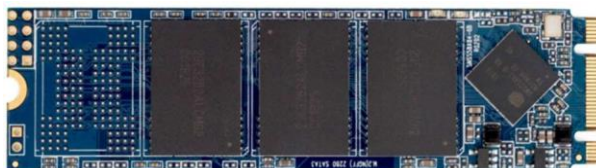


M.2 NGFF 2280 SATA DATASHEET

M.2 NGFF 2280 SATA-III SOLID STATE DRIVE



The information and specification provided in this document should be used for comparative analysis and reference purposes. The contents of this document are subject to change without prior notice.

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1.0 PRODUCT DESCRIPTION

1.1 PRODUCT OVERVIEW

The introduction of the NGFF is full consists of semiconductor devices using NAND flash memory which provide high reliability and high performance for a storage media. And opens up some very exciting possibilities for the Industrial and Commercial storage market. The NGFF are substantially smaller, lighter weight and consume less power compared to hard drives, yet have sufficient storage space to load an O/S and serve as a bootable drive for embedded applications. Moreover, these devices have excellent resistance to shock, vibration, dust, temperature extremes and other environmental hazards.

NGFF which features outstanding performance. Available in 64GB to 2TB capacities, this drives electrically complied with the SATA-II/SATA-III standards and is electrically compatible with a serial ATA disk drive.

Measuring 22.0mm x 80.0mmx 2.2mm, the NGFF is very small in volume and Super Speed, it can match and satisfy different customer's demand. It can easily mount on notebook without any cable, and provides fast read and writes speed, high reliability it an ideal storage solution for the server and mobile environment.

1.2 TARGET APPLICATIONS

- Military and Aerospace
- Embedded / Industrial Systems
- Medical Industry
- Notebook
- Casino Gaming

1.3 PRODUCT FEATURES

- Capacity: 64GB, 128GB, 256GB,512GB,1TB,2TB
- Form Factor: 80mm M.2 (80mm NGFF B Key)
- Reliable TLC or MLC or SLC NAND type flash
- Electrically fully complied with the SATA-II/SATA-III standards
- Complied with the slot B primary key SSD SATA pinout
- Modules with the "B" and "M" key for ultimate performance SSD or cache
- Data retention: JESD47 compliant
- S.M.A.R.T. command transport (SCT) technology

- Enhanced endurance by dynamic/static wear-leveling
- Hardware BCH ECC 66 bits in 1,024 bytes
- Data integrity under power-cycling
- Spec meet Next Generation Form Factor (NGFF-xx-B-M)
- 100% tested HW and SW

1.4 SYSTEM REQUIREMENTS

Operating Voltage Requirement: $V_{cc} = 3.3V \pm 5\%$

Operating System: Supported by all operating systems

Interface: SATA 6.0Gbps (SATA-III) or SATA 3.0Gbps (SATA-II) or SATA 1.5Gbps (SATA-I)

Installation Requirements:

- System Hardware which supports SATA-II/SATA-III standards
- System Hardware includes NGFF socket or transfer board

2.0 PRODUCT ORDERING PART NUMBERS

2.1 ORDERING PART STRUCTURE

Table 1: Ordering Part Structure

<u>Prefix</u> X	<u>Product</u> XX	<u>Controller</u> XX	<u>Density</u> XXXX	<u>Flash Comp.</u> XX	<u>Temp. & Remark</u> X
A	SC- SATA III M.2 NGFF 2280	SA-SM2258XT	064G - 64GByte 128G - 128GByte 256G - 256GByte 512G - 512GByte 001T -1024GByte	XT - TLC	C-Commercial

2.2 VALID ORDERING PART NUMBERS

Table 2: Valid Ordering Part Numbers

Product Family	Capacity	Flash	Form Factor	Part Number
M.2 NGFF	64GB	TLC	M.2 2280	ASCSA064GXTC
	128GB			ASCSA128GXTC
	256GB			ASCSA256GXTC
	512GB			ASCSA512GXTC
	1TB			ASCSA001TXTC

3.0 PHYSICAL SPECIFICATIONS

3.1 MECHANICAL SPECIFICATIONS(PCBA)

Length: 80.0 ± 0.2 mm

Width: 22.0 ± 0.2 mm

Thickness: 2.20 ± 0.15 mm

Weight: <7.0g

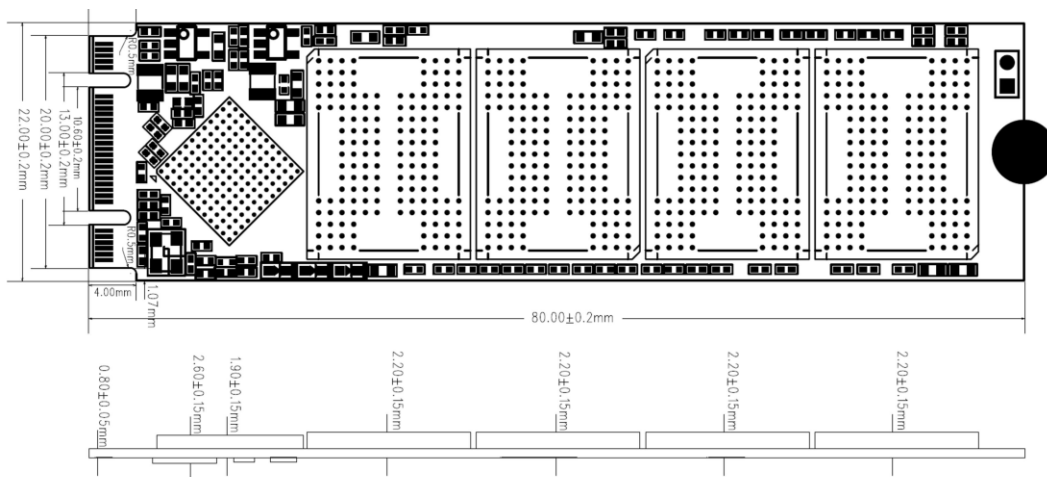


Figure 1: NGFF Outline Drawing

4.0 ELECTRICAL SPECIFICATIONS

Operating Voltage: $V_{CC} = 3.3V \pm 5\%$

Modes: SATA 6.0Gbps (SATA-III) or SATA 3.0Gbps (SATA-II) or SATA 1.5Gbps (SATA-I) standards

4.1 PERFORMANCE SPECIFICATIONS

Access Time: 0.2 ms

Seek Time: 0 ms

Mount Time: Dependent on system HW and SW

Power on to Ready: Dependent on system HW and SW

Data Transfer Time: Rated Data Transfer Speeds are maximums based on Crystal Disk Mark

* NGFF Port and the installation of an enhanced driver required for maximum speed

Table 3: Data Transfer Time Specifications

Device	Sequential Read Max (MB/Sec)	Sequential Write Max (MB/Sec)
ASCSA064GXTC	561	304
ASCSA128GXTC	557	498
ASCSA256GXTC	561	510
ASCSA512GXTC	561	501
ASCSA001TXTC	559	511

4.2 POWER AND TEMPERATURE CONDITIONS

Table 4: Absolute Maximum Ratings

Symbol	Rating	Value	Unit
V_{CC}	Power Supply Voltage	-0.3 to +3.6	V
V_{IN}	Input Voltage	-0.5 to $V_{CC} + 0.5$	V
T_{STG}	Storage Temperature	-55 to 115	°C
T_{OPR}	Commercial Grade	0 to +70	°C
	Industrial Grade	-40 to +85	°C

4.3 POWER CONSUMPTION TEST FOR RESULT

Table 5: Power Consumption Test for Result

Test software: Crystal Disk Mark6.0.0				Device: M.2 NGFF 2280 256GB	
Times		1	2	3	Power (W=U*I)
Static current(Idle mode current)					3.3V*0.095A=0.3135W
Dynamic current (R/W mode current)	Seq. read	560.1	558.9	561.0	3.3V*0.295A=0.9735W
	Seq. write	509.7	509.1	510	3.3V*0.3A=0.99W
	4K Q8T8 read	224.7	225.2	224.5	3.3V*0.19A=0.627W
	4K Q8T8 write	324.5	324.2	224.0	3.3V*0.29A=0.957W
	4K Q32T1 read	224.5	223.1	224.7	3.3V*0.13A=0.429W
	4K Q32T1 write	203.5	203.0	204.1	3.3V*0.2A=0.66W
	4K Q1T1 read	39.76	40.0	38.5	3.3V*0.13A=0.429W
	4K Q1T1 write	111.2	112.3	110.5	3.3V*0.2A=0.66W

5.0 ENVIRONMENTAL SPECIFICATIONS

Operating Temperature:

Commercial Grade: 0°C to +70°C

Industrial Grade: -40°C to +85°C

Humidity: 5% to ~98% RH

Operating Shock: 1500G

Operating Vibration: 16G

Operating Altitude: TBD

6.0 QUALITY AND RELIABILITY SPECIFICATIONS

Data Retention: JESD47 compliant

Wear Leveling: Dynamic and static wear-leveling

Bad Block Management: Drive will self identify bad blocks and remap physical to logical addresses to avoid bad blocks

ECC/EDC (Error Correction Code/Error Detection Code): Built in error detection and correction will correct physical bit errors in NAND. Drives use LDPC ECC

MTBF: >1,000,000 hours

Power Cycle: 1000 times

Table 6: Compatibility Test Config

Test Platform: Compatibility Test Config				
Test Items	Total Times	PASS Times	Fail Times	Log Photo
Cycles	1000 times	1000 times	0 times	
Random	1000 times	1000 times	0 times	

8.2 PIN SIGNALS ASSIGNMENTS

Table 7: Pin Assignment

Pin	Signal Name	Description	Pin	Signal Name	Description
1	GND	Return Current Path	2	+3.3V	3.3V Power (Source)
3	GND	Return Current Path	4	+3.3V	3.3V Power (Source)
5	N/A	Removed	6	N/A	Reserved
7	N/A	Removed	8	N/A	Reserved
9	N/A	Removed	10	DAS/DSS#	Device Activity Signal/Disable Staggered Spinup
11	N/A	Removed	12	Notch	B Key
13	Notch	B Key	14	Notch	B Key
15	Notch	B Key	16	Notch	B Key
17	Notch	B Key	18	Notch	B Key
19	Notch	B Key	20	N/A	Reserved
21	N/A	Removed	22	N/A	Reserved
23	N/A	Removed	24	N/A	Reserved
25	N/A	Removed	26	N/A	Reserved
27	GND	Return Current Path	28	N/A	Reserved
29	N/A	Reserved	30	N/A	Reserved
31	N/A	Reserved	32	N/A	Reserved
33	GND	Return Current Path	34	N/A	Reserved
35	N/A	Reserved	36	N/A	Reserved
37	N/A	Reserved	38	DEVSLP	Device Sleep
39	GND	Return Current Path	40	N/A	Reserved
41	TX+	SATA transmitter differential pair	42	N/A	Reserved
43	TX-		44	N/A	Reserved
45	GND	Return Current Path	46	N/A	Reserved
47	RX-	SATA receiver differential pair	48	N/A	Reserved
49	RX+		50	N/A	Reserved
51	GND	Return Current Path	52	N/A	Reserved
53	N/A	Reserved	54	N/A	Reserved
55	N/A	Reserved	56	MFG Data	Reserved
57	GND	Return Current Path	58	MFG Clock	Reserved
59	Notch	M Key	60	Notch	M Key
61	Notch	M Key	62	Notch	M Key
63	Notch	M Key	64	Notch	M Key
65	Notch	M Key	66	Notch	M Key
67	N/A	Removed	68	SUSCLK	Reserved
69	GND	Return Current Path	70	+3.3V	3.3V Power (Source)
71	GND	Return Current Path	72	+3.3V	3.3V Power (Source)
73	GND	Return Current Path	74	+3.3V	3.3V Power (Source)
75	GND	Return Current Path			

9.0 SUPPORTED ATA COMMAND SET

9.1 ATA COMMAND REGISTER

NGFF supports the command show in the following tables.

Table 8: Command Set

Command Name	Code (Hex)	Protocol
General Feature Set		
Execute Device Diagnostic	90h	Execute device diagnostic
Flush Cache	E7h	Non-data
Identify Device	ECh	PIO data-in
Initialize Drive Parameters	91h	Non-data
Read DMA	C8h	DMA
Read Log Ext	2Fh	PIO data-in
Read Multiple	C4h	PIO data-in
Read Sector(s)	20h	PIO data-in
Read Verify Sector(s)	40h or 41h	Non-data
Set Feature	EFh	Non-data
Set Multiple Mode	C6h	Non-data
Write DMA	CAh	DMA
Write Multiple	C5h	PIO data-out
Write Sector(s)	30h	PIO data-out
NOP	00h	Non-data
Read Buffer	E4h	PIO data-in
Write Buffer	E8h	PIO data-out
Power Management Feature Set		
Check Power Mode	E5h or 98h	Non-data
Idle	E3h or 97h	Non-data
Idle Immediate	E1h or 95h	Non-data
Sleep	E6h or 99h	Non-data
Standby	E2h or 96h	Non-data
Standby Immediate	E0h or 94h	Non-data
Security Mode Feature Set		
Security Set Password	F1h	PIO data-out
Security Unlock	F2h	PIO data-out
Security Erase Prepare	F3h	Non-data
Security Erase Unit	F4h	PIO data-out
Security Freeze Lock	F5h	Non-data
Security Disable Password	F6h	PIO data-out
SMART Feature Set		
SMART Disable Operations	B0h	Non-data
SMART Enable/Disable Autosave	B0h	Non-data

Command Name	Code (Hex)	Protocol
SMART Enable Operations	B0h	Non-data
SMART Execute OFF-LINE Immediate	B0h	Non-data
SMART Read Log	B0h	PIO data-in
SMART Read Data	B0h	PIO data-in
SMART Read Threshold	B0h	PIO data-in
SMART Return Status	B0h	Non-data
SMART Save Attribute Values	B0h	Non-data
SMART Write Log	B0h	PIO data-out
Host Protected Area Feature Set		
Read Native Max Address	F8h	Non-data
Set Max Address	F9h	Non-data
Set Max Set Password	F9h	PIO data-out
Set Max Lock	F9h	Non-data
Set Max Freeze Lock	F9h	Non-data
Set Max Unlock	F9h	PIO data-out
48-bit Address Feature Set		
Flush Cache Ext	EAh	Non-data
Read Sector(s) Ext	24h	PIO data-out
Read DMA Ext	25h	DMA
Read Multiple Ext	29h	PIO data-out
Read Native Max Address Ext	27h	Non-data
Read Verify Sector(s) Ext	42h	Non-data
Set Max Address Ext	37h	Non-data
Write DMA Ext	35h	DMA
Write Multiple Ext	39h	PIO data-out
Write Sector(s) Ext	34h	PIO data-out
NCQ Feature Set		
Read FPDMA Queued	60h	DMA Queued
Write FPDMA Queued	61h	DMA Queued
Others		
Data Set Management	06h	DMA
Seek	70h	Non-data

Table 9: Set Features Register Values

Value	Command	Value	Command
D0h	Read Data	D5h	Read Log
D1h	Read Attribute Threshold	D6h	Write Log
D2h	Enable/Disable Autosave	D8h	Enable SMART Operations
D3h	Save Attribute Values	D9h	Disable SMART Operations
D4h	Execute OFF-LINE Immediate	DAh	Return Status

Note: If the reserved size is below the threshold, the status can be read from the Cylinder Register using the Return Status command (DAh).

9.2 IDENTIFY DEVICE COMMAND INFORMATION

Table 10: Identify Device Command Definition Abbreviation Decoder

Parameter	Definition
F/V	Fixed/Variable Content
F	Content (byte) is fixed and does not change.
V	Content (byte) is variable and may change depending on the state of the device or the commands executed by the device.
X	Content (byte) is vendor specific and may be fixed or variable.

Table 11: Identify Device Table Information

Word	Value	F/V	Description
0	044Ah	F	General configuration
1	XXXXh	X	Default number of cylinders
2	0000h	V	Reserved
3	00XXh	X	Default number of heads
4	0000h	X	Obsolete
5	0240h	X	Obsolete
6	XXXXh	F	Default number of sectors per track
7-8	XXXXh	V	Number of sectors per card (Word 7 = MSW, Word 8 = LSW)
9	0000h	X	Obsolete
10-19	XXXXh	F	Serial number in ASCII (Right justified)
20	0002h	X	Obsolete
21	0002h	X	Obsolete
22	0000h	X	Obsolete
23-26	XXXXh	F	Firmware revision in ASCII Big Endian Byte Order in Word
27-46	XXXXh	F	Model number in ASCII (Left justified) Big Endian Byte Order in Word
47	8001h	F	Maximum number of sectors on Read/Write Multiple command
48	0000h	F	Reserved
49	0300h	F	Capabilities
50	4000h	F	Capabilities
51	0200h	F	PIO data transfer cycle timing mode
52	0000h	X	Obsolete
53	0007h	F	Field validity
54	XXXXh	X	Current numbers of cylinders
55	XXXXh	X	Current numbers of heads
56	XXXXh	X	Current sectors per track
57-58	XXXXh	X	Current capacity in sectors (LBAs) (Word 57 = LSW , Word 58 = MSW)

Word	Value	F/V	Description
59	0101h	F	Multiple sector setting
60-61	XXXXh	F	Total number of user addressable logical sectors for 28-bit commands (DWord)
62	0000h	X	Reserved
63	0207h	F	Multiword DMA transfer Supports MDMA mode 0, 1 and 2
64	0003h	F	Advanced PIO modes supported
65	0078h	F	Minimum Multiword DMA transfer cycle time per word
66	0078h	F	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	4000h	F	Additional supported
70-74	0000h	F	Reserved
75	001Fh	F	Queue depth
76	030Eh	F	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	0080h	F	Serial ATA additional capability • DevSleep_to_ReducedPwrState
78	0148h	F	Serial ATA features supported • Supports Device Sleep • Supports • Software settings preservation • Device supports initiating power management
79	0040h	V	Reserved
80	03FCh	F	Major version number (ACS-2)
81	0000h	F	Minor version number
82	702Bh	F	Command sets supported 0
83	7500h	F	Command sets supported 1
84	4002h	F	Command sets supported 2
85-87	XXXXh	V	Command set/feature enabled
88	007Fh	V	Ultra DMA mode supported and selected
89	0003h	F	Time required for a Normal Erase mode Security Erase Unit command
90	0001h	F	Time required for an Enhanced Erase mode Security Erase Unit command
91	0000h	V	Current advanced power management value
92	FFFEh	V	Master password identifier
93-99	0000h	V	Reserved
100-103	XXXXh	V	Maximum user LBA for 48-bit address feature set
104	0000h	V	Reserved

Word	Value	F/V	Description
105	0100h	F	Maximum number of 512-byte blocks per Data Set Management command
106-127	0000h	V	Reserved
128	0009h	V	Security status
129-159	XXXXh	X	Vendor specific
160	0000h	F	CFA power mode
161	0000h	X	Reserved
162	0000h	F	Key management schemes supported
163	0000h	F	CF Advanced True IDE Timing mode capability and setting
164-168	0000h	V	Reserved
169	0001h	F	Data Set Management supported
170-216	XXXXh	V	Reserved
217	0001h	F	Non-rotating media (SSD)
218-221	0000h	X	Reserved
222	107Fh	F	Transport major revision (SATA Rev 3.1)
223-254	0000h	X	Reserved
255	XXXXh	X	Integrity word

9.3 SUPPORTED IDENTIFY DEVICE COMMAND INFORMATION DEFINITIONS

Table 12: SMART Data Vendor-specific Attributes

Attribute ID(Hex)	Raw Attribute Value						Attribute Name
01	MSB	00	00	00	00	00	Read error rate
05	LSB	MSB	00	00	00	00	Reallocated sectors count
09	LSB			MSB	00	00	Reserved
0C	LSB			MSB	00	00	Power cycle count
A0	LSB			MSB	00	00	Uncorrectable sector count when read/write
A1	LSB	MSB	00	00	00	00	Number of valid spare block
A2	LSB	MSB	00	00	00	00	Number of cache data block
A3	LSB	MSB	00	00	00	00	Number of initial invalid block
A4	LSB			MSB	00	00	Total erase count
A5	LSB			MSB	00	00	Maximum erase count
A6	LSB			MSB	00	00	Minimum erase count
A7	LSB			MSB	00	00	Average erase count
C0	LSB				MSB	00	Power-off retract count
C2	MSB	00	00	00	00	00	Controlled temperature
C3	LSB			MSB	00	00	Hardware ECC recovered
C4	LSB			MSB	00	00	Reallocation event count
C7	LSB	MSB	00	00	00	00	UltraDMA CRC error count
F1	LSB			MSB	00	00	Total LBAs written (each write unit=32MB)
F2	LSB			MSB	00	00	Total LBAs read (each read unit=32MB)

10.0 INSTALLATION

BEFORE GETTING STARTED

1. Back Up Your Data

VISUAL INSPECTION

1. Before unpacking and handling the SSD, discharge the static electricity by touching the metal chassis of your computer or by using an anti-static wrist strap
2. Inspect the box and device for the following
 - a. Box is damaged or water-stained
 - b. Any damage to the SSD

HANDLING THE SSD

1. Be cautious when unpacking, installing, and handling the SSD drive. Misuse of the SSD voids all warranty. Follow the succeeding instructions when managing the SSD
2. Follow all ESD pre-cautions
3. Always operate the SSD within environmental conditions
4. Never switch DC power to the drive by plugging an electrically live source cable into the drive's power connector

INSTALLATION

System Requirements

To install the SSD in your computer, ensure that you have the following items:

1. Mounting Screws (If needed)

Install the SSD

Follow these steps to install the SSD

1. Power down the PC
2. Remove the computer system outside cover
3. Insert the SSD to the connector on motherboard
4. Replace the PC cover
5. Power on the PC

6. A BIOS sign-on message appears and displays a key sequence to enter the BIOS setup. Set up the BIOS to recognize the SSD.
7. Installation is Complete

USING THE SSD IN A MS-DOS OS

The SSD is already partitioned and formatted by NTFS, so if you want to install MS-DOS O/S on the SSD, it should be re-partitioned and re-formatted. After installing the SSD, it must be installed as a disk drive under DOS. Run the DOS commands as listed below and follow the instructions displayed for each command.

1. Run the DOS FDISK program to partition the SSD
2. Verify that the partition is active and ready for formatting
3. Run the DOS FORMAT command to high-level format the SSD

USING THE SSD IN A WINDOWS OS

No modifications need to be made to use the SSD in a Windows OS platform

USING THE SSD IN A LINUX O/S

Port driver is needed to be made to use the SSD in Linux OS platforms. **USING THE SSD IN OTHER O/S**

Port driver is needed to be made to use the SSD in other OS platforms.

CHANGE RECORD

Table 13: Change Record

Version	Release Date	Changes
1.0	Nov 6st, 2018	Initial Release in new template