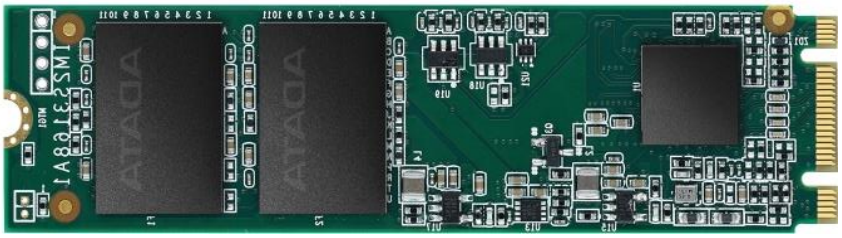
M.2 SATA SSD



(Photo for reference only.)

Version 5.0

Jan. 12, 2022

SU650NS38

120GB, 128GB, 240GB, 256GB, 480GB, 512GB, 1TB

Revision History

Revision	Date	Description	Editor
1.0	May. 22, 2019	Initial Release	Bunny Xing
2.0	Aug. 30, 2019	Change Package	Bunny Xing
2.1	Mar. 05, 2021	Update Format	Bunny Xing
3.0	Mar. 29, 2021	Update Information	Bunny Xing
3.1	Apr. 21, 2021	Update Format	Phil Fei
4.0	Oct. 12, 2021	Add 256GB、512GB、1TB	Bunny Xing
5.0	Jan. 12, 2022	Add 128GB	Bunny Xing

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Key Features

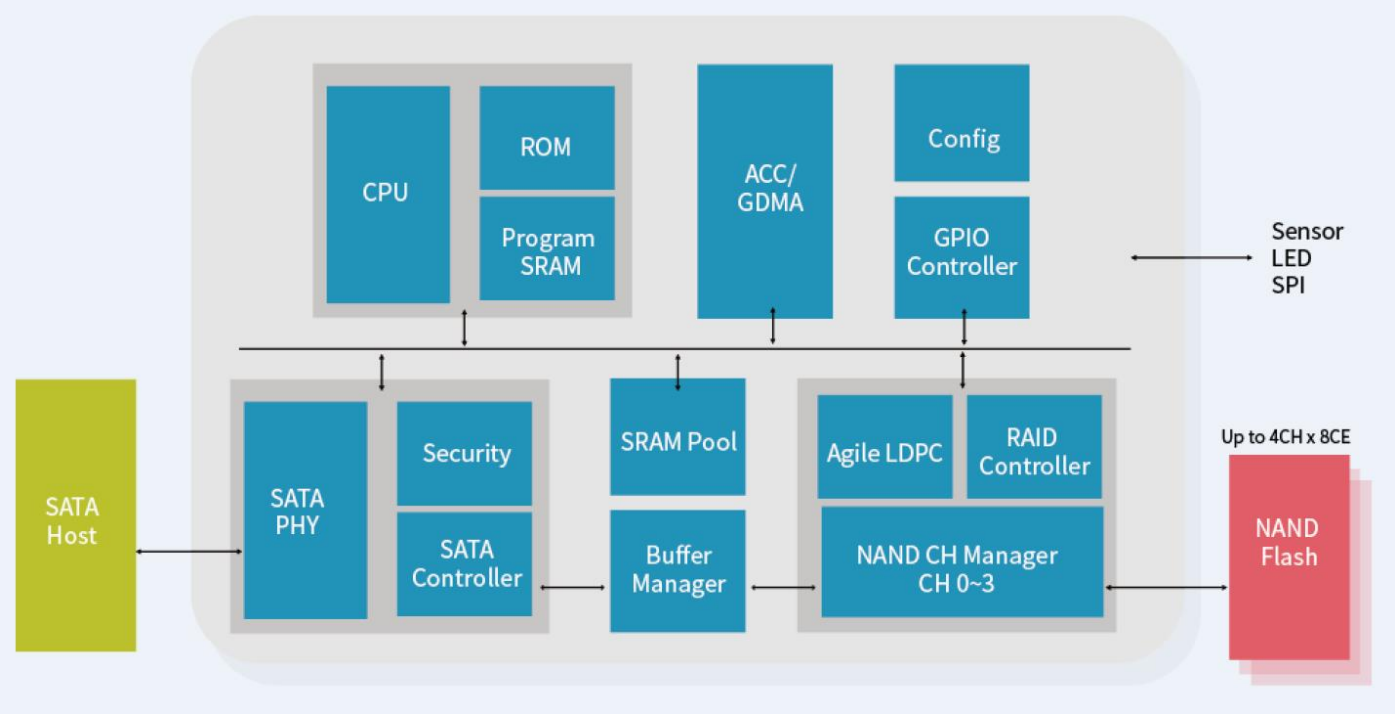
- **Capacity:**
  - 120GB, 128GB, 240GB, 256GB , 480GB, 512GB, 1TB
- **NAND Flash:** 3D NAND
- **Form Factor:** M.2 2280
- **Host Interface:**
  - Serial ATA 6Gb/s interface
  - Compliant with ATA-8 Standard
  - Compliant SATA Revision 3.2
- **Flash Management:**
  - LDPC ECC engine
  - RAID engine
  - Enhanced endurance by Static /dynamic wear leveling
  - Bad block management
  - Garbage collection
  - TRIM command
  - SLC cache technology
  - NCQ command
- **Data Integrity:**
  - Thermal throttling
  - S.M.A.R.T. monitor
- **Performance:**
  - Sequential Read: Up to 550 MB/s
  - Sequential Write: Up to 510 MB/s
  - Random 4K Read: Up to 80K IOPS
  - Random 4K Write: Up to 60K IOPS
- **Power Consumption:**
  - Slumber: 0.65W
  - Idle: 0.79W
  - Sequential Read/Write : 1.74W/1.88W
  - Random Read/Write : 1.71W/1.64W
- **Temperature:**
  - Standard: 0°C ~ 70°C
  - Non-operation: -40°C ~ 85°C
- **Reliability:**
  - Shock: 1500G/0.5ms
  - Vibration 20G Peak, 20~2000Hz
  - MTBF: 2,000,000 hours
- **Endurance:**
  - TBW: Up to 420TB

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 SU650NS38 offers capacities 120GB、128GB、240GB、256GB、480GB、512GB、1TB using 3D TLC type flash memories.

1.1 Functional Block

Figure 1-1 Functional Block



2.0 Mechanical Specifications

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

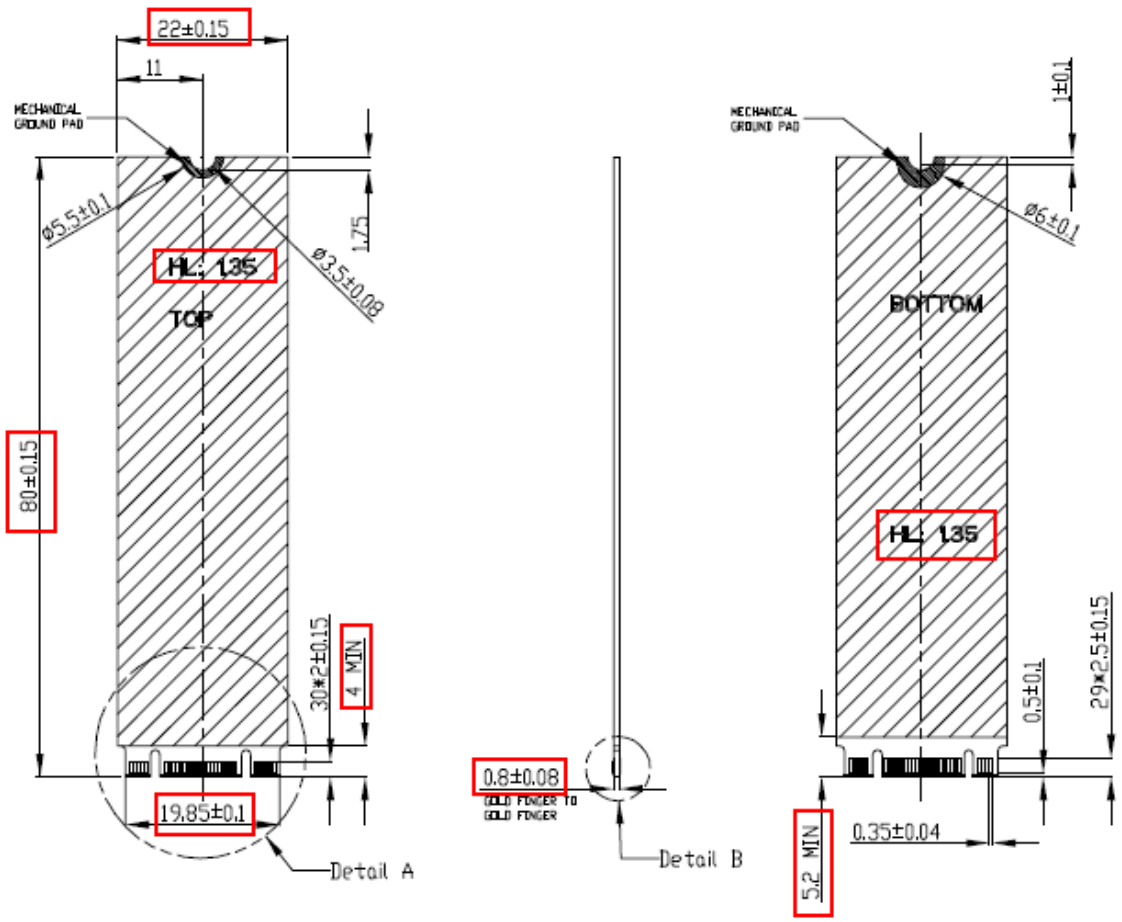
2.1 Physical Dimensions and Weights

Table 2-1 Dimensions and Weights

Capacity(GB)	Length(mm)	Width(mm)	Height(mm)	Weight(gram)
120GB	80±0.15	22±0.15	Max 3.58	Max 6±1g
128GB	80±0.15	22±0.15	Max 3.58	Max 6±1g
240GB	80±0.15	22±0.15	Max 3.58	Max 6±1g
256GB	80±0.15	22±0.15	Max 3.58	Max 6±1g
480GB	80±0.15	22±0.15	Max 3.58	Max 6±1g
512GB	80±0.15	22±0.15	Max 3.58	Max 6±1g
1TB	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 Configurations

- Compliant with Serial ATA International Organization: Serial ATA revision 3.2
- Compliant with 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	**SU650NS38**						
Unformatted Capacity	120GB	128GB	240GB	256GB	480GB	512GB	1TB
Total User Addressable Sectors (LBA Mode)	234,441,648	250,069,680	468,862,128	500,118,192	937,703,088	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 ATTO Performance

Table 3-2 Read/Write Performance (ATTO)

	120GB	**128GB**	**240GB**	**256GB**	**480GB**	**512GB**	**1TB**	**Unit**
Sequential Read	550	550	550	550	550	550	550	MB/s
Sequential Write	410	410	500	500	510	510	510	MB/s

-Seq. Read & Write speed test by ATTO
-The system conditions and test environment may affect test result

3.3.2 CDM Performance

Table 3-3 Read/Write Performance (CDM)

	120GB	**128GB**	**240GB**	**256GB**	**480GB**	**512GB**	**1TB**	**Unit**
Sequential Q32 Read	550	550	550	550	550	550	550	MB/s
Sequential Q32 Write	410	410	500	500	510	510	510	MB/s

-Seq. Read & Write speed test by Crystal Disk Mark 6.0.2

3.3.3 IOPS Performance

Table 3-4 Read/Write IOPS Performance

	120GB	128GB	240GB	256GB	480GB	512GB	1TB	Unit
4K Random Read	60K	60K	80K	80K	80K	80K	80K	IOPS
4K Random Write	40K	40K	60K	60K	60K	60K	60K	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)
-Different system conditions and test environments may affect test results

3.3.4 AS-SSD Performance

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

	120GB	128GB	240GB	256GB	480GB	512GB	1TB	Unit
Sequential Read	520	520	520	520	520	520	520	MB/s
Sequential Write	380	380	460	460	460	460	460	MB/s
4K-64 Thrd Read	100	100	220	160	200	190	200	MB/s
4K-64 Thrd Write	260	260	260	260	250	260	260	MB/s

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

3.4 Electrical Specifications

3.4.1 Operating Voltage

Table 3-6 Operating Voltage

Operating Voltage	
Input Power	DC 3.3V ± 5%
Maximum Allowable Ripple	100mV p-p

3.4.2 Power Consumption

Table 3-7 Power Consumption (Typical)

	120GB	128GB	240GB	256GB	480GB	512GB	1TB	Unit
Slumber	0.64	0.29	0.65	0.42	0.65	0.29	0.29	**W**
Idle	0.68	0.46	0.68	0.45	0.79	0.29	0.29	**W**
Sequential Read	1.30	0.94	1.35	1.68	1.13	1.74	1.09	**W**
Sequential Write	1.20	1.03	1.42	1.84	1.53	1.88	1.21	**W**
Random Read	1.20	0.88	1.31	1.57	1.36	1.71	1.17	**W**
Random Write	1.05	0.84	1.16	1.36	1.15	1.64	1.06	**W**

- The typical value means to measure the power consumption by using IO Meter with 128KB Sequential and 4K Random read/write transfers within 15 minutes.
- The measurement may vary among different host systems and settings.

3.5 Environmental Conditions

Table 3-8 Temperature and Humidity

Feature	Operating	Non-Operating
Standard Temperature	0°C to 70°C	-40°C to 85°C
Humidity	5%~95% RH, non-condensing	

3.6 Reliability

Table 3-9 Shock and Vibration

Parameter	Conditions	Reference Standards
Shock	1500G, 3 axes, duration 0.5ms, Half Sine Wave	JESD22-B110
Vibration	20G , 3 axes , Peak, 20~2000Hz	JESD22-B103

Table 3-10 MTBF

Parameter	Conditions	Hours
MTBF	JESD219A	2,000,000

3.7 Endurance

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

Table 3-11 Terabytes Written

Capacity	120GB	128GB	240GB	256GB	480GB	512GB	1TB	Unit
TBW	70	70	140	140	210	210	420	TB

4.0 Support Command Sets

4.1 Identify Device Command

IDENTIFY DEVICE (ECh). These 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.

Table 4-1 Identify Device Table

Word	F/V/X	Default Value	Description
0	F	0040h	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	0000h	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 numbers of cylinders
55	X	XXXXh	Current numbers 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	0101h	Multiple sector setting
60 - 61	F	XXXXh	Total number of user addressable logical sectors for 28-bit commands (DWord)
62	X	0000h	Reserved
63	F	0207h	Multiword DMA transfer Supports MDMA mode 0, 1 and 2
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	F	4000h	Additional supported
70 - 74	F	0000h	Reserved
75	F	001Fh	Queue depth
76	F	070Eh	Serial ATA capabilities • Supports Serial ATA Gen3 • Supports Serial ATA Gen2 • Supports Serial ATA Gen1 • Supports Phy event counters log • Supports receipt of host initiated power management requests • Supports Native Command Queuing
77	F	0080h	Serial ATA additional capability • DevSleep_to_ReducedPwerState
78	F	0148h	Serial ATA features supported • Supports Device Sleep • Supports software settings preservation • Device supports initiating power management
79	V	0040h	Reserved
80	F	03F0h	Major version number (ACS-2)
81	F	0000h	Minor version number
82	F	742Bh	Command sets supported 0
83	F	7500h	Command sets supported 1
84	F	4023h	Command sets supported 2
85 - 87	V	XXXXh	Command set/feature enabled
88	V	007Fh	Ultra DMA mode supported and selected
89	F	0003h	Time required for a Normal Erase mode Security Erase Unit command
90	F	0001h	Time required for an Enhanced Erase mode Security Erase Unit

			command
91	V	0000h	Current advanced power management value
92	V	FFFEh	Master password identifier
93 - 99	V	0000h	Reserved
100 - 103	V	XXXXh	Maximum user LBA for 48-bit address feature set
104	V	0000h	Reserved
105	F	0100h	Maximum number of 512-byte blocks per Data Set Management command
106 - 127	V	0000h	Reserved
128	V	0001h	Security status
129 - 159	X	XXXXh	Vendor specific
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 - 168	V	0000h	Reserved
169	F	0001h	Data Set Management supported
170 - 216	V	XXXXh	Reserved
217	F	0001h	Non-rotating media (SSD)
218 - 221	X	0000h	Reserved
222	F	107Fh	Transport major revision (SATA Rev 3.2)
223 - 254	X	0000h	Reserved
255	X	XXXXh	Integrity word

Notes:
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 4-2 S.M.A.R.T. Attribute

Attribute ID (hex)	Attribute Name
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

Table 5-1 Pin assignment and descriptions

Signals	S1	GND	System Ground
	S2	Rx+	Differential signals pair receive
	S3	Rx-	
	S4	GND	System Ground
	S5	Tx-	Differential signals pair transmit
	S6	Tx+	
	S7	GND	System Ground
Power	P1	V33	NC
	P2	V33	NC
	P3	DEVSLP	Device Sleep Signal Pin
	P4	GND	System Ground
	P5	GND	System Ground
	P6	GND	System Ground
	P7	V5/PC	+5V Power supply, 2nd Pre-charge
	P8	V5	+5V Power supply
	P9	V5	+5V Power supply
	P10	GND	System Ground
	P11	DAS	Reserved
	P12	GND	System Ground
	P13	V12/PC	NC
	P14	V12	NC
	P15	V12	NC

6.0 Ordering Information

Table 6-1 Ordering Information

Model Name	Capacity	Type	Remark
ASU650NS38-120GT-C	120GB	M.2 2280 SATA	0℃~70℃
ASU650NS38-128GT-C	128GB	M.2 2280 SATA	
ASU650NS38-240GT-C	240GB	M.2 2280 SATA	
ASU650NS38-256GT-C	256GB	M.2 2280 SATA	
ASU650NS38-480GT-C	480GB	M.2 2280 SATA	
ASU650NS38-512GT-C	512GB	M.2 2280 SATA	
ASU650NS38-1TT-C	1TB	M.2 2280 SATA	

7.0 Package Specification

Figure 7-1 Package Specification