ShenZhen Renice Technology Co., Ltd

X10 2.5" SATAIII R-SLC SSD

Datasheet

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1. Introduction

1.1 Product Overview

The Renice X10 Industrial SSD (referred to as 2.5” R-SLC SSD in this datasheet) are high-performance, high reliability solid state drive, built with NAND Flash memory, DRAM memory, and an advanced Serial ATA (SATA) controller in a standard 2.5-inch form factor housing.

2.5” R-SLC SSD is using 1-bit-per-cell (SLC) NAND configuration, it is well suited for write-intensive applications used in high temperature, high stress environments, such as aviation, rail transportation, marine equipment, seismic instrumentation, data loggers, base stations, industrial control and factory automation. All R-SLC based products operate at industrial temperatures, between -40 and +85 degree Celsius.

The Renice’s advanced SATA SSD controller with built-in advanced NAND management firmware communicates with the host through the standard SATA protocol. This firmware effectively optimizes the use of NAND Flash memory program/erase (P/E) cycles, improves endurance, enhances data security and minimizes write amplification, optimize NAND Flash use and extend the lifespan of aging NAND, achieving the longest device lifetime possible.

2.5” R-SLC SSD technology helps the data rebuild when die retired or failed. This innovative technology combines robust NAND Controller hardware error correction capabilities with advanced wear-leveling algorithms and bad blocks management to improve data reliability and significantly extend the life of product.

1.2 Feature

- **Standard Serial ATA:** SATA III, 6.0Gbps (Backward compatible with SATA 1.5 and 3.0Gbps)
- **Form factor:** 2.5 inch 100.45mm x 69.85mm x 9.0mm (L x W x H)
- **Connector:** 7-pin signal segment and a 15-pin power segment
- **Performance:**
  - Max Sequential Data Read/Write: 530MB/520MB/s
  - 4Kb Random Read/Write IOPS: 70,000 / 70,000
  - Latency: Sequential Read/Write: 75μs/35μs (typical)
    Random Read/Write: 130μs/35μs (typical)
- **Capacities:** 960GB, 1.92TB
- **Lifetime Endurance:** 30 Drive Writes Per Day (DWPD) for 5 years
- **Data Retention:** 10 years/ 1year (JESD218B.01)
- **Data Security:**
  - AES 256-bit Encryption
  - End-to-End data path protection
  - Secure Erase (data sanitization)
- **NAND Configuration: 1 bit per cell (R-SLC)**
- **Power Management:**
  - Input voltage: 5V (±5%)
  - Active mode: 7W
- **Temperature ranges:**

– Operation: -40 to 85°C (Industrial)
– Storage: -50 to +110°C

- **Intelligent features:**
  - Built-in ECC
  - End-to-End data protection (local CRC)
  - AES 256-bit encryption
  - Unrecoverable Bit Error Rate (UBER): <1 sector per 10^{17} bits read
  - Static and Dynamics Wear Leveling
  - On-Chip Adaptive RAID data rebuild protection
  - Read only mode when not enough reserved space
  - Dedicated Power Interrupt Data Protection
- **MTBF:** >2,000,000 Hours @25C

2. Product Specifications

2.1 Physical Specifications

Table 1: Physical Specifications

Form Factor		2.5 INCH
Dimensions	Length	100.45±0.25mm
	Width	69.85±0.25mm
	Height	9.0±0.25mm
Weight		<100g
Connector		SATA III 7+15 pin

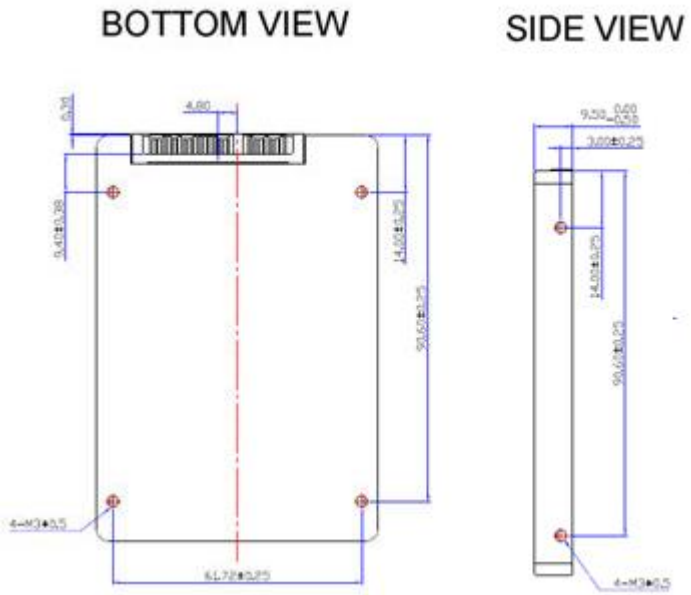

Figure 2: Renice X10 2.5" SATAIII SSD mechanical dimensions

2.2 Host Interface

Industrial Standard SATA Revision 3.2 compliant
Supports SATA interface rate of 6Gb/s(backward compatible to 1.5Gb/s and 3Gb/s)
S.M.A.R.T. command transport (SCT) technology
SATA Device Sleep (Dev Sleep)
Data Set Management command (TRIM)

2.3 Capacity

Table 2: Capacity Specification

Parameter	User Addressable Sector	Bytes per Sector
960GB	1,875,385,008	512 Byte
1.92TB	3,750,748,848	

3. Interface Description

3.1 Pin Assignments

Table 3: Signal and Power segment

Pin No.	Pin Name	Pin No.	Pin Name
S1	GND (2nd mate)	P1	Not Connect
S2	SATA Differential A+ based on SSD	P2	Not Connect
S3	SATA Differential A- based on SSD	P3	Reserved
S4	GND(2nd mate)	P4	GND
S5	SATA Differential B- based on SSD	P5	GND
S6	SATA Differential B+ based on SSD	P6	GND
S7	GND(2nd mate)	P7	+5V pre-charge
		P8	+5V
		P9	+5V
		P10	GND
		P11	DAS
		P12	GND
		P13	Not Used (12V pre-charge)
		P14	Not Used (12V)
		P15	Not Used (12V)

4. Power Specifications

4.1 Operating Voltage

Operating voltage: 5V (±5%)

4.2 Power Consumption (typical)

Table 4: Power Consumption

Capacity	Part Number	Active Write (Typ)	Active Read (Typ)	Idle
960GB	RIT960-SX102	3.6W	3.2W	2W
1.92TB	RIT1920-SX102	4.8W	4W	2.8W

5. Reliability Specification

Renice 2.5” R-SLC SSD integrate a SATA SSD controller with up to 12 NAND Flash multi-chip packages and DRAM in a standard 2.5-inch form factor housing.

5.1 Environment

Table 5: Environmental Specifications

Item	Features	
Temperature	Operation	-40°C ~+85°C
	Storage	-50°C ~+110°C
Humidity	5-95%	
Vibration	10Hz-2000Hz, 16.4 G (X, Y, Z axis, 1 hour /axis)	
Shock	Peak Acceleration: 1,500 G, 0.5ms(Half-sine wave, ±X,±Y,±Z axis, 1 time/axis) Peak Acceleration: 50 G, 11ms(Half-sine wave, ±X,±Y,±Z axis, 3 times/axis)	

5.2 R-SLC™

R-SLC™ is a proprietary 3D NAND management technology developed by Renice for high reliability applications requiring ultra-high endurance and superior data retention. With advanced hardware ECC capabilities and NAND Flash management algorithms, R-SLC Technology can significantly extend the write endurance of SSDs reaching industry leading 250K program-erase (P/E) cycles. Using 1-bit-per-cell (SLC) NAND configuration, R-SLC enable SSDs are ideal for write-intensive applications used in extreme temperature, high stress environments. R-SLC enable solid state drives offer a high reliability flash storage solution with ultra-high write endurance that exceeds capabilities of legacy, planar SLC NAND based products. Renice X10 Series SSD are ideal for embedded and enterprise systems requiring “true SLC” endurance and performance at a lower cost per GByte.

5.3 Power Failure Data Protection

Power Failure Data Protection is a mechanism to help prevent data loss during unexpected power failure events. Enhanced data integrity is supported by the controller’s advanced firmware during abnormal power loss. The controller proactively optimizes the amount and stay time of the “in-flight” data residing in the cache. To ensure there is no data loss risk caused by power cycling, the controller sends an acknowledgement to the host only when the incoming data is fully committed to the NAND Flash.

5.4 On-Chip Adaptive RAID

By default, 2.5” R-SLC SSD uses 15+1 RAID. When there occurs an uncorrectable read error for one NAND Die, the data will not be lost, which can be reconstructed from the other 15 NAND Die using RAID. Thus it can improve the reliability of the controller significantly by several orders of magnitude. If there has a lot of retired RG Blocks in one NAND Die due to some special reason, this Die will be retired. In this case, the 15+1 RAID will become 14+1 RAID adaptively. Note the user capacity will not decrease, while the over position will be reduced accordingly. In one 14+1 RAID Group, if there occurred another defect NAND Die, it may become 13+1 RAID Group adaptive as long as the rest over position can ensure the normal running. The transformation from 15+1 RAID Group to 14+1 (or 14+1 to 13+1) is implemented in the background in the run time. There is no need for the user to power off the device and then to do some special recovery for this kind of error.

5.5 Advanced NAND Management

2.5’ R-SLC SSD’s SATA controller uses advanced wear-leveling algorithms to substantially increase the longevity of NAND Flash media. Wear caused by data writes is evenly distributed in all of select blocks in the device that prevents “hot spots” in locations that are programmed and erased extensively. This effective wear-leveling technique results in optimized device endurance, enhanced

data retention and higher reliability required by long-life applications.

5.6 Advanced Data Security

Advanced data security measures include end-to-end data path protection, data sanitization (Secure Erase) and cryptographic erase (Crypto Erase) support. Secure Erase is an effective method to quickly wipe all data from a SATA-based SSD using the SATA protocol. Cryptographic erase resets the cryptographic key of an OPAL-activated SSD making all encrypted user data useless. 2.5” R-SLC SSD’s controller supports industry standard AES-256 bit encryption to protect sensitive user data.

6. Supported Commands

Table 6: Device Identification

Capacity	*1 (Word 1/ Word 54)	*2 (Word57-58)	*3 (Word 60-61)	*4 (Word 100-103)
960GB	3FFFh	3C4F:00EC	FFFF:0FFFh	BA4D4AB0
1.92TB	3FFFh	3C4F:00EC	FFFF:0FFFh	DF8FE2B0

6.1 Command Description

2.5” R-SLC SSD supports the following command set compliant with ATA8-ACS4 specification.

Table 7: SMART Attributes

Attribute ID	Description
09h	Power-on Hours (POH) Count
0Ch	Drive Power Cycle Count (involve unexpected power down)
A8h	SATA PHY Error Count (Only record from power-on; when power-off this value will clear to zero. These values include PHY Error Count, e.g., data FIS CRC, code error, disparity error, command FIS CRC, etc.)
AAh	Available Reserved Space
AEh	Number of Unexpected Power Losses
BBh	NAND Flash read uncorrectable error count
BEh	SSD On-board Temperature
C0h	Number of Unexpected Power Losses
C2h	Controller Junction Temperature
C7h	Number of Accumulated CRC Errors (read/write data FIS CRC error)
F1h	Host Writes Data Count The raw value of this attribute reports the total number of sectors written by the host system. The raw value is increased by 1 for every 65,536 sectors (32MB) written by the host.
F2h	Host Read Data Count The raw value of this attribute reports the total number of sectors read by the host system. The raw value is increased by 1 for every 65,536 sectors (32MB) read by the host.

Table 8: ATA Support Command Set (1 of 2)

Command	Code	Command	Code
NOP	00h	SMART Disable Operations	B0h/D9h
Data Set Management	06h	SMART Return Status	B0h/DAh
Read Sector(s)	20h	Sanitize	B4h
Read Sector(s) EXT	24h	Sanitize Status EXT	B4h/00h
Read DMA EXT	25h	Crypto Scramble EXT	B4h/11h
Read Multiple EXT	29h	Block Erase EXT	B4h/12h
Read Log EXT	2Fh	Overwrite EXT	B4h/14h
Write Sector(s)	30h	Sanitize Freeze Lock EXT	B4h/20h
Write Sector(s) EXT	34h	Sanitize Antifreeze Lock EXT	B4h/40h
Write DMA EXT	35h	Read Multiple	C4h
Write Multiple EXT	39h	Write Multiple	C5h
Write DMA FUA EXT	3Dh	Set Multiple Mode	C6h
Write Log EXT	3Fh	Read DMA	C8h
Read Verify Sector(s)	40h	Write DMA	CAh
Read Verify Sector(s) EXT	42h	Write Multiple FUA EXT	CEh
Write Uncorrectable EXT	45h	Standby Immediate	E0h
Read log DMA EXT	47h	Idle Immediate	E1h
Write Log DMA EXT	57h	Standby	E2h
Read FPDMA Queued	60h	Idle	E3h
Write FPDMA Queued	61h	Read Buffer	E4h
Set Date and Time EXT	77h	Check Power Mode	E5h
Accessible MAX Address Configuration	78h	Set Sleep Mode	E6h
Execute Device Diagnostic	90h	Flush Cache	E7h
Download Microcode	92h	Write Buffer	E8h
Download Microcode DMA	93h	Read Buffer DMA	E9h
SMART	B0h	Flush Cache EXT	EAh
SMART Read Data	B0h/D0h	Write Buffer DMA	EBh
SMART Read Attribute Thresholds	B0h/D1h	Identify Drive	ECh
SMART Enable/Disable Attribute Autosave	B0h/D2h	Set Features	EFh
SMART Execute Off-line Immediate	B0h/D4h	Enable Volatile Write Cache	EFh/02h
SMART Read Log	B0h/D5h	Set Transfer Mode	EFh/03h
SMART Write Log	B0h/D6h	Enable the APM Feature	EFh/05h
SMART Enable Operations	B0h/D8h		

Table 9: ATA Support Command (2 of 2)

Command	Code	Command	Code
Enable Use of SATA Feature	EFh/10h	Security Set Password	F1h
Enable DMA Setup FIS Auto-Activate Optimization Feature	EFh/10h/02h	Security Unlock	F2h
Enable DIPM Transitions	EFh/10h/03h	Security Erase Prepare	F3h
Enable SSP	EFh/10h/06h	Security Erase Unit	F4h
Enable Device Automatic Partial to Slumber Transitions Feature	EFh/10h/07h	Security Freeze Lock	F5h
Enable Device Sleep	EFh/10h/09h	Security Disable Password	F6h
Disable Reverting to Power-on Defaults	EFh/66h	Read Native Max Address	F8h
Disable Volatile Write Cache	EFh/82h	Set Max Address	F9h/00h
Disable Use of SATA Feature	EFh/90h	Set Max Set Password	F9h/01h
Disable DMA Setup FIS Auto-Activate Optimization Feature	EFh/90h/02h	Set Max Lock	F9h/02h
Disable DIPM Transitions	EFh/90h/03h	Set Max Unlock	F9h/03h
Disable SSP	EFh/90h/06h	Set Max Freeze Lock	F9h/04h
Disable Device Automatic Partial to Slumber Transitions Feature	EFh/90h/07h	Set Max Set Password DMA	F9h/05h
Disable Device Sleep	EFh/90h/09h	Set Max Unlock DMA	F9h/06h
Enable Reverting to Power-on Defaults	EFh/CCh		
Obsolete CMD by the ATA/ATAPI specifications			
Recalibrate	10h	Device Configuration	B1h
Read Sectors Without Retry	21h	Set Max Address EXT	94h
Write Sectors Without Retry	31h	Read DMA Without Retry	C9h
Read Verify Sectors Without Retry	41h	Write DMA Without Retry	CBh
Seek	70h	Read Native Max Address EXT	27h

6.2 Identify-Drive - Ech

The Identify-Drive command enables the host to receive parameter information from 2.5” SSD. This command has the same protocol as the Read-Sector(s) command. The parameter Words in the buffer have the arrangement and meanings defined in the following table. All reserved bits or Words are zero. The following table gives the definition for each field in the Identify-Drive information.

Table 10: Identify-Drive Information (1 of 2)

Word Address	Total Bytes	Default Value	Data Field Type Information
0	2	0000h	General configuration
1	2	3FFFh 1)	Obsolete
2	2	C837h	Specific configuration
3	2	000Fh 1)	Obsolete
4-5	4	0000h-0000h	Retired
6	2	003Fh 1)	Obsolete
7-8	4	0000h	Reserved for the CompactFlash™ Association
9	2	0000h	Retired
10-19	20	ASCII	Serial number in ASCII Code
20-21	4	0000h-0000h	Retired
22	2	0000h	Obsolete
23-26	8	aaaah 5)	Firmware revision in ASCII
27-46	40	ASCII	Model number
47	2	8010h	Read/Write-Multiple command
48	2	4000h	Trusted Computing feature set options
49	2	2F00h	Capabilities
50	2	4000h	Capabilities
51-52	4	0200h 1)	Obsolete
53	2	0007h	Field Validity
54-58	10	xxxxh 1)	Obsolete
59	2	BD10h	Multiple sector setting
60-61	4	FFFF:0FFFh 3)	Total number of user addressable logical sectors for 28-bit commands
62	2	0000h 1)	Obsolete
63	2	0007h	DMA data transfer is supported in Device
64	2	0003h	Advanced PIO Transfer mode supported
65	2	0078h	Minimum Multiword DMA transfer cycle time per Word
66	2	0078h	Manufacturer’s recommended Multiword DMA transfer cycle time
67	2	0078h	Minimum PIO transfer cycle time without flow control
68	2	0078h	Minimum PIO transfer cycle time with IORDY flow control
69	2	0D18h	Additional Supported

70-74	10	0000h [1)]	Reserved
75	2	001Fh	Queue depth
76	2	050Eh	Serial ATA Capabilities
77	2	0006h	Serial ATA Additional Capabilities
78	2	0044h	Serial ATA features supported
79	2	0044h	Serial ATA features enabled
80	2	07FCh	Major version number
81	2	011Bh	Minor version number
82	2	702Bh	Commands and feature sets supported
83	2	7401h	Commands and feature sets supported
84	2	4063h	Commands and feature sets supported
85	2	7029h	Commands and feature sets supported or enabled
86	2	B401h	Commands and feature sets supported or enabled
87	2	4163h	Commands and feature sets supported or enabled
88	2	607Fh	UDMA modes
89	2	0001h	Time required for Normal Erase mode command

Table 11: Identify-Drive Information (2 of 2)

Word Address	Total Bytes	Default Value	Data Field Type Information
90	2	0001h	Time required for Enhanced Erase mode command
91	2	0000h	Current APM level value
92	2	FFFEh	Master Password Identifier
93	2	0000h	Hardware reset result
94	2	0000h	Obsolete
95	2	0000h	Stream minimum request size
96	2	0000h	Streaming Transfer Time –DMA
97	2	0000h	Streaming Access Latency – DMA and PIO
98-99	4	0000h-0000h	Streaming Performance Granularity (DWord)
100-103	8	nnnnh [3)]	Total # of user addressable logical sectors
104	2	0000h	Streaming Transfer time - PIO
105	2	0008h	Maximum number of 512-Byte blocks of LBA Range Entries
106	2	6003h	Physical sector size / logical sector size
107	2	0000h	Inter-seek delay for ISO 7779 standard acoustic testing
108-111	8	0000h	World Wide Name
112-115	8	0000h [1)]	Reserved
116	2	0000h	Obsolete
117-118	4	bbbbh [2)]	Logical sector size (DWord)
119	2	411Ch	Commands and feature sets supported
120	2	401Ch	Commands and feature sets supported or enabled
121-126	10	0000h [1)]	Reserved for expanded supported and enabled settings

127	2	0000h	Obsolete
128	2	0029h	Security status
129-159	62	0000h 1)	Vendor specific
160-167	18	0000h 1)	Reserved for the CompactFlash™ Association
168	2	0003h	Nominal Form Factor
169	2	0001h	DATA SET MANAGEMENT is supported
170-173	8	xxxxh	Additional product identifier
174- 175	4	0000h	Reserved
176-205	60	xxxxh 1)	Current media serial number
206	2	0000h	SCT command transport
207-208	4	0000h 1)	Reserved
209	2	4000h	Alignment of logical blocks within a physical block
210-211	4	0000h	Write-Read-Verify sector count mode 3 (DWord)
212-213	4	0000h	Write-Read-Verify sector count mode 2 (DWord)
214	2	0000h	Obsolete
215-216	6	0000h	Obsolete
217	2	0001h	Nominal media rotation rate
218	2	0000h 1)	Reserved
219	2	0000h	Obsolete
220	2	0000h	Write-Read-Verify feature set current mode
221	2	0000h	Reserved
222	2	10FFh	Transport major version number
223	2	0000h	Transport minor version number
224-229	12	xxxxh 1)	Reserved
230-233	8	xxxxh	Extend number of user addressable sectors
234	2	0001h	Min # of 512-Byte data block per DOWNLOAD MICROCODE CMD for mode 03h
235	2	1000h	Max # of 512-Byte data block per DOWNLOAD MICROCODE CMD for mode 03h
236-254	38	0000h 1)	Reserved
255	2	5CA5h 4)	Integrity Word

1) xxx- This field is subject to change by the host or the device.

2) bbbb- default value set by the controller. The selections could be user programmable

3) n- calculated data based on product configuration

4) dddd- unique number of each device

5) aaaa- any unique Renice firmware revision

7. Ordering Information

Table 12: Valid Combinations

Part Number	Description
RIT960-SX102	960GB X10 2.5” SATAIII R-SLC SSD, Industrial Temp. -40°C to +85°C
RIT1920-SX102	1920TB X10 2.5” SATAIII R-SLC SSD, Industrial Temp. -40°C to +85°C

7.1 Part Number Naming Rule