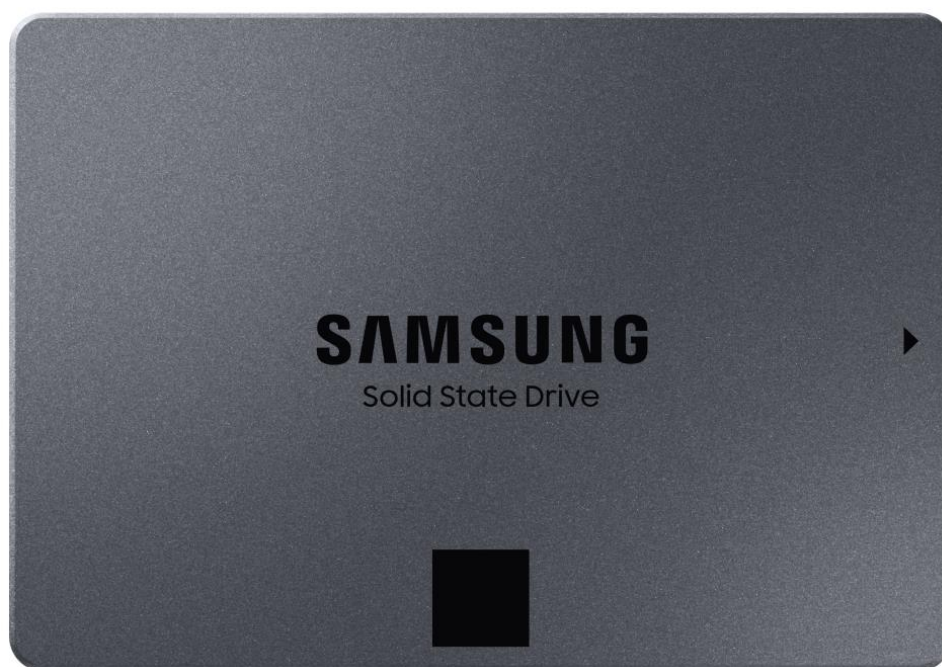# Samsung V-NAND SSD
870 QVO

2020 Data Sheet

Revision 1.0

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Revision History

Revision Number	Description	Revision Date
1.0	Initial Release	June 2020

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THE SAMSUNG SSD 870 QVO Features

FEATURES

- SATA 6.0Gbps (Partially complies with revision 3.3)
- 2.5" 7mmT Cased
- Fully Complies with ATA/ATAPI-7 Standard
  (Partially Complies with ATA/ATAPI-8)
- Support NCQ (up to 32 depth) Command Set
- Support TRIM Command
- RoHS Compliant
- Intelligent TurboWrite Technology

PERFORMANCE

- Data Transfer Rate[2]
  - Sequential Read Up to 560 MB/s
  - Sequential Write Up to 530 MB/s[3]
  - Random Read (4KB, QD32) Up to 98 KIOPS[4]
  - Random Write (4KB, QD32) Up to 88 KIOPS[4]

RELIABILITY

- Non-recoverable Read Error 1 sector per 10^{15} bits read
- MTBF 1,500,000 hours

WARRANTY[5] [6]

- 3 years limited
TBW[10]–1TB:360TB/2TB:720TB/4TB:1,440TB/8TB:2,880TB

ENVIRONMENTAL SPECIFICATIONS

- Temperature
  - Operating[7] 0 ~ 70 °C
  - Non-operating -40 ~ 85 °C
- Humidity (non-condensing) 5 ~ 95%
- Linear Shock (1/2 sine pulse) 1,500 G (0.5ms)
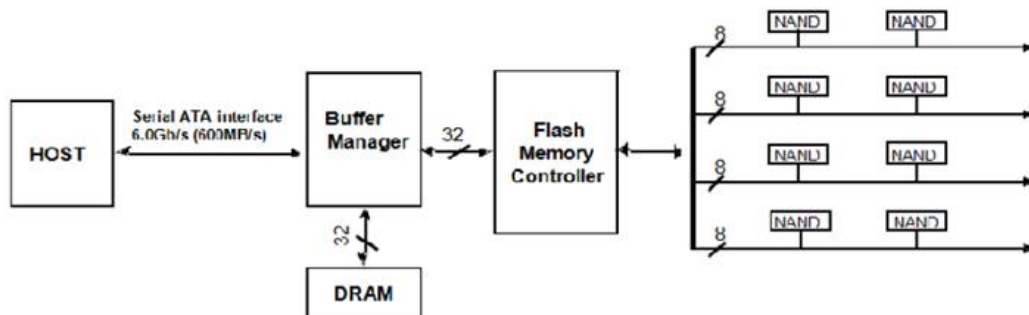- Vibration (non-operating) 20G, 20~2,000 Hz, Sinusoidal

POWER REQUIREMENTS

- Supply Voltage 5V ± 5%
- Voltage Ripple/Noise (max.) 100mV p-p
- Active[8] (typical) up to 3.3 W
- Idle[9] (typical) up to 45 mW
- Devslp (typical) up to 10 mW

PHYSICAL DIMENSION

- Width 100.20 ±0.25 mm
- Depth 69.85 ±0.25 mm
- Height 6.80 ± 0.20 mm
- Weight Up to 60 g

SSD Functional Block Diagram

NOTE: Specifications are subject to change without notice.

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1) 1MB = 1,000,000 Bytes, 1GB = 1,000,000,000 Bytes, Unformatted Capacity. User accessible capacity may vary depending on operating environment and formatting.

2) Performance vary depending on capacity. Sequential performance measurements are based on CrystalDiskMark v. 5.0.2. Random performance measurements are based on IOmeter1.1.0. Performance may vary based on SSD's firmware version, system hardware & configuration. Test system configuration: Intel® Core i7-7700K CPU@4.20GHz, DDR4 1200MHz 32GB, OS-Windows 10 Pro 64bit, Chipset-ASUS PRIME Z270-A.

3) Sequential write performance measurements are based on Intelligent TurboWrite technology. Performances after Intelligent Turbowrite region are 80 MB/s (1TB), 160 MB/s (2/4/8TB).

4) QD32 Random performances after Intelligent TurboWrite are 45K IOPS (1TB), 74K IOPS (2/4/8TB) for reads, 22K IOPS(1TB), 42K IOPS(2/4/8TB) for writes.

5) Warranty provides coverage for the stated time period or the TBW, whichever comes first.

6) All documented endurance test results are obtained in compliance with JESD218 Standards. Please visit www.jedec.org for detailed information on JESD218 Standards

7) Operating Temperature measured by SSD temperature sensor (SMART Attribute 194), Proper airflow recommended.

8) Active Power in measured during execution Intel Core i7-7700K @ 4.2GHz, SAMSUNG DDR4 8GB, Gigabyte GA-Z270X, OS – Windows 10 PRO 64bit.

9) Idle power is measured on max density with DIPM on

10) TBW means Total Bytes Written.

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Table of Contents

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Data Sheet SAMSUNG PROPRIETARY

1.0 Introduction

1.1 General Description

This document describes the specification of 870 QVO SSD which use SATA 6Gb/s interface. 870 QVO are fully consist of semiconductor device and using NAND Flash Memory which has a high reliability and a high technology for a storage media. As the SSD doesn't have a moving parts such as platter(disk) and head media, it gives a good solution for a storage device with a high performance, high capacity. 870 QVO delivers 560MB/s for sequential read and 530MB/s for sequential write speed under up to 3.3 W power.

1.2 Product List

Form Factor	Density	Model Name	Model Code	Part Number
2.5"	8TB	MZ-77Q8T0	MZ-77Q8T0BW,B/AM,B/CN	MZ7M38T0HALC
	4TB	MZ-77Q4T0	MZ-77Q4T0BW,B/AM,B/CN	MZ7M34T0HALC
	2TB	MZ-77Q2T0	MZ-77Q2T0BW,B/AM,B/CN	MZ7M32T0HALC
	1TB	MZ-77Q1T0	MZ-77Q1T0BW,B/AM,B/CN	MZ7M31T0HALD

1.3 Ordering Information

<div align="center">

M Z – 7 7 Q X X X X X X

1 2 3 4 5 6 7 8 9 10 11 12 13

</div>

1. Memory (M)	**7~9. SSD Density** 1T0: 1TB
2. Module Classification Z: SSD	2T0: 2TB 4T0: 4TB 8T0: 8TB
3. "-"	
	11 Packing Type B : Box Type
4. Form Factor 7: 2.5" 7mmT SATA	
	12~13: Region W : Worldwide
5~6. Line-Up 7Q : 870 QVO	/AM : America /CN : China

Revision 1.0

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2.0 Product Specifications

2.1 Interface and Compliance

- SATA 6.0Gbps (Partially Complies with revision 3.3)
- Fully compatible with ATA/ATAPI-7 Standard (Partially Complies with ATA/ATAPI-8)
- Native Command Queueing (NCQ) support up to queue depth of 32
- Support Trim(Data Set Management) Command
- RoHS Compliant
- Intelligent TurboWrite Technology

2.2 Driver Capacity

[Table 1] User Capacity and Addressable Sectors

Density	1TB	2TB	4TB	8TB
User-Addressable Sectors	1,953,525,167	3,907,029,167	7,814,037,167	15,628,053,167
Bytes per Sector	512 Bytes			

NOTE:
1. Megabyte (MB) = 1 Million bytes; 1 Gigabyte (GB) = 1 Billion bytes
2. Actual usable capacity may be less (due to formatting, partitioning, operating system, applications or otherwise)

2.3 Performance

[Table 2] Sequential Read / Write Performance1)

Read / Write	1TB	2TB	4TB	8TB
Sequential Read[1] (Up to)	560	560	560	560
Sequential Write[1] (Up to)	530	530	530	530
Random Read [2] (QD1, Up to)	11,000	11,000	11,000	11,000
Random Write[2] (QD1, Up to)	35,000	35,000	35,000	35,000
Random Read [3] (QD32, Up to)	98,000	98,000	98,000	98,000
Random Write[3] (QD32, Up to)	88,000	88,000	88,000	88,000

NOTE:
1) Sequential performance measurements based on CrystalDiskMark v.5.0.2. (QD=32), Sequential Write performance measurements based on TurboWrite technology, Sequential write performances after TurboWrite region are 80MB/s(1TB) and 160MB/s(2TB/4TB/8TB).
2) Random performance measured using IOMeter 1.1.0. QD1 Random performances after Intelligent TurboWrite are 5.0K IOPS(1/2/4/8TB) for reads, 22K IOPS(1TB) 34K IOPS(2/4/8TB) for writes.
3) QD32 Random performances after Intelligent TurboWrite are 45K IOPS (1TB), 74K IOPS (2/4/8TB) for reads, 22K IOPS(1TB), 42K IOPS(2/4/8TB) for writes.
4) Write cache enabled. Actual performance may vary depending on use conditions and environment.

2.4 Electrical Characteristics

[Table 3] Operating Voltage

Item	Requirements
Allowable voltage	5.0 V +/- 5%
Allowable noise / ripple	100 mV p-p or less

[Table 4] Power Consumption

Read / Write	1TB	2TB	4TB	8TB
Active(typ.)	2.1 W / 2.2 W	2.1 W / 3.0 W	2.2 W / 3.2 W	2.4 W / 3.3 W
Idle(typ.)	30 mW	30 mW	35 mW	45 mW
Devslp(typ.)	3 mW	4 mW	7 mW	10 mW

NOTE:

1) Power Consumption measured with IOmeter1.1.0 version with Intel Core i7-7700K @ 4.2GHz, SAMSUNG DDR4 8GB, Gigabyte GA-Z270X, OS – Windows 10 PRO 64bit

2) Typical power consumption may vary depending on use conditions and environment.

[Table 5] Inrush Current

Parameter	Requirements
Inrush Current[1]	Max. 1.2A

NOTE:

1) Power on slew rate should be over 1ms.

2.5 Environmental Specifications

[Table 6] Environmental Specifications

Features	Operating	Non-Operating
Temperature[1]	0 °C to 70 °C	-40 °C to 85 °C
Humidity	5 % to 95 %, non-condensing	
Shock	1500 G, duration 0.5 ms, Half Sine Wave	
Vibration	20G, 20 ~ 2,000 Hz, Sinusoidal	

NOTE:

1) Measured by SMART Temperature. Proper airflow recommended

2.6 Reliability

[Table 7] MTBF Specifications

Parameter	1TB	2TB	4TB	8TB
MTBF[1]	1,500,000 hours			

NOTE:
1) MTBF is Mean Time Between Failure, and is the predicted elapsed time between inherent failures of a system during operation.

[Table 8] UBER Specifications

Parameter	1TB	2TB	4TB	8TB
UBER[1]	1 sector per 10^{15} bits read			

NOTE:
1) Uncorrectable Bit Error Rate (UBER) is a metric for the rate of occurrence of data errors, equal to the number of data errors per bits read as specified in the JESD218 document of JEDEC standard.

2.7 Warranty

[Table 9] Warranty Information[1] [2]

Parameter	1TB	2TB	4TB	8TB
Period	3 year limited			
TBW[3]	360TB	720TB	1,440TB	2,880TB

NOTE:
1) Warranty provides coverage for the stated time period or the TBW, whichever comes first.
2) All documented endurance test results are obtained in compliance with JESD218 Standards. Please visit www.jedec.org for detailed information on JESD218 Standards
3) TBW means Total Bytes Written.

3.0 Mechanical Specification

[Table 10] Physical Dimensions and Weight

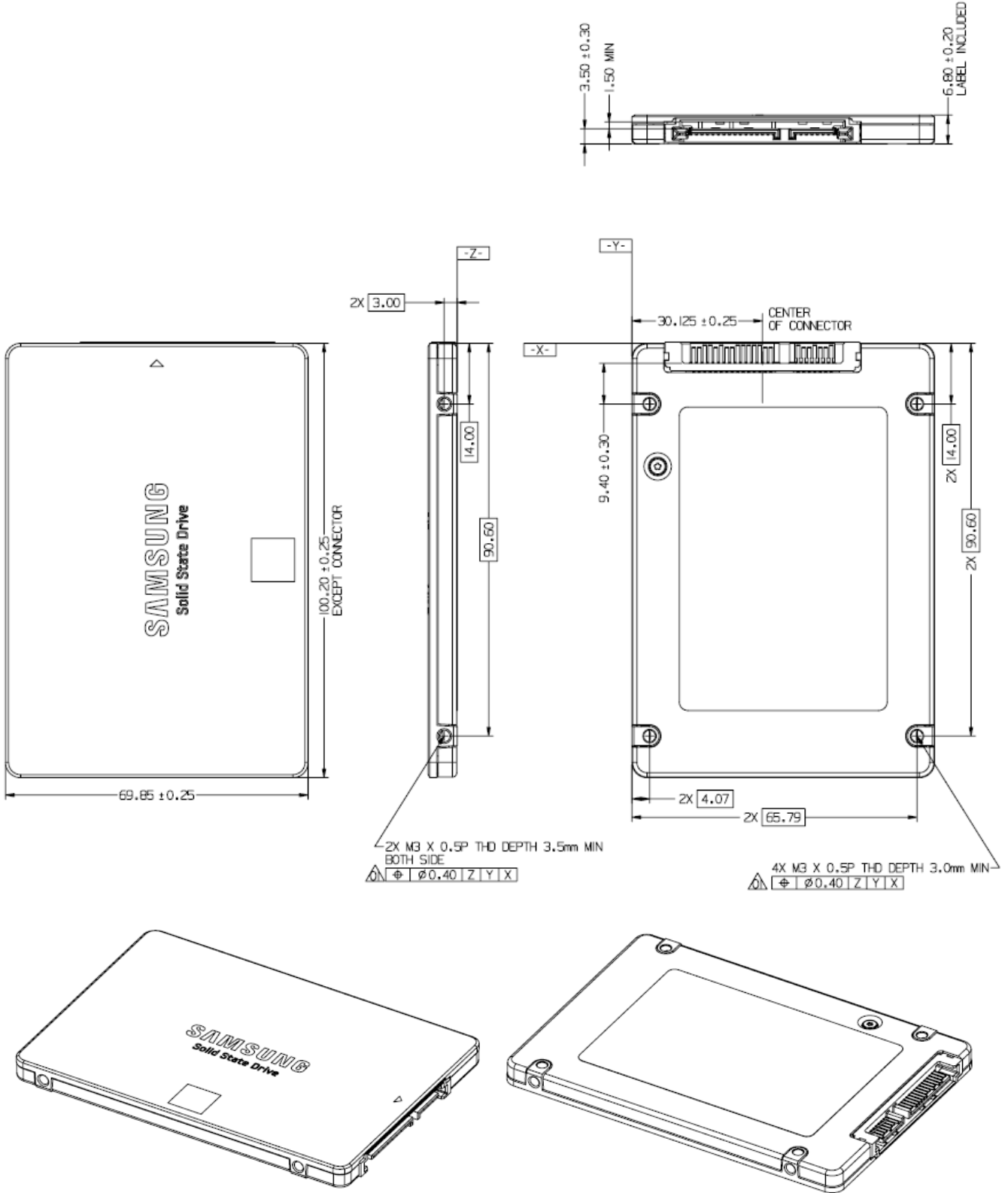| Model	Form Factor	Height (mm)	Width (mm)	Length (mm)	Weight(gram)
1TB/2TB/4TB/8TB	2.5" 7.0mm	6.80 ± 0.20	69.85 ± 0.25	100.20 ± 0.25	60 g (Max)

Figure 1. Physical Dimension

4.0 Electrical Interface Specification
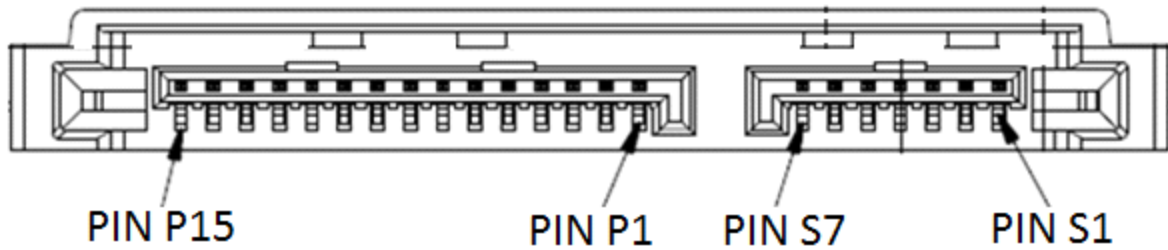
4.1 Serial ATA Interface Connector

Figure 2. Drive Plug Connector

4.2 Pin Assignments

[Table 11] Pin Assignments[1]

Word	No.	Assignment	Description
Signal	S1	GND	Ground, 2ND mate
	S2	A +	SATA Differential RX+
	S3	A -	SATA Differential RX-
	S4	GND	Ground, 2ND mate
	S5	B -	SATA Differential TX-
	S6	B +	SATA Differential TX+
	S7	GND	Ground, 2ND mate
Key and spacing separate signal and power segments			
Power	P1	Reserved	No Connect (Reserved for future use)
	P2	PERST#	No Connect(PCIe Only)
	P3	DEVSLP	Enter/Exit Device Sleep
	P4	IFDet	Interface Detect, 1st mate
	P5	GND	Ground, 2nd mate
	P6	GND	Ground, 2nd mate
	P7	V5	5 V power, pre-charge, 2nd mate
	P8	V5	5 V Source
	P9	V5	5 V Source
	P10	GND	Ground, 2nd mate
	P11	DAS/DSS	Device Activity Signal / Disable Staggered Spin-up
	P12	GND	Ground, 1st mate
	P13	V12	No Connect (12 V power, pre-charge, 2nd mate)
	P14	V12	No Connect (12 V power)
	P15	V12	No Connect (12 V power)

NOTE:

1) Uses 5 V power only. 3.3 V and 12 V power are not used

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5.0 Command Descriptions

5.1 Supported ATA Commands

[Table 12] Supported ATA Commands Summary

Command Name	Command Code (Hex)	Command Name	Command Code (Hex)
CHECK POWER MODE	E5h / 98h	SEND FPDMA QUEUED	64h
DEVICE CONFIGURATION	B1h	SET FEATURES	EFh
DOWNLOAD MICROCODE	92h	SET MAX ADDRESS	F9h
DOWNLOAD MICROCODE DMA	93h	SET MAX ADDRESS EXT	37h
EXECUTE DEVICE DIAGNOSTIC	90h	SET MULTIPLE MODE	C6h
FLUSH CACHE	E7h	SLEEP	E6h / 99h
FLUSH CACHE EXT	EAh	S.M.A.R.T.	B0h
IDENTIFY DEVICE	ECh	STANDBY	E2h / 96h
IDLE	E3h / 97h	STANDBY IMMEDIATE	E0h / 94h
IDLE IMMEDIATE	E1h / 95h	TRIM	06h
INITIALIZE DEVICE PARMETERS	91h	WRITE BUFFER	E8h
NOP	00h	WRITE BUFFER DMA	EBh
READ BUFFER	E4h	WRITE DMA	Cah
READ BUFFER DMA	E9h	WRITE DMA (w/o retry)	CBh
READ DMA	C8h	WRITE DMA EXT	35h
READ DMA (w/o retry)	C9h	WRITE DMA FUA EXT	3Dh
READ DMA EXT	25h	WRITE FPDMA QUEUED	61h
READ FPDMA QUEUED	60h	WRITE LOG DMA EXT	57h
READ LOG DMA EXT	47h	WRITE LOG EXT	3Fh
READ LOG EXT	2Fh	WRITE MULTIPLE	C5h
READ MULTIPLE	C4h	WRITE MULTIPLE EXT	39h
READ MULTIPLE EXT	29h	WRITE MULTIPLE FUA EXT	CEh
READ NATIVE MAX ADDRESS	27h	WRITE SECTORS	30h
READ NATIVE MAX ADDRESS EXT	F8h	WRITE SECTORS (w/o retry)	31h
READ SECTORS	20h	WRITE SECTORS EXT	34h
READ SECTORS (w/o retry)	21h	WRITE UNCORRECTABLE EXT	45h
READ SECTORS EXT	24h		
READ VERIFY SECTORS	40h		
READ VERIFY SECTORS (w/o retry)	41h		
READ VERIFY SECTORS EXT	42h		
RECEIVE FPDMA QUEUED	65h		
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		

5.2 Individual Attribute Data Structure

The following defines the 12 bytes that make up the information for each Attribute entry in the Device Attribute Data Structure.

[Table 13] Attribute Entry in Device Attribute Data Structure

Byte	Descriptions
0	Attribute ID number 01-FFh
1-2	Status flag bit 0 (pre-failure / advisory bit) bit 0 = 0: If attribute value is less than the threshold, the drive is in advisory condition. Product life period maybe expired. bit 0 = 1: If attribute value is less than the threshold, the drive is in pre-failure condition. The drive may have failure. bit 1 (on-line data collection bit) bit 1 = 0: Attribute value will be changed during off-line data collection operation. bit 1 = 1: Attribute value will be changed during normal operation. bit 2 (Performance Attribute bit) bit 3 (Error rate Attribute bit) bit 4 (Event Count Attribute bit) bit 5 (Self-Preserving Attribute bit) bit 6 - 15 Reserved
3	Attribute value 01h - FDh *1 00h, FEh, FFh = Not in use 01h = Minimum value 64h = Initial value Fdh = Maximum value
4	Worst Ever normalized Attribute Value (valid values from 01h - FEh)
5-10	Raw Attribute Value Attribute specific raw data (FFFFFFh - reserved as saturated value)
11	Reserved (00h)

*1 For ID = 199 CRC Error Count

The device supports following Attribute ID Numbers.

[Table 14] SMART Attributes

ID (Word)	Attribute name
5	Reallocated Sector Count
9	Power-on Hours
12	Power-on Count
177	Wear Leveling Count
179	Used Reserved Block Count (total)
181	Program Fail Count (total)
182	Erase Fail Count (total)
183	Runtime Bad Count (total)
187	Uncorrectable Error Count
190	Airflow Temperature
195	ECC Error Rate
199	CRC Error Count
235	POR Recovery Count
241	Total LBAs Written

6.0 Product Compliance

[Table 15] Certifications and Declarations

Category	Certification
CE	Comunaute Europeenne
BSMI	BSMI Bureau of Standards, Metrology and Inspection
KCC	Korea Communications commission
VCCI	Voluntary Control Council for Interference
C-Tick	Radio Telecommunication Labeling
FCC	Federal Communications Commission
IC	Industry Canada
UL	Underwriters Laboratories, Inc.
TUV	Technischer Uberwachungs Verine e.V
CB	Scheme of the IECEE for Mutual Recognition of Test Certificates for Electrical Equipment

Caution: Any changes or modifications in construction of this device which are not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide rea-sonable protection against harmful interference in a residential installation This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications, However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encour-aged to try to correct the interference by one or more of the following measures:

  - Reorient or relocate the receiving antenna.

  - Increase the separation between the equipment and receiver.

  - Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

  - Consult the dealer or an experienced radio / TV technician for help. Modifications not expressly approved by the manufacturer could void the user's authority to operated the equipment under FCC rules.

Industry Canada ICES-003 Compliance Label: *CAN ICES-3 (B)/NMB-3(B)*