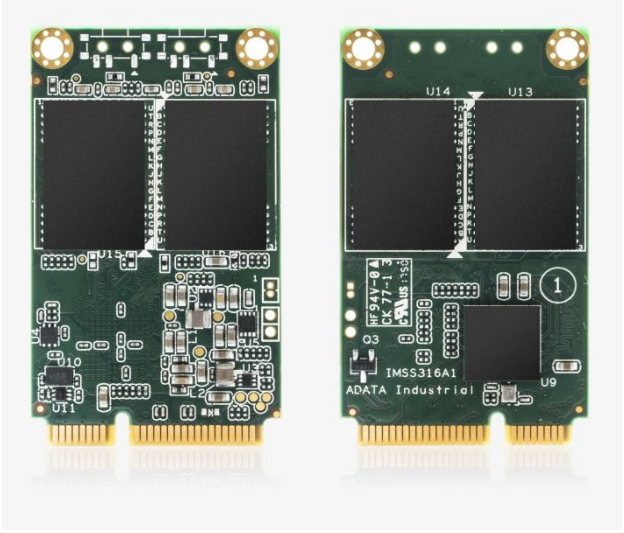
mSATA SSD

IMSS316

64GB、128GB、256GB、512GB、1TB

Product Datasheet

Version 0



Revision History

Revision	Date	Description	Editor
0	May.23.2019	Modify format	Andrew

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Key Features:

- **Capacity:**

  64GB, 128GB, 256GB, 512GB, 1TB

- **NAND Flash:** 3D TLC
- **Form Factor:** mSATA
- **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
  - Max Random 4K Read:

    Up to 90,000
  - Max Random 4K Write:

    Up to 70,000
- **Power Consumption:**
  - Slumber: 0.07W
  - Active: 0.62W
  - SR/SW : 1.37W / 1.29W
  - RR/RW: 1.58W / 1.15W
  - Device Sleep : 3.3mW
- **Temperature:**
  - Operation: 0°C ~ 70°C (Normal)
  - Operation: -40°C ~ 85°C(Wide)
  - Non-operation: -55°C to 95°C
- **Reliability**
  - Shock: 1500G/0.5ms
  - Vibration 20G Peak, 10~2000Hz
  - MTBF: 2,000,000 hours
  - TBW :850 TB

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 mSATA SSD IMSS316 offers capacities 64GB、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. “

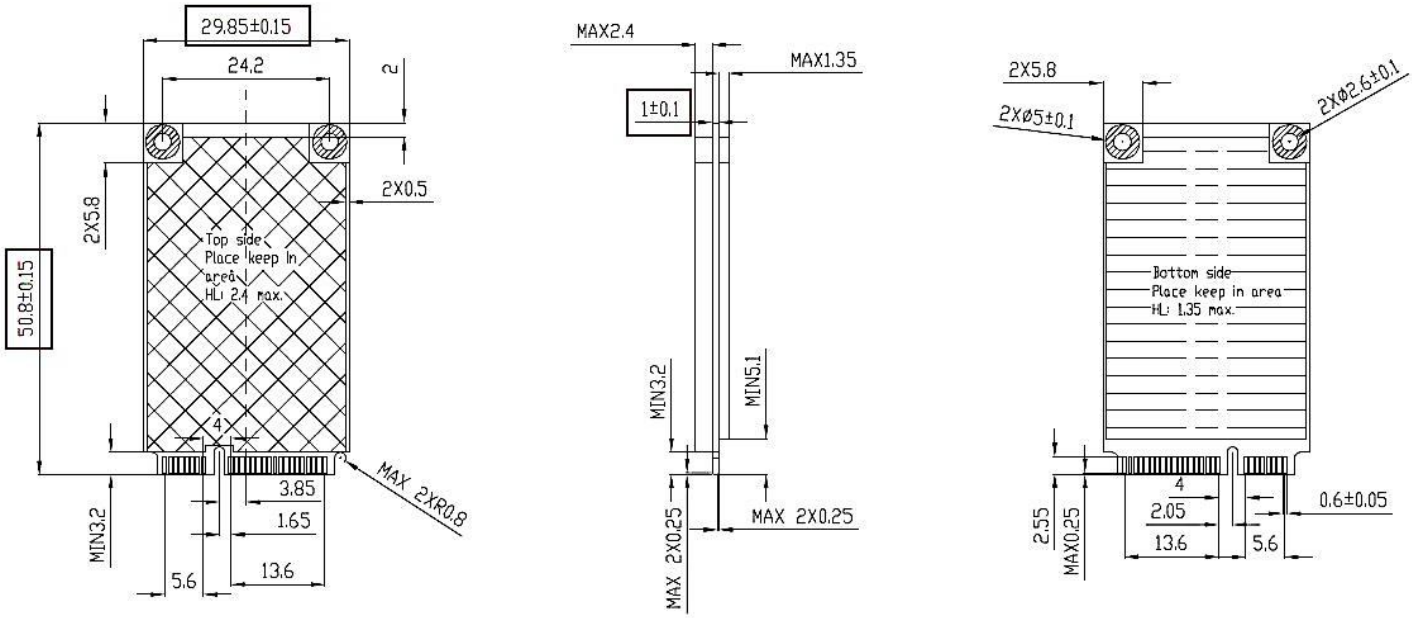
2.1 Physical dimensions and Weight

Table 2-1 Dimensions and Weight

Model	Length(mm)	Width(mm)	Height(mm)	Weight(gram)
IMSS316	Max 50.95	Max 30	Max 4.85	Max 7±1g

2.2 Product Dimensions

Figure 2-1 Product Dimensions of mSATA



3.0 Product Specification

3.1 Interface and configuration

- Compliant with Serial ATA International Organization: Serial ATA Revision 3.1
- Compliant SSD Alliance compliance program.
- Support ATA-8 Command Set
- Support 1-port 1.5/3.0/6.0 Gbps SATA I/II/III interface.

3.2 Capacity

Table 3-1 User Addressable Sectors

Model	IMSS316				
Unformatted Capacity	64GB	128GB	256GB	512GB	1TB
Total User Addressable Sectors (LBA Mode)	125,045,424	250,069,680	500,118,192	1,000,215,216	2,000,409,264

Total useable capacity may be less (duo 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)

	64GB	128GB	256GB	512GB	1TB	Unit
Sequential Read	450	550	550	550	550	MB/s
Sequential Write	250	460	470	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)

	64GB	128GB	256GB	512GB	1TB	Unit
Sequential Q32 Read	450	560	560	560	560	MB/s
Sequential Q32 Write	250	470	500	530	500	MB/s
4K-QD32 Read	140	240	270	360	270	MB/s
4K-QD32 Write	230	300	300	310	300	MB/s

-Seq. Read & Write speed test by Crystal Disk Mark 5.2.1

3.3.3 IOPS Performance

Table 3-4 Read/Write & IOPS Performance

	64GB	128GB	256GB	512GB	1TB	Unit
4K Random Read	20K	60K	90K	90K	90K	IOPS
4K Random Write	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)

	64GB	128GB	256GB	512GB	1TB	Unit
Sequential Read	350	500	500	520	490	MB/s
Sequential Write	60	430	450	470	440	MB/s
4K-64 Thrd Read	70	130	220	250	250	MB/s
4K-64 Thrd Write	190	250	250	260	250	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	
Input Power	DC 3.3V ± 5%
Maximum Ripple	100mV p-p or less

3.4.2 Power Consumption (Typical)

Table 3-8 Power Consumption (Typical)

	64GB	128GB	256GB	512GB	1TB	Unit
Slumber	0.07	0.07	0.07	0.07	0.07	W
Active	0.62	0.62	0.62	0.62	0.62	W
Sequential Read	1.37	1.37	1.37	1.37	1.37	W
Sequential Write	1.29	1.29	1.29	1.29	1.29	W
Random Read	1.58	1.58	1.58	1.58	1.58	W
Random Write	1.15	1.15	1.15	1.15	1.15	W
Device Sleep	3.3m	3.3m	3.3m	3.3m	3.3m	W

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

3.5 Environmental Conditions

Table 3-9 Temperature, Humidity, Shock, Vibration

Feature	Operating (Commercial)	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	5%~95% RH, non-condensing	
Vibration	20G Peak, 10~2000Hz	
Shock	1500G, duration 0.5ms, Half Sine Wave	

3.6 Reliability

3.6.1 MTBF

Table 3-10 Reliability Specification

Parameter	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 on JESD219 Client workload.

Table 3-11 Reliability Specification

Total Byte Written (TBW)	64GB	128GB	256GB	512GB	1TB	Unit
	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		General configuration bit-significant information:
		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
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		Capabilities
		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
		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
		V	R/W Multiple
		V	command
60-61	XXXXh	F	Total number of user addressable sectors
62	0000h	X	Obsolete

63	0007h	F V V V F F F F	15-11 Reserved 10 1 = Multiword DMA mode 2 is selected 0 = Multiword DMA mode 2 is not selected 9 1 = Multiword DMA mode 1 is selected 0 = Multiword DMA mode 1 is not selected 8 1 = Multiword DMA mode 0 is selected 0 = Multiword DMA mode 0 is not selected 7-3 Reserved 2 1 = Multiword DMA mode 2 and below are supported 1 1 = Multiword DMA mode 1 and below are supported 0 1 = Multiword DMA mode 0 is supported
64	0003h	F F	15-8 Reserved 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		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 F 3 Obsolete X 2 Obsolete X 1 Obsolete F 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
		F	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		Command set/feature supported extension.
		F	15 Shall be cleared to zero
		F	14 Shall be set to one
		F	13-2 Reserved
		F	1 1 = SMART self-test supported
		F	0 1 = SMART error logging supported

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

88	xh	V V V V V F F F F F F	15-14 Reserved 13 1 = Ultra DMA mode 5 is selected 0 = Ultra DMA mode 5 is not selected 12 1 = Ultra DMA mode 4 is selected 0 = Ultra DMA mode 4 is not selected 11 1 = Ultra DMA mode 3 is selected 0 = Ultra DMA mode 3 is not selected 10 1 = Ultra DMA mode 2 is selected 0 = Ultra DMA mode 2 is not selected 9 1 = Ultra DMA mode 1 is selected 0 = Ultra DMA mode 1 is not selected 8 1 = Ultra DMA mode 0 is selected 0 = Ultra DMA mode 0 is not selected 7-6 Reserved 5 1 = Ultra DMA mode 5 and below are supported 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 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 10 = Reserved 11 = Reserved

128	0001h		Security status
		F	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		Integrity word
			15-8 Checksum
		X	7-0 Signature

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 SMART Attribute

ID (Hex)	Attribute Description
09h	Power-On Hours Count
0Ch	Drive Power Cycle Count
A7h	SSD Protect Mode
A8h	PHY Error Count
A9h	Bad Block Count
ADh	Erase Count
AFh	Bad Cluster Table Count
B4h	User Block Count Left
C0h	Unexpected Power Loss Count
C2h	Temperature
E7h	SSD Life Left
E9h	Write Sector Count to Nand
EAh	Read Sector Count from Nand
F1h	Write Sector Count
F2h	Read Sector Count

5.0 Pin assignment and descriptions

5.1 mSATA Interface

Figure 5-1 mSATA Interface

Pin	Assignment	Descriptions	Descriptions	Assignment	Pin
1	N/A	No Connect	System Ground	GND	27
2	3.3V	DC 3.3V input source	Reserved	Reserved	28
3	N/A	No Connect	System Ground	GND	29
4	GND	System Ground	No Connect	N/A	30
5	N/A	No Connect	SATA Differential RX-	SATA_RX- -	31
6	Reserved	Reserved	No Connect	N/A	32
7	N/A	No Connect	SATA Differential RX+	SATA_RX+	33
8	N/A	No Connect	System Ground	GND	34
9	GND	System Ground	System Ground	GND	35
10	N/A	No Connect	Reserved	Reserved	36
11	N/A	No Connect	System Ground	GND	37
12	N/A	No Connect	Reserved	Reserved	38
13	N/A	No Connect	DC 3.3V input source	3.3V	39
14	N/A	No Connect	System Ground	GND	40
15	GND	System Ground	DC 3.3V input source	3.3V	41
16	N/A	No Connect	No Connect	N/A	42
17	N/A	No Connect	No Connect	N/A	43
18	GND	System Ground	System Activity	DevSlp	44
19	Reserved	Reserved	Reserved	Reserved	45
20	Reserved	Reserved	No Connect	N/A	46
21	GND	System Ground	Reserved	Reserved	47
22	N/A	No Connect	Reserved	Reserved	48
23	SATA_TX+	SATA Differential TX+	Device Activity	DAS/DSS	49
24	3.3V	DC 3.3V input source	System Ground	GND	50
25	SATA_TX-	SATA Differential TX-	System Ground	GND	51
26	GND	System Ground	DC 3.3V input source	3.3V	52

6.0 Product Line up

Table 6-1 Product Line up

Part Number	Capacity	Type	Remark
IMSS316-064GD	64GB	mSATA	Normal, 0~70℃
IMSS316-128GD	128GB	mSATA	Normal, 0~70℃
IMSS316-256GD	256GB	mSATA	Normal, 0~70℃
IMSS316-512GD	512GB	mSATA	Normal, 0~70℃
IMSS316-001TD	1TB	mSATA	Normal, 0~70℃
IMSS316-064GP	64GB	mSATA	Wide, -40~85℃
IMSS316-128GP	128GB	mSATA	Wide, -40~85℃
IMSS316-256GP	256GB	mSATA	Wide, -40~85℃
IMSS316-512GP	512GB	mSATA	Wide, -40~85℃
IMSS316-001TP	1TB	mSATA	Wide, -40~85℃

7.0 Package Specifications

Figure 7-1 Package