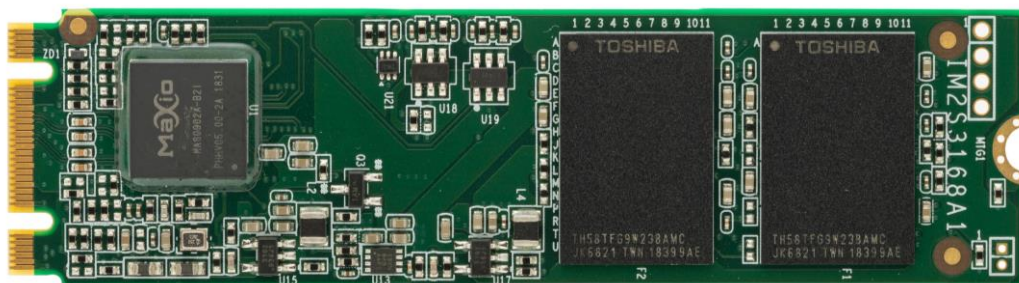


# M.2 2280 SATA SSD



Product Name: IM2S3168 (KIOXIA OG IC Edition)

Capacity: 128GB 、 256GB 、 512GB 、 1TB

## Revision History

Revision	Date	Description	Editor
0	June.27.2019	Modify format	Andrew
1	Oct.23.2019	Modify new format	Steven Wang
2	Nov. 11. 2019	TBW typo issues	Steven Wang
3	Apr. 10. 2020	Add DWPD	Steven Wang

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## Key Features

- **Capacity:**
  - 128GB, 256GB, 512GB, 1TB
- **NAND Flash:** 3D TLC
- **Form Factor:** M.2 2280
- **Compatibility:**
  - Serial ATA 6Gb/s interface
  - Complies with ATA-8 Standard
  - Complies SATA Revision 3.1
  - S.M.A.R.T feature supported
  - NCQ Command set supported
- **Performance:**
  - Sequential Read:  
Up to 550MB/s
  - Sequential Write:  
Up to 500MB/s
  - Random 4K Read:  
Up to 90K
  - Random 4K Write:  
Up to 70K
- **Power Consumption:**
  - Slumber: 0.07W
  - Active: 0.62W
  - Device sleep: 3.3mW
  - SR/SW: 1.37W/1.29W
  - RR/RW: 1.58W/1.15W
- **Temperature:**
  - Operation: 0°C - 70°C ( Normal )
  - Operation: -40°C - 85°C( Wide )
  - Non-operation: -55°C - 95°C
- **Reliability**
  - Shock: 1500G/0.5ms
  - Vibration 20G Peak, 10~2000Hz
  - MTBF: 2,000,000 hours
  - TBW : 850TB
  - DWPD : 0.75

## 1.0 General Description

Taking the advantages of NAND flash memory, Solid State Drive (SSD) provides better solutions on durability, performance, and power efficiency over traditional hard disk drives. Employing static wear-leveling technology to maximize device mean time between failures (MTBF), The SSD solutions are your best choice on wide-ranged mobile computing devices and consumer electronic products. With standard SATA form factor or customized module form factor, The M.2 SSD IM2S3168 (KIOXIA OG IC Edition) offers capacities 128GB 、256GB 、512GB 、1TB using 3D TLC type flash memories.

## 2.0 Mechanical Specification

All product specifications not covered in this document (electrical performance, appearance, etc.) are in accordance with ADATA's defined norms and standards.

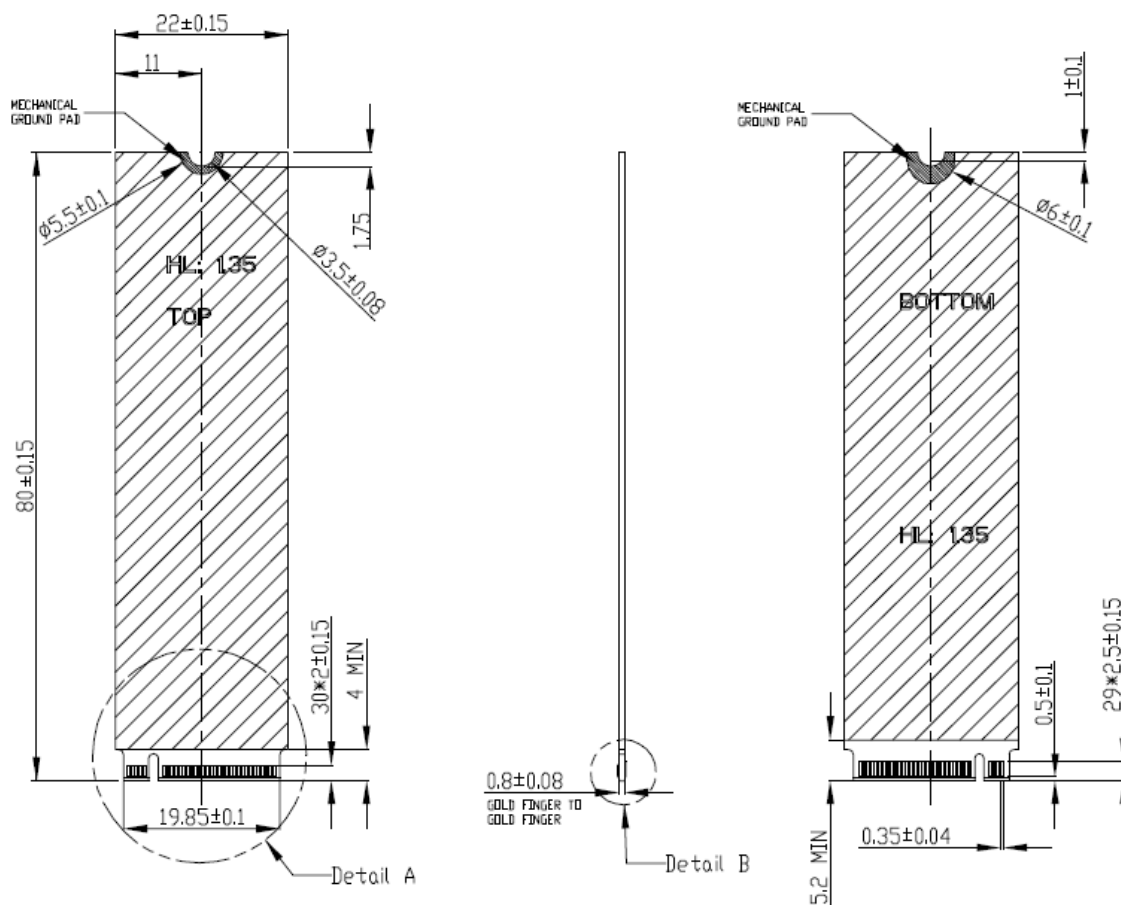
### 2.1 Physical dimensions and Weight

Table 2-1 Dimensions and Weight

Model	Length(mm)	Width(mm)	Height(mm)	Weight(gram)
IM2S3168-128GD	80±0.15	22±0.15	Max 3.58	Max 6±1g
IM2S3168-256GD	80±0.15	22±0.15	Max 3.58	Max 6±1g
IM2S3168-512GD	80±0.15	22±0.15	Max 3.58	Max 6±1g
IM2S3168-001TD	80±0.15	22±0.15	Max 3.58	Max 6±1g

### 2.2 Product Dimensions

Figure 2-1 Product Dimensions



## 3.0 Product Specifications

### 3.1 Interface and configuration

- Supports 1-port 1.5/3.0/6.0 Gbps SATA I/II/III interface.
- Compliant with Serial ATA International Organization: Serial ATA Revision 3.1.
- Compliant SSD Alliance compliance program.

### 3.2 Capacity

**Table 3-1 User Addressable Sectors**

Model	IM2S3168					
Unformatted Capacity	32GB	64GB	128GB	256GB	512GB	1TB
Total User Addressable Sectors (LBA Mode)	62,533,296	125,045,424	250,069,680	500,118,192	1,000,215,216	2,000,409,264

Total useable capacity may be less (due to formatting, flash management, and other functions).  
1GB=1,000,000,000 bytes; 1sector = 512bytes.

### 3.3 Performance

#### 3.3.1 Read/Write & ATTO Performance

**Table 3-2 Read/Write Performance (ATTO)**

	32GB	64GB	128GB	256GB	512GB	1TB	Unit
Sequential Read	320	450	550	550	550	550	MB/s
Sequential Write	65	150	470	480	480	500	MB/s

-Seq. Read & Write speed test by ATTO

-The system conditions and test environment may affect test result

#### 3.3.2 Read/Write & CDM Performance

**Table 3-3 Read/Write Performance (CDM)**

	32GB	64GB	128GB	256GB	512GB	1TB	Unit
Sequential Q32 Read	350	450	560	560	560	560	MB/s
Sequential Q32 Write	70	150	470	500	530	500	MB/s

-Seq. Read & Write speed test by Crystal Disk Mark 5.1.2

### 3.3.3 IOPS Performance

**Table 3-4 Read/Write & IOPS Performance**

	32GB	64GB	128GB	256GB	512GB	1TB	Unit
<b>4K Random Read</b>	20K	40K	60K	90K	90K	90K	IOPS
<b>4K Random Write</b>	12K	30K	60K	70K	70K	70K	IOPS

-Seq. Read & Write speed test by IOMeter 2010 with "00" pattern (Queue depth of 32; Measurements are performed on 10% capacity of LBA range. Write cache enable)

-IOPS Test Utility: IOMeter 2010 (Queue depth of 32; Measurements are performed on 10% capacity of LBA range. Write cache enable)

-The system conditions and test environment may affect test result

### 3.3.4 Read/Write & AS-SSD Performance

**Table 3-5 Read/Write Performance (AS-SSD)**

	32GB	64GB	128GB	256GB	512GB	1TB	Unit
<b>Sequential Read</b>	300	450	500	500	520	490	MB/s
<b>Sequential Write</b>	70	140	430	450	470	440	MB/s

-Seq. Read & Write speed test by AS-SSD with Random pattern

## 3.4 Electrical

### 3.4.1 Operating Voltage

**Table 3-7 Operating Voltage**

Operating Voltage	
<b>Input Power</b>	DC 3.3V $\pm$ 10%
<b>Maximum Ripple</b>	100mV p-p or less

### 3.4.2 Power Consumption (Typical)

**Table 3-7 Power Consumption (Typical)**

	32GB	64GB	128GB	256GB	512GB	1TB	Unit
<b>Slumber</b>	0.07	0.07	0.07	0.07	0.07	0.07	W
<b>Active</b>	0.6	0.62	0.62	0.62	0.62	0.62	
<b>Sequential Read</b>	1.06	1.37	1.37	1.37	1.37	1.37	
<b>Sequential Write</b>	0.79	1.29	1.29	1.29	1.29	1.29	
<b>Random Read</b>	0.76	1.58	1.58	1.58	1.58	1.58	
<b>Random Write</b>	0.79	1.15	1.15	1.15	1.15	1.15	mW
<b>Device Sleep</b>	3	3.3	3.3	3.3	3.3	3.3	

To measure consumption in /Slumber/ Active mode and Sequential Read/Write and Random Read/Write



### 3.5 Environmental Conditions

**Table 3-8 Temperature, Humidity, Shock, Vibration**

Feature	Operating	Non-Operating
Normal Temperature	0°C to 70°C	-55°C to 95°C
Wide Temperature	-40°C to 85°C	-55°C to 95°C
Humidity	0°C to 55°C / 5%~95% RH, non-condensing	
Vibration	20G Peak, 10~2000Hz	
Shock	1500G, duration 0.5ms, Half Sine Wave	

### 3.6 Reliability

**Table 3-9 Reliability Specification**

Parameter	Simulate Value
Mean Time Between Failures (MTBF) The MTBF statistics were calculated by Part Count Method, not relevant to individual units	2,000,000 hours

### 3.7 Endurance

Endurance for the SSD can be predicted based on the operating workload. The tables as below shows the drive lifetime for each SSD capacity based JESD219 client workload.

**Table 3-10 Tera Byte Written**

	32GB	64GB	128GB	256GB	512GB	1TB	Unit
TBW	25	50	100	210	430	850	TB

## 4.0 Supported Command Sets

### 4.1 Identify Controller

IDENTIFY DEVICE (ECh). This commands read out 512Bytes of drive parameter information. Parameter Information consists of the arrangement and value as shown in the following table. This command enables the host to receive the Identify Drive Information from the device.

Word	Value	F/V	Description
0	0040h	F 15 0 = ATA device X 14-8 Retired F 7 1 = removable media device X 6 Obsolete X 5-3 Retired F 2 Reserved X 1 Retired F 0 Reserved	General configuration bit-significant information:
1	XXXXh	X	Number of logical cylinders
2	C837h	V	Specific configuration
3	00XXh	X	Number of logical heads
4-5	XXXXh	X	Retired
6	XXXXh	X	Number of logical sector per logical track
7-8	XXXXh	V	Reserved for assignment by the CompactFlash_ Association
9	000Eh	X	Retired
10-19	XXXXh	F	Serial number (20 ASCII characters)
20-21	XXXXh	X	Retired
22	003Fh	X	Obsolete
23-26	XXXXh	F	Firmware revision (8 ASCII characters)
27-46	XXXXh	F	Model number (40 ASCII characters)
47	8000h	F 15-8 80h F 7-0 00h = Reserved F 01h = Maximum number of 1 sectors on READ/WRITE MULTIPLE commands	
48	4000h	F	Reserved
49	2F00h	F 15-14 Reserved for the IDENTIFY PACKET DEVICE command. F 13 1 = Standby timer values as specified in this standard are supported 0 = Standby timer values shall be managed by the device F 12 Reserved for the IDENTIFY PACKET DEVICE command. F 11 1 = IORDY supported 0 = IORDY may be supported F 10 1 = IORDY may be disabled F 9 1 = LBA supported	Capabilities

		F	8 1 = DMA supported.
		X	7-0 Retired
50	4000h		Capabilities
		F	15 Shall be cleared to zero.
		F	14 Shall be set to one.
		F	13-2 Reserved.
		X	1 Obsolete
		F	0 Shall be set to one to indicate a device specific Standby timer value minimum.
51-52	0000h	X	Obsolete
53	0007h		15-3 Reserved
		F	2 1 = the fields reported in word 88 are valid
		F	0 = the fields reported in word 88 are not valid
			1 1 = the fields reported in words 70:64 are valid
		F	0 = the fields reported in words 70:64 are not valid
			0 1 = the fields reported in words 58:54 are valid
		X	0 = the fields reported in words 58:54 are not valid
54-58	XXXXh	X	Obsolete
59	0000h		15-9 Reserved
			8 1 = Multiple sector setting is valid
		F	7-0 xxh = Setting for number of sectors that shall be transferred per interrupt on R/W
		V	Multiple
		V	command
60-61	XXXXh	F	Total number of user addressable sectors
62	0000h	X	Obsolete
63	0007h		15-11 Reserved
		V	10 1 = Multiword DMA mode 2 is selected
			0 = Multiword DMA mode 2 is not selected
		V	9 1 = Multiword DMA mode 1 is selected
			0 = Multiword DMA mode 1 is not selected
		V	8 1 = Multiword DMA mode 0 is selected
			0 = Multiword DMA mode 0 is not selected
		F	7-3 Reserved
		F	2 1 = Multiword DMA mode 2 and below are supported
		F	1 1 = Multiword DMA mode 1 and below are supported
		F	0 1 = Multiword DMA mode 0 is supported
64	0003h	F	15-8 Reserved
		F	7-0 Advanced PIO modes supported
65	0078h	F	Minimum Multiword DMA transfer cycle time per word
66	0078h	F	Manufacturer's recommended Multiword DMA transfer cycle time
67	0078h	F	Minimum PIO transfer cycle time without flow control
68	0078h	F	Minimum PIO transfer cycle time with IORDY flow control
69-74	0000h	F	Reserved (for future command overlap and queuing)

75	0000h	F	Queue depth 15:5 Reserved 4:0 Maximum queue depth - 1
76	xh	F	Serial ATA Capabilities 15:13 Reserved for Serial ATA 12 1 = Supports NCQ priority information 11 1 = Supports Unload while NCQ commands are outstanding 10 1 = Supports the SATA Phy Event Counters log 9 1 = Supports receipt of host initiated power management requests 8 1 = Supports the NCQ feature set 7:4 Reserved for Serial ATA 3 1 = Supports SATA Gen3 Signaling Speed (6.0Gb/s) 2 1 = Supports SATA Gen2 Signaling Speed (3.0Gb/s) 1 1 = Supports SATA Gen1 Signaling Speed (1.5Gb/s) 0 Shall be cleared to zero
77			Reserved
78	xh		Serial ATA features supported 15:7 Reserved for Serial ATA 6 1 = Device supports Software Settings Preservation 5 Reserved for Serial ATA 4 1 = Device supports in-order data delivery 3 1 = Device supports initiating power management 2 1 = Device supports DMA Setup auto-activation 1 1 = Device supports non-zero buffer offsets 0 Shall be cleared to zero
79	xh		Serial ATA features enabled 15:7 Reserved for Serial ATA 6 1 = Software Settings Preservation enabled 5 Reserved for Serial ATA 4 1 = In-order data delivery enabled 3 1 = Device initiated power management enabled 2 1 = DMA Setup auto-activation enabled 1 1 = Non-zero buffer offsets enabled F 0 Shall be cleared to zero
80	01FEh	F	Major version number 0000h or FFFFh = device does not report version F 15 Reserved F 14 Reserved for ATA/ATAPI-14 F 13 Reserved for ATA/ATAPI-13 F 12 Reserved for ATA/ATAPI-12 F 11 Reserved for ATA/ATAPI-11 F 10 Reserved for ATA/ATAPI-10 F 9 Reserved for ATA/ATAPI-9

		F 8 Reserved for ATA/ATAPI-8 F 7 1 = supports ATA/ATAPI-7 F 6 1 = supports ATA/ATAPI-6 F 5 1 = supports ATA/ATAPI-5 F 4 1 = supports ATA/ATAPI-4 X 3 Obsolete X 2 Obsolete F 1 Obsolete 0 Reserved
81	0021h	F Minor version number
82	0068h	Command set supported. 15 Obsolete X 14 1 = NOP command supported F 13 1 = READ BUFFER command supported F 12 1 = WRITE BUFFER command supported F 11 Obsolete X 10 1 = Host Protected Area feature set supported F 9 1 = DEVICE RESET command supported F 8 1 = SERVICE interrupt supported F 7 1 = release interrupt supported F 6 1 = look-ahead supported F 5 1 = write cache supported F 4 Shall be cleared to zero to indicate that the PACKET Command feature set is not supported. F 3 1 = mandatory Power Management feature set supported F 2 1 = Removable Media feature set supported F 1 1 = Security Mode feature set supported F 0 1 = SMART feature set supported
83	5000h	Command sets supported. F 15 Shall be cleared to zero F 14 Shall be set to one F 13-9 Reserved F 8 1 = SET MAX security extension supported F 7 Reserved F 6 1 = SET FEATURES subcommand required to spin up after power-up F 5 1 = Power-Up In Standby feature set supported F 4 1 = Removable Media Status Notification feature set supported F 3 1 = Advanced Power Management feature set supported F 2 1 = CFA feature set supported F 1 1 = READ/WRITE DMA QUEUED supported F 0 1 = DOWNLOAD MICROCODE command supported

84	4000h	<p>Command set/feature supported extension.</p> <p>F 15 Shall be cleared to zero</p> <p>F 14 Shall be set to one</p> <p>F 13-2 Reserved</p> <p>F 1 1 = SMART self-test supported</p> <p>F 0 1 = SMART error logging supported</p>
85	0008h	<p>Command set/feature enabled.</p> <p>15 Obsolete</p> <p>X 14 1 = NOP command enabled</p> <p>F 13 1 = READ BUFFER command enabled</p> <p>F 12 1 = WRITE BUFFER command enabled</p> <p>F 11 Obsolete</p> <p>X 10 1 = Host Protected Area feature set enabled</p> <p>V 9 1 = DEVICE RESET command enabled</p> <p>F 8 1 = SERVICE interrupt enabled</p> <p>V 7 1 = release interrupt enabled</p> <p>V 6 1 = look-ahead enabled</p> <p>V 5 1 = write cache enabled</p> <p>V 4 Shall be cleared to zero to indicate that the PACKET Command feature set is not supported.</p> <p>F 3 1 = Power Management feature set enabled</p> <p>F 2 1 = Removable Media feature set enabled</p> <p>V 1 1 = Security Mode feature set enabled</p> <p>V 0 1 = SMART feature set enabled</p>
86	5000h	<p>Command set/feature enabled.</p> <p>F 15-9 Reserved</p> <p>F 8 1 = SET MAX security extension enabled by SET MAX SET PASSWORD</p> <p>F 7 See Address Offset Reserved Area Boot, INCITS TR27:2001</p> <p>F 6 1 = SET FEATURES subcommand required to spin-up after power-up</p> <p>V 5 1 = Power-Up In Standby feature set enabled</p> <p>V 4 1 = Removable Media Status Notification feature set enabled</p> <p>V 3-1 1 = Advanced Power Management feature set enabled</p> <p>F 0 1 = DOWNLOAD MICROCODE command supported</p>
87	4000h	<p>Command set/feature default.</p> <p>F 15 Shall be cleared to zero</p> <p>F 14 Shall be set to one</p> <p>F 13-2 Reserved</p> <p>F 1 1 = SMART self-test supported</p> <p>F 0 1 = SMART error logging supported</p>
88	xh	<p>V 15-14 Reserved</p> <p>13 1 = Ultra DMA mode 5 is selected</p> <p>V 0 = Ultra DMA mode 5 is not selected</p>

		V	12 1 = Ultra DMA mode 4 is selected 0 = Ultra DMA mode 4 is not selected
		V	11 1 = Ultra DMA mode 3 is selected 0 = Ultra DMA mode 3 is not selected
		V	10 1 = Ultra DMA mode 2 is selected 0 = Ultra DMA mode 2 is not selected
		F	9 1 = Ultra DMA mode 1 is selected 0 = Ultra DMA mode 1 is not selected
		F	8 1 = Ultra DMA mode 0 is selected 0 = Ultra DMA mode 0 is not selected
		F	7-6 Reserved
		F	5 1 = Ultra DMA mode 5 and below are supported
		F	4 1 = Ultra DMA mode 4 and below are supported
			3 1 = Ultra DMA mode 3 and below are supported
			2 1 = Ultra DMA mode 2 and below are supported
			1 1 = Ultra DMA mode 1 and below are supported
			0 1 = Ultra DMA mode 0 is supported
89	0000h	F	Time required for security erase unit completion
90	0000h	F	Time required for Enhanced security erase completion
91	0000h	V	Current advanced power management value
92	0000h	V	Master Password Revision Code
93	0000h	X	Hardware reset result
94-126	0000h	V	Reserved
127	0000h	F	Removable Media Status Notification feature set support 15-2 Reserved 1-0 00 = Removable Media Status Notification feature set not supported 01 = Removable Media Status Notification feature supported
		F	10 = Reserved 11 = Reserved
128	0001h	F	Security status 15-9 Reserved
		V	8 Security level 0 = High, 1 = Maximum
		F	7-6 Reserved
		F	5 1 = Enhanced security erase supported
		V	4 1 = Security count expired
		V	3 1 = Security frozen
		V	2 1 = Security locked
		V	1 1 = Security enabled
		F	0 1 = Security supported
129-159	0000h	X	Vendor specific
160-254	0000h	X	Reserved

255	0000h	X	Integrity word 15-8 Checksum 7-0 Signature
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Note:

F/V = Fixed/variable content

F = the content of the word is fixed and does not change. For removable media devices, these values may change when media is removed or changed.

V = the contents of the word is variable and may change depending on the state of the device or the commands executed by the device.

X = the content of the word may be fixed or variable.



## 4.2 S.M.A.R.T. Attribute

The following table defines the vendor specific data in byte 2 to 361 of the 512-byte SMART data.

**Table 4-3 S.M.A.R.T. Attribute**

ID (Dec)	ID (Hex)	Attribute Description	Flag	Threshold
9	09h	Power-On Hours Count	32h	00h (N/A)
12	0Ch	Drive Power Cycle Count	32h	00h (N/A)
167	A7h	SSD Protect Mode	22h	00h (N/A)
168	A8h	PHY Error Count	32h	00h (N/A)
169	A9h	Bad Block Count	32h	0Ah
173	ADh	Erase Count	32h	00h (N/A)
175	AFh	Bad Cluster Table Count	22h	0Ah
180	B4h	User Block Count Left	33h	14h
192	C0h	Unexpected Power Loss Count	32h	00h (N/A)
194	C2h	Temperature	22h	1Eh
231	E7h	SSD Life Left	23h	05h
233	E9h	Write Sector Count to NAND	32h	00h (N/A)
234	EAh	Read Sector Count from NAND	32h	00h (N/A)
241	F1h	Write Sector Count	32h	00h (N/A)
242	F2h	Read Sector Count	32h	00h (N/A)

## 5.0 Pin assignment and descriptions

Top Side			Bottom Side		
No.	Pin	Descriptions	Descriptions	Pin	No
75	GND	System Ground			
73	GND	System Ground	3.3V	POWER	74
71	GND	System Ground	3.3V	POWER	72
69	GND	System Ground	3.3V	POWER	70
67	NC	NC	3.3V	POWER	68
Module-KEY					
57	GND	System Ground	MFG_CLK	UART	58
55	NC	NC	MFG_DATA	UART	56
53	NC	NC	NC	NC	54
51	GND	System Ground	NC	NC	52
49	Diff	SATA-A+	NC	NC	50
47	Diff	SATA-A-	NC	NC	48
45	GND	System Ground	NC	NC	46
43	Diff	SATA-B-	NC	NC	44
41	Diff	SATA-B+	NC	NC	42
39	GND	System Ground	NC	NC	40
37	NC	NC	DEVSLP	DEVSLP	38
35	NC	NC	NC	NC	36
33	GND	System Ground	NC	NC	34
31	NC	NC	NC	NC	32
29	NC	NC	NC	NC	30
27	GND	System Ground	NC	NC	28
25	NC	NC	NC	NC	26
23	NC	NC	NC	NC	24
21	GND	System Ground	NC	NC	22
			NC	NC	20
Module-KEY					
11	NC	NC			
9	NC	NC	LED1#(option)	INDICATE	10
7	NC	NC	NC	NC	8
5	NC	NC	NC	NC	6
3	GND	System Ground	3.3V	POWER	4
1	GND	System Ground	3.3V	POWER	2

## 6.0 Product Line up

Table 6-1 Product Line up

Part Number	Capacity	Type	Remark
IM2S3168-128GD	128GB	M.2 2280 SATA	Normal, 0°C-70°C
IM2S3168-256GD	256GB	M.2 2280 SATA	Normal, 0°C-70°C
IM2S3168-512GD	512GB	M.2 2280 SATA	Normal, 0°C-70°C
IM2S3168-001TD	1TB	M.2 2280 SATA	Normal, 0°C-70°C
IM2S3168-128GP	128GB	M.2 2280 SATA	Wide, -40°C-85°C
IM2S3168-256GP	256GB	M.2 2280 SATA	Wide, -40°C-85°C
IM2S3168-512GP	512GB	M.2 2280 SATA	Wide, -40°C-85°C
IM2S3168-001TP	1TB	M.2 2280 SATA	Wide, -40°C-85°C

## 7.0 Package Specifications

