5 TBW
ME64NKORB-XN000-D	64GB MLC Industrial	1 TBW	9 TBW
ME1HNKCRB-XN000-D	128GB MLC Industrial	3 TBW	17 TBW
ME02TFHRB-XN000-D	2GB SLC Industrial	2 TBW	8 TBW
ME04TFNRB-XN000-D	4GB SLC Industrial	5 TBW	16 TBW
ME08TFNRB-XN000-D	8GB SLC Industrial	10 TBW	29 TBW
ME16TFPRB-XN000-D ME16TGPRB-XN000-D	16GB SLC Industrial	18 TBW	52 TBW
ME32MGGRB-XN000-D	32GB SLC Industrial	19 TBW	104 TBW
ME64MGMRB-XN000-D	64GB SLC Industrial	39 TBW	187 TBW

The figures provided are estimates and not guarantees of endurance. Actual results may vary depending on usage, operating temperature and other conditions.

2 Electrical Specifications

2.1 Pin and Signal Assignments

Table 3. Power and signal pin-out

Pin #	mSATA	Description
1	NC	No Connect
2	+3.3V	3.3V Source
3	NC	No Connect
4	DGND	Digital GND
5	NC	No Connect
6	NC	No Connect
7	NC	No Connect
8	NC	No Connect
9	DGND	Digital GND
10	NC	No Connect
11	NC	No Connect
12	NC	No Connect
13	NC	No Connect
14	NC	No Connect
15	DGND	Digital GND
16	NC	No Connect
17	NC	No Connect
18	DGND	Digital GND
19	NC	No Connect
20	NC	No Connect
21	SATA GND	SATA Ground Return Pin
22	NC	No Connect
23	TXP (out)	Host Receiver Differential Signal Pair
24	+3.3V	3.3V Source
25	TXN (out)	Host Receiver Differential Signal Pair

Pin #	mSATA	Description
26	SATA GND	SATA Ground Return Pin
27	SATA GND	SATA Ground Return Pin
28	NC	No Connect
29	SATA GND	SATA Ground Return Pin
30	NC	No Connect
31	RXN (in)	Host Receiver Differential Signal Pair
32	NC	No Connect
33	RXP (in)	Host Transmitter Differential Signal Pair
34	DGND	Digital GND
35	SATA GND	SATA Ground Return Pin
36	NC	No Connect
37	SATA GND	SATA Ground Return Pin
38	NC	No Connect
39	+3.3V	3.3V Source
40	DGND	Digital GND
41	+3.3V	3.3V Source
42	NC	No Connect
43	NC	No Connect
44	NC	No Connect
45	NC	Reserved pin
46	NC	No Connect
47	NC	Reserved pin
48	NC	No Connect
49	DA/DSS (option)	Option for LED output
50	DGND	Digital GND
51	GND	Default connect to GND
52	+3.3V	3.3V Source

2.2 Supply Voltage

Table 4. Supply voltage

Parameter	Rating
Operating Voltage	3.3V

2.3 Power Consumption

Table 5. Power Consumption

Parameter	Value (mA)
Idle	190
Read	250
Write	350

Note: Values based on 32GB (64Gbit MLC x4) statistics.

3 Command Descriptions

3.1 Supported ATA Commands

The commands listed in the following table are supported by the mSATA SSD.

Table 6. Supported ATA Commands

Command Name	Command Code (Hex)	Command Name	Command Code (Hex)
Check power mode	E5h	Security Erase Prepare	F3h
Check power mode	98h	Security Erase Unit	F4h
Download Microcode	92h	Security Freeze Lock	F5h
Execute drive diagnostic	90h	Security Set Password	F1h
Flush cache	E7h	Security Unlock	F2h
Flush cache Ext	Eah	Seek	7xh
Identify device	Ech	Set features	Efh
Idle	E3h	Set Max Address Ext	37h
Idle immediate	E1h	Set multiple mode	C6h
Idle immediate	95h	Sleep	E6h
Idle	97h	Sleep	99h
Initialize drive parameters	91h	Smart	B0h
NOP	00h	Standby	E2h
Read buffer	E4h	Standby immediate	E0h
Read DMA (w/retry)	C8h	Standby immediate	94h
Read DMA (w/o retry)	C9h	Standby	96h
Read Log Ext	2Fh	Write buffer	E8h
Read multiple	C4h	Write DMA (w/retry)	Cah
Read multiple Ext	29h	Write DMA (w/o retry)	CBh
Read sector(s) (w/retry)	20h	Write Log Ext	3Fh

Command Name	Command Code (Hex)	Command Name	Command Code (Hex)
Read sector(s) (w/o retry)	21h	Write multiple	C5h
Read sector(s) Ext	24h	Write sector(s) (w/retry)	30h
Read DMA Ext	25h	Write sector(s) (w/o retry)	31h
Read verify sector(s) (w/retry)	40h	Write sector(s) Ext	34h
Read verify sector(s) (w/o retry)	41h	Write DMA Ext	35h
Read FPDMA Ext	60h	Write sector(s) (w/o erase)	38h
Read Verify Ext	42h	Write FPDMA Ext	61h
Recalibrate	1xh	Write multiple Ext	39h
Security Disable Password	F6h		

3.2 Identity Device Data

The following table details the sector data returned by the IDENTIFY DEVICE command.

Table 7. Device Sector Data

Word	F: Fixed V: Variable X: Both	Default Value	Description
0	F	045Ah	General configuration bit-significant information
1	X	3FFFh	Obsolete - Number of logical cylinders(16383)
2	V	0000h	Specific configuration
3	X	0010h	Obsolete - Number of logical heads (16)
4-5	X	02007E00h	Retired
6	X	003Fh	Obsolete - Number of logical sectors per logical track (63)
7-8	V	0h	Reserved for assignment by the Compact Flash Association
9	X	0h	Retired
10-19	F	Varies	Serial number (20 ASCII characters)
20-21	X	0h	Retired

Word	F: Fixed V: Variable X: Both	Default Value	Description
22	X	0h	Obsolete
23-26	F	Varies	Firmware revision (8 ASCII characters)
27-46	F	Varies	Model number (xxxxxxx)
47	F	8001h	7:0 - Maximum number of sectors transferred per interrupt on MULTIPLE commands.
48	F	0h	Reserved
49	F	0F00h	Capabilities
50	F	4000h	Capabilities
51-52	X	00000200h	Obsoleted
53	F	0007h	Words 88 and 70:64 valid
54	X	3FFFh	Obsolete - Number of logical cylinders (16383)
55	X	0010h	Obsolete - Number of logical heads (16)
56	X	003Fh	Obsolete - Number of logical sectors per track (63)
57-58	X	00FBFC10h	Obsolete
59	F	0100h	Number of sectors transferred per interrupt on MULTIPLE commands
60-61	F	037DFF40h (32G) xxxxxxxh (64G)	Total number of user addressable sectors
62	X	0h	Obsolete
63	F	0007h	Multi-word DMA modes supported/selected
64	F	0003h	PIO modes supported
65	F	0078h	Minimum Multiword DMA transfer cycle time per word
66	F	0078h	Manufacturer's recommended Multiword DMA transfer cycle time
67	F	0078h	Minimum PIO transfer cycle time without flow control
68	F	0078h	Minimum PIO transfer cycle time with IORDY flow control
69-70	F	0h	Reserved
71-74	F	0h	Reserved for the IDENTIFY PACKET DEVICE command
75	F	0h	Queue depth

Word	F: Fixed V: Variable X: Both	Default Value	Description
76	F	0002h	Serial SATA capabilities
77	F	0h	Reserved for future Serial ATA definition
78	F	0000h	Serial ATA features supported
79	V	0000H	Serial ATA features enabled
80	F	00F8h	Major Version Number
81	F	0021h	Minor Version Number
82	F	7429h	Command set supported
83	F	7008h	Command set supported
84	F	4000h	Command set/feature supported extension
85	V	7028h	Command set/feature enabled
86	V	3000h	Command set/feature enabled
87	V	4000h	Command set/feature default
88	V	007Fh	Ultra DMA Modes
89	F	0000h	Time required for security erase unit com
90	F	0000h	Time required for Enhanced security erase completion
91	V	0h	Current advanced power management value
92	V	0000h	Master Password Revision Code
93	F	0h	Hardware reset result. The contents of the bits (12:0) of this word shall change only during the execution of a hardware reset.
94	V	0h	Vendor's recommended and actual acoustic management value
95	F	0h	Stream Minimum Request Size
96	V	0h	Streaming Transfer Time - DMA
97	V	0h	Streaming Access Latency - DMA and PIO
98-99	F	0h	Streaming Performance Granularity
100-103	V	xxxxxxxh (32G) xxxxxxxh (64G) xxxxxxxh (128G) xxxxxxxh (256G)	Maximum user LBA for 48-bit Address feature set
104	V	0h	Streaming Transfer Time - PIO

Word	F: Fixed V: Variable X: Both	Default Value	Description
105	F	0h	Reserved
106	F	0h	Physical sector size/Logical sector size
107	F	0h	Inter-seek delay for ISO-7779 acoustic testing in microseconds
108-111	F	0h	Unique ID
112-115	F	0h	Reserved
116	V	0h	Reserved
117-118	F	0h	Words per logical Sector
119	F	0h	Supported settings
120	F	0h	Command set/Feature Enabled/Supported
121-126	F	0h	Reserved
127	F	0h	Removable Media Status Notification feature set support
128	V	0h	Security status
129-159	X	0h	Vendor specific
160	F	0h	Compact Flash Association (CFA) power mode 1
161-175	X	0h	Reserved for assignment by the CFA
176-205	V	0h	Current media serial number
206-216	F	0h	Reserved
217	F	0h	Non-rotating media device
218-221	F	0h	Reserved
222	F	0h	Reserved
223-233	F	0h	Reserved
234	F	0h	Reserved
235	F	0h	Reserved
236-255	F	0h	Reserved
255	X	Varies	Integrity word (Checksum and Signature)

4 SMART Capabilities

4.1 SMART Command Set

The controller used in the Delkin Devices SlimSATA and mSATA modules supports the SMART command set and defines some vendor-specific data to report spare/bad block numbers in each memory management unit.

The following table defines the SMART command set that is supported by the Delkin SlimSATA. Please note that D1h and D3h are obsolete commands. Although obsolete, the interfaces are still provided to maintain backward compatibility with the previous ATA specification.

Table 8. Smart Command Set

Value	Command	Value	Command
D0h	SMART Read Data	D4h	SMART Execute OFF-LINE Immediate
D1h	SMART Read Attribute Threshold (Obsolete)	D8h	SMART Enable Operations
D2h	SMART Enable / Disable Attribute Autosave	D9h	SMART Disable Operations
D3h	SMART Save Attribute Values (Obsolete)	DAh	SMART Return Status

4.2 SMART Data Structure

The following 512 bytes make up the device SMART data structure. Users can obtain the data using the “Read Data” command (D0h.)

Table 9. Smart Data Structure

Byte	F / V	Description
0 – 1	X	Revision code
2 – 361	X	Vendor specific (see SMART Attributes)
362	V	Off-line data collection status
363	X	Self-test execution status byte
364 – 365	V	Total time in seconds to complete off-line data collection activity
366	X	Vendor specific
367	F	Off-line data collection capability
368 – 369	F	SMART capability
370	F	Error logging capability <ul style="list-style-type: none"> • 7-1 Reserved • 0 1 = Device error logging supported
371	X	Vendor specific
372	F	Short self-test routine recommended polling time (in minutes)
373	F	Extended self-test routine recommended polling time (in minutes)
374	F	Conveyance self-test routine recommended polling time (in minutes)
375 – 385	R	Reserved
386 – 395	F	Firmware Revision / Date Code
396 – 397	F	Reserved
398 – 399	F	Reserved
400 – 406	F	Controller
407 – 415	X	Vendor specific
416	F	Reserved
417	F	Program / write the strong page only
418 – 419	V	Number of spare blocks
420 – 423	V	Average Erase Count
424 – 510	X	Vendor specific
511	V	Data structure checksum

Notes:

1. F = content (byte) is fixed and does not change
2. V = content (byte) is variable and may change depending on the state of the device or the commands executed by the device
3. X = content (byte) is vendor specific and may be fixed or variable
4. R = content (byte) is reserved and shall be zero.

4.3 SMART Attributes

The following table defines the current SMART data attributes currently supported and their descriptions. These SMART attributes are located at offset 2 of the SMART Data Structure.

Table 10. Smart Attributes

Attribute ID	Attribute Name	Reset at Power On	Max Size (Bytes)	Attribute Description
0x01	Read Error Rate	Yes	4	The rate of the total CRC errors occurred over the total of LBAs read. The total LBAs read will be reset to 0 after each power cycle while the CRC errors are accumulated for the life of the device.
0x05	Reallocated Sectors Count	No	2	Total number of bad blocks that are generated after the card is initialized by the pretest code.
0x09	Power-on Hours	No	4	Total accumulated hours the device is powered on.
0x0C	Power Cycle Count	No	2	Total number of power cycles that have occurred during the life of the drive.
0xA0	Uncorrectable Sector Count during Read/Write	Yes	4	Total count of uncorrectable errors when device performing read/write operations.
0xA1	Number of Valid Spare Blocks	No	2	Total number of overall valid spare blocks
0xA3	Number of Initial Invalid Blocks	No	2	Total number of bad blocks found during the card initialization (pretest mode.)
0xA4	Total Erase Count	No	7	Total number of erase operations that have been performed on all the blocks (excluding the system blocks, bad blocks and reserved blocks.)
0xA5	Maximum Erase Count	No	4	The maximum number of erase operations that have ever been performed on a single block (excluding the system blocks, bad blocks and reserved blocks.)
0xA6	Minimum Erase Count	No	4	The minimum number of erase operations that have ever been performed on a single block (excluding the system blocks, bad blocks and reserved blocks.)
0xA7	Average Erase Count	No	4	The average number of erase operations that have ever been performed on a single block (excluding the system blocks, bad blocks and reserved blocks.)
0xC0	Power-off Retract Count	No	2	Total number of sudden power-off count that affects data reliability.

Attribute ID	Attribute Name	Reset at Power On	Max Size (Bytes)	Attribute Description
0xC2	Temperature	N/A	N/A	The temperature of the device. (This attribute is not currently supported.)
0xC3	Hardware ECC Recovered	N/A	N/A	Total number of errors that can be corrected by ECC engine. This attribute is not currently implemented. The value should be 0.
0xC4	Reallocation Event Count	N/A	N/A	Total count of re-mapping operations. This attribute is not currently implemented. The value should be 0.
0xC6	Uncorrectable Sector Count Off-line	No	4	Total accumulated count of errors that cannot be corrected by ECC engine for the life of the device.
0xC7	UltraDMA CRC Error Count	No	2	Total count of CRC errors during communication via the interface cable.
0xF1	Total LBAs Written	No	7	The lower 7 bytes of the 12-byte total number of LBAs written to the device. The higher 5 byte value is located at attribute 0xF3.
0xF2	Total LBAs Read	No	7	The lower 7 bytes of the 12-byte total number of LBAs read from the device. The higher 5 byte value is located at attribute 0xF4.
0xF3	Total LBAs Written Expanded	No	5	The upper 5 bytes of the 12-byte total number of LBAs written to the device. The lower 7 byte value is located at attribute 0xF1.
0xF4	Total LBAs Read Expanded	No	5	The upper 5 bytes of the 12-byte total number of LBAs read from the device. The lower 7 byte value is located at attribute 0xF2.

Data Structure

The attribute information occupies 12 bytes of data, which is described in the following table:

Byte	Description
0	Attribute ID
1 – 2	Reserved
3	Contains normalized fixed value (“0x64”)
4	Duplicate of byte 3, which is a fixed value (“0x64”)
5 - 11	Raw Data value in little-endian format

4.4 SMART Read Attribute Threshold (D1h)

This command is obsolete, starting with the ATA-4 specification. The command interface is still supported to maintain backward compatibility with older hosts implementing ATA-4. When invoked, the controller will respond the command by returning normal output (providing the right command and parameters are entered) together with the fixed threshold data values. However, these threshold values should be ignored, since they don't have any significant meaning.

Data Structure

The following table describes the data structure returned by this SMART Read Attribute Threshold Command:

Byte	Description
0	Attribute ID
1	Threshold Value
2 - 11	Reserved. Set these bytes to 0x00

Threshold Values

The following table describes the fixed values returned by the controller firmware. These values are provided here for reference only, as mentioned previously, they should be ignored.

Attribute ID	Attribute Name	Threshold Value
0x01	Read Error Rate	0x00
0x05	Reallocated Sectors Count	0x00
0x09	Power-on Hours	0x00
0x0C	Power Cycle Count	0x00
0xA0	Uncorrectable Sector Count during Read/Write	0x00
0xA1	Number of Valid Spare Blocks	0x00
0xA3	Number of Initial Invalid Blocks	0x00
0xA4	Total Erase Count	0x00
0xA5	Maximum Erase Count	0x32
0xA6	Minimum Erase Count	0x32
0xA7	Average Erase Count	0x64
0xC0	Power-off Retract Count	0x00
0xC2	Temperature	0x00
0xC3	Hardware ECC Recovered	0x00
0xC4	Reallocation Event Count	0x10
0xC6	Uncorrectable Sector Count Off-line	0x32
0xC7	UltraDMA CRC Error Count	0x32
0xF1	Total LBAs Written	0x00
0xF2	Total LBAs Read	0x00
0xF3	Total LBAs Written Expanded	0x00
0xF4	Total LBAs Read Expanded	0x00

4.5 SMART Enable / Disable Attribute Auto-Save (D2h)

The purpose of this command is to enable and disable the optional attribute auto-save feature. In Delkin's SlimSATA, the auto-save feature is always enabled, even if the disable function is invoked. This prevents the controller from losing any information that is critical to the device's life monitors. The drive still responds by returning normal outputs when the commands and correct parameters are executed.

4.6 SMART Save Attribute Values (D3h)

This command is obsolete beginning with the ATA-6 standard. The command interface is still supported to provide backward compatibility with older hosts implementing ATA-6 or earlier standards. The Delkin SlimSATA responds to the command by returning normal outputs, provided the command and correct parameters are entered. It is currently not necessary to call this command, since the controller saves the attribute values automatically. Please refer to SMART Enable / Disable Attribute Auto-Save (D2h) for further explanation.

The purpose of this command is to immediately initiate any activities that collect SMART data or execute self-diagnostic test routines in an off-line mode or captive mode, depending on the given sub commands. The off-line data collection status, self-test execution status and estimated time of completion for the off-line data collection activity will be reported in the SMART data structure offset 362, 363 and 364, respectively. Please refer to SMART Data Structure.

Although the interfaces are supported, the controller does not currently have any off-line data collection or self-test defined in the firmware. Calling the off-line data collection sub-command will always result in status value of 02h, which is "off-line data collection activity was completed without error". Calling self-test sub-commands will always result in status value of 0, which means that "the previous self-test routine completed without error or no self-test has ever been run."

The following sub-command interfaces are currently accepted by the controller. Other sub-commands will result in command aborted error.

Value	Description of Sub-Command to be Executed
0	Execute SMART off-line routine immediately in off-line mode
1	Execute SMART Short self-test routine immediate in off-line mode
2	Execute SMART Extended self-test routine immediate in off-line mode
3	Execute SMART Conveyance self-test routine immediate in off-line mode
4	Execute SMART Selective self-test routine immediate in off-line mode
127	Abort off-line mode self-test routine
129	Execute SMART Short self-test routine immediate in captive mode
130	Execute SMART Extended self-test routine immediate in captive mode
131	Execute SMART Conveyance self-test routine immediate in captive mode
132	Execute SMART Selected self-test routine immediate in captive mode

4.7 SMART Enable Operations (D8h)

This command enables access to all SMART command operations. With enabling the SMART operations, all of the SMART commands above will return command aborted errors.

4.8 SMART Disable Operations (D9h)

This command disables access to all SMART command operations. When the SMART operation is disabled, accessing all the other SMART commands (other than D8h and D9h) will return command aborted errors.

4.9 SMART Return Status (DAh)

This command returns the reliability status of the device to the host. It will check the device's attributes against pre-determined threshold values and return the status results. If the attributes have reached the threshold values, then the device will set the LBA Mid register to F4h and the LBA High register to 2Ch. Otherwise, it will keep the original LBA Mid Register value of 4Fh and the LBA High register value of C2h.

Currently, the controller only checks the total available spare blocks on the device against the minimum spare block threshold. This spare block threshold value is set in the CID offset 0x2C.

The controller used in the Delkin Devices SlimSATA and mSATA modules supports the SMART command set and defines some vendor-specific data to report spare/bad block numbers in each memory management unit.

5 Mechanical Specifications

5.1 Mechanical Form Factor

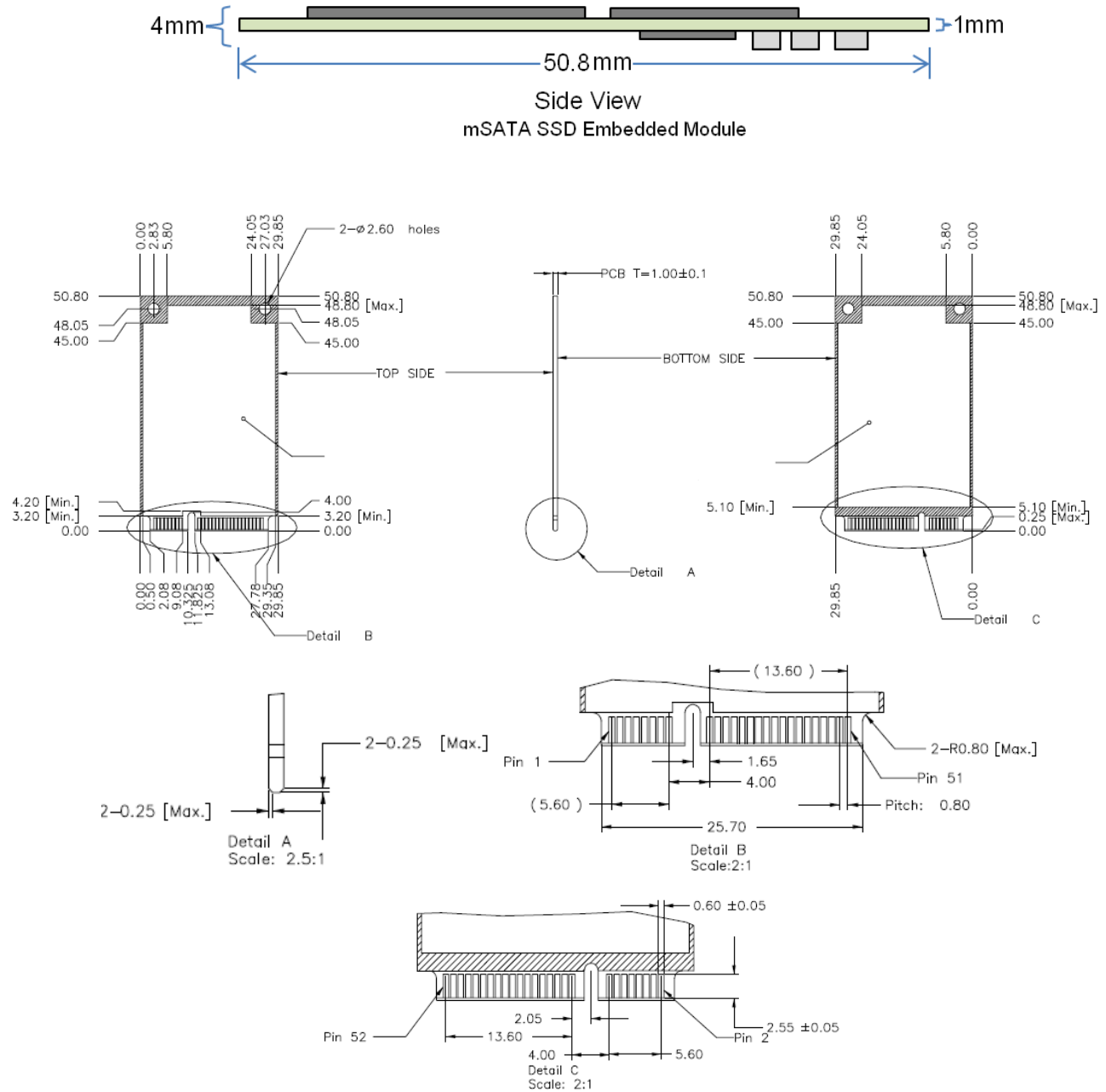


Figure 3. mSATA Embedded Module Mechanical Description

5.2 Physical Dimensions

Table 11. mSATA SSD Physical Dimensions

Dimension	Measurement
Height	4mm
Width	29.85mm
Length	50.8mm