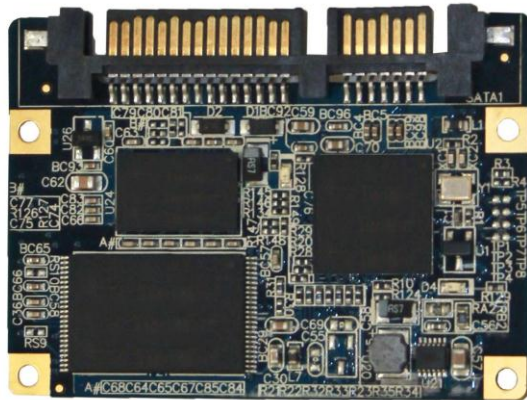


DELKIN DEVICES®

SlimSATA Solid State Drive JEDEC MO-297 Embedded Flash Module Engineering Specification

Document Number: L500109

Revision: 1.1



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1 General Specifications

Delkin's SlimSATA SSD drive combines solid state reliability with SATA connectivity for significant performance advantages over traditional hard disk drives. Manufactured to JEDEC MO-297 form factor specifications, the SlimSATA 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 145/130MB/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	39.0 x 54.0 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.
Interface connector	22-pin standard SATA (7-signal, 15-power)
Hot swappable	Yes
Performance	
Interface burst speed	1.5 or 3.0 Gb/s
Sustained read (512 byte)	Up to 145 MB/s
Sustained write (512 byte)	Up to 130 MB/s
Reliability/Data Integrity	
MTBF	2,000,000 power on hours
Data reliability	1 in 10 ¹⁴ bits, read
Endurance	Erase/program cycles: <ul style="list-style-type: none"> • SLC>2,000,000 • MLC>1,000,000
Power	
Supply voltage (allowable)	5.0V ±10%
Typical current:	
Idle	155 mA
Read	220 mA
Write	285 mA
Environmental	
Storage temperature (°C)	-50 ~ 100°C
Operating temperature options (°C):	
• MLC Commercial	0 ~ 70°C
• SLC Commercial	0 ~ 70°C
• SLC Industrial	-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	54.0 ± 0.15mm
Length	39.0 mm (Reference)

1.1 Interfaces

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

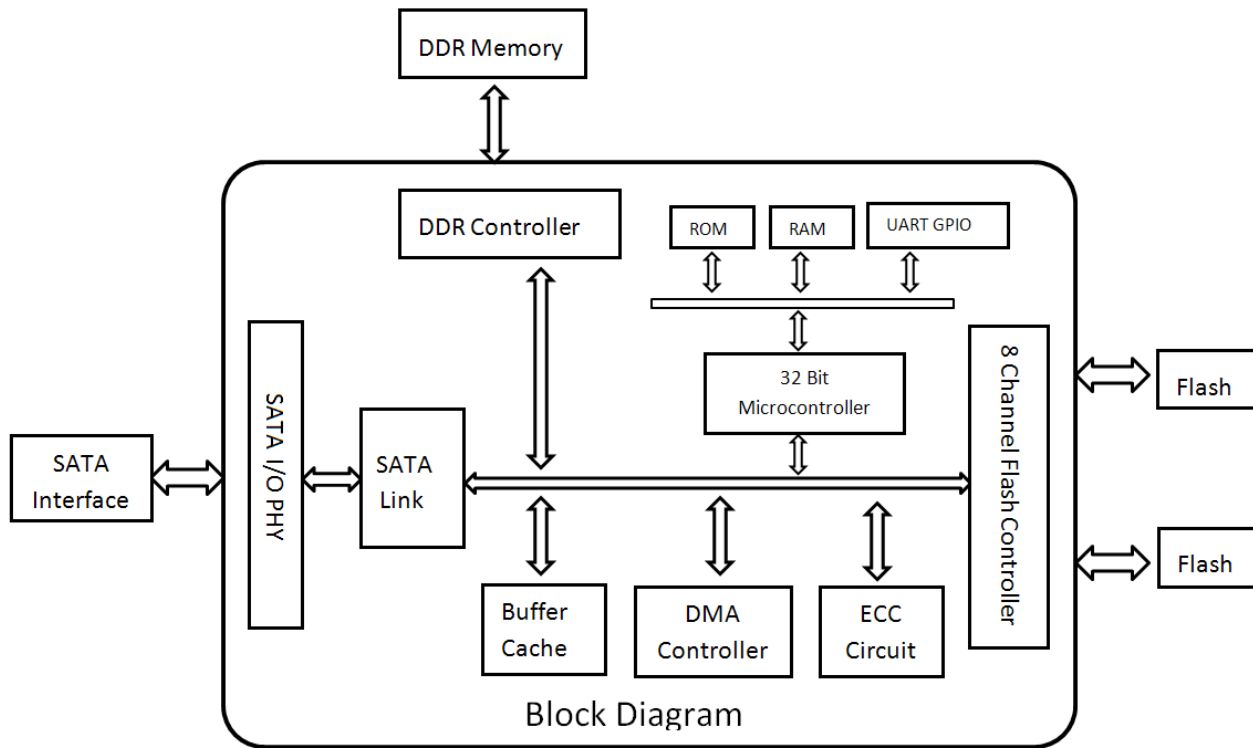


Figure 1. SlimSATA Flash Controller Block Diagram

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) & Synchronous Flash (1.8V or 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
- **NAND flash interface**
 - Built-in hardware ECC circuit (up to 40bit/1KB)
 - Support all types of SLC and MLC Large Block 8KB/page NAND Flash
 - Flash: 4 channels bus width: 8-bit or 16-bit each channel
 - Contains 4 pieces TSOP Flash
- **DDR1 interface**
 - 16-bit data bus
 - Data Rate: 300Mbps
 - Support Capacity : 64MB
- **Built-in 32-bit micro-controller**
 - Universal Asynchronous Receiver/Transceiver (UART)
 - General Purpose Input/Output (GPIO) for additional control options.

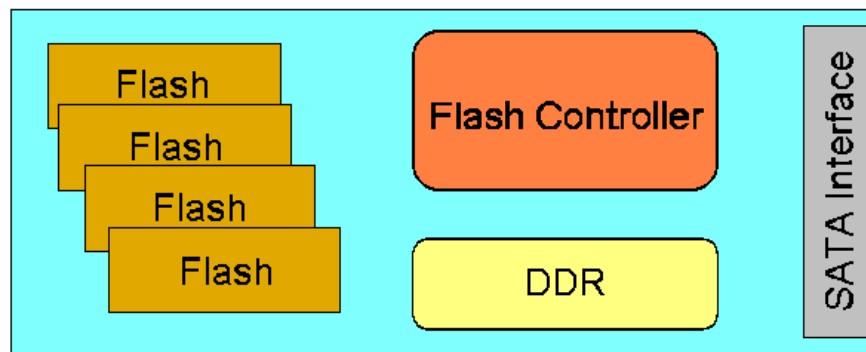


Figure 2. Delkin SlimSATA SSD block diagram with DDR cache buffer

1.2 Part Number Availability

Delkin SlimSATA Solid State Drives are available in the product grades and capacities shown in the table below. Drives are also available that feature Delkin's Tekta™ Infusion conformal coating process for greater protection in extreme environments.

Table 2. Delkin SlimSATA SSD Capacities and Part Numbers

Capacity*	Product Grade	Delkin Part Number
8GB	MLC Commercial (0 to +70C)	MK08NFWTS-XN000-D
16GB	MLC Commercial (0 to +70C)	MK16NFXTS-XN000-D
32GB	MLC Commercial (0 to +70C)	MK32NFFTS-XN000-D
64GB	MLC Commercial (0 to +70C)	MK64NHETS-XN000-D
128GB	MLC Commercial (0 to +70C)	MK1HNHDTS-XN000-D
4GB	SLC Commercial (0 to +70C)	MK04TFNTS-XN000-D
8GB	SLC Commercial (0 to +70C)	MK08TFNTS-XN000-D
16GB	SLC Commercial (0 to +70C)	MK16MHSTS-XN000-D
32GB	SLC Commercial (0 to +70C)	MK32MGGTS-XN000-D
64GB	SLC Commercial (0 to +70C)	MK64MGMTS-XN000-D
4GB	SLC Industrial (-40 to +85C)	ML04TFNTT-XN000-D
8GB	SLC Industrial (-40 to +85C)	ML08TFNTT-XN000-D
16GB	SLC Industrial (-40 to +85C)	ML16MHSTT-XN000-D
32GB	SLC Industrial (-40 to +85C)	ML32MGGTT-XN000-D
64GB	SLC Industrial (-40 to +85C)	ML64MGMTT-XN000-D

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

2 Electrical Specifications

2.1 Pin and Signal Assignments

Table 3. Signal & Power Pin-out

Signal Pin #	SlimSATA	Description
S1	GND	Power Ground
S2	RX+	Differential Signal Pair A
S3	RX-	
S4	GND	Power Ground
S5	TX-	Differential Signal Pair B
S6	TX+	
S7	GND	Power Ground
Power Pin #	SlimSATA	Description
P1	N.C.	No Connection
P2	N.C.	No Connection
P3	N.C.	No Connection
P4	GND	Ground
P5	GND	Ground
P6	GND	Ground
P7	V5	5V Power Input
P8	V5	5V Power Input
P9	V5	5V Power Input
P10	GND	Ground
P11	GND	Ground
P12	GND	Ground
P13	N.C.	No Connection
P14	N.C.	No Connection
P15	N.C.	No Connection

2.2 Supply Voltage

Table 4. Supply Voltage

Parameter	Rating
Operating Voltage	5.0V \pm 10%

2.3 Power Consumption

Table 5. Power Consumption

Parameter	Value @ 5.0V (mA)
Idle	155
Read	220
Write	285

Note: Values based on 64GB SLC (128Gbit x4) and 32GB MLC (64Gbit x 4) measurements.

3 Command Descriptions

3.1 Supported ATA Commands

The commands listed in the following table are supported by the SlimSATA 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	03DFF40h (32G) xxxxxxxxh (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)

3.3 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.

Table 8. Smart Command Set

Value	Command	Value	Command
D0h	Read Data	D5h	Reserved
D1h	Read Attribute Threshold	D6h	Reserved
D2h	Enable / Disable Autosave	D7h	Enable SMART Operations
D3h	Save Attribute Values	D8h	Disable SMART Operations
D4h	Execute OFF-LINE Immediate	DAh	Return Status

If the reserved size is below the threshold, the status can be read from the Cylinder Register using the Return Status command (DAh.)

3.4 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
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	Number of initial invalid blocks (396 = MSB, 397 = LSB)
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 – 445	F	Reserved
446 – 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 Mechanical Specifications

4.1 Mechanical Form Factor

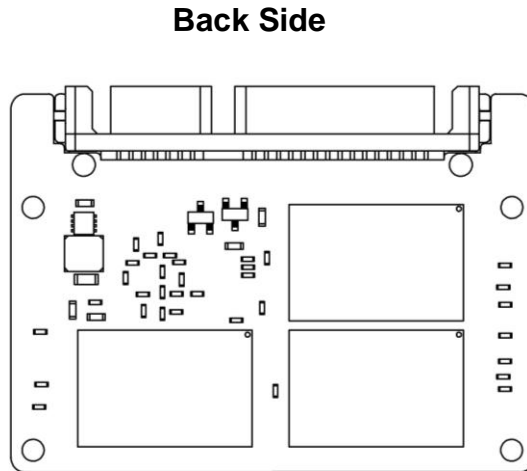
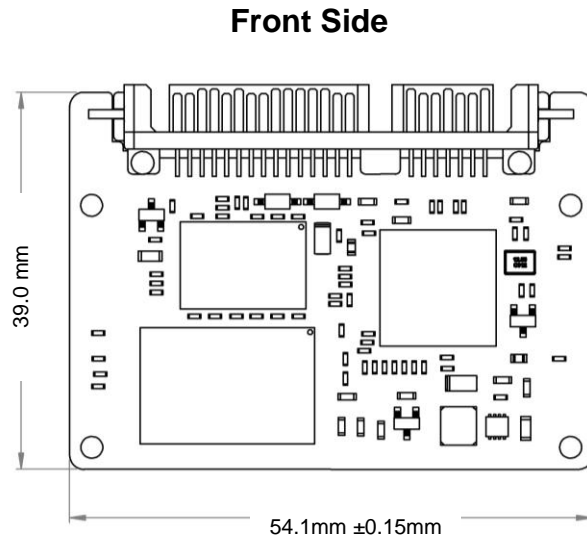


Figure 3. SlimSATA Embedded Module Mechanical Description

4.2 Physical Dimensions

Table 10. SlimSATA SSD Physical Dimensions

Dimension	Measurement
Height	4mm
Width	39.0mm
Length	54.0mm ± 0.15mm