DELKIN DEVICES®

mSATA Mini Embedded Flash Module

(MO-300B Mini - Variation B)

Engineering Specification

Document Number: L500583

Revision: A

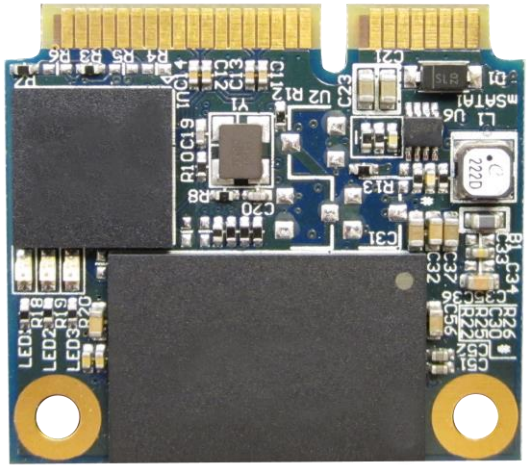

Table of Contents

List of Figures

List of Tables

1 Product Overview

Delkin's mSATA Mini SSD is an ideal embedded storage solution for applications where space is tight, but robustness and performance are key. These drives have superior features such as:

- High Speed Performance (varies by capacity)
  - up to 195MB/sec sustained read speed
  - up to 145MB/sec sustained write speed
- Industrial temperature (-40 to 85˚C) operating range
- Capacities supported
  - SLC: 4GB - 64GB
  - MLC: 8GB - 128GB
- Compliant with Serial ATA Revision 2.6 specification with 1.5 Gbps / 3.0 Gbps interface rate
- Compliant with ATA/ATAPI-8
- Compliant with JEDEC MO-300B Mini Variation B Mechanical standard
- Advanced Security Features, including:
  - Supports quick erase and ATA8 security feature set
  - Supports real time Full Disk Encryption (FDE) with AES 128/256
  - Supports Hardware SHA 128/256 and True Random Number Generator (TRNG)
- Global Wear Leveling
- BCH ECC capable of correcting up to 72 bits /1KB
- Compliant with European Union Directive 2002/95/EC (RoHS)
- Shock: 10g's for 11ms, MIL-STD-810, Method 516.6
- Vibration: 20Hz to 2,000Hz, 7.7GRMS, MIL-STD-810, Method 514.6
- Humidity: 5 - 95% RH at 55˚C, non-condensing
- Altitude: 80,000 feet
- Solid State – no moving parts
- Customization available upon request – image duplication, labels, serialization and packaging
- All configurations are available with proprietary conformal coating

*Dependent on card capacity, host configuration and testing equipment.

2 General Specifications

Delkin's mSATA Mini SSD drive combines solid state reliability with SATA connectivity for significant performance advantages over traditional hard disk drives. Manufactured to JEDEC MO-300B Mini form factor specifications, the mSATA Mini 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 195/145MB/s and feature storage capacities from 4GB to 128GB.

Table 1. Specification Summary

Specification	Value
Model number	See Table 2
Capacity	SLC: 4GB – 64GB MLC: 8GB – 128GB
Form factor	26.8 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 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 195 MB/s (varies by configuration)
Sustained write (512 byte)	Up to 145 MB/s (varies by configuration)
Reliability/Data Integrity	
MTBF	2,000,000 power on hours at 0°C
Endurance	Refer to Table 3 on page 7
Power	
Supply voltage (allowable)	3.3V ±10%
Typical current (varies by capacity):	
Idle	80 mA
Read	170 mA
Write	290 mA
Environmental	
Storage temperature	-50 ~ 100°C
Operating temperature	-40 ~ 85°C
Relative humidity (non-condensing)	95% up to 55°C
Vibration (operating/non-operating)	20Hz – 2000 Hz, 7.7GRMS (MIL-STD-810, Method 514.6)
Shock (operating/non-operating)	10 G / 11 ms (MIL-STD-810, Method 516.6)
Acoustic noise	0 dB
Altitude	80,000 feet max.

Physical Dimensions	
Height	4 mm
Width	29.85 mm
Length	26.8 mm

2.1 Part Number Availability

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

Table 2. Delkin mSATA SSD Capacities and Part Numbers

Capacity*	Product Grade	Delkin Part Number
4GB	SLC Industrial (-40 to +85C)	MN04MJAW5–XN000–D
8GB	SLC Industrial (-40 to +85C)	MN08MLSW5–XN000–D
16GB	SLC Industrial (-40 to +85C)	MN16MLTW5–XN000–D
32GB	SLC Industrial (-40 to +85C)	MN32MJHW5–XN000–D
64GB	SLC Industrial (-40 to +85C)	MN64MHZW5–XN000–D
8GB	MLC Industrial (-40 to +85C)	MN08NLUW5–XN000–D
16GB	MLC Industrial (-40 to +85C)	MN16NLUW5–XN000–D
32GB	MLC Industrial (-40 to +85C)	MN32NJJW5–XN000–D
64GB	MLC Industrial (-40 to +85C)	MN64NLVW5–XN000–D
128GB	MLC Industrial (-40 to +85C)	MN1HNKJW5–XN000–D

Notes:

- To add conformal coating, replace the “000” in the part number with “050”.
- 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.

1.3Reliability

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

		Sequential Write Size, 24/7 Operation	
Part Number(s)	Description	1000 Bytes/Sec	5000 Bytes/Sec
MN04MJAW5–XN000–D	4GB SLC Industrial	4.5 TBW	10.2 TBW
MN08MLSW5–XN000–D	8GB SLC Industrial	4.6 TBW	20.4 TBW
MN16MLTW5–XN000–D	16GB SLC Industrial	8.8 TBW	37.5 TBW
MN32MJHW5–XN000–D	32GB SLC Industrial	17.4 TBW	72.1 TBW
MN64MHZW5–XN000–D	64GB SLC Industrial	33.8 TBW	133.9 TBW
MN08NLUW5–XN000–D	8GB MLC Industrial	236 GBW	976 TBW
MN16NLUW5–XN000–D	16GB MLC Industrial	438 GBW	1.9 TBW
MN32NJJW5–XN000–D	32GB MLC Industrial	864 GBW	3.6 TBW
MN64NLVW5–XN000–D	64GB MLC Industrial	1.6 TBW	6.7 TBW
MN1HNKJW5–XN000–D	128GB MLC Industrial	3.1 TBW	12.9 TBW

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

3 Electrical Specifications

3.1 Pin and Signal Assignments

Table 4. 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

3.2 Supply Voltage

Table 5. Supply voltage

Parameter	Rating
Operating Voltage	3.3V

3.3 Power Consumption

Table 6. Power Consumption (Current Draw)

Parameter	Value (mA)
Idle	80
Read	170
Write	290

4 Command Descriptions

4.1 Supported ATA Commands

Table 7. Supported ATA Commands

Command Set	Command Name	Command Code	Protocol
General Feature Set	Execute drive diagnostic	90h	Device Diagnostic
	Flush cache	E7h	Non-data
	Identify device	Ech	PIO data-in
	Initialize drive parameters	91h	Non-data
	Read DMA	C8h	DMA
	Read multiple	C4h	PIO data-in
	Read sector(s)	20h or 21h	PIO data-in
	Read verify sector(s)	40h or 41h	Non-data
	Set feature	Efh	Non-data
	Set multiple mode	C6h	Non-data
	Write DMA	CAh	DMA
	Write multiple	C5h	PIO data-out
	Write sector(s)	30h or 31h	PIO data-out
	NOP	00h	Non-data
	Read buffer	E4h	PIO data-in
	Write buffer	E8h	PIO data-out
Power Management Feature Set	Check power mode	E5h or 98h	Non-data
	Idle	E3h or 97h	Non-data
	Idle immediate	E1h or 95h	Non-data
	Sleep	E6h or 99h	Non-data
	Standby	E2h or 96h	Non-data
	Standby immediate	E0h or 94h	Non-data

Command Set	Command Name	Command Code	Protocol
Security Mode Feature Set	Security Set Password	F1h	PIO data-out
	Security Unlock	F2h	PIO data-out
	Security Erase Prepare	F3h	Non-data
	Security Erase Unit	F4h	PIO data-out
	Security Freeze Lock	F5h	Non-data
	Security Disable Password	F6h	PIO data-out
SMART Feature Set	SMART Disable Operations	B0h	Non-data
	SMART Enable/Disable Autosave	B0h	Non-data
	SMART Enable Operations	B0h	Non-data
	SMART Return Status	B0h	Non-data
	SMART Execute Off-Line Immediate	B0h	Non-data
	SMART Read Data	B0h	PIO data-in
	SMART Read Threshold	B0h	PIO data-in
	SMART Save Attribute Values	B0h	Non-data
Host Protected Area Feature Set	Read Native Max Address	F8h	Non-data
	Set Max Address	F9h	Non-data
	Set Max Set Password	F9h	PIO data-out
	Set Max Lock	F9h	Non-data
	Set Max Freeze Lock	F9h	Non-data
	Set Max Unlock	F9h	PIO data-out
48-bit Address Feature Set	Flush Cache Ext	Eah	Non-data
	Read sector(s) Ext	24h	PIO data-in
	Read DMA Ext	25h	DMA
	Read Multiple Ext	29h	PIO data-in
	Read Native Max Address Ext	27h	Non-data
	Read Verify Ext	42h	Non-data

Command Set	Command Name	Command Code	Protocol
48-bit Address Feature Set (continued)	Set Max Address Ext	37h	Non-data
	Write DMA Ext	35h	DMA
	Write DMA FUA Ext	3Dh	DMA
	Write Multiple Ext	39h	PIO data-out
	Write Multiple FUA Ext	CEh	PIO data-out
	Write sector(s) Ext	34h	PIO data-out
CFA Feature Set	Request Sense	03h	Non-data
	Write Sector(s) (w/o erase)	38h	PIO data-out
	Erase Sectors	C0h	Non-data
	Write Multiple without Erase	CDh	PIO data-out
	Translate Sector	87h	PIO data-in
	Set Features Enable/Disable 8-bit Transfer	EFh	Non-data
Others	Seek	70h	Non-data
	Wear Level	F5h	Non-data

4.2 Identity Device Data

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

Table 8. Device Sector Data

Word	F: Fixed V: Variable X: Both	Default Value	Description
0	F	044Ah	General configuration
1	X	XXXXh	Default number of cylinders
2	V	0000h	Reserved
3	X	00XXh	Default number of heads
4	X	0000h	Obsolete
5	X	0240h	Obsolete
6	F	XXXXh	Default number of sectors per track
7-8	V	XXXXh	Number of sectors per card (Word 7 =MSW, Word 8= LSW)
9	X	0000h	Obsolete
10-19	F	XXXXh	Serial number in ASCII (right justified)
20	X	0002h	Obsolete
21	X	0002h	Obsolete
22	X	0004h	Obsolete
23-26	F	XXXXh	Firmware revision in ASCII. Big Endian Byte Order in Word.
27-46	F	XXXXh	Model number in ASCII (left justified). Big Endian Byte Order in Word.
47	F	8001h	Maximum number of sectors on Read/Write Multiple command.
48	F	0000h	Reserved
49	F	0F00h	Capabilities
50	F	4000h	Capabilities
51	F	0200h	PIO data transfer cycle timing mode
52	X	0000h	Obsolete
53	F	0007h	Field Validity
54	X	XXXXh	Current number of cylinders

Word	F: Fixed V: Variable X: Both	Default Value	Description
55	X	XXXXh	Current number of heads
56	X	XXXXh	Current sectors per track
57-58	X	XXXXh	Current capacity in sectors (LBAs) (Word 57 =LSW, Word 58=MSW)
59	F	0100h	Multiple sector setting
60-61	F	XXXXh	Total number of sectors addressable in LBA mode
62	X	0000h	Reserved
63	F	0007h	Multi-word DMA transfer
64	F	0003h	Advanced PIO modes supported
65	F	0078h	Minimum Multiword DMA transfer cycle time per word
66	F	0078h	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
69-74	F	0000h	Reserved
75	F	0000h	Queue depth
76	F	0006h	Serial SATA capabilities • Supports Serial ATA Gen 1 • Supports Serial ATA Gen 2
	F	0206h	Supports receipt of host-initiated interface power management requests
77	V	0000h	Reserved
78	F	0008h	Device supports initiating interface power management
79	V	0000h	Reserved
80	F	01FCh	Major Version Number (ATA8-ACS)
81	F	0000h	Minor Version Number
82	F	742Bh	Command sets supported 0
83	F	7500h	Command set supported 1
84	F	4002h	Command set supported 2

Word	F: Fixed V: Variable X: Both	Default Value	Description
85 - 87	V	XXXXh	Command set/feature enabled
88	V	007Fh	Ultra DMA Modes supported and selected
89	F	0003h	Time required for security erase unit completion
90	F	0000h	Time required for Enhanced security erase completion
91	V	0000h	Current advanced power management value
92	V	FFFEh	Master Password Revision Code
93 - 99	V	0000h	Reserved
100-103	V	XXXXh	Maximum user LBA for 48-bit Address feature set
104-127	V	0000h	Reserved
128	V	0001h	Security status
129-159	X	0000h	Vendor unique bytes
160	F	0000h	Power requirement description
161	X	0000h	Reserved
162	F	0000h	Key management schemes supported
163	F	0000h	CF Advanced True IDE Timing Mode Capability and Setting
164-216	V	0000h	Reserved
217	F	0001h	Non-rotating media device
218-255	X	0000h	Reserved

4.3 SMART Command Set

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

Table 9. 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.)

4.4 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 10. 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 • 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

Byte	F / V	Description
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.

5 Mechanical Specifications

5.1 Mechanical Form Factor

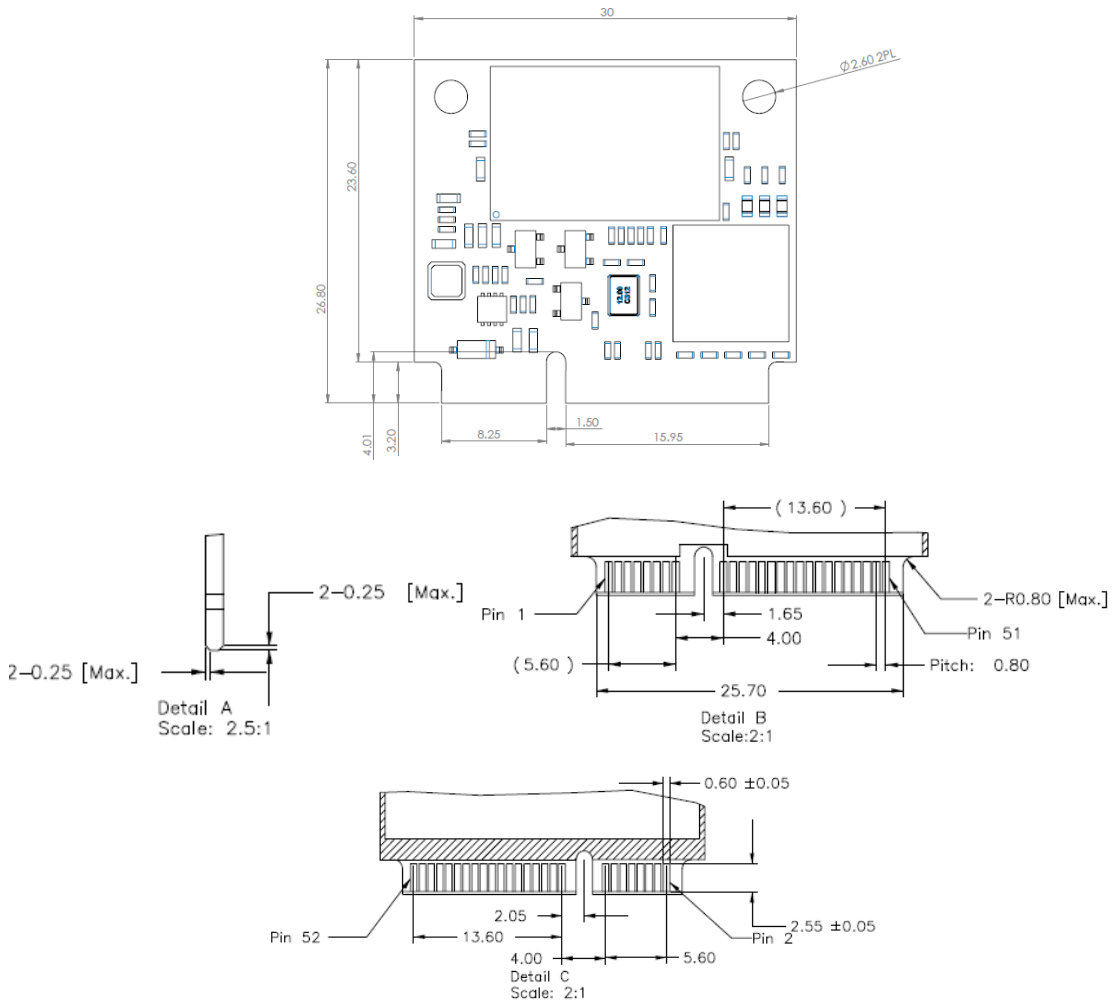

Figure 1. mSATA Mini Embedded Module Mechanical Description

5.2 Physical Dimensions

Table 11. mSATA Mini SSD Physical Dimensions

Dimension	Measurement
Height	4mm
Width	29.85mm
Length	26.8mm