KTA-320 2.5’’ SATA3 SSD Datasheet

Version 1.0

Product Overview

- **Capacity**
  - 128GB,256GB,512GB
- **SATA Interface**
  - SATA Revision 3.1 compliant
  - SATA 1.5Gbps, 3Gbps, and 6Gbps interface
- **Flash Interface**
  - Flash type: 3D TLC
- **Performance(measured by CrystalDiskMark v3.0)**
  - Read: up to 510 MB/s
  - Write: up to 500 MB/s
- **MTBF**
  - More than 1,000,000 hours
- **Temperature Range**
  - Operation: 0°C ~ 70°C
  - Storage: -40°C ~ 85°C
- **Advanced Flash Management**
  - NCQ
  - TRIM
  - S.M.A.R.T
  - Support AES 256bit encryption
  - Advanced LDPC ECC engine
  - Optional Advanced RAID/XOR engine for higher error correction capability.
  - Embedded End-to-End protection for internal data path
  - Advanced Garbage Collection algorithm
  - Advanced wear-leveling algorithm
  - Quick Response Logical to Physical address mapping algorithm.
- **RoHS compliant**

Performance

Capacity	Performance	
	Read(MB/s)	Write(MB/s)
128GB	500	400
256GB	500	450
512GB	510	500

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1. INTRODUCTION

1.1. General Description

Tigo KTA-320 2.5'' SATA3 SSD delivers all the advantages of flash disk technology with the Serial ATA I/II/III interface and is fully compliant with the standard 2.5'' form factor. The module is designed to operate at a maximum operating frequency with 50MHz external crystal. Moreover, it can reach up to 510MB/s read as well as 500MB/s write high performance based on flash (measured by CrystalDiskMark). Meanwhile, the power consumption of the 2.5'' module is much lower than traditional hard drives.

1.2. Controller Block Diagram

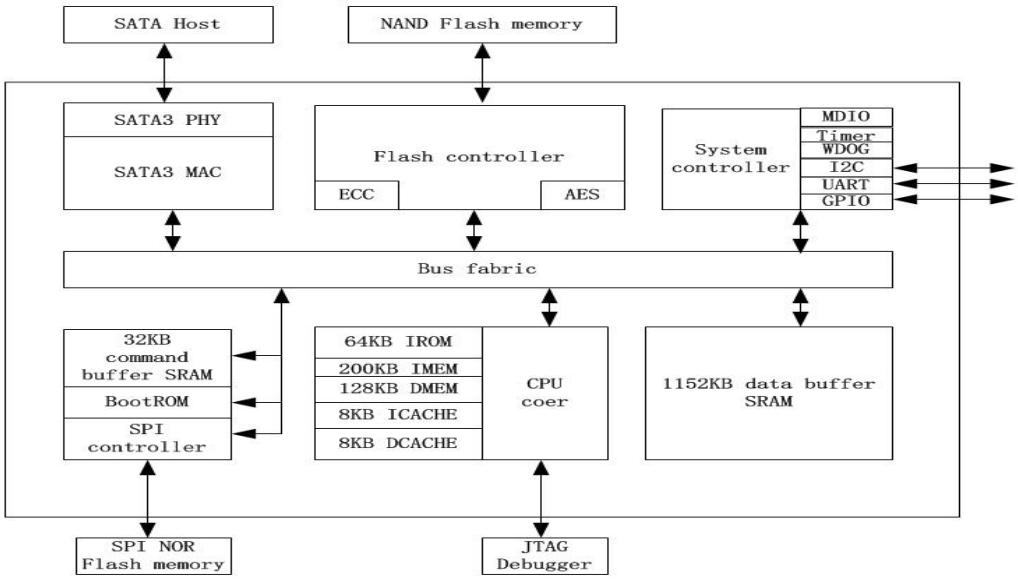


Figure 1- 1 KTA-320 2.5'' SATA SSD Controller Block Diagram

1.3. Product Block Diagram

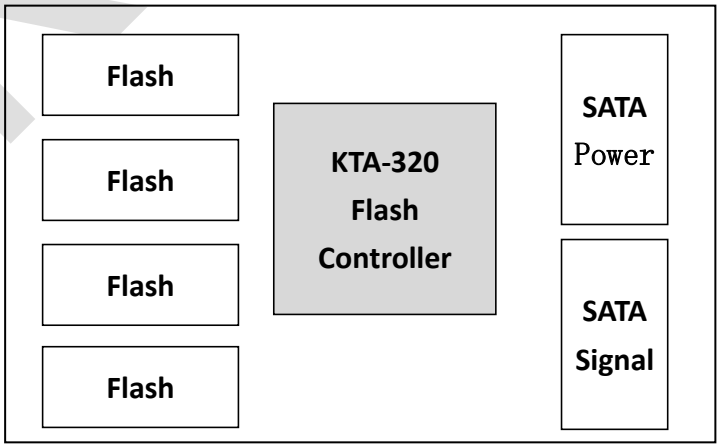


Figure 1- 2 KTA-320 2.5'' SATA SSD Product Block Diagram

1.4. Flash Management

1.4.1. Error Correction Code (ECC)

Flash memory cells will deteriorate with use, which might generate random bit errors in the stored data. Thus, KTA-320 2.5'' SATA SSD Controller applies the LDPC ECC algorithm. The Hardware Error Correction Coding(ECC)engine executes parity generation and error detection/correction features, and enhances decoding throughput and data reliability. With LDPC ECC, the powerful ECC engine is able to support the latest generation NAND flash.

1.4.2. Wear Leveling

NAND flash devices can only undergo a limited number of program/erase cycles, and in most cases, the flash media are not used evenly. If some areas get updated more frequently than others, the lifetime of the device would be reduced significantly. Wear leveling is to arrange data so that erasures and re-writes are distributed evenly across the Flash. In this way, no single erase block prematurely fails due to a high concentration of write cycles.Hence, it extends the lifespan of SSD.

Tigo provides advanced Wear Leveling algorithm, which can efficiently spread out the flash usage through the whole flash media area. Moreover, by implementing both dynamic and static Wear Leveling algorithms, the life expectancy of the NAND flash is greatly improved.

1.4.3. Bad Block Management

Bad blocks are blocks that include one or more invalid bits, and their reliability is not guaranteed. Blocks that are identified and marked as bad by the manufacturer are referred to as "Initial Bad Blocks". Bad blocks that are developed during the lifespan of the flash are named "Later Bad Blocks". Tigo implements an efficient bad block management algorithm to detect the factory-produced bad blocks and manages any bad blocks that appear with use. This practice further prevents data being stored into bad blocks and improves the data reliability.

1.4.4. TRIM

TRIM is a feature which helps improve the read/write performance and speed of solid-state drives (SSD). Unlike hard disk drives (HDD), SSDs are not able to overwrite existing data, so the available space gradually becomes smaller with each use. TRIM allows an OS to inform SSD which blocks of data are no longer considered in use and can be wiped internally. It can enable SSD to handle garbage collection in advance to prevent slowing sown the future write operations to the involved blocks.With the TRIM command, the operating system can inform the SSD which blocks of data are no longer in use and can be removed permanently. Thus, the SSD will perform the erase action, which prevents unused data from occupying blocks all the time.

1.4.5. SMART

SMART, an acronym for Self-Monitoring, Analysis and Reporting Technology, is an open standard that allows a hard disk drive to automatically detect its health and report potential failures. When a failure is recorded by SMART, users can choose to replace the drive to prevent unexpected outage or data loss. Moreover, SMART can inform users of impending failures while there is still time to perform proactive actions, such as copy data to another device.

1.4.6. Over-Provision

Over provisioning is the difference between physical capacity of the Flash and the logical capacity presented through OS as available for users. This additional space from over-provisioning helps to lower the write amplification when the controller writes to the Flash.

Over Provisioning refers to the inclusion of extra NAND capacity in a SSD, which is not visible and cannot be used by users. With Over Provisioning, the performance and IOPS (Input/Output Operations per Second) are improved by providing the controller additional space to manage P/E cycles, which enhances the reliability and endurance as well. Moreover, the write amplification of the SSD becomes lower when the controller writes data to the flash.

1.5. Low Power Management

1.5.1. DevSleep Mode (Optional)

Device or Host initiated power management modes enable the system to enter partial sleep mode, in which clock may be lowered down or DRAM are periodically refreshed.Device Sleep (DevSleep) mode, which helps further reduce the power consumption of the device, itenables the device to completely power down the device PHY and other sub-systems, making the device reach a new level of lower power operation. The DevSleep does not specify the exact power level a device can achieve in the DevSleep mode, but the power usage can be dropped down to 5mW or less.

1.6. Advanced Device Security Features

1.6.1. Secure Erase

Secure Erase is a standard ATA command and will write all “0xFF” to fully wipe all the data on hard drives and SSDs. When this command is issued, the SSD controller will erase its storage blocks and return to its factory default settings.

1.6.2. Write Protect

When a SSD contains too many bad blocks and data are continuously written in, then the SSD might not be usable anymore. Thus, Write Protect is a mechanism to prevent data from being written in and protect the accuracy of data that are already stored in the SSD.

2. PRODUCT SPECIFICATIONS

- **Capacity**
  - 128/256/512GB (support 48-bit addressing mode)
- **Electrical/Physical Interface**
  - SATA Interface
    - Compliant with SATA Revision 3.3
    - Support 8CE pins per channel.
    - Compatible with SATA 1.5Gbps, 3Gbps and 6Gbps interface
    - Support Native Command Queuing
    - Support power management
    - Compatible with ONFI v4.0/Toggle 2.0, and speed up to 266MHz.
    - Support NAND multi-plane (1, 2 and 4) operation
- **ECC Scheme**
  - KTA-320 2.5'' SATA SSD can through LDPC ECC engine to protect data.
- **UART function**
- **GPIO**
- **Support SMART and TRIM commands**
- **Performance**

Capacity	Sequential	
	Read (MB/s)	Write (MB/s)
128GB	500	400
256GB	500	450
512GB	510	500

NOTES:

1. The performance was measured using CrystalDiskMark with SATA 6Gbps host.
2. Performance may differ according to flash configuration, SDR configuration, and platform.
3. The table above is for reference only. The criteria for MP (mass production) and for accepting goods shall be discussed based on different flash configuration.

3. ENVIRONMENTAL SPECIFICATIONS

3.1. MTBF

MTBF, an acronym for Mean Time between Failures, is a measure of a device's reliability. Its value represents the average time between a repair and the next failure. The measure is typically in units of hours. The higher the MTBF value, the higher the reliability of the device. The predicted result of Tigo's KTA-320 2.5'' SATA SSD is more than 1,000,000 hours.

3.2. Certification & Compliance

- RoHS
- SATA III (SATA Rev. 3.1)
- Up to ATA/ATAPI-8 (Including S.M.A.R.T)

4. ELECTRICAL SPECIFICATIONS

4.1. Supply Voltage

Table 4- 1 Supply Voltage of KTA-320 2.5'' SATA SSD

Parameter	Rating
Operating Voltage	5V

4.2. Power Consumption

Table 4- 2 Power Consumption of KTA-320 2.5'' SATA SSD

Capacity	Read	Write	Idle
128GB	1.95	1.75	0.9
256GB	2.2	1.9	0.95
512GB	2.45	2.4	0.95

Unit: W

NOTES:

1. The average value of power consumption is achieved based on 100% conversion efficiency.
2. The measured power voltage is 5V.
3. Sequential R/W is measured while testing 4000MB sequential R/W 5 times by CyrstalDiskMark.DevSleep is measured while entering device sleep mode for 5 minutes.
4. Power Consumption may differ according to flash configuration, SDR configuration, and platform.

5. INTERFACE

5.1. Pin Assignment and Descriptions

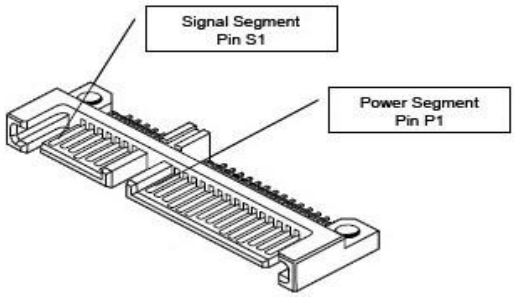


Figure 5- 1 KTA-320 2.5'' SATA SSD Pin Assignment

Table 5- 1Signal Segment Pin Assignment and Descriptions

Pin Number	Function
S1	GND
S2	A+ (Differential Signal Pair A)
S3	A – (Differential Signal Pair A)
S4	GND
S5	B – (Differential Signal Pair B)
S6	B+ (Differential Signal Pair B)
S7	GND

Table 5- 2 Power Segment Pin Assignment and Descriptions

Pin Number	Function
P1	Not Used (3.3V)
P2	Not Used (3.3V)
P3	DEVSLP
P4	GND
P5	GND
P6	GND
P7	5V pre-charge
P8	5V
P9	5V
P10	GND
P11	Reserved
P12	GND
P13	Not Used (12V pre-charge)
P14	Not Used (12V)
P15	Not Used (12V)

6. SUPPORTED COMMANDS

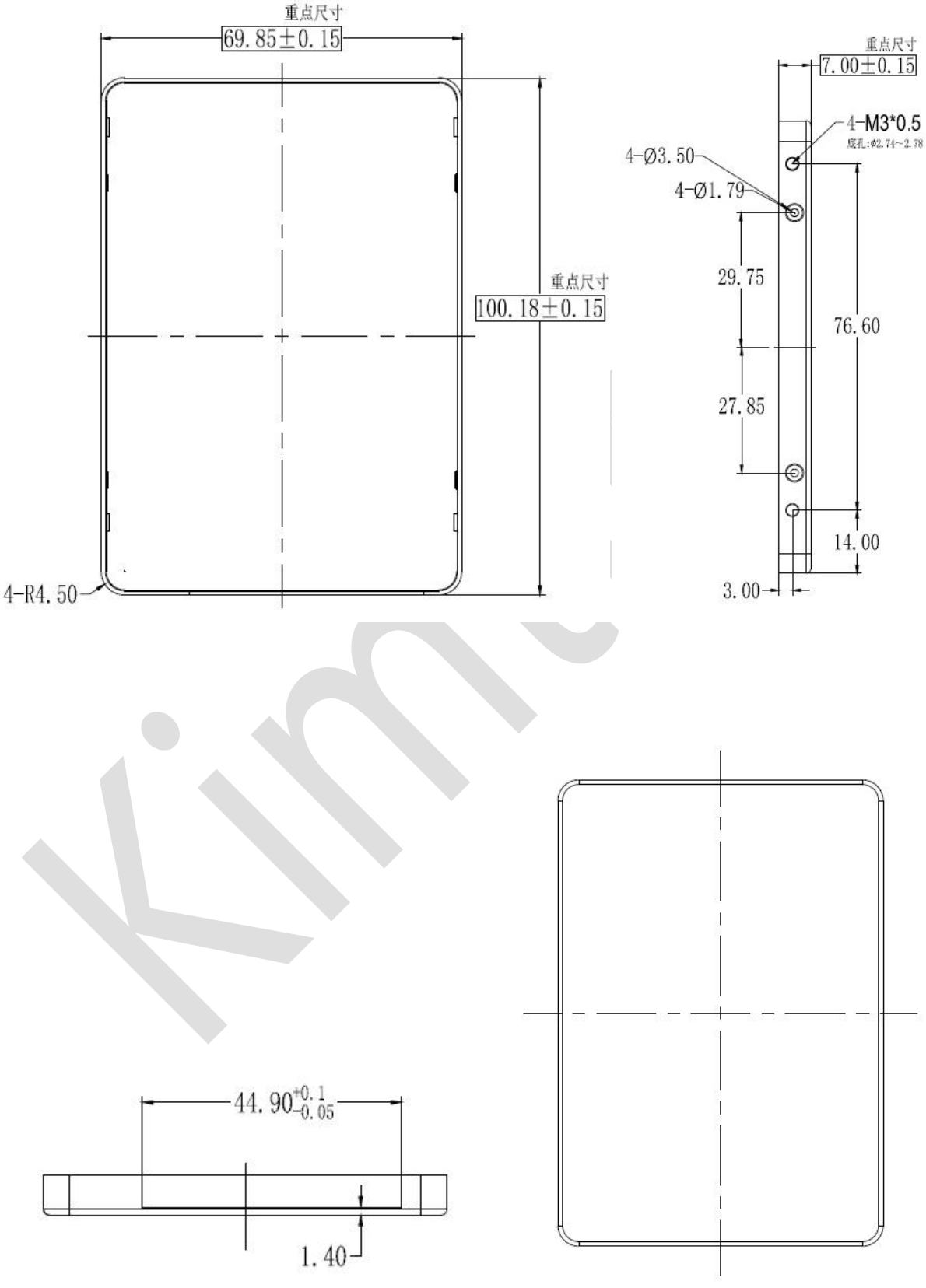
6.1. ATA Command List

Table 6- 1 ATA Command List

Op Code	Description	Op Code	Description
00h	NOP	97h	IDLE
06h	Data Set Management	98h	CHECK POWER MODE
10h-1Fh	Recalibrate	99h	SLEEP
20h	Read Sectors	B0h	SMART
21h	Read Sectors without Retry	B1h	DEVICE CONFIGURATION
24h	Read Sectors EXT	C4h	Read Multiple
25h	Read DMA EXT	C5h	Write Multiple
27h	Read Native Max Address EXT	C6h	Set Multiple Mode
29h	Read Multiple EXT	C8h	Read DMA
2Fh	Read Log EXT	C9h	Read DMA without Retry
30h	Write Sectors	CAh	Write DMA
31h	Write Sectors without Retry	CBh	Write DMA without Retry
34h	Write Sectors EXT	Ceh	Write Multiple FUA EXT
35h	Write DMA EXT	E0h	Standby Immediate
37h	Set Native Max Address EXT	E1h	Idle Immediate
38h	CFA WRITE SECTORS WITHOUT ERASE	E2h	Standby
39h	Write Multiple EXT	E3h	Idle
3Dh	Write DMA FUA EXT	E4h	Read Buffer
3Fh	Write Long EXT	E5h	Check Power Mode
40h	Read Verify Sectors	E6h	Sleep
41h	Read Verify Sectors without Retry	E7h	Flush Cache
42h	Read Verify Sectors EXT	E8h	Write Buffer
45h	WRITE UNCORRECTABLE EXT	Eah	Flush Cache EXT
60h	Read FPDMA Queued	Ech	Identify Device
61h	Write FPDMA Queued	Efh	Set Features
70h-7Fh	Seek	F1h	Security Set Password
90h	Execute Device Diagnostic	F2h	Security Unlock
91h	Initialize Device Parameters	F3h	Security Erase Prepare
92h	Download Microcode	F4h	Security Erase Unit
93h	DOWNLOAD MICROCODE DMA	F5h	Security Freeze Lock
94h	STANDBY IMMEDIATE	F6h	Security Disable Password
95h	IDLE IMMEDIATE	F8h	Read Native Max Address
96h	STANDBY	F9h	Set Max Address

7.PHYSICAL DIMENSION

Dimension: 100.00mm(L) x 69.85mm(W) x 7.00mm(H)



8. REFERENCES

The following table is to list out the standards that have been adopted for designing the product.

Table 8- 1List of References

Title	Acronym/Source
RoHS	Support
Serial ATA Revision 3.1	http://www.sata-io.org
ATA-8 spec	http://www.t13.org

9. TERMINOLOGY

The following table is to list out the acronyms that have been applied throughout the document.

Table 9- 1 List of Terminology

Term	Definitions
ATTO	Commercial performance benchmark application
DEVSLP	Device sleep mode
LBA	Logical block addressing
MB	Mega-byte
MTBF	Mean time between failures
NCQ	Native command queue
SATA	Serial advanced technology attachment
SDR	Synchronous dynamic access memory
S.M.A.R.T.	Self-monitoring, analysis and reporting technology
SSD	Solid state disk