OSCOO OE100 DATASHEET

V1.0

Contents

1．Overview

OE100 is 2.5-inch SSD product series with SATA III interface, ideal for cloud service, data centers and enterprise applications.

OE100 adopts standard 2.5-inch SATA form factor, and provides five capacity options including 480GB, 960GB, 1.92TB, 3.84TB and 7.68TB. OE100 operates in the temperature range from 32℉（0℃）to 158℉（70℃）.

OE100 uses InnoGrit IG5600BAA as SSD Controller, and integrates YMTC/Kioxia/Western Digital 3D eTLC NAND flash, as well as DDR4/LPDDR4 SDRAM.

IG5600BAA is an industry-leading one-port SATA III SSD controller with 8 NAND CH x 8 CE. Leveraging the first generation of InnoGrit's proprietary 4K LDPC ECC technology, data failure rate is extremely lowered, and data retention ability is largely enhanced. IG5600BAA also supports advanced features such as Smart Cache, multi-level power management, thermal throttling protection. With excellent performance, as well as outstanding stability, reliability and endurance, IG5600BAA is extremely ideal for storage media usage.

Product Name	OE100				
Category	SATA SSD				
Controller	InnoGrit IG5600BAA				
NAND Type	YMTC X2-9060 (alternatives: Kioxia BiCS5 / WD BiCS5)				
SSD Capacity	480GB	960GB	1.92TB	3.84TB	7.68TB
DDR Type	DDR4/LPDDR4				
Reference Dimensions Outer Case (mm)	Compliant with SFF-8201 standard 100.45(-0.25) x 69.85(±0.15) x 7(+0.20, -0.40)				
Hardware Interface	SATA III				
Operating Temperature	Commercial grade, 32℉ (0℃) ~ 158℉ (70℃)				
Operating System	Windows10 or above Linux				
Customizable Data Security Solution	AES-128/256				

2 . System Architecture

When connected with a host, OE100 uses the integrated IG5600BAA controller to manage the SSD's embedded NAND flash and DDR4/LPDDR4 SDRAM. Data transfer is implemented by using the SATA III interface.
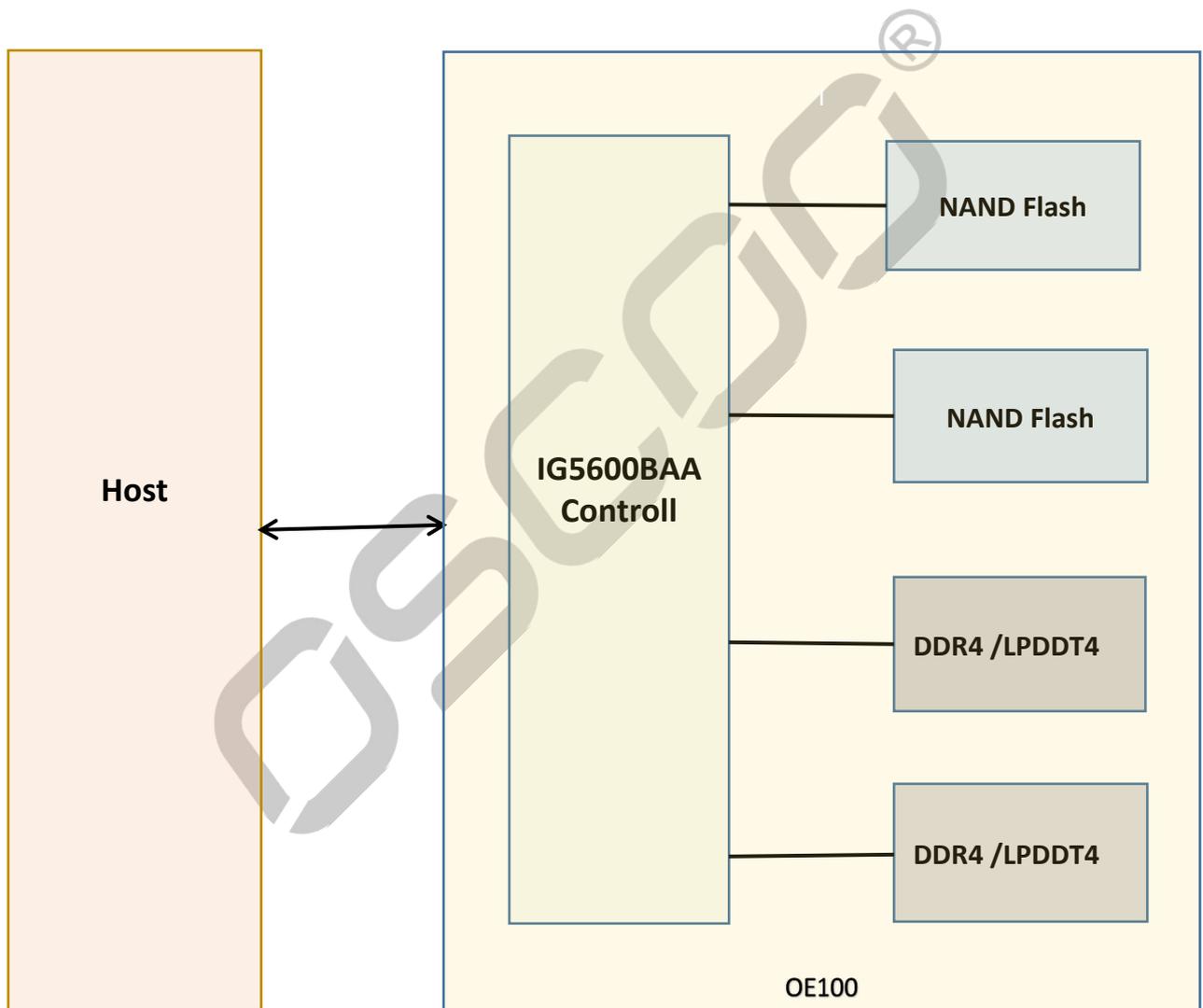

Figure 2-1   Block Diagram

3 . Typical Application

The typical application of OE100 includes, but not limited to the following:

- Cloud Services

- Data centers

- Enterprise applications

4 . Key Features

- High-stability, high-performance system architecture that is completely refactored

- Controller: InnoGrit® IG5600BAA

- NAND flash: YMTC X2-9060 / Kioxia BiCS5 / WD BiCS5 eTLC NAND

- SSD capacity: 480GB/960GB/1.92TB/3.84TB/7.68TB

- DDR SDRAM: DDR4/LPDDR4

- Supported standards and commands:

- SATA 3.3, 6Gb/s

- Form factor complies with *SNIA SFF TWG TA SFF-8201 Spec, Rev 3.4*

- Connector location dimensions comply with *SNIA SFF-8223 Spec, Rev 2.5*

- Fully compatible with ATA/ATAPI-7 standard

- Compatible with ATA/ATAPI-8 ACS4 mandatory commands

- Support ATA Security Password

- Support NCQ*8 command set

- Support Sanitize/Data Set Management

- Support AES-128/256

- Comprehensive data protection:

   ▪ Customizable data encryption and protection schemes, including AES , SHA ,

ECC, CRC and RAID

   ▪ Apply the second generation of proprietary 4K LDPC ECC technology for

intelligent, flexible, and low-power error correction, effectively improving data

retention ability

   ▪ Support End-to-End protection with full-link data check ensures the accuracy

across data transfer

   ▪ PLP provides smooth integrity protection of user data in Cache under

accidental media failures and sudden power loss

   ▪ Secure Erase

   ▪ Recording and backup for vital events

   ▪ Data read-only protection even with increasing bad NAND blocks

- Advanced NAND flash management:

   ▪ Use highly-effective GC policy with support for Read Disturb GC

   ▪ Support Bad Block Control. Transfer data in detected Bad Block to Idle Block and

correct error to reduce invalid data

   ▪ Use dynamic management of Trim task load for fast response to Trim command,

to ensure performance and low latency. Power loss has no impact on Trim information.

   ▪ Support Static/Dynamic Wear Leveling mechanism, to minimize NAND aging

- Power management:

   ▪ Embed highly-integrated PMU

   ▪ Support HIPM and DIPM

- Hot-plug and surge current control

- Outstanding thermal design:

   ▪ High thermal-conductivity metal case

   ▪ Two on-board temperature sensors

   ▪ Maximum design of high thermal conductivity material between SSD PCB and metal case

   ▪ Intelligent thermal throttling algorithm

   ▪ Change IO level in real-time for better control of temperature status

- Improve QoS:

   ▪ Balance usage of internal IO resources, avoiding IO blocking

   ▪ Support Erase/Program Suspend

- SATA-protocol-based S.M.A.R.T. monitoring and SCT* 16 provide internal attribute configuration and real-time query

- Firmware upgrade

   ▪ Support standard tool

   ▪ Support Firmware upgrade during IO

- Support Secure Boot

- Follow high quality control standard to ensure outstanding stability, reliability, and endurance

5 . Key Specification

5.1   User Addressable Sectors

Capacity	Host Sector Size	Number of addressable LBAs
480GB	512 Bytes	937,703,088
960GB	512 Bytes	1,875,385,008
1.92TB	512 Bytes	3,750,748,848
3.84TB	512 Bytes	7,501,476,528
7.68TB	512 Bytes	15,002,931,888

Table 5-1 User Addressable Sectors

5.2 .Read/Write Performance and Latency

Item	480GB	960GB	1.92TB	3.84TB	7.68TB	Unit
128KB Sequential Read Performance (Max.)	530	530	530	530	530	MB/S
128KB Sequential Write Performance (Max.)	510	510	510	510	510	MB/S
4KB Random Read Performance (Max.)	80K	80K	80K	80K	80K	IOPs
4KB Random Write Performance (Max.)	27K	35K	50K	50K	50K	IOPs
4KB Random Read IOPs Consistency	95					%

4KB Random Write IOPs Consistency	90	%
Max. Average Power Consumption at Write	< 5	W
Max. Average Power Consumption at Idle state	< 1.5	W

Table 5-2   Read/Write performance

Item	480GB	960GB	1.92TB	3.84TB	7.68TB	Unit
4KB Read Latency	140	140	140	140	140	μs
4KB Write Latency	38	38	38	38	38	μs

Table 5-3   Latency

5.3 Electrical Characteristics

Item	Value
Operating Voltage	5V ± 0.25V

Table 5-4   Operating Voltage

Item	480GB	960GB	1.92TB	3.84TB	7.68TB	Unit
Surge Current	1.3	1.3	1.3	1.6	2.2	A

Table 5-5   Operating current

5.4 Reliability

Item	Value	Condition
UBER	$\leq 10^{-17}$	
MTBF	2 million hours	
Data Retention Duration(power removed)	3 months	Temperature $\leq 104℉$ (40℃)

Table 5-7   Reliability Specification

5.5 Endurance

Item	480GB	960GB	1.92TB	3.84TB	7.68TB	Unit
TBW	876	1752	3504	7008	14,016	TB
Warranty Period	5	5	5	5	5	Year
DWPD	1	1	1	1	1	Cycle

Table 5-8   Endurance Specification

5.6 Environmental Specification

Item	Value	Note
Operating Temperature	32℉ (0℃) ~ 158℉ (70℃)	Commercial grade
Storage Temperature	-40℉ (-40℃) ~ 185℉ (85℃)	
Operating Humidity	5% ~ 95%	
Non-operating Humidity	5% ~ 95%	

Table 5-9   Environmental Specification

5.7 Anti-Vibration and Shock Resistance

Anti-Vibration and Shock Resistance	Value
Vibration (Non-operation)	3.13 Grms (5Hz ~ 800Hz)
Shock (Non-operation)	1,500G (0.5ms half-sine)

Table 5-12   Anti-Vibration and Shock Resistance

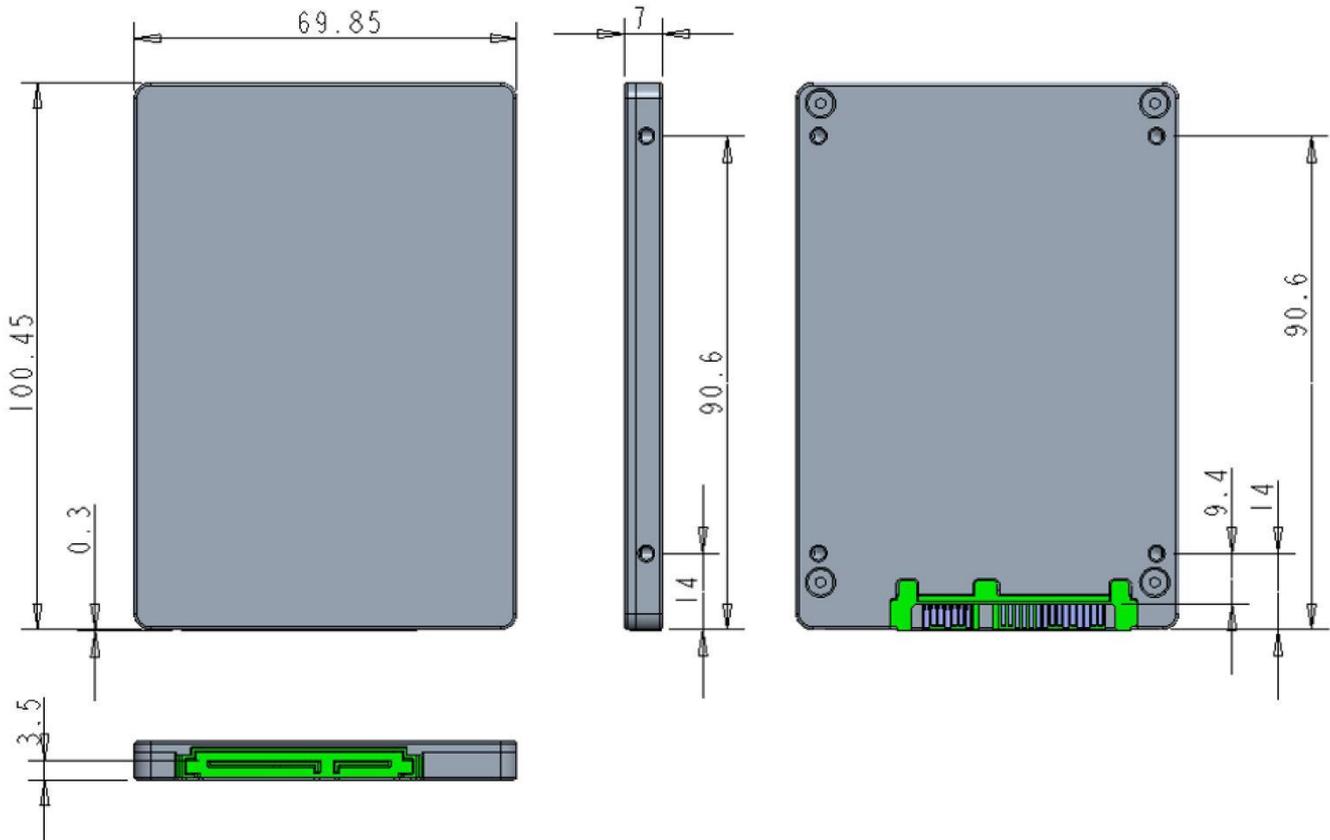# 6 . Product Structure

6.1 Mechanical Information

Figure 6-1 Dimension Diagram (Unit: mm)

Length (mm)	Width (mm)	Height (mm)
100.45 - 0.25	69.85 ± 0.15	7.00 + 0.20, - 0.40

Table 6-1   Dimension specifications

6.2 Pins and Signals

Signal Segment
Key

Signal Segment
Pin S1

Power Segment
Pin P1

Power Segment
Key
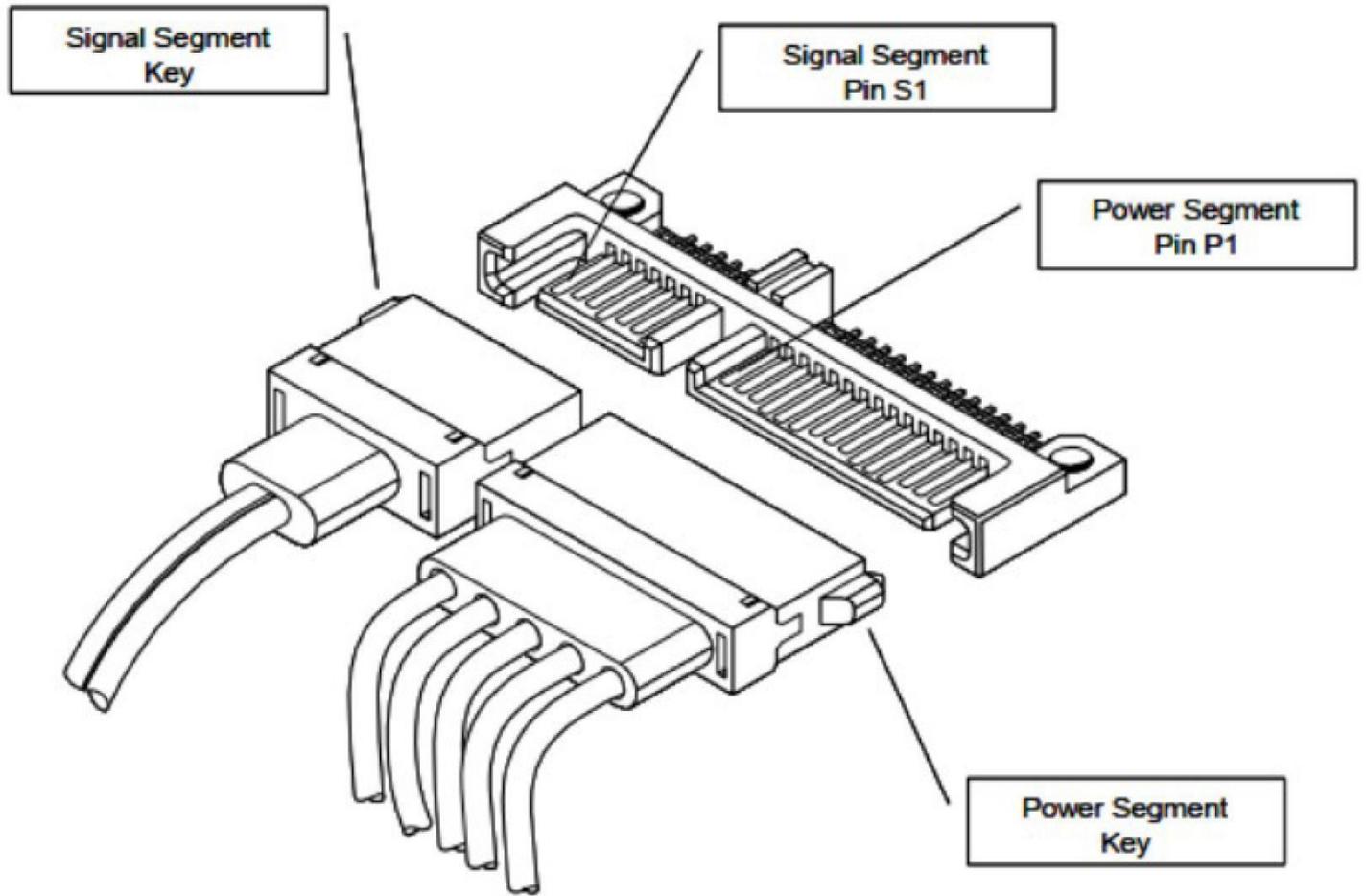
Figure 6-2   Pin Layout

Parameter	Signal	Type	Description
			Signal Segment Key
Signal	S1	GND	Ground
	S2	A+	Differential signal pair A
	S3	A-	
	S4	GND	Ground
	S5	B+	Differential signal pair B
	S6	B-	
	S7	GND	Ground
			Signal Segment "L"
			Central Connector Gap
			Power Segment "L"
Power	P1	Retired	Reserved
	P2	Retired	Reserved
	P3	Retired	Reserved
	P4	GND	Ground
	P5	GND	Ground
	P6	GND	Ground
	P7	V5	5V power supply
	P8	V5	5V power supply
	P9	V5	5V power supply
	P10	GND	Ground
	P11	DAS	Device Activity Signal
	P12	GND	Ground
	P13	Retired	Reserved
	P14	Retired	Reserved
	P15	Retired	Reserved
			Power Segment Key

Table 6-2   Signal Description

7. PLP

With the support of hardware PCB design by adding capacitors with enough capacitance, PLP (Power Loss Protection) function can be implemented to process urgent cases due to unstable power supply, e.g. power disruption when storing data into SSD.

In such cases, the capacitors can supply power for the SSD temporarily by discharging, and CPU will receive interrupt request in time. It will take several ten milliseconds or so to run multiple write-to-flash cycles, so that user data in Cache can be stored to flash in time. Then at the next power up, a status tracking will be performed to retrieve mapping tableand previously programmed Blocks will be resumed to check whether there's any incomplete transaction.

8 . Wear Leveling

By establishing a Static or Dynamic Wear Leveling mechanism, the difference value between the maximum EP (Erase/Program) cycle and the minimum EP cycle is within an expected value (default value is 200), and data will be exchanged between Block with the maximum EP cycle and Block with the minimum EPcycle. The data exchange can release Block with smaller EP cycle, and avoid data from occupying Block with the minimum EP cycle.

This mechanism will avoid repeated programming and erasing operations performed on the same memory cells as much as possible, so as to maximize the usage of flash blocks, level out the wearing down of flash blocks to be almost evenly distributed, and reduce block aging. Thus, the SSD can extend its lifespan.

9 . End-to-End Data Protection

Both SRAM and DDR are deployed with ECC protection, and feature 1-bit error correction and detection of two or more bits error.

CRC16 algorithm is used for each Sector to protect data transfer between host and NAND, supporting 512-Byte Sector Size. LBA number is used as the seed of CRC16, to avoid silent data corruption when returning incorrect Sector data.

10 . RAID

OE100 supports Plane RAID and DIE RAID for data integrity protection. However, both will occupy OP space and affect SSD performance. DIE RAID provides better integrity protection, but requires more OP space and has a greater impact on performance. In addition, Layer RAID is also supported, which provides one-layer space for parity check in one SPB, and different layers sharing the same stripe have the same offset page. Layer RAID has no significant impact on OP space and performance.

11 . Supported ATA Command Set

Command Name	Command Code (hexadecimal)	Command Name	Command Code (hexadecimal)
CHECK POWER MODE	E5h	DOWNLOAD MICROCODE	92h
EXECUTE DEVICE DIAGNOSTIC	90h	FLUSH CACHE	E7h
FLUSH CACHE EXT	EAh	IDENTIFY DEVICE	ECh
IDLE	E3h	IDLE IMMEDIATE	E1h
INITIALIZE DEVICE PARMETERS	91h	READ BUFFER	E4h
READ BUFFER DMA	E9h	READ DMA	C8h
READ DMA EXT	25h	READ FPDMA QUEUED	60h
READ LOG DMA EXT	47h	READ LOG EXT	2Fh
READ MULTIPLE	C4h	READ MULTIPLE EXT	29h
READ SECTORS	20h	READ SECTORS EXT	24h
READ VERIFY SECTORS	40h	READ VERIFY SECTORS EXT	42h
RECALIBRATE	10h	SANITIZE DEVICE	B4h
SECURITY DISABLE PASSWORD	F6h	SECURITY ERASE PREPARE	F3h
SECURITY ERASE UNIT	F4h	SECURITY FREEZE LOCK	F5h
SECURITY SET PASSWORD	F1h	SECURITY UNLOCK	F2h
SET FEATURES	EFh	SET MULTIPLE MODE	C6h
SLEEP	E6h	S.M.A.R.T.	B0h
STANDBY	E2h	STANDBY IMMEDIATE	E0h
TRIM	06h	WRITE BUFFER	E8h
WRITE BUFFER DMA	EBh	WRITE DMA	CAh
WRITE DMA EXT	35h	WRITE DMA FUA EXT	3Dh
WRITE FPDMA QUEUED	61h	WRITE LOG DMA EXT	57h
WRITE LOG EXT	3Fh	WRITE MULTIPLE	C5h
WRITE MULTIPLE EXT	39h	WRITE MULTIPLE FUA EXT	CEh
WRITE SECTORS	30h	WRITE SECTORS EXT	34h

Table 10-1   Command Set

11 . Supported S.M.A.R.T. Attributes

ID Number	Attribute Name	Description
5	Reallocated Sectors Count	Cumulative count number of reallocated NAND physical blocks due to increasing bad blocks
9	Power-On Hours Count	Total count number of power-on hours (unit: hour)
12	Power Cycle Count	Total count number of power cycles for an SSD after being fresh-out-of-box
167	SuperCap Voltage	Voltage of super capacitors used for PLP function (unit: mV).
168	SuperCap Status	Health status of super capacitors used for PLP function. Value larger than 65 indicates the capacitors are normal and have enough electrical energy. Value within the range from 1 to 65 indicates low electrical energy left in the capacitors. Value 0 indicates the capacitors are broken.
169	Protocol Fatal Error Count	Total count number of fatal protocol-end errors, including: 10Bto-8B Decode Error, Disparity Error, CRC Error, Handshake Error, Link Sequence Error (i.e. Error of State Machine in protocol), and Transport State Transition Error
170	Reserved Block Count	Total count number of reserved blocks for an SSD after being fresh-out-of-box
171	Bad Block Ratio	Ratio of the number of bad blocks to total block number
172	DDR Uncorrectable Error Count	Count number of 2-bit errors that occurred when reading data from DDR or writing data into DDR
173	DDR ECC Error Count	Count number of 1-bit errors that occurred when reading data from DDR or writing data into DDR
174	Ungraceful shutdown count	Cumulative count number of L2P table reconstructions due to ungraceful power loss
181	Program Failed Count	Cumulative count number of Program (Write) operations for NAND physical blocks that failed

182	Erase Failed Count	Cumulative count number of Erase operations for NAND physical blocks that failed
184	Error Correction Count	Cumulative count number of End-to-End data errors
187	Reported Uncorrectable Errors	Cumulative count number of reported uncorrectable errors (i.e., ECC failures)
194	Temperature	SSD composite temperature
198	GC Reported Uncorrectable	Cumulative count number of uncorrectable errors (i.e., ECC failures) reported during GC.
199	Ultra-DMA CRC Error Count	Total count number of FIS CRC errors on Read or Write protocol side
202	Percentage of Lifetim Remaining	Current percentage of SSD's remaining lifetime
232	Available Reserved Space	The original value is current count number of free logical blocks
233	Media Wearout Indicator	Average value of cumulative count number of Erase operations for all logical blocks
235	GC Status	GC status indication 1: SSD is executing GC. 0: SSD is not executing GC.
241	Total LBAs Written	Total length of data that Host has written into SSD (unit: 32MB)
242	Total LBAs Read	Total length of data that Host has read from SSD (unit: 32MB)
243	Total NAND Written	Total length of data written into NAND (unit: 32MB)

Table 11-1   Supported S.M.A.R.T. Attribute List

Revision History

Version	Release Date	Changes
1.0	On October 30,2024	Initial Release