

# **mSATA 630**

# **Datasheet**

**(SQF-SMSxx-xG-S9x)**

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## Revision History

| Rev. | Date       | History                                            |
|------|------------|----------------------------------------------------|
| 0.1  | 2014/2/17  | 1. 1 <sup>st</sup> draft                           |
| 0.2  | 2014/04/03 | 1. Update information                              |
| 0.3  | 2014/12/25 | 1. Add 1-CH 8G MLC                                 |
| 0.4  | 2015/2/6   | 1. Update write protect pin description            |
| 0.5  | 2015/6/8   | 1. Correct the description of Write Protect jumper |
|      |            |                                                    |

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## 1. Overview

Advantech SQFlash 630 series mSATA delivers all the advantages of Flash Disk technology with the Serial ATA III (6.0Gb) interface, fully compliant with standard mSATA form factor. The SQF-SMS is based on the mSATA form factor which is generated by JEDEC and could provide a wide range capacity from 1GB to 32GB for SLC, 2GB to up to 64GB for Ultra MLC, and 4GB to up to 128GB for MLC. Also it can reach more than 480MB/s read as well as 180MB/s write high performance even based on MLC flash. The power consumption of Flash Disk is also much lower than traditional Hard Drive.

## 2. Features

### ■ Standard SATA interface

- Support SATA 1.5/3.0/6.0 Gbps interface
- SATA Revision 3.0 compliant

### ■ Operating Voltage : 3.3V

### ■ Support 72 bit ECC correct per 1K Byte data

### ■ TRIM 、 AHCI supported

### ■ Hardware write protect supported

- Pin header type: default on short position for write protect disable

### ■ Temperature Ranges

- Commercial Temperature
  - 0°C to 70°C for operating
  - -40°C to 85°C for storage
- Industrial Temperature
  - -40°C to 85°C for operating
  - -40°C to 85°C for storage

### ■ Mechanical Specification

- Shock : 1,500G / 0.5ms
- Vibration : 20G / 80~2,000Hz

### ■ Humidity

- Humidity : 5% ~ 95% under 55°C

### ■ Endurance : > 2,000,000 program/erase cycles

- This is a test result of the whole SQFlash drive. The test is to keep writing a fixed logical block address (LBA) and see if any bad blocks occur after 2M cycles. With wear-levelling mechanism, although the disk was kept writing the same LBA but the physical block changes per block writing. So this test also proves that wear-leveling is really working, or the block would be wearout after its designated life cycles.

### ■ Data Retention

- 10 years

### ■ Acquired RoHS 、 WHQL 、 CE 、 FCC Certificate

### ■ Acoustic : 0 dB

### ■ Dimension : 50.8 mm x 30.0 mm x 4.2 mm

3. Specification Table

■ Performance

|           |            | Sequential Performance (MB/sec) |        | Random Performance (IOPS @4K) |        |
|-----------|------------|---------------------------------|--------|-------------------------------|--------|
|           |            | Read                            | Write  | Read                          | Write  |
| SLC       | 1 GB       | 33.83                           | 21.16  | 6,994                         | 2,533  |
|           | 2 GB       | 67.44                           | 41.19  | 13,652                        | 4,531  |
|           | 4 GB       | 133.40                          | 90.05  | 20,987                        | 14,687 |
|           | 8 GB       | 286.40                          | 86.94  | 40,832                        | 18,468 |
|           | 16 GB      | 523.00                          | 153.00 | 36,608                        | 27,392 |
|           | 32 GB      | 503.70                          | 148.00 | 41,779                        | 27,238 |
|           | 64 GB      | 509.50                          | 152.20 | 36,762                        | 27,418 |
| Ultra MLC | 2 GB       | 153.10                          | 52.93  | 24,105                        | 8,609  |
|           | 4 GB       | 301.20                          | 96.34  | 43,366                        | 18,381 |
|           | 8 GB       | 310.00                          | 100.00 | 42,000                        | 23,726 |
|           | 16 GB      | 495.40                          | 160.50 | 46,797                        | 27,930 |
|           | 32 GB      | 491.80                          | 185.60 | 39,450                        | 24,072 |
|           | 64 GB      | 488.50                          | 182.80 | 33,178                        | 16,399 |
|           | 128 GB     | 524.10                          | 196.70 | 36,147                        | 27,904 |
| MLC       | 4 GB       | 150.40                          | 49.93  | 22,612                        | 4,155  |
|           | 8 GB (1CH) | 123.60                          | 41.98  | 20,728                        | 9,392  |
|           | 8 GB (2CH) | 290.00                          | 97.24  | 41,037                        | 7,414  |
|           | 16 GB      | 522.10                          | 184.10 | 48,410                        | 28,698 |
|           | 32 GB      | 484.60                          | 153.80 | 46,797                        | 28,083 |
|           | 64 GB      | 484.70                          | 194.30 | 39,757                        | 24,527 |
|           | 128 GB     | 482.80                          | 182.90 | 33,152                        | 24,000 |
|           | 256 GB     | 514.90                          | 193.80 | 36,122                        | 27,341 |

\* All performance above are tested with AHCI mode.

## ■ Endurance

According to JEDEC subcommittee JC-64.8, the actual endurance of flash storage can be presented by Terabyte Write (TBW), which is measured by NAND Flash physical endurance, Wear-leveling Efficiency (WLE) and Write Amplification Factor (WAF) of specific capacities with following formula.

$$\text{TBW} = [(\text{NAND Flash Physical Endurance}) \times \text{Capacity} \times \text{WLE}] / \text{WAF}$$

### • TBW of sequential writing

|        | WLE    | WAF    | TBW  |           |     |
|--------|--------|--------|------|-----------|-----|
|        |        |        | SLC  | Ultra MLC | MLC |
| 1 GB   | 0.9130 | 1.1013 | 80   | --        | --  |
| 2 GB   | 0.9130 | 1.1017 | 161  | 32        | --  |
| 4 GB   | 0.9130 | 1.1025 | 323  | 64        | 9   |
| 8 GB   | 0.9120 | 1.1026 | 646  | 129       | 19  |
| 16 GB  | 0.9120 | 1.1031 | 1291 | 258       | 38  |
| 32 GB  | 0.9120 | 1.1029 | 2584 | 516       | 77  |
| 64 GB  | 0.9110 | 1.1039 | 5157 | 1031      | 154 |
| 128 GB | 0.9110 | 1.1039 | --   | 2603      | 309 |
| 256 GB | 0.9100 | 1.1041 | --   | --        | 618 |

### • TBW of random writing

|        | WLE    | WAF    | TBW  |           |     |
|--------|--------|--------|------|-----------|-----|
|        |        |        | SLC  | Ultra MLC | MLC |
| 1 GB   | 0.9130 | 1.2176 | 73   | --        | --  |
| 2 GB   | 0.9130 | 1.2837 | 138  | 27        | --  |
| 4 GB   | 0.9130 | 1.3034 | 273  | 54        | 8   |
| 8 GB   | 0.9120 | 1.3278 | 536  | 107       | 16  |
| 16 GB  | 0.9120 | 2.2323 | 638  | 127       | 19  |
| 32 GB  | 0.9120 | 2.3535 | 1210 | 242       | 36  |
| 64 GB  | 0.9110 | 2.4396 | 2333 | 466       | 70  |
| 128 GB | 0.9110 | 2.3141 | --   | 984       | 147 |
| 256 GB | 0.9100 | 2.2614 | --   | --        | 301 |

## 4. General Description

### ■ Advanced NAND Flash Controller

Advantech SQFlash 630 series mSATA includes Bad Block Management Algorithm, Wear Leveling Algorithm, Error Detection / Correction Code (EDC/ECC) Algorithm, Fragment Writing Technology, and GuaranteedFlush Technology.

### ■ Bad Block Management

Bad blocks are blocks that contain one or more invalid bits of which the reliability is not guaranteed. Bad blocks may be representing when flash is shipped and may developed during life time of the device. Advantech SQFlash 630 series mSATA implement an efficient bad block management algorithm to detect the factory produced bad blocks and manages any bad blocks that may develop over the life time of the device. This process is completely transparent to the user, user will not aware of the existence of the bad blocks during operation.

### ■ Wear Leveling

NAND Type flash have individually erasable blocks, each of which can be put through a finite number of erase cycles before becoming unreliable. It means after certain cycles for any given block, errors can be occurred in a much higher rate compared with typical situation. Unfortunately, in the most of cases, the flash media will not been used evenly. For certain area, like file system, the data gets updated much frequently than other area. Flash media will rapidly wear out in place without any rotation.

Wear leveling attempts to work around these limitations by arranging data so that erasures and re-writes are distributed evenly across the full medium. In this way, no single sector prematurely fails due to a high concentration of program/erase cycles.

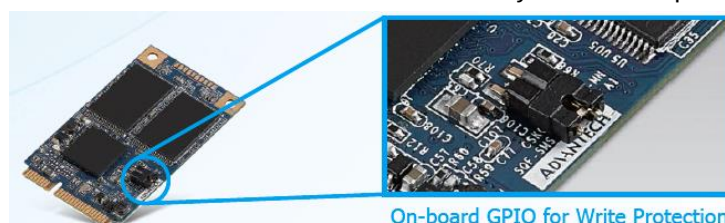
Advantech SQFlash 630 series mSATA provides advanced wear leveling algorithm, which can efficiently spread out the flash usage through the whole flash media area. By implement both dynamic and static wear leveling algorithms, the life expectancy of the flash media can be improved significantly.

### ■ Error Detection / Correction

Advantech SQFlash 630 series mSATA utilizes BCH ECC Algorithm which offers one of the most powerful ECC algorithms in the industry. This algorithm can support 72 bit ECC correct per 1K Byte data.

### ■ Hardware Write Protect Pin

A 2-pin header is mounted and connected to controller reserved GPIO for the drive write protection. When the pins are opened, all of the write command will be carried to a buffer area without real programming to the Flash IC. So the data won't be saved in this mode and will be totally discarded upon power shutting down.

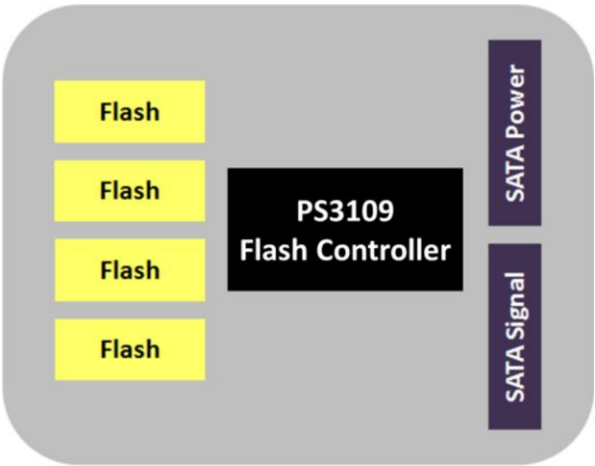


### ■ Sophisticate Product Management Systems

Since industrial application require much more reliable devices compare with consumer product, a more sophisticated product management system become necessary for industrial customer requirement. The key to providing reliable devices is product traceability and failure analysis system. By implement such systems end customer can expect much more reliable product.

■

Block Diagram



■

LBA value

| Density | LBA            |
|---------|----------------|
| 1 GB    | 1,974,672      |
| 2 GB    | 3,928,176      |
| 4 GB    | 7,835,184      |
| 8 GB    | 15,649,200     |
| 16 GB   | 31,277,232     |
| 32 GB   | 62,533,296     |
| 64 GB   | 125,045,424    |
| 128 GB  | 250,069,680    |
| 256 GB  | 500,118,192.00 |

## 5. Pin Assignment and Description

### 5.1 mSATA Interface Pin Assignments

| Pin # | Function | 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    | B+       | Host Receiver Differential Signal Pair    |
| 24    | +3.3V    | 3.3V Source                               |
| 25    | B-       | Host Receiver Differential Signal Pair    |
| 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    | A-       | Host Transmitter Differential Signal Pair |
| 32    | NC       | No Connect                                |
| 33    | A+       | 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    | DEVSLP   | Enter/Exit DevSleep                       |
| 45    | NC       | Reserved pin                              |
| 46    | NC       | No Connect                                |

Specifications subject to change without notice, contact your sales representatives for the most update information.

|    |        |                        |
|----|--------|------------------------|
| 47 | NC     | Reserved pin           |
| 48 | NC     | No Connect             |
| 49 | DA/DSS | Device Activity Signal |
| 50 | DGND   | Digital GND            |
| 51 | GND    | Default connect to GND |
| 52 | +3.3V  | 3.3V Source            |

## 6. Identify Device Data

The Identify Device Data enables Host to receive parameter information from the device. The parameter words in the buffer have the arrangement and meanings defined in below table. All reserve bits or words are zero

| Word Address | Default Value | Data Field Type Information                                                   |
|--------------|---------------|-------------------------------------------------------------------------------|
| 0            | 0040h         | General configuration bit-significant information                             |
| 1            | <b>*1</b>     | Obsolete – Number of logical cylinders                                        |
| 2            | C837h         | Specific configuration                                                        |
| 3            | 0010h         | Obsolete – Number of logical heads (16)                                       |
| 4-5          | 0000h         | Retired                                                                       |
| 6            | 003Fh         | Obsolete – Number of logical sectors per logical track (63)                   |
| 7-8          | 0000h         | Reserved for assignment by the Compact Flash Association                      |
| 9            | 0000h         | Retired                                                                       |
| 10-19        | Varies        | Serial number (20 ASCII characters)                                           |
| 20-21        | 0000h         | Retired                                                                       |
| 22           | 0000h         | Obsolete                                                                      |
| 23-26        | Varies        | Firmware revision (8 ASCII characters)                                        |
| 27-46        | Varies        | Model number (xxxxxxxx)                                                       |
| 47           | 8010h         | 7:0- Maximum number of sectors transferred per interrupt on MULTIPLE commands |
| 48           | 4000h         | Trusted Computing feature set options(not support)                            |
| 49           | 2F00h         | Capabilities                                                                  |
| 50           | 4000h         | Capabilities                                                                  |
| 51-52        | 00000h        | Obsolete                                                                      |
| 53           | 0007h         | Words 88 and 70:64 valid                                                      |
| 54           | <b>*1</b>     | Obsolete – Number of logical cylinders                                        |
| 55           | 0010h         | Obsolete – Number of logical heads (16)                                       |
| 56           | 003Fh         | Obsolete – Number of logical sectors per track (63)                           |
| 57-58        | <b>*2</b>     | Obsolete – Current capacity in sectors                                        |
| 59           | 0110h         | Number of sectors transferred per interrupt on MULTIPLE commands              |
| 60-61        | <b>*3</b>     | Maximum number of sector ( 28bit LBA mode)                                    |
| 62           | 0000h         | Obsolete                                                                      |
| 63           | 0407h         | Multi-word DMA modes supported/selected                                       |
| 64           | 0003h         | PIO modes supported                                                           |
| 65           | 0078h         | Minimum Multiword DMA transfer cycle time per word                            |
| 66           | 0078h         | Manufacturer's recommended Multiword DMA transfer cycle time                  |
| 67           | 0078h         | Minimum PIO transfer cycle time without flow control                          |
| 68           | 0078h         | Minimum PIO transfer cycle time with IORDY flow control                       |

|         |           |                                                                                                                                 |
|---------|-----------|---------------------------------------------------------------------------------------------------------------------------------|
| 69      | 0100h     | Additional Supported (support download microcode DMA)                                                                           |
| 70      | 0000h     | Reserved                                                                                                                        |
| 71-74   | 0000h     | Reserved for the IDENTIFY PACKET DEVICE command                                                                                 |
| 75      | 001Fh     | Queue depth                                                                                                                     |
| 76      | 670eh     | Serial SATA capabilities                                                                                                        |
| 77      | 0084h     | Serial ATA Additional Capabilities                                                                                              |
| 78      | 014Ch     | Serial ATA features supported                                                                                                   |
| 79      | 0040h     | Serial ATA features enabled                                                                                                     |
| 80      | 07F8h     | Major Version Number                                                                                                            |
| 81      | 0000h     | Minor Version Number                                                                                                            |
| 82      | 346bh     | Command set supported                                                                                                           |
| 83      | 7d09h     | Command set supported                                                                                                           |
| 84      | 6063h     | Command set/feature supported extension                                                                                         |
| 85      | 3469h     | Command set/feature enabled                                                                                                     |
| 86      | bc01h     | Command set/feature enabled                                                                                                     |
| 87      | 6063h     | Command set/feature default                                                                                                     |
| 88      | 003Fh     | Ultra DMA Modes                                                                                                                 |
| 89      | 0001h     | Time required for security erase unit completion                                                                                |
| 90      | 001Eh     | Time required for Enhanced security erase completion                                                                            |
| 91      | 0000h     | Current advanced power management value                                                                                         |
| 92      | FFFEh     | Master Password Revision Code                                                                                                   |
| 93      | 0000h     | Hardware reset result. The contents of the bits (12:0) of this word can be changed only during the execution of hardware reset. |
| 94      | 0000h     | Vendor's recommended and actual acoustic management value                                                                       |
| 95      | 0000h     | Stream Minimum Request Size                                                                                                     |
| 96      | 0000h     | Streaming Transfer Time – DMA                                                                                                   |
| 97      | 0000h     | Streaming Access Latency – DMA and PIO                                                                                          |
| 98-99   | 0000h     | Streaming Performance Granularity                                                                                               |
| 100-103 | <b>*4</b> | Maximum user LBA for 48 bit Address feature set                                                                                 |
| 104     | 0000h     | Streaming Transfer Time – PIO                                                                                                   |
| 105     | 0008h     | Maximum number of 512-byte blocks per DATA SET MANAGEMENT command                                                               |
| 106     | 4000h     | Physical sector size/Logical sector size                                                                                        |
| 107     | 0000h     | Inter-seek delay for ISO-7779 acoustic testing in microseconds                                                                  |
| 108-111 | 0000h     | Unique ID                                                                                                                       |
| 112-116 | 0000h     | Reserved                                                                                                                        |
| 117-118 | 0000h     | Words per logical Sector                                                                                                        |
| 119     | 4014h     | Supported settings                                                                                                              |

Specifications subject to change without notice, contact your sales representatives for the most update information.

|         |                                                        |                                                                                    |
|---------|--------------------------------------------------------|------------------------------------------------------------------------------------|
| 120     | 4014h                                                  | Command set/Feature Enabled/Supported                                              |
| 121-126 | 0000h                                                  | Reserved                                                                           |
| 127     | 0000h                                                  | Removable Media Status Notification feature set support                            |
| 128     | 0021h                                                  | Security status                                                                    |
| 129-140 | 0000h                                                  | Vendor specific                                                                    |
| 141     | 0001h                                                  | Vendor specific                                                                    |
| 142-159 | 0000h                                                  | Vendor specific                                                                    |
| 160     | 0000h                                                  | Compact Flash Association (CFA) power mode 1                                       |
| 161-167 | 0000h                                                  | Reserved for assignment by the CFA                                                 |
| 168     | 3h 2.5 inch<br>4h 1.8 inch<br>5h Less<br>than 1.8 inch | Device Nominal Form Factor                                                         |
| 169     | 0001h                                                  | DATA SET MANAGEMENT command is supported                                           |
| 170-173 | 0000h                                                  | Additional Product Identifier                                                      |
| 174-175 | 0000h                                                  | Reserve                                                                            |
| 176-205 | 0000h                                                  | Current media serial number                                                        |
| 206     | 0000h                                                  | SCT Command Transport                                                              |
| 207-208 | 0000h                                                  | Reserved                                                                           |
| 209     | 4000h                                                  | Alignment of logical blocks within a physical block                                |
| 210-211 | 0000h                                                  | Write-Read-Verify Sector Count Mode 3 (not support)                                |
| 212-213 | 0000h                                                  | Write-Read-Verify Sector Count Mode 2 (not support)                                |
| 214-216 | 0000h                                                  | NV Cache relate (not support)                                                      |
| 217     | 0001h                                                  | Non-rotating media device                                                          |
| 218     | 0000h                                                  | Reserved                                                                           |
| 219     | 0000h                                                  | NV Cache relate (not support)                                                      |
| 220     | 0000h                                                  | Write read verify feature set current mode                                         |
| 221     | 0000h                                                  | Reserved                                                                           |
| 222     | 107Fh                                                  | Transport major version number                                                     |
| 223     | 0000h                                                  | Transport minor version number                                                     |
| 224-229 | 0000h                                                  | reserved                                                                           |
| 230-233 | 0000h                                                  | Extend number of user addressable sectors                                          |
| 234     | 0001h                                                  | Minimum number of 512-byte data blocks per DOWNLOAD MICROCODE command for mode 03h |
| 235     | 0080h                                                  | Maximum number of 512-byte data blocks per DOWNLOAD MICROCODE command for mode 03h |
| 236-254 | 0000h                                                  | Reserved                                                                           |
| 255     | XXA5h<br>XX is<br>variable                             | Integrity word (Checksum and Signature)                                            |

| Capacity (GB) | *1 (Word 1 / 54) | *2 (Word 57 - 58) | *3 (Word 60 - 61) | *4 (Word 100 – 103) |
|---------------|------------------|-------------------|-------------------|---------------------|
| 1             | 7A7h             | 1E2190h           | 1E2190h           | 1E2190h             |
| 2             | F39h             | 3BF070h           | 3BF070h           | 3BF070h             |

Specifications subject to change without notice, contact your sales representatives for the most update information.

|    |       |         |          |          |
|----|-------|---------|----------|----------|
| 4  | 1E5Dh | 778E30h | 778E30h  | 778E30h  |
| 8  | 3CA5h | EEC9B0h | EEC9B0h  | EEC9B0h  |
| 16 | 3FFFh | FBFC10h | 1DD40B0h | 1DD40B0h |
| 32 | 3FFFh | FBFC10h | 3BA2EB0h | 3BA2EB0h |
| 64 | 3FFFh | FBFC10h | 7740AB0h | 7740AB0h |

## 7. ATA Command Set [Command Set List]

| Op-Code | Command Description               |
|---------|-----------------------------------|
| 06h     | Data Set Management               |
| 10h-1Fh | Recalibrate                       |
| 20h     | Read Sectors                      |
| 21h     | Read Sectors without Retry        |
| 24h     | Read Sectors EXT                  |
| 25h     | Read DMA EXT                      |
| 27h     | Read Native Max Address EXT       |
| 29h     | Read Multiple EXT                 |
| 2Fh     | Read Log EXT                      |
| 30h     | Write Sectors                     |
| 31h     | Write Sectors without Retry       |
| 34h     | Write Sectors EXT                 |
| 35h     | Write DMA EXT                     |
| 37h     | Set Native Max Address EXT        |
| 39h     | Write Multiple EXT                |
| 3Dh     | Write DMA FUA EXT                 |
| 3Fh     | Write Long EXT                    |
| 40h     | Read Verify Sectors               |
| 41h     | Read Verify Sectors without Retry |
| 42h     | Read Verify Sectors EXT           |
| 60h     | Read FPDMA Queued                 |
| 61h     | Write FPDMA Queued                |
| 70h     | Seek                              |
| 90h     | Execute Device Diagnostic         |
| 91h     | Initialize Device Parameters      |
| 92h     | Download Microcode                |
| B0h     | SMART                             |
| C4h     | Read Multiple                     |
| C5h     | Write Multiple                    |
| C6h     | Set Multiple Mode                 |
| C8h     | Read DMA                          |
| C9h     | Read DMA without Retry            |
| CAh     | Write DMA                         |
| CBh     | Write DMA without Retry           |
| CEh     | Write Multiple FUA EXT            |
| E0h     | Standby Immediate                 |
| E1h     | Idle Immediate                    |
| E2h     | Standby                           |
| E3h     | Idle                              |
| E4h     | Read Buffer                       |
| E5h     | Check Power Mode                  |
| E6h     | Sleep                             |
| E7h     | Flush Cache                       |
| E8h     | Write Buffer                      |
| EAh     | Flush Cache EXT                   |
| ECh     | Identify Device                   |
| EFh     | Set Features                      |

Specifications subject to change without notice, contact your sales representatives for the most update information.

|     |                           |
|-----|---------------------------|
| F1h | Security Set Password     |
| F2h | Security Unlock           |
| F3h | Security Erase Prepare    |
| F4h | Security Erase Unit       |
| F5h | Security Freeze Lock      |
| F6h | Security Disable Password |
| F8h | Read Native Max Address   |
| F9h | Set Max Address           |

Note: ND = Non-Data Command  
 PI = PIO Data-In Command  
 PO = PIO Data-Out Command  
 DM = DMA Command  
 DD = Execute Diagnostic Command

## [Command Set Descriptions]

### 1. CHECK POWER MODE (code: E5h);

This command allow host to determine the current power mode of the device.

### 2. DOWNLOAD MICROCODE (code: 92h);

This command enable the host to alter the device's microcode. The data transferred using the DOWNLOAD MICROCODE command is vendor specific.

All transfers shall be an integer multiple of the sector size. The size of the data transfer is determined by the content of the LBA Low register and the Sector Count register.

This allows transfer sizes from 0 bytes to 33,553,920 bytes, in 512bytes increments.

### 3. EXECUTE DEVICE DIAGNOSTIC (code: 90h);

This command performs the internal diagnostic tests implemented by the module.

### 4. FLUSH CACHE (code: E7h);

This command used by the host to request the device to flush the write cache.

### 5. FLUSH CACHE EXT (code: EAh);

This command is used by the host to request the device to flush the write cache. If there is data in the write cache, that data shall be written to the media.

### 6. IDENTIFY DEVICE (code: ECh);

The IDENTIFY DEVICE command enables the host to receive parameter information from the module.

### 7. IDLE (code: 97h or E3h);

This command allows the host to place the module in the IDLE mode and also set the Standby timer. INTRQ may be asserted even through the module may not have fully transitioned to IDLE mode. If the Sector Count register is non-"0", then the Standby timer shall be enabled. The value in the Sector Count register shall be used to determine the time programmed into the Standby timer. If the Sector Count register is "0" then the Standby timer is disabled.

### 8. IDLE IMMEDIATE (code: E1h);

This command causes the module to set BSY, enter the Idle (Read) mode, clear BSY and generate an interrupt.

### 9. INITIALIZE DEVICE PARAMETERS (code: 91h);

This command enables the host to set the number of sectors per track and the number of heads per cylinder.

**10. NOP (code: 00h);**

If this command is issued, the module respond with command aborted.

**11. READ BUFFER (code: E4h);**

This command enables the host to read the current contents of the module's sector buffer.

**12. READ DMA (code: C8h or C9h);**

This command reads from "1" to "256" sectors as specified in the Sector Count register using the DMA data transfer protocol. A sector count of "0" requests "256" sectors transfer. The transfer begins at the sector specified in the Sector Number register.

**13. READ DMA Ext (code: 25h);**

This command allows the host to read data using the DMA data transfer protocol.

**14. READ MULTIPLE (code: C4h);**

This command performs similarly to the READ SECTORS command. Interrupts are not generated on each sector, but on the transfer of a block which contains the number of sector per block is defined by the content of word 59 in the IDENTIFY DEVICE response.

**15. READ MULTIPLE EXT (code: 29h);**

This command performs similarly to the READ SECTORS command. The number of sectors per block is defined by a successful SET MULTIPLE command. If no successful SET MULTIPLE command has been issued, the block is defined by the device's default value for number of sectors per block as defined in bits (7:0) in word 47 in the IDENTIFY DEVICE information.

**16. READ NATIVE MAX ADDRESS (code: F8h);**

This command returns the native maximum address. The native maximum address is the highest address accepted by the device in the factory default condition.

**17. READ NATIVE MAX ADDRESS EXT (code: 27h);**

This command returns the native maximum address.

**18. READ SECTOR(S) (code: 20h or 21h);**

This command reads from "1" to "256" sectors as specified in the Sector Count register. A sector count of "0" requests "256" sectors transfer. The transfer begins at the sector specified in the Sector Number register.

**19. READ SECTOR(S) EXT (code: 24h);**

This command reads from "1" to "65536" sectors as specified in the Sector Count register. A sector count of "0" requests "65536" sectors transfer. The transfer begins at the sector specified in the Sector Number register.

**20. READ VERIFY SECTOR(S) (code: 40h or 41h);**

This command is identical to the READ SECTORS command, except that DRQ is never set and no data is transferred to the host.

**21. READ VERIFY SECTOR(S) EXT (code: 42h);**

This command is identical to the READ SECTORS command, except that DRQ is never set and no data is transferred to the host.

**22. RECALIBRATE (code: 1Xh);**

This command return value is select address mode by the host request.

**23. SECURITY DISABLE PASSWORD (code: F6h);**

This command transfers 512 bytes of data from the host. Table defines the content of this information. If the password selected by word 0 match the password previously saved by the device, the device shall disable the Lock mode. This command shall not change the Master password. The Master password shall be reactivated when a User password is set.

**24. SECURITY ERASE PREPARE (code: F3h);**

This command shall be issued immediately before the SECURITY ERASE UNIT command to enable device erasing and unlocking.

**25. SECURITY ERASE UNIT (code: F4h);**

This command transfer 512 bytes of data from the host. Table## defines the content of this information. If the password does not match the password previously saved by the device, the device shall reject the command with command aborted.

The SECURITY ERASE PREPARE command shall be completed immediately prior to the SECURITY ERASE UNIT command.

**26. SECURITY FREEZE LOCK (code: F5h);**

This command shall set the device to frozen mode. After command completion any other commands that update the device Lock mode shall be command aborted. Frozen shall be disabled by power-off or hardware reset.

If SECURITY FREEZE LOCK is issued when the drive is in frozen mode, the drive executes the command and remains in frozen mode.

**27. SECURITY SET PASSWORD (code: F1h);**

This command transfer 512 bytes of data from the host. Table defines the content of this information. The data transferred controls the function of this command. Table defines the interaction of the identifier and security level bits.

**28. SECURITY UNLOCK (code: F2h);**

This command transfer 512 bytes of data from the host. Table (as Disable Password) defines the content of this information.

If the Identifier bit is set to Master and the device is in high security level, then the password supplied shall be compared with the stored Master password. If the device is in maximum security level then the unlock shall be rejected.

If the identifier bit is set to user then the device shall compare the supplied password with the stored User password.

If the password compare fails then the device shall return command aborted to the host and decrements the unlock counter. This counter shall be initially set to five and shall be decremented for each password mismatch when SECURITY UNLOCK is issued and the device is locked. When this counter reaches zero then SECURITY UNLOCK and SECURITY ERASE UNIT command shall be aborted until a power-on or a hardware reset.

**29. SEEK (code: 7Xh);**

This command performs address range check.

**30. SET MAX ADDRESS (code: F9h);**

After successful command completion, all read and write access attempts to address greater than specified by the successful SET MAX ADDRESS command shall be rejected with an IDNF error.

IDENTIFY DEVICE response words (61:60) shall reflect the maximum address set with this command.

**31. SET MAX ADDRESS EXT (code: 37h);**

After successful command completion, all read and write access attempts to address greater than specified by the successful SET MAX ADDRESS command shall be rejected with an IDNF error.

IDENTIFY DEVICE response words (61:60) shall reflect the maximum address set with this command.

**32. SET FEATURE (code: EFh);**

This command is used by the host to establish parameters that affect the execution of certain device features.

**33. SET MULTIPLE MODE (code: C6h);**

This command enables the device to perform READ and Write Multiple operations and establishes the block count for these commands.

**34. SLEEP (code: 99h or E6h);**

This command causes the module to set BSY, enter the Sleep mode, clear BSY and generate an interrupt.

**35. SMART READ DATA (code: B0h with Feature register value of D0h);**

This command returns the Device SMART data structure to the host.

**36. SMART ENABLE/DISABLE AUTO SAVE (code: B0h with Feature register value of D2h);**

This command enables and disables the optional attribute autosave feature of the device.

**37. SMART EXECUTE OFF\_LINE (code: B0h with Feature register value of D4h);**

This command cause the device to immediately initiate the optional set of activities that collect SMART data in an off-line mode and then save this data to the device's non-volatile memory, or execute a self-diagnostic test routine in either captive or off-line mode.

**38. SMART READ LOG (code: B0h with Feature register value of D5h);**

This command returns the specified log data to the host.

**39. SMART ENABLE OPERATION (code: B0h with Feature register value of D8h);**

This command enables access to all SMART capabilities within the device. Prior to receipt of this command SMART data are neither monitored nor saved by the device.

**40. SMART DISABLE OPERATION (code: B0h with Feature register value of D9h);**

This command disables all SMART capabilities within the device including any and all timer and event count functions related exclusively to this feature. After command acceptance the device shall disable all SMART operations.

After receipt of this command by the device, all other SMART commands including SMART DISABLE OPERATION commands, with exception of SMART ENABLE OPERATIONS, are disabled and invalid and shall be command aborted by the device.

**41. SMART RETURN STATUS (code: B0h with Feature register value of DAh);**

This command cause the device to communicate the reliability status of the device to the host.

**42. STANDBY (code: E2h);**

This command causes the module to set BSY, enter the Standby mode, clear BSY and return the interrupt immediately.

**43. STANDBY IMMEDIATE (code: E0h);**

This command causes the module to set BSY, enter the Standby mode, clear BSY and return the interrupt immediately.

**44. WRITE BUFFER (code: E8h);**

This command enables the host to overwrite contents of the module's sector buffer with any data pattern desired.

**45. WRITR DMA (code: CAh or CBh);**

Specifications subject to change without notice, contact your sales representatives for the most update information.

This command writes from “1” to “256” sectors as specified in the Sector Count register using the DMA data transfer protocol. A sector count of “0” requests “256” sectors transfer. The transfer begins at the sector specified in the Sector Number register.

**46. WRITR DMA EXT (code: 35h);**

This command writes from “1” to “65536” sectors as specified in the Sector Count register using the DMA data transfer protocol. A sector count of “0” requests “65536” sectors transfer. The transfer begins at the sector specified in the Sector Number register.

**47. WRITE MULTIPLE (code: C5h);**

This command is similar to the WRITE SECTORS command. Interrupts are not presented on each sector, but on the transfer of a block which contains the number of sectors defined by Set Multiple command.

**48. WRITE MULTIPLE EXT (code: 39h);**

This command is similar to the WRITE SECTORS command. Interrupts are not presented on each sector, but on the transfer of a block which contains the number of sectors defined by Set Multiple command.

**49. WRITE SECTOR(S) (code: 30h);**

This command writes from “1” to “256” sectors as specified in the Sector Count register. A sector count of “0” requests “256” sectors transfer. The transfer begins at the sector specified in the Sector Number register.

**50. WRITE SECTOR(S) EXT (code: 34h);**

This command writes from “1” to “65536” sectors as specified in the Sector Count register. A sector count of “0” requests “65536” sectors transfer. The transfer begins at the sector specified in the Sector Number register.

**51. WRITE SECTOR(S) W/O ERASE (code: 38h);**

This command writes from “1” to “256” sectors as specified in the Sector Count register. A sector count of “0” requests “256” sectors transfer. The transfer begins at the sector specified in the Sector Number register.

**52. WRITE VERIFY (code: 3Ch);**

This command is similar to the WRITE SECTOR(S) command, except that each sector is verified before the command is completed.

## 8. System Power Consumption

### 8.1 Supply Voltage

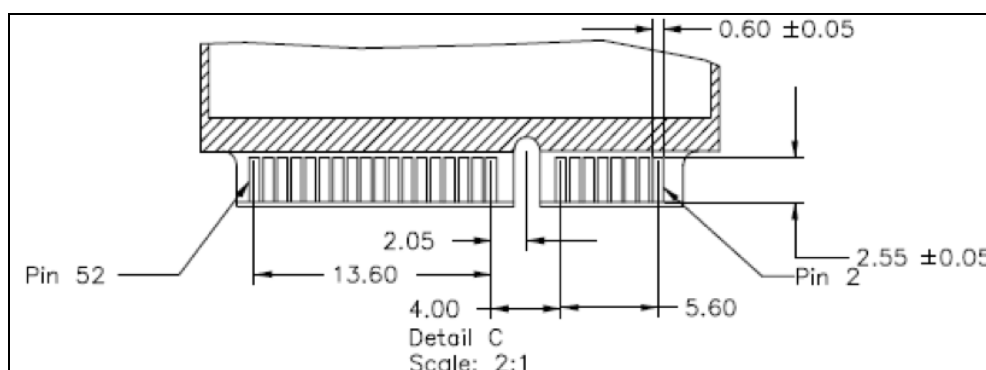
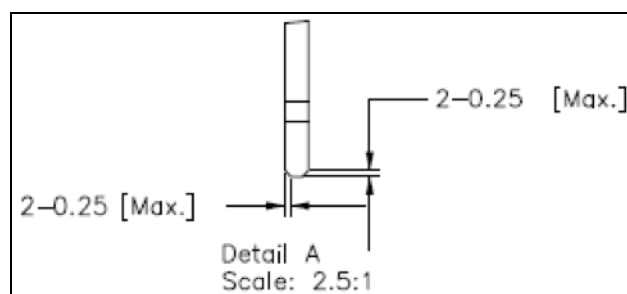
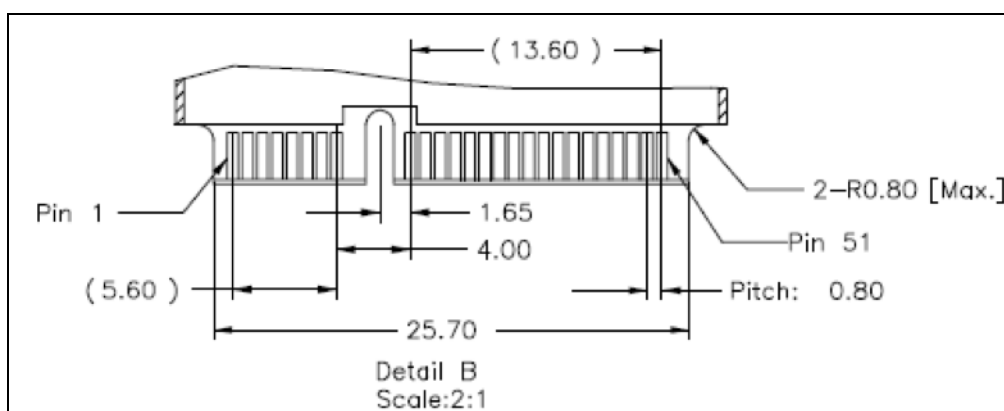
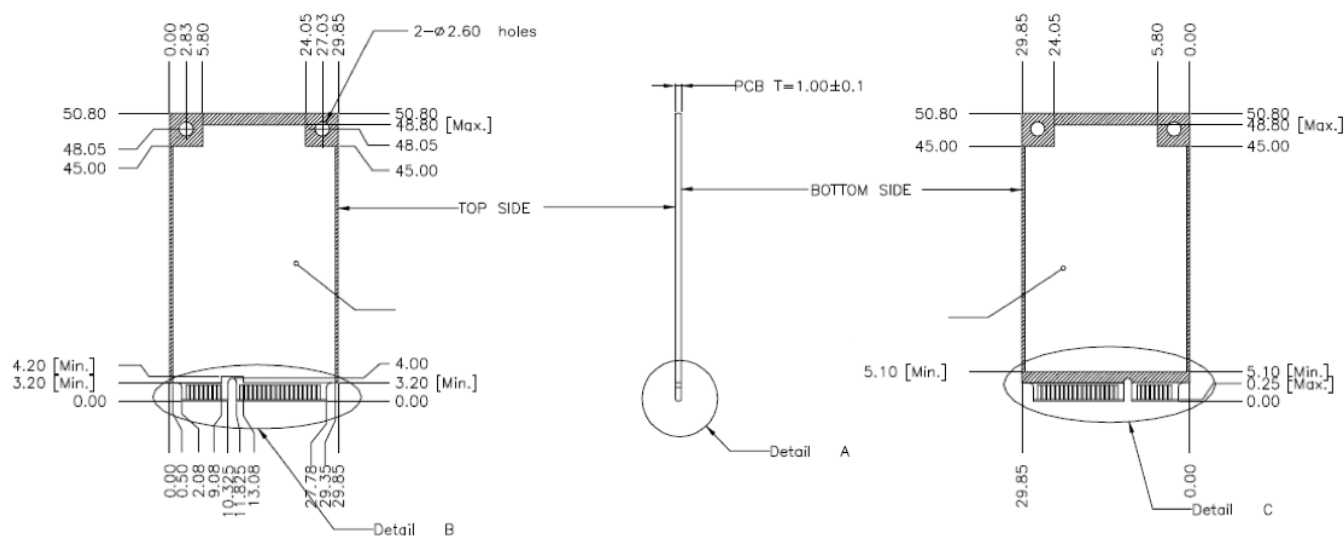
| Parameter         | Rating |
|-------------------|--------|
| Operating Voltage | 3.3V   |

### 8.2 Power Consumption

| mA        |        | Read   | Write  | Idle  | Slumber |
|-----------|--------|--------|--------|-------|---------|
| SLC       | 1 GB   | 169.70 | 172.73 | 79.90 | 9.60    |
|           | 2 GB   | 193.94 | 184.85 | 76.20 | 8.90    |
|           | 4 GB   | 193.94 | 234.85 | 76.00 | 8.80    |
|           | 8 GB   | 275.76 | 287.88 | 84.85 | 9.09    |
|           | 16 GB  | 298.48 | 300.00 | 84.85 | 9.09    |
|           | 32 GB  | 363.64 | 393.94 | 84.85 | 9.09    |
|           | 64 GB  | 439.39 | 424.24 | 84.85 | 9.09    |
| Ultra MLC | 2 GB   | 239.39 | 203.03 | 78.79 | 12.12   |
|           | 4 GB   | 304.55 | 245.45 | 78.79 | 12.12   |
|           | 8 GB   | 460.61 | 339.39 | 78.79 | 15.15   |
|           | 16 GB  | 412.12 | 339.39 | 78.79 | 19.70   |
|           | 32 GB  | 406.06 | 343.94 | 78.79 | 21.21   |
|           | 64 GB  | 496.97 | 366.67 | 84.85 | 22.73   |
|           | 128 GB | 566.67 | 403.03 | 84.85 | 22.73   |
| MLC       | 4 GB   | 236.36 | 198.48 | 76.36 | 7.88    |
|           | 8 GB   | 250.00 | 250.00 | 75.76 | 7.58    |
|           | 16 GB  | 436.36 | 265.15 | 76.67 | 8.79    |
|           | 32 GB  | 413.64 | 345.45 | 76.67 | 8.18    |
|           | 64 GB  | 459.09 | 368.18 | 76.06 | 7.88    |
|           | 128 GB | 533.33 | 427.27 | 85.76 | 8.79    |
|           | 256 GB | 593.94 | 524.24 | 85.76 | 10.30   |

## 9. Physical Dimension

mSATA (Unit: mm)



Specifications subject to change without notice, contact your sales representatives for the most update information.

## Appendix: Part Number Table

### SLC

| Product                          | Advantech PN      |
|----------------------------------|-------------------|
| SQF MSATA 630 1G SLC (0~70°C)    | SQF-SMSS1-1G-S9C  |
| SQF MSATA 630 2G SLC (0~70°C)    | SQF-SMSS2-2G-S9C  |
| SQF MSATA 630 4G SLC (0~70°C)    | SQF-SMSS4-4G-S9C  |
| SQF MSATA 630 8G SLC (0~70°C)    | SQF-SMSS2-8G-S9C  |
| SQF MSATA 630 16G SLC (0~70°C)   | SQF-SMSS4-16G-S9C |
| SQF MSATA 630 32G SLC (0~70°C)   | SQF-SMSS4-32G-S9C |
| SQF MSATA 630 64G SLC (0~70°C)   | SQF-SMSS4-64G-S9C |
| SQF MSATA 630 1G SLC (-40~85°C)  | SQF-SMSS1-1G-S9E  |
| SQF MSATA 630 2G SLC (-40~85°C)  | SQF-SMSS2-2G-S9E  |
| SQF MSATA 630 4G SLC (-40~85°C)  | SQF-SMSS4-4G-S9E  |
| SQF MSATA 630 8G SLC (-40~85°C)  | SQF-SMSS2-8G-S9E  |
| SQF MSATA 630 16G SLC (-40~85°C) | SQF-SMSS4-16G-S9E |
| SQF MSATA 630 32G SLC (-40~85°C) | SQF-SMSS4-32G-S9E |
| SQF MSATA 630 64G SLC (-40~85°C) | SQF-SMSS4-64G-S9E |

### Ultra MLC

| Product                            | Advantech PN       |
|------------------------------------|--------------------|
| SQF MSATA 630 2G UMLC (0~70°C)     | SQF-SMSU1-2G-S9C   |
| SQF MSATA 630 4G UMLC (0~70°C)     | SQF-SMSU2-4G-S9C   |
| SQF MSATA 630 8G UMLC (0~70°C)     | SQF-SMSU4-8G-S9C   |
| SQF MSATA 630 16G UMLC (0~70°C)    | SQF-SMSU4-16G-S9C  |
| SQF MSATA 630 32G UMLC (0~70°C)    | SQF-SMSU4-32G-S9C  |
| SQF MSATA 630 64G UMLC (0~70°C)    | SQF-SMSU4-64G-S9C  |
| SQF MSATA 630 128G UMLC (0~70°C)   | SQF-SMSU4-128G-S9C |
| SQF MSATA 630 2G UMLC (-40~85°C)   | SQF-SMSU1-2G-S9E   |
| SQF MSATA 630 4G UMLC (-40~85°C)   | SQF-SMSU2-4G-S9E   |
| SQF MSATA 630 8G UMLC (-40~85°C)   | SQF-SMSU4-8G-S9E   |
| SQF MSATA 630 16G UMLC (-40~85°C)  | SQF-SMSU4-16G-S9E  |
| SQF MSATA 630 32G UMLC (-40~85°C)  | SQF-SMSU4-32G-S9E  |
| SQF MSATA 630 64G UMLC (-40~85°C)  | SQF-SMSU4-64G-S9E  |
| SQF MSATA 630 128G UMLC (-40~85°C) | SQF-SMSU4-128G-S9E |

## MLC

| Product                             | Advantech PN       |
|-------------------------------------|--------------------|
| SQF MSATA 630 4G MLC (0~70°C)       | SQF-SMSM1-4G-S9C   |
| SQF MSATA 630 8G 1CH MLC (0~70°C)   | SQF-SMSM1-8G-S9C   |
| SQF MSATA 630 8G MLC (0~70°C)       | SQF-SMSM2-8G-S9C   |
| SQF MSATA 630 16G MLC (0~70°C)      | SQF-SMSM4-16G-S9C  |
| SQF MSATA 630 32G MLC (0~70°C)      | SQF-SMSM4-32G-S9C  |
| SQF MSATA 630 64G MLC (0~70°C)      | SQF-SMSM4-64G-S9C  |
| SQF MSATA 630 128G MLC (0~70°C)     | SQF-SMSM4-128G-S9C |
| SQF MSATA 630 256G MLC (0~70°C)     | SQF-SMSM4-256G-S9C |
| SQF MSATA 630 4G MLC (-40~85°C)     | SQF-SMSM1-4G-S9E   |
| SQF MSATA 630 8G 1CH MLC (-40~85°C) | SQF-SMSM1-8G-S9E   |
| SQF MSATA 630 8G MLC (-40~85°C)     | SQF-SMSM2-8G-S9E   |
| SQF MSATA 630 16G MLC (-40~85°C)    | SQF-SMSM4-16G-S9E  |
| SQF MSATA 630 32G MLC (-40~85°C)    | SQF-SMSM4-32G-S9E  |
| SQF MSATA 630 64G MLC (-40~85°C)    | SQF-SMSM4-64G-S9E  |
| SQF MSATA 630 128G MLC (-40~85°C)   | SQF-SMSM4-128G-S9E |
| SQF MSATA 630 256G MLC (-40~85°C)   | SQF-SMSM4-256G-S9E |