3.5 type SATA Hard Disk Drives

MG09ACA18T A/E/AY/EY
MG09ACA16T A/E/AY/EY
MG09ACA14T A/E/AY/EY
MG09ACA12T A/E/AY/EY
MG09ACA10T A/E/AY/EY
MG09ACP18T A/E
MG09ACP16T A/E
MG09ACP14T A/E
MG09ACP12T A/E
MG09ACP10T A/E

Product Specification

Toshiba Electronic Devices &
Storage Corporation

No.
4 4 0 0 8 2 1 0 4
TOTAL 59 CONT.ON 2 PAGE No. 1

Revision History

TITLE: 3.5 type SATA Hard Disk Drives MG09ACA18T A/E/AY/EY- MG09ACA16T A/E/AY/EY- MG09ACA14T A/E/AY/EY - MG09ACA12T A/E/AY/EY - MG09ACA10T A/E/AY/EY - MG09ACP18T A/E- MG09ACP16T A/E - MG09ACP14T A/E - MG09ACP12T A/E - MG09ACP10T A/E Product Specification

REV No.	DATE	CONTENTS	DEP.	REVISED	APP'D	STGE. PER.
00	2020-12-18	Initial issue	HDGI	S.Nakano	T.Iwamoto	—
01	2021-12-07	(1) Page 1-3, 8, 20-21; The following 18 models were added. -MG09ACA 14T/12T/10T A/E/AY/EY (12 models) -MG09ACP 14T/12T/10T A/E (6 models) (2) Page 9; The applied standard of RoHS category on CE marking was revised from EN5081 to EN IEC 63000. In addition, a description about UKCA Marking was added. (3) Page 25-26; Table 2.6 and 2.7 were added. (4) Page 27-28; Current waveforms observed in MG09ACA 14T/12T/10T were added.	HDGI	S.Nakano	S.Kurosawa	—

Preface

This document describes the 7200 rpm MG09ACA18TA / MG09ACA16TA / MG09ACA14TA / MG09ACA12TA / MG09ACA10TA / MG09ACA18TE / MG09ACA16TE / MG09ACA14TE / MG09ACA12TE / MG09ACA10TE / MG09ACA18TAY / MG09ACA16TAY / MG09ACA14TAY / MG09ACA12TAY / MG09ACA10TAY / MG09ACA18TEY / MG09ACA16TEY / MG09ACA14TEY / MG09ACA12TEY / MG09ACA10TEY / MG09ACP18TA / MG09ACP16TA / MG09ACP14TA / MG09ACP12TA / MG09ACP10TA / MG09ACP18TE / MG09ACP16TE / MG09ACP14TE / MG09ACP12TE / MG09ACP10TE 3.5 type hard disk drives with an embedded Serial ATA (SATA).

This document details the specifications and functions of the above hard disk drive, and gives the requirements and procedures for installing it into a host computer system.

This document is written for users who have a basic understanding of hard disk drives and their use in computer systems. The DOCUMENT ORGANIZATION section describes organization and scope of this document. The need arises, use the other manuals.

The organization of this document, related reference document and conventions for alert messages follow.

Overview of Document

This document consists of the following seven chapters:

Chapter 1 General Description

This chapter introduces the hard disk drives standard features, hardware, and system configuration.

Chapter 2 Specifications

This chapter gives detailed specifications of the hard disk drives and the installation environment.

Chapter 3 Installation Requirements

This chapter describes the basic physical and electrical requirements for installing the hard disk drives.

Chapter 4 Installation

This chapter explains how to install the hard disk drives. It includes the notice and procedures for setting device number and operation modes, mounting the hard disk drive, and confirming drive operation.

Chapter 5 Maintenance

This chapter describes the automatic diagnosis, and maintenance of the hard disk drive. This chapter also describes diagnostic methods for operation check and the basics of troubleshooting the hard disk drives.

Conventions Used in this Document

The MG09ACA / MG09ACP series are described as "the HDD" in this document.

Decimal number is represented normally.

Hexadecimal number is represented as X'17B9', 17B9h or 17B9H.

Binary number is represented as "010".

The sector size might be described in this document as the logical data block length.

Toshiba Electronic Devices & Storage Corporation and its subsidiaries and affiliates are hereinafter called “TDSC”.

Safety Precautions

This section lists important precautions which users of our product(s) (and anyone else) should observe in order to avoid injury to human body and damage to property, and to ensure safe and correct use of our products. Please be sure that you understand the meanings of the labels and graphic symbols described below before you move on to the detailed descriptions of the precautions, and comply with the precautions stated.

Explanation of Labels

⚠DANGER	⚠WARNING	⚠CAUTION	*NOTICE*
Indicates a hazardous situation which, if not avoided, will result in death or serious injury[1].	Indicates a hazardous situation which, if not avoided, could result in death or serious injury[1].	Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury[2].	Indicates practices that may cause property damage[3] and other problems, but not personal injury

1. Serious injury includes blindness, wounds, burns (low and high temperature), electric shock, fractures, and poisoning, etc. with long-lasting effects or that require hospitalization and/or long-term hospital visits for treatment.

2. Minor or moderate injury includes wounds, burns, electric shock, etc. not requiring hospitalization and/or long-term hospital visits for treatment.

3. Property damage means damage to customer or third party machines and equipment.

Explanation of Graphic Symbols

 **Prohibited**	 **Instructions**
Indicates prohibited actions.	Indicates actions that must be undertaken for safety purposes.

⚠CAUTION	
 **Prohibited**	Safety Do not touch sharp edges or pins of the drive. Sharp edges and protrusions etc. may cause injury.

⚠CAUTION	
 **Prohibited**	Electrical shock Do not touch the HDDs while power-feeding.
 **Prohibited**	Damage 1) Do not use a conductive cleaner to clean the HDDs. 2) Do not remove any labels from the HDD or deface the HDDs in any way. 3) Do not disassemble, analyze, reverse-engineer, alter, modify, translate or copy HDDs, whether in whole or in part. Failure to do so voids any warranty, expressed or implied.

⚠CAUTION	
 **Instructions**	High temperature To prevent injury such as burn, do not touch the HDD while it is hot. The HDA and LSI become hot during operation and remain hot immediately after turning off the power.
 **Instructions**	Data loss Save data stored on the HDD to other media before requesting repair. TDSC assumes no liability if data is corrupted during servicing or repair.
 **Instructions**	Damage Always ground yourself with such as a wrist strap connected to ground before handling. ESD (Electrostatics Discharge) may cause the damage to the device.
 **Instructions**	Damage When dismounting the HDD which is mounted on the system while power is supplied; 1) Stop the spindle motor. It takes about 20 seconds for the spindle motor to stop completely. 2) Then, dismount the HDD using such as the HDD mounting/dismounting mechanism of the system. When removing the HDD, avoid exposing it to shock or vibration or don't let the metal frame come in contact with PCBA. Just in case, stop dismounting once and wait until the spindle motor stops (about 20 seconds) when SATA connector breaks off contact.
 **Instructions**	Damage When dismounting the HDD which is mounted on the system while power is not supplied; Dismount the HDD using such as the HDD mounting/dismounting mechanism of the system. When removing the HDD, avoid exposing it to shock or vibration or don't let the metal frame come in contact with PCBA.
 **Instructions**	Damage When storing or transporting the HDD, put it in the antistatic bag (refer to Section 4.1 and 5.3).

Related Standards

The product specifications and functions described in this document conform to the following standards:

Specification (document) number	Name	Concerned organization
X3T132008D Revision 6	Information technology -AT Attachment-3 Interface (ATA-3)	American National Standards Institute (ANSI)
T13/1153D Revision 17	Information technology - AT Attachment with Packet Interface Extension (ATA-4)	
T13/1321D Revision 3	Information technology - AT Attachment with Packet Interface-5 (ATA-5)	
T13/1410D Revision 3b	Information technology - AT Attachment with Packet Interface-6 (ATA-6)	
T13/1532D Volume 1 Revision 4b T13/1410D Volume 2 Revision 4b T13/1410D Volume 3 Revision 4b	Information technology - AT Attachment with Packet Interface-7 (ATA-7)	
T13/1699-D Revision 4b	Information technology - AT Attachment 8 - ATA/ATAPI Command Set (ATA8-ACS)	
T13/2015-D Revision 7	Information technology – ATA/ATAPI Command Set-2 (ACS-2)	
T13/2161-D Revision 5	Information technology – ATA/ATAPI Command Set-3 (ACS-3)	
T13/BSR INCITS 529 Revision 5	Information technology – ATA/ATAPI Command Set-4 (ACS-4)	
Serial ATA Workgroup Revision 2.6	Serial ATA: High Speed Serialized AT Attachment Revision 2.6	Serial ATA International Organization (SATA IO)
Serial ATA Workgroup Revision 3.0	Serial ATA: High Speed Serialized AT Attachment Revision 3.0	
Serial ATA Workgroup Revision 3.1	Serial ATA: High Speed Serialized AT Attachment Revision 3.1	
Serial ATA Workgroup Revision 3.2	Serial ATA: High Speed Serialized AT Attachment Revision 3.2	
Serial ATA Workgroup Revision 3.3	Serial ATA: High Speed Serialized AT Attachment Revision 3.3	
SFF-8447	Specification for LBA Count for Disk Drives Revision 0.5	SFF Committee

Marking

1) WEEE

Following information is only for EU-member states:

The use of the symbol indicates that this product may not be treated as household waste. By ensuring this product is disposed of correctly, you will help prevent potential negative consequences for the environment and human health, which could otherwise be caused by inappropriate waste handling of this product. For more detailed information about recycling of this product, please contact your local city office, your household waste disposal service or the shop where you purchased the product.

2) Names and Contents of Hazardous Substances or Elements in Products

产品中有害物质的名称及含量

部件名称	有害物质					
	铅（Pb）	汞（Hg）	镉（Cd）	六价铬（Cr(VI)）	多溴联苯（PBB）	多溴二苯醚（PBDE）
HDD(硬盘驱动器)	×	○	○	○	○	○

本表格依据 SJ/T 11364 的规定编制。
○：表示该有害物质在该部件所有均质材料中的含量均在 GB/T 26572 规定的限量要求以下。
×：表示该有害物质至少在该部件的某一均质材料中的含量超出 GB/T 26572 规定的限量要求。

中华人民共和国环保使用期限

Safety/EMC Standards

The drive satisfies the following standards.

Item
Underwriters Laboratories (UL)
Canadian Standard Association (CSA)
Technischer Uberwachungs-Verein (TUV)
Bureau of Standards, Metrology and Inspection (BSMI)
Korea Certification (KC) (Note 1)
Regulatory Compliance Mark (RCM)

(Note 1) Marks of KC

Made in Japan	1. 기기의 명칭(모델명) : MG09ACA18T/16T/14T/12T/10T A/E/AY/EY, MG09ACP18T/16T/14T/12T/10T A/E 2. 인증번호 : R-R-T48-MG09ACA18TE 3. 인증받은 자의 상호 : TOSHIBA ELECTRONIC DEVICES & STORAGE CORPORATION 4. 제조년월일 : 2020-05 5. 제조자 / 제조국가 : TOSHIBA ELECTRONIC DEVICES & STORAGE CORPORATION / 일본
Made in Philippines	1. 기기의 명칭(모델명) : MG09ACA18T/16T/14T/12T/10T A/E/AY/EY, MG09ACP18T/16T/14T/12T/10T A/E 2. 인증번호 : R-R-T48-MG09ACA18TE 3. 인증받은 자의 상호 : TOSHIBA ELECTRONIC DEVICES & STORAGE CORPORATION 4. 제조년월일 : 2020-05 5. 제조자 / 제조국가 : TOSHIBA ELECTRONIC DEVICES & STORAGE CORPORATION / 필리핀

B급 기기 (가정용 방송통신기자재)	이 기기는 가정용(B급) 전자파적합기기로서 주로 가정에서 사용하는 것을 목적으로 하며, 모든 지역에서 사용할 수 있습니다.

CE Marking

The drive satisfies the following standards.

Category	Applied standard	Issued year	Comment
EMC 2014/30/EU	Emission: EN55032	2015	Class B (including domestic environment)
	Immunity: EN55035	2017	Product immunity standard for IT-equipment
RoHS 2011/65/EU	EN IEC63000	2018	Category 3

UKCA Marking

The drive satisfies the following standards.

Category	Applied standard	Issued year	Comment
EMC	Emission: BS EN55032	2015	Class B (including domestic environment)
	Immunity: BS EN55035	2017	Product immunity standard for IT-equipment
RoHS	BS EN IEC63000	2018	Category 3

DOCUMENT ORGANIZATION

MG09 SATA PRODUCT SPECIFICATION (This document)	1. General Description 2. Specifications 3. Installation Requirements 4. Installation 5. Maintenance
MG09 SATA INTERFACE SPECIFICATION (DOC NO: 440082105)	1. Serial ATA (SATA) Interface 2. Command Processing 3. Command Specifications 4. Disk Management
MG09 SAS/SATA SED SPECIFICATION (DOC NO: 440082106)	1. Introduction 2. Overview 3. Implementation Details 4. Error handling
MG09 SAS/SATA SIE SPECIFICATION (DOC NO: 440082107)	1. Introduction 2. Specification

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CHAPTER 1 General Description

This chapter describes the feature and configuration of the hard disk drives (HDDs).
The HDDs are high performance large capacity 3.5 type hard disk drives with an embedded Serial ATA (SATA) controller.

The interface used to connect the HDDs to the host system complies with (SATA IO) Serial ATA Workgroup Revision 3.3:Serial ATA: High Speed Serialized AT Attachment and, ANSI T13/BSR INCITS 529 Revision 5 Information technology - ATA/ATAPI Command Set-4 (ACS4) which covers items ranging from SATA physical layers to ATA command protocols.

The high-speed data transfer and long-distance transmission capabilities of SATA technology and the powerful command set the HDDs facilitate creation of high-performance and highly reliable disk subsystems with large storage capacities.

1.1 Standard Features

(1) Compactness

The HDDs are a compact enclosure which complies with the 3.5 type hard disk drive form factor.

(2) Environmental Protection

The HDDs comply with the Restriction of the use of certain Hazardous Substances in electrical and electronic equipment (RoHS) directive issued by European Union (EU).

(3) SATA Standard

The HDDs are equipped with a Serial ATA (SATA) as a host interface.

- Transfer speed: 6.0 Gbit/s, 3.0 Gbit/s, 1.5 Gbit/s

(4) High-speed data transfer

The maximum data-transfer speed is 600 MB/s per SATA port. The large-capacity data buffer of the HDDs enable the effective use of such high-speed data transfers available on the SATA connection.

(5) Continuous block processing

The addressing method of data blocks is logical block address. The host system can access data by specifying block number in a logically continuous data space without concerning the physical structure of the track or cylinder boundaries.

The continuous processing up to 65 536 blocks in a command can be achieved, and the HDDs can perform continuous read/write operation when processing data blocks on several tracks or cylinder.

(6) Multi-segment data buffer

The data buffer is 512 MiB. Data is transferred between SATA port and disk media through this data buffer. This feature provides the suitable usage environment for users.

(7) Cache feature

After executing the READ command, the HDDs read automatically and store (prefetches) the subsequent data blocks into the data buffer (Read-ahead caching).

The high speed sequential data access can be achieved by transferring the data from the data buffer without reaccessing the disk in case the subsequent command requests the prefetched data blocks.

The Write Cache feature is supported. When this feature is enabled, the status report is issued without waiting for completion of write processing to disk media, thereby enabling high speed write processing.

IMPORTANT

When Write Cache is enabled, you should ensure that the cached data is surely flushed to the disk media before you turn off the HDDs power.
To ensure it, you should issue either the FLUSH CACHE/FLUSH CACHE EXT command or the STANDBY IMMEDIATE command and then confirm that the command is surely terminated with the GOOD STATUS.

(8) Command queuing feature (Native Command Queuing: NCQ)

The HDDs can queue maximum 32 commands, and optimizes the issuing order of queued commands by the reordering function. This feature realizes the high speed processing.

(9) Error recovery

The HDDs can try to recover from errors in the HDD using its powerful retry processing. If a recoverable data check occurs, error-free data can be transferred to the host system after being corrected in the data buffer. The host system software is released from the complicated error recover processing by these error recovery functions of the HDDs.

(10) Automatic alternate block reassignment

If a defective data block is detected during read or write the HDDs can automatically reassign its alternate data block.

(11) Defective block slipping

A logical data block can be reallocated in a physical sequence by slipping the defective data block at formatting. This results in high speed contiguous data block processing without a revolution delay due to defective data block.

(12) High speed positioning

A rotary voice coil motor achieves fast positioning with high performance access control.

(13) Large capacity

A large capacity can be obtained from the HDDs by dividing all cylinders into several partitions and changing the recording density on each partition (constant density recording). The disk subsystem with large capacity can be constructed in the good space efficiency.

(14) Start/Stop of spindle motor

Using the SATA primitive the host system can start and stop the spindle motor.

(15) Diagnosis

The HDDs have a diagnostic capability which checks internal controller functions and HDD operations. Also, for early detection of and recovery from the errors on the disk, the HDD has a function for periodically implementing a full scan of the disk.

(16) Low power consumption

By using highly integrated LSI components, the power consumption of the HDDs is very low, and this enables the unit to be used in wide range of environmental conditions. Also, unloading the head with idle status realizes the significant reduction of power consumption.

(17) Low acoustic noise

The acoustic noise level is low. This makes it ideal for office use.

(18) PWC (Persistent Write Cache) with PLP (Power Loss Protection)

PWC with PLP is a function to secure the write data that the drive reports "Normal completion" to the host but not being stored to the Media disk yet. This function improves Write performance under Write Cache Disable condition. The Write data may be written to media (Back up Cache area or target LBA area).The un-written data to above area (media) is stored to Flash ROM when the power supply to the drive suddenly is shut down in operation (PLP). And, after PLP operation, it is required more time to start up the drive than in case of normal shutdown.

1) PLP does not secure data in the mode of all the power shutdowns. When power supplies other than recommended procedure are intercepted, data might be lost.

2) In the power shutdown before it reports on the Write completion, data not anticipated might be lost.

(19) Self Encryption Drive (SED)

SED model is available in this HDD series. SED model is TCG (Trusted Computing Group) protocol. This function will prevent information leakage if stolen or missing the HDD, so it is a good data security from accident.
Refer to SAS/SATA SED Specification (Document No. 440082106) for more detail.

(20) Sanitize Instant Erase (SIE) functions

SIE model is available in this HDD series. SIE model is supported sanitize device feature set and TCG is not supported. When the deletion of data is executed by using this function, the HDDs cannot restore all this recorded data.
Refer to SAS/SATA HDD SIE Specification (Document No. 440082107) for more detail.

(21) Logical Depop function

This HDD series features Logical Depop function. This function supports special format to remove specified head from logical block. When the specified head is removed, the number of logical blocks is reduced according to the number of physical blocks of removed head.

1.2 Hardware Structure

The HDDs have a head disk assembly (HDA) and a printed circuit board assembly (PCBA). The HDA includes heads on an actuator and disks on a spindle motor mounted on the HDA. The PCBA includes a read/write circuit and a controller circuit.

(1) Disks

The disks have an outer diameter of 96 mm {3.78 inch}.

(2) Heads

The heads have MR (Magnet-Resistive) read element on Ramp Load type slider.

(3) Spindle motor

The disks are rotated with an FDB (Fluid Dynamic Bearing) motor. The specified speed of the motor is maintained with the motor terminal's counter electromotive voltage, which is used to detect the motor speed.

(4) Actuator

The actuator, which uses a rotary voice coil motor (VCM), consumes little power and generates little heat. The heads at the end of the actuator arm are controlled and positioned via feedback servo loop.

The heads are positioned on the ramp when the power is off or the spindle motor is stopped.

(5) Read/write circuit

The read/write circuit uses a LSI chip for the read/write preamplifier and an MEEPRML (Modified Enhanced Extended Partial Response Maximum Likelihood) modulation/demodulation circuit in order to prevent errors being triggered by external noise and to improve data reliability.

(6) Controller circuit

The controller circuit supports Serial ATA (SATA) interface, and it realized a high performance by integration into LSI.

1.3 System Configuration

For the SATA, the ANSI standard defines Point-to-Point technology. Figure 1.1 gives an example of the SATA system configuration.

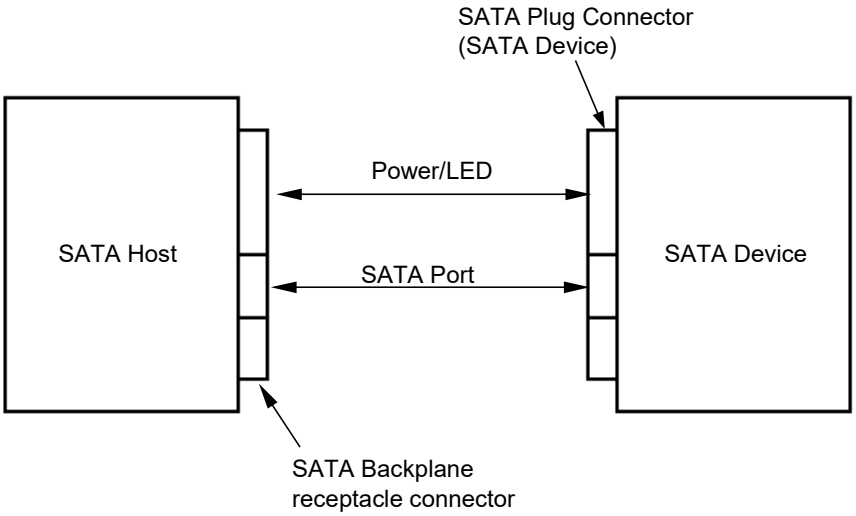


Figure 1.1 Example of SATA system configuration

CHAPTER 2 Specifications

2.1 Hardware Specifications

This chapter describes specifications of the HDDs.

2.1 Hardware Specifications

2.1.1 Model Number

Each model has different recording capacities when shipped.

Table 2.1 lists the model name.

The data format can be changed by reinitializing with the user's system.

Table 2.1 Model numbers

Model number	Interface type	Capacity (*1) (user area)	Model type (*2)	Function	
				SDFS (*3)	TCG (*4)
MG09ACA18T A/E	SATA-3.3 (6.0 Gbit/s, 3.0 Gbit/s, 1.5 Gbit/s)	18 TB	Base	No	No
MG09ACA16T A/E	SATA-3.3 (6.0 Gbit/s, 3.0 Gbit/s, 1.5 Gbit/s)	16 TB	Base	No	No
MG09ACA14T A/E	SATA-3.3 (6.0 Gbit/s, 3.0 Gbit/s, 1.5 Gbit/s)	14 TB	Base	No	No
MG09ACA12T A/E	SATA-3.3 (6.0 Gbit/s, 3.0 Gbit/s, 1.5 Gbit/s)	12 TB	Base	No	No
MG09ACA10T A/E	SATA-3.3 (6.0 Gbit/s, 3.0 Gbit/s, 1.5 Gbit/s)	10 TB	Base	No	No
MG09ACA18T AY/EY	SATA-3.3 (6.0 Gbit/s, 3.0 Gbit/s, 1.5 Gbit/s)	18 TB	SIE	Yes	No
MG09ACA16T AY/EY	SATA-3.3 (6.0 Gbit/s, 3.0 Gbit/s, 1.5 Gbit/s)	16 TB	SIE	Yes	No
MG09ACA14T AY/EY	SATA-3.3 (6.0 Gbit/s, 3.0 Gbit/s, 1.5 Gbit/s)	14 TB	SIE	Yes	No
MG09ACA12T AY/EY	SATA-3.3 (6.0 Gbit/s, 3.0 Gbit/s, 1.5 Gbit/s)	12 TB	SIE	Yes	No
MG09ACA10T AY/EY	SATA-3.3 (6.0 Gbit/s, 3.0 Gbit/s, 1.5 Gbit/s)	10 TB	SIE	Yes	No
MG09ACP18T A/E	SATA-3.3 (6.0 Gbit/s, 3.0 Gbit/s, 1.5 Gbit/s)	18 TB	SED	Yes	Yes
MG09ACP16T A/E	SATA-3.3 (6.0 Gbit/s, 3.0 Gbit/s, 1.5 Gbit/s)	16 TB	SED	Yes	Yes
MG09ACP14T A/E	SATA-3.3 (6.0 Gbit/s, 3.0 Gbit/s, 1.5 Gbit/s)	14 TB	SED	Yes	Yes
MG09ACP12T A/E	SATA-3.3 (6.0 Gbit/s, 3.0 Gbit/s, 1.5 Gbit/s)	12 TB	SED	Yes	Yes
MG09ACP10T A/E	SATA-3.3 (6.0 Gbit/s, 3.0 Gbit/s, 1.5 Gbit/s)	10 TB	SED	Yes	Yes

(*1) One terabyte (TB) = one trillion bytes; accessible capacity will be less and actual capacity depends on the operating environment and formatting.

(*2) Model type is displayed as Base, SIE (Sanitize Instant Erase) and SED (Self Encrypting drive).

(*3) SDFS : Sanitize Device Feature Set.

(*4) TCG : TCG Enterprise SSC.

2.1.2 Function Specifications

Table 2.2 shows the function specifications of the HDDs.

Table 2.2 Function specifications

Item		Specification				
		MG09ACA18T MG09ACP18T	MG09ACA16T MG09ACP16T	MG09ACA14T MG09ACP14T	MG09ACA12T MG09ACP12T	MG09ACA10T MG09ACP10T
Formatted capacity (*1)		18 TB	16 TB	14 TB	12 TB	10 TB
Sector size	MG09ACAxxx A/AY MG09ACPxxx A (fixed length)	4096 B				
	MG09ACAxxx E/EY MG09ACPxxx E (emulation) (*2)	Host 512 B Disk 4096 B				
Number of sectors	4096 B / sectors	105F00000h	E8D80000h	CBBC0000h	AEA00000h	91880000h
	512 B / sectors	82F800000h	746C00000h	65DE00000h	575000000h	48C400000h
Interface speed (*3)		6.0 Gbit/s, 3.0 Gbit/s, 1.5 Gbit/s				
Maximum sustained data rate (*3) (Typ.)		268 MiB/s				
Data buffer (*4)		512 MiB				
Rotation speed		7200 rpm				
Start time (*5) (Typ. (Max.))		20 s (30 s)				
Stop time (*6) (Max)		20 s				
External dimensions	Height (Max.)	26.1 mm				
	Width (Max.)	101.85 mm				
	Length (Max.)	147.0 mm				
Weight (Max. (Typ.))		720 g (694 g)		705 g (679 g)	690 g (664 g)	
Acoustics (Sound Power) (*7) (Typ.)		Idle: 20 dB, Active: 32 dB				

(*1) One terabyte (TB) = one trillion bytes; accessible capacity will be less and actual capacity depends on the operating environment and formatting.

(*2) Read–modify-write is supported.

(*3) The maximum sustained data rate and interface speed may be restricted to the response speed of host system and by transmission characteristics.
1 Gbit/s = 1 000 000 000 bit/s. 1 MiB/s = 1 048 576 B/s

(*4) 1 MiB = 1 048 576 B.

(*5) The start time is the time from power on to when the HDDs are ready.

(*6) The stop time is the time for disks to completely stop from power off or stop command.

(*7) The measuring method is based on ISO 7779. Idle is active idle mode.

2.1.3 Environmental Specifications

Table 2.3 lists environmental requirements.

Table 2.3 Environmental requirements

Item			Specification
Operating condition	Ambient temperature (*1)		5 to 55 °C (No condensation)
	Enclosure surface temperature (*1)		5 to 60 °C (No condensation)
	Temperature gradient (*1)		20 °C/h or less (No condensation)
	Relative humidity		5 to 90 %RH (No condensation)
	Humidity gradient		20 %/h (No condensation)
	Maximum wet bulb temperature		29.4 °C (No condensation)
	Vibration (*2) (*3)		7.35 m/s^2 {0.75 G} (5 to 300 Hz) 2.45 m/s^2 {0.25 G} (300 to 500 Hz)
	Rotational vibration		13.53 rad/s^2 (20 to 2200 Hz)
	Shock (*2)		686 m/s^2 {70 G} (2 ms duration)
	Altitude		-305 to +3048 m (5 to 55 °C Ambient)
Non-operating condition (*4)	Storage condition	Ambient temperature	0 to 70 °C (No condensation)
		Altitude	-305 m to +3048 m
		Period	6 months within shipping package
		Ambient temperature (*1) (*5)	-40 to 70 °C (No condensation)
		Altitude	-305 to +12 192 m
		Temperature gradient (*1)	30 °C/h or less (No condensation)
		Relative humidity	5 to 95 %RH (No condensation)
		Humidity gradient	20 %/h (No condensation)
		Maximum wet bulb temperature	29.4 °C (No condensation)
		Vibration (*2) (*6)	29.4 m/s^2 {3.0 G} (5 to 500 Hz)
		Shock (*2)	2450 m/s^2 {250 G} (2 ms duration)
		Rotational shock	25 krad/s^2 (1.0 ms)

(*1) For detail condition, see Section 3.1

(*2) Vibration applied to the HDD is measured at near the mounting screw hole on the frame as much as possible.

(*3) At random seek write/read and default on retry setting with log sweep vibration.

(*4) Non-operating condition (except storage condition) assumes short term transportation.

(*5) The range of altitude is 3048 m or less.

Up to 55 °C at 7620 m. Up to 40°C at 12 192 m.

(*6) At power-off state after installation

2.1.4 Power Specification

(1) Power requirements

Table 2.4 Power requirements

Item	DC +5 V (*1)	DC +12 V (*1)
Regulation	+10 % / - 7 % (*2)	±10 %
Rise time	1 ms or more, 100 ms or less 0 V => 5 V	1 ms or more, 100 ms or less 0 V => 12 V
Ripple (*3) (peak-to-peak value)	250 mV or less (100 Hz to 20 MHz)	800 mV or less (100 Hz to 8 kHz) 450 mV or less (8 kHz to 100 kHz) 250 mV or less (100 kHz to 20 MHz)

(*1) Input voltages are specified at the HDD connector side, during HDD ready state.

(*2) Make sure the value is not less than DC – 0.3 V (less than – 0.6 V, 0.1 ms) when turning on or off the power.

(*3) High frequency noise (over 20 MHz) is less than 100 mV (peak-to-peak value).

(2) Power consumption

Table 2.5, Table 2.6 and Table 2.7 list typical power consumption under power supply at nominal voltage ±1 % and 25 °C ambient.

Table 2.5 Power consumption (MG09ACA18T / MG09ACA16T)

Item		Current (Typ)		Wattage (Typ)
		DC +5 V	DC +12 V	
Spin up	Peak (*1)	0.29 A	1.44 A	-
	Maximum DC (*2)	0.25 A	1.28 A	-
Random Read 4KB Q1	Peak	0.96 A	1.96 A	-
	Average	0.25 A	0.57 A	8.08 W
Random Read 4KB Q16	Peak	0.92 A	1.95 A	-
	Average	0.29 A	0.63 A	8.97 W
Random Write 4KB Q1	Peak	0.68 A	1.97 A	-
	Average	0.29 A	0.41 A	6.28 W
Random Write 4KB Q16	Peak	0.72 A	1.97 A	-
	Average	0.29 A	0.41 A	6.28 W
Sequential Read	Peak	0.99 A	0.73 A	-
	Average	0.73 A	0.34 A	7.64 W
Sequential Write	Peak	0.69 A	0.60 A	-
	Average	0.57 A	0.39 A	7.43 W
Random Write/Read 4KB Q1	Peak	0.97 A	1.95 A	-
	Average	0.26 A	0.59 A	8.35 W
Random Write/Read 4KB Q16	Peak	0.87 A	1.96 A	-
	Average	0.29 A	0.58 A	8.32 W
Idle_A	Average	0.13 A	0.30 A	4.16 W
Idle_B	Average	0.12 A	0.21 A	3.01 W
Idle_C	Average	0.12 A	0.17 A	2.54 W
Standby	Average	0.08 A	0.003 A	0.43 W

(*1) Not including glitch less than 100 µs.

(*2) Average value in 500 ms window.

Table 2.6 Power consumption (MG09ACA14T)

Item		Current (Typ)		Wattage (Typ)
		DC +5 V	DC +12 V	
Spin up	Peak (*1)	0.31 A	1.45 A	-
	Maximum DC (*2)	0.28 A	1.28 A	-
Random Read 4KB Q1	Peak	1.02 A	1.92 A	-
	Average	0.26 A	0.55 A	7.78 W
Random Read 4KB Q16	Peak	0.97 A	1.91 A	-
	Average	0.29 A	0.61 A	8.66 W
Random Write 4KB Q1	Peak	0.63 A	1.91 A	-
	Average	0.28 A	0.38 A	5.88 W
Random Write 4KB Q16	Peak	0.63 A	1.92 A	-
	Average	0.28 A	0.38 A	5.89 W
Sequential Read	Peak	0.93 A	0.64 A	-
	Average	0.73 A	0.32 A	7.41 W
Sequential Write	Peak	0.67 A	0.56 A	-
	Average	0.54 A	0.36 A	7.00 W
Random Write/Read 4KB Q1	Peak	1.05 A	1.91 A	-
	Average	0.26 A	0.56 A	7.96 W
Random Write/Read 4KB Q16	Peak	0.93 A	1.91 A	-
	Average	0.28 A	0.60 A	8.51 W
Idle_A	Average	0.13 A	0.27 A	3.77 W
Idle_B	Average	0.12 A	0.19 A	2.81 W
Idle_C	Average	0.12 A	0.16 A	2.39 W
Standby	Average	0.08 A	0.003 A	0.41 W

(*1) Not including glitch less than 100 µs.

(*2) Average value in 500 ms window.

Table 2.7 Power consumption (MG09ACA12T / MG09ACA10T)

Item		Current (Typ)		Wattage (Typ)
		DC +5 V	DC +12 V	
Spin up	Peak (*1)	0.30 A	1.50 A	-
	Maximum DC (*2)	0.27 A	1.33 A	-
Random Read 4KB Q1	Peak	1.00 A	1.88 A	-
	Average	0.25 A	0.51 A	7.25 W
Random Read 4KB Q16	Peak	0.94 A	1.87 A	-
	Average	0.29 A	0.57 A	8.20 W
Random Write 4KB Q1	Peak	0.60 A	1.90 A	-
	Average	0.27 A	0.34 A	5.33 W
Random Write 4KB Q16	Peak	0.60 A	1.86 A	-
	Average	0.27 A	0.34 A	5.34 W
Sequential Read	Peak	0.87 A	0.59 A	-
	Average	0.71 A	0.28 A	6.82 W
Sequential Write	Peak	0.64 A	0.53 A	-
	Average	0.53 A	0.32 A	6.45 W
Random Write/Read 4KB Q1	Peak	0.98 A	1.87 A	-
	Average	0.26 A	0.52 A	7.43 W
Random Write/Read 4KB Q16	Peak	0.92 A	1.88 A	-
	Average	0.27 A	0.56 A	7.94 W
Idle_A	Average	0.13 A	0.23 A	3.30 W
Idle_B	Average	0.13 A	0.17 A	2.60 W
Idle_C	Average	0.13 A	0.14 A	2.23 W
Standby	Average	0.08 A	0.003 A	0.41 W

(*1) Not including glitch less than 100 µs.

(*2) Average value in 500 ms window.

(3) Current waveform (reference)

Figure 2.1 shows the spin-up current waveform and moving average line (10 ms) of DC +5 V and DC +12 V.

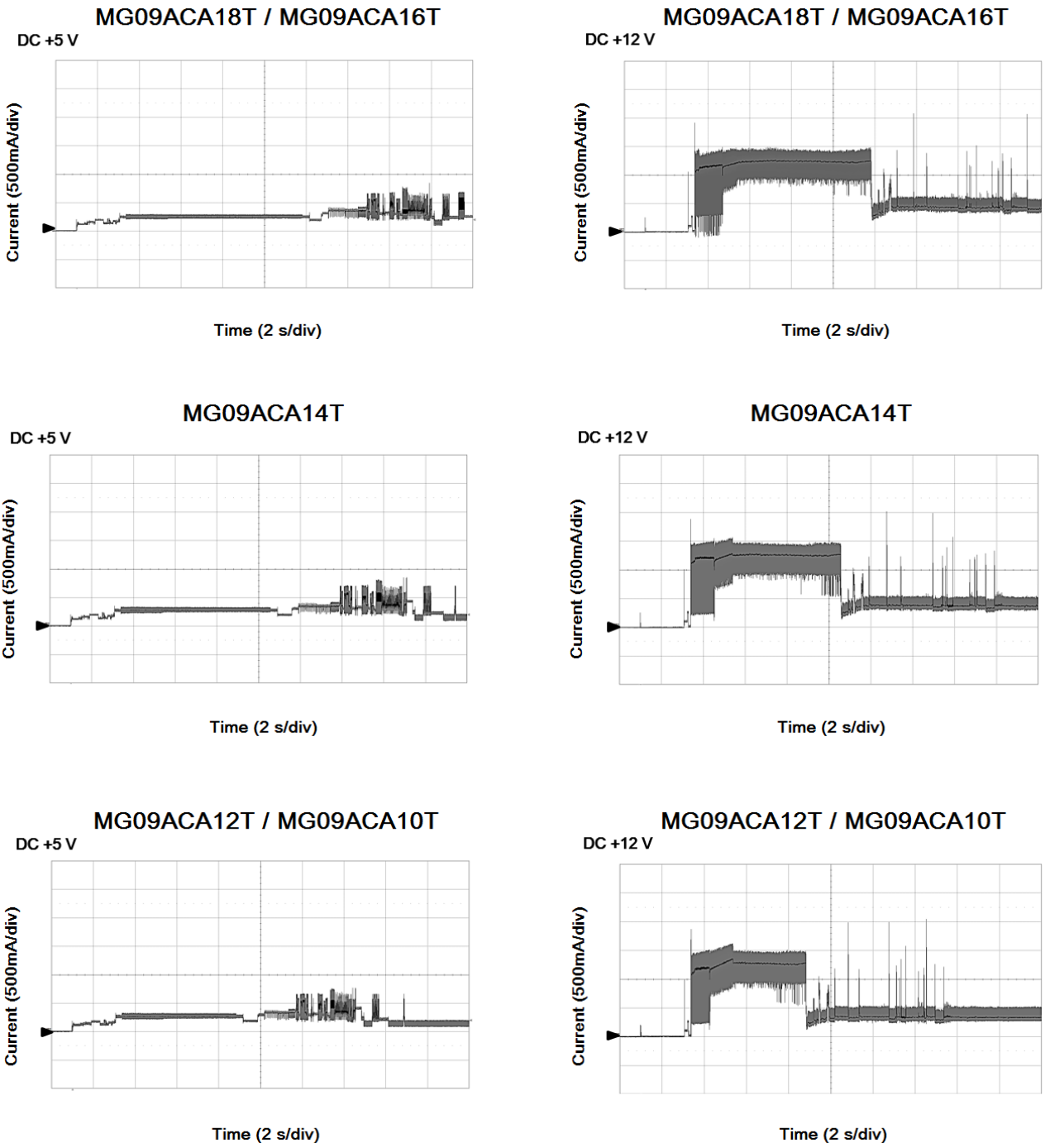


Figure 2.1 Current waveform (Spin-up)

Figure 2.2 shows the Max Seek current waveform of DC +5 V and DC +12 V.

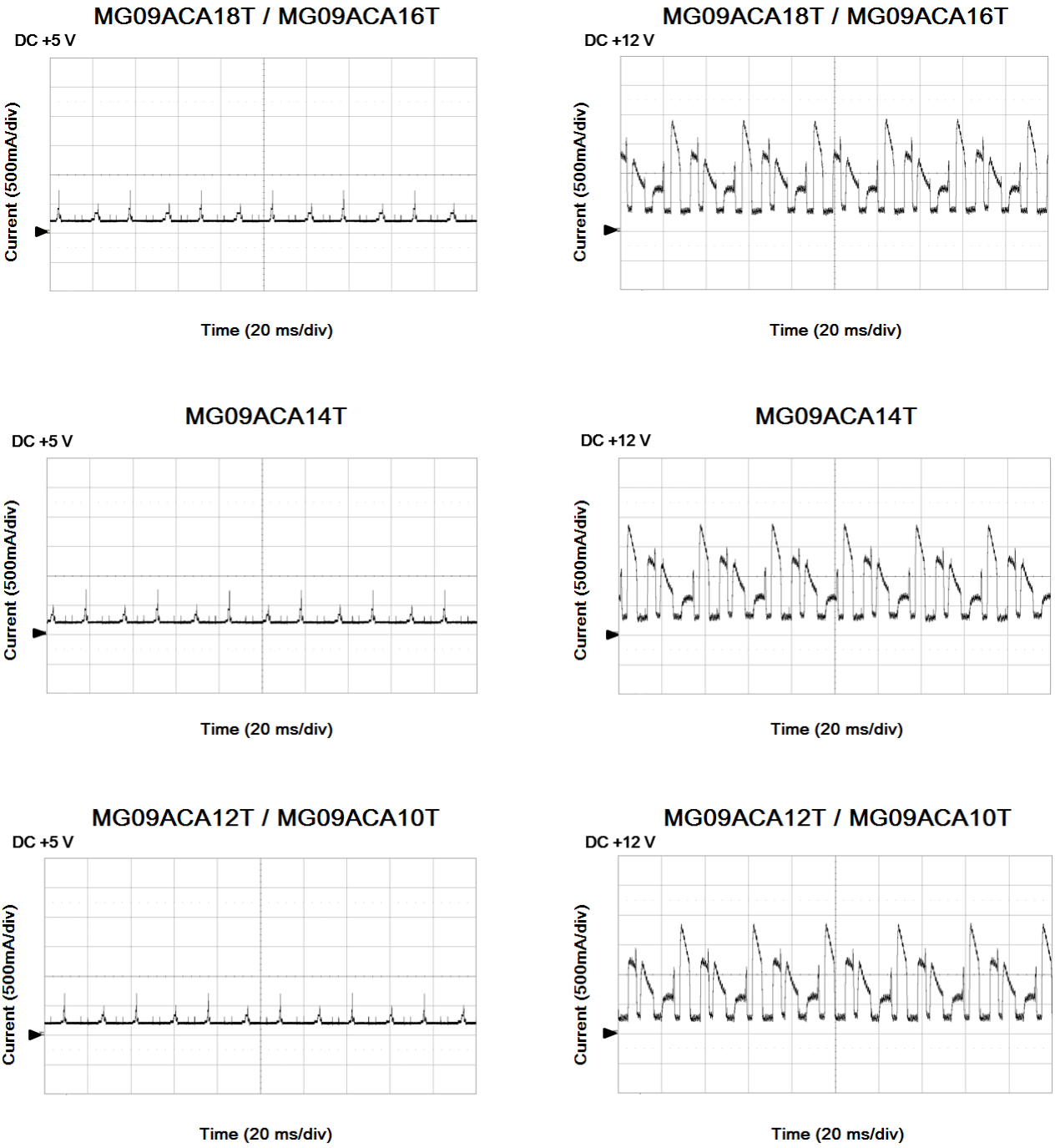


Figure 2.2 Current waveform (Max seek)

2.1.5 Error Rate

Errors detected during initialization and replaced by alternate block assignments are not included in the error rate. Data blocks to be accessed should be distributed over the disk equally.

(1) Unrecoverable error rate

Errors which cannot be recovered within 63 retries and ECC correction should not exceed 10 per 10^{16} bits read.

(2) Positioning error rate

Positioning errors which can be recovered by one retry should be 10 or less per 10^{8} seeks.

2.1.6 Reliability

(1) Mean Time to Failures (MTTF) and Annualized Failure Rate (AFR)

MTTF of the HDDs during its life time is 2 500 000 hours and AFR is 0.35 %. (POH: 8760 hours per one year (24 hours per one day, 7 days per one week). Average HDA surface temperature: 40 °C or less, workloads: 550 TB per one year, which is defined as the amount of data written, read or verified by commands from host system). Continual or sustained operation at case HDA surface temperature above 40 °C may degrade product reliability.

Note:

The MTTF is defined as:

$$\text{MTTF} = \frac{\text{Operating time (hours) at all field sites}}{\text{The number of equipment failures from all field sites}}$$

Failure of the equipment means failure that requires repair, adjustments, or replacement. Mishandling by the operator, failures due to bad environmental conditions, power trouble, host system trouble, cable failures, or other failures not caused by the equipment are not considered.

The AFR is defined as:

$$\text{AFR} = \frac{\text{8760 hours}}{\text{MTTF}}$$

(2) Service life

The service life under suitable conditions and treatment is as follows.

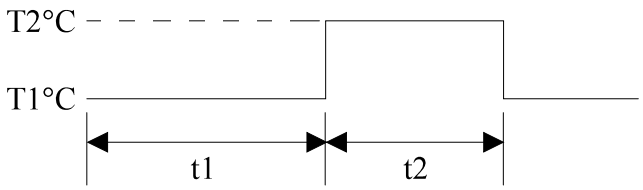
The service life is depending on the environment temperature. Therefore, the user must design the system cabinet so that the average HDA surface temperature is as low as possible.

- HDA surface temperature: from 5 °C to 40 °C 5 years
- HDA surface temperature: more than 40 °C to 45 °C 4.5 years
- HDA surface temperature: more than 45 °C to 50 °C 4 years
- HDA surface temperature: more than 50 °C to 55 °C 3.5 years
- HDA surface temperature: more than 55 °C to 60 °C 3 years
- HDA surface temperature: more than 60 °C or less than 5 °C
  No guarantee
  (Keep the HDA surface temperature from 5 °C to 60 °C.)

Even if the HDDs are used intermittently, the longest service life is 5 years.

Note:

The "average HDA surface temperature" means the average temperature at the HDA surface throughout the year when the HDDs are operating.



$$\text{Average DE surface temperature} = \frac{T1 \times t1 + T2 \times t2}{t1 + t2}$$

(3) Storage Period

The maximum storage period of HDD is specified as six months without turning the power on, while being stored in original unopened shipping package, within the defined non-operating limits (refer to Table 2.3 Environmental requirements).

The storage time can be extended to maximum twelve months, while being stored in the original unopened shipping package, under the below environmental conditions. During this period, the maximum storage time after the bag is opened is six months under the below same environmental conditions:

- Temperature: 20 to 35 °C
- Humidity: 5 to 40 %RH
- Altitude: -305 m to 3048 m
- No condensing
- No corrosive.

(4) Data security at power failure

Integrity of the data on the disk is guaranteed against all forms of DC power failure except on blocks where a write operation is being performed. The above does not applied to formatting disks or assigning alternate blocks.

2.1.7 Load/Unload

Be sure to issue and complete the following commands for unloading before cutting off the power supply.

600 000 times of normal Load /Unload can be performed by a command and power management.

Unload is executed by the following commands:

- STANDBY
- STANDBY IMMEDIATE
- SLEEP

Load / unload is also executed in the idle mode commands of the drive. In this case, it remains the spindle motor is rotated.

- IDLE
- IDLE IMMEDIATE

If power is removed from the drive while the heads are over the media an Emergency Unload will take place. An Emergency Unload is performed by routing the back-EMF of the spindle motor to the actuator voice coil. An Emergency Unload is mechanically much more stressful to this drive than a controlled Unload. The minimum number of Emergency Unloads that can be successfully performed is 50 000. Emergency Unload should only be performed when it is not possible to perform a controlled Unload.

2.1.8 Required power-off sequence

Required power-off sequence is as follows:

1. Issued the following commands.

    1) FLUSH CAHCE (EXT) (Wait until the command completion.)

    2) STANDBY IMMEDIATE (Wait until the command completion.)

2. Turn off power to the drive.

When the last power off (shutdown) was not the normal operation, HDD may not reply (maximum) three seconds on S-ATA interface at next power on.

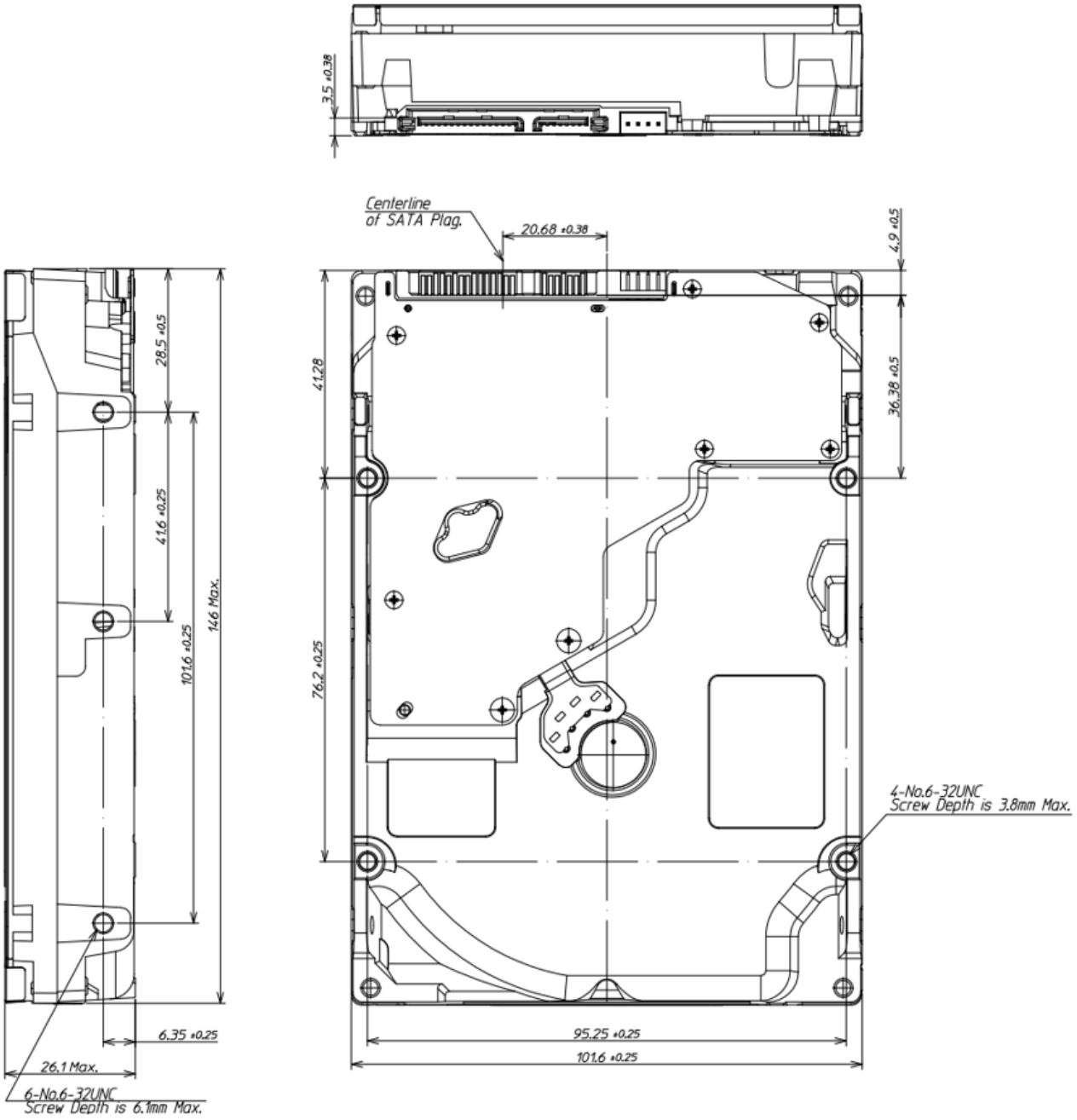
CHAPTER 3 Installation Requirements

This chapter describes the mounting, power supply, connection, and environmental requirements.

3.1 Mounting Requirements

3.1.1 Dimensions

Figure 3.1 show the dimensions of the HDDs and the location of the mounting screw holes. See the SFF-8301 for details.



[Unit: mm]

Figure 3.1 Dimensions

3.1.2 Mounting Orientations

As shown in Figure 3.2, the HDD can be installed flat on any of its six sides. Inclination from a vertical or horizontal plane should not exceed 5 degree angle.

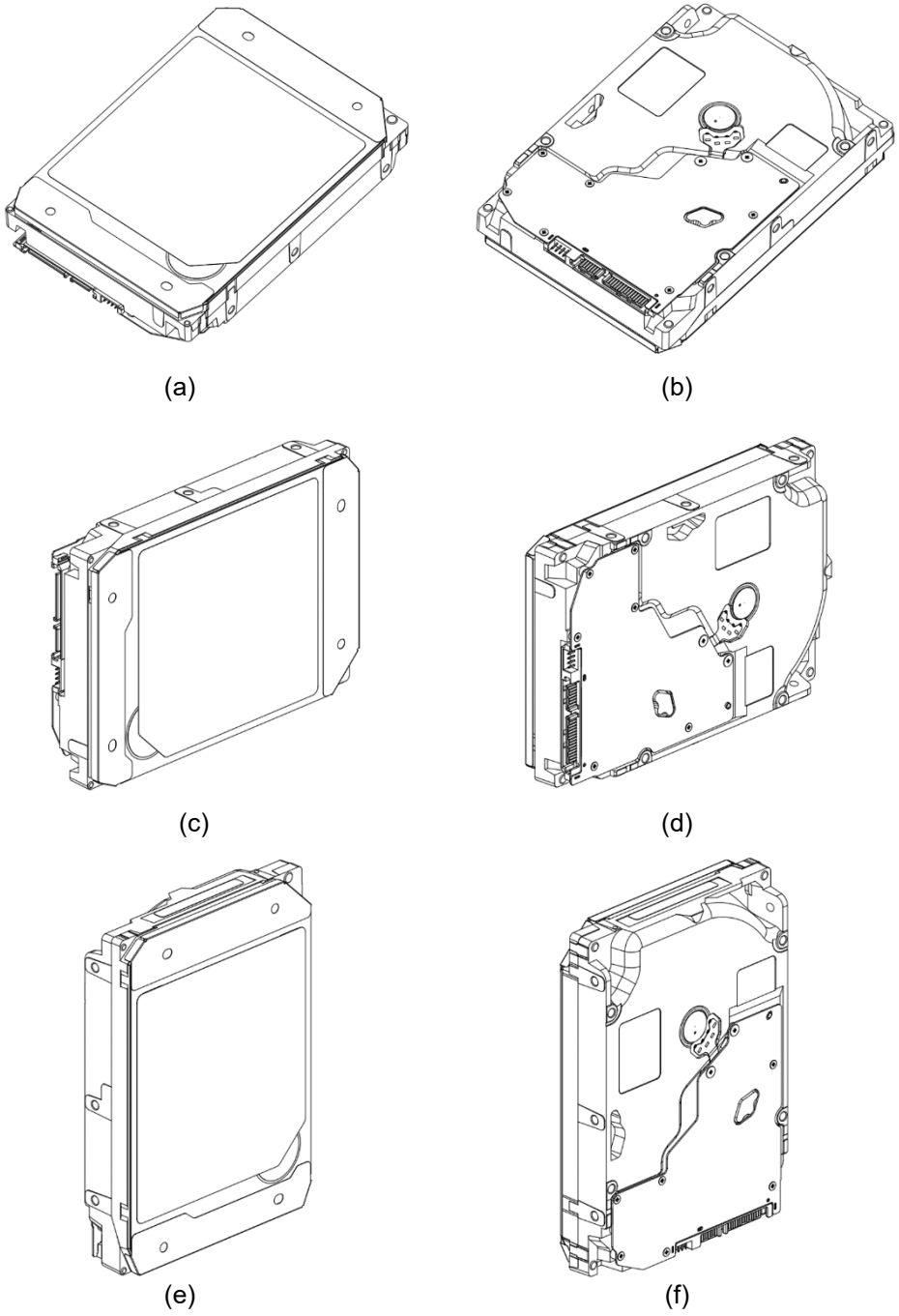


Figure 3.2 HDD orientations

3.1.3 Notes on Mounting

⚠CAUTION	
Prohibited	Damage Do not remove any labels from the HDD or deface the HDDs in any way. HDDs, whether in whole or in part. Failure to do so voids any warranty, expressed or implied.

(1) Mounting screw

The mounting screws must use No.6-32UNC

(2) Mounting frame structure

As for a system frame structure mounting the HDDs, the following attentions are required.

a) The frame shall not touch the PCBA of the HDDs. For example as shown in Figure 3.3, mount the HDDs with a gap of 2.5 mm or more from the frame.

b) As shown in Figure 3.3, the inward projection of the screw from the HDD frame wall at the corner must be 3 to 4.5 mm on the bottom mounting, 3 to 6.1 mm on the side mounting.

c) Tightening torque of screw must be secured with 0.59 N·m { 6 kgf·cm } ±12 %.

d) The frame must not distort the HDDs.

e) The impact by an electric screwdriver must not exceed the HDD specifications.

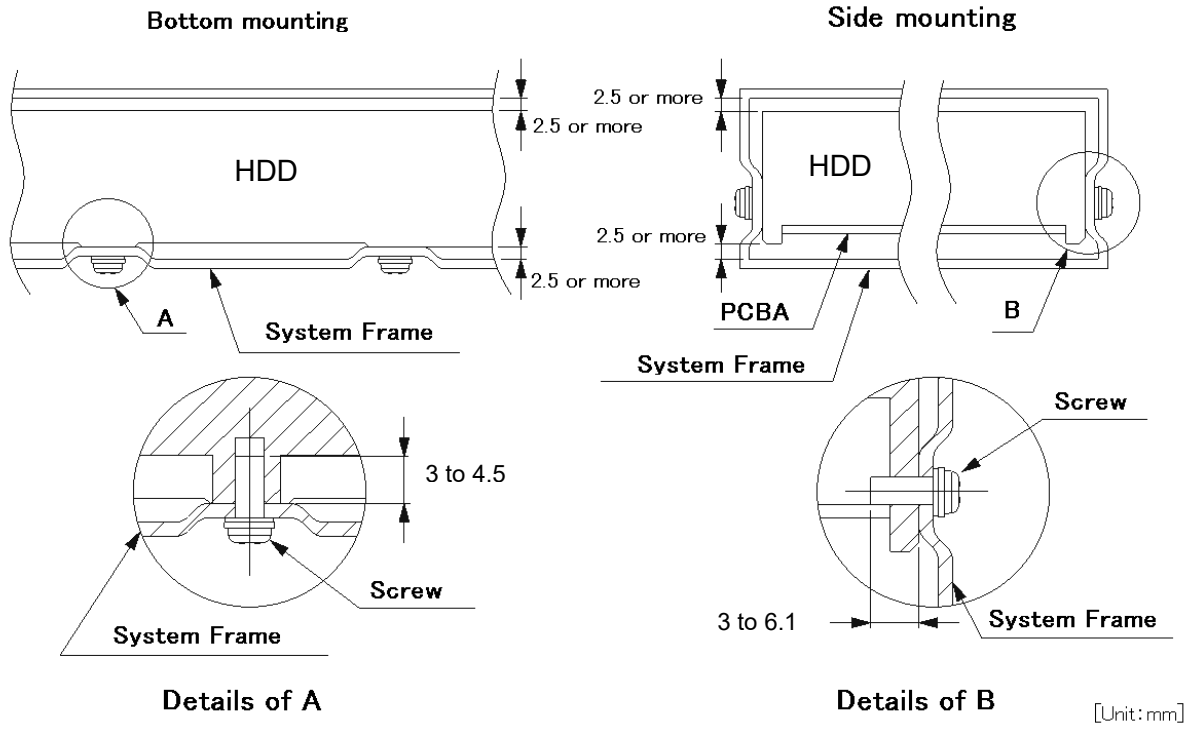


Figure 3.3 Mounting frame structure example

(3) Limitation of side-mounting

Mount the HDDs using the 4 screw holes at the both ends on the both sides as shown in Figure 3.4. Do not use the center hole by itself.

In case of using the center hole, it must be used in combination with 2 holes on both ends. (Total 6 screws for 6 holes enclosed)

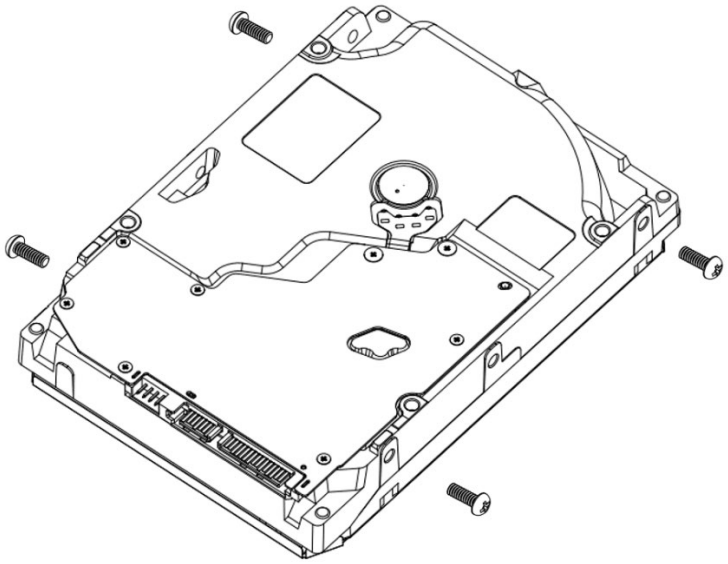


Figure 3.4 Limitation of side-mounting

(4) Limitation of bottom-mounting

Use all 4 mounting holds on the bottom face.

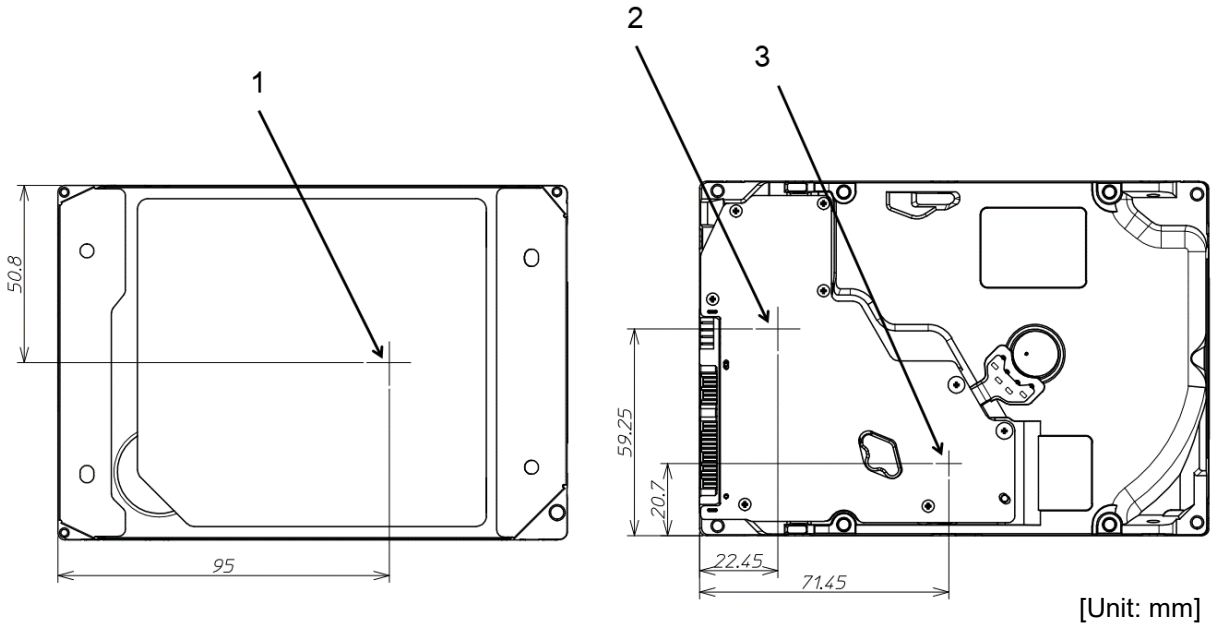
(5) Environmental temperature

Temperature condition at installed in a cabinet is indicated with ambient temperature measured 30 mm from the HDD. At designing the system cabinet, consider following points.

- Make a suitable air flow so that the enclosure surface temperature never exceeds 60 °C.
- Cool the PCBA side especially with air circulation inside the cabinet. Confirm the cooling effect by measuring the surface temperature of the PCBA and the HDD. These measurement results must satisfy the temperature condition listed in Table 3.1.
- Keep the enclosure surface temperature at 40 °C or below to meet the condition for assuring MTTF of the HDD.

Table 3.1 Surface temperature check point and maximum temperature

Measurement point	Maximum temperature
1 (HDA surface)	60 °C
2 (PCBA surface)	91 °C
3 (PCBA surface)	92 °C



[Unit: mm]

Figure 3.5 Surface temperature measurement points

(6) Environmental magnetic field

Do not install the HDDs in the vicinity of equipment giving off strong magnetic fields, such as monitors, televisions, or loudspeakers.

(7) Leakage magnetic flux

Do not mount the HDDs near the devices which may be affected by leakage magnetic.

3.2 Power Supply Requirements

(1) Allowable input voltage and current

The power supply input voltage measured at the power supply connector pin of the HDDs (receiving end) must satisfy the requirement given in Subsection 2.1.4. (For other requirements, see Items (3) and (4) below.)

(2) Power on/off sequence

The order of the power on/off sequence of DC +5 V and DC +12 V, supplied to the HDDs, does not matter.

(3) Sequential starting of spindle motors

After power is turned on to the HDDs, a large amount of current flows in the DC +12 V line when the spindle motor rotation starts. Therefore, if more than one HDD are the spindle motors should be started sequentially using one of the following procedures to prevent overload of the power supply unit.

a) Control the sending of the Staggered Spin Up primitives in intervals of 12 seconds or more so that the spindle motors of individual HDDs are started sequentially.

b) Turn on the DC +12 V power in the power supply unit at intervals of 25 seconds or more to start the spindle motors sequentially.

(4) Noise filter

To eliminate AC line noise, a noise filter should be installed at the AC input terminal on the HDD power supply unit. The specification of this noise filter is as follows:

- Attenuation: 40 dB or more at 10 MHz
- Circuit construction: T-configuration as shown in Figure 3.6 is recommended.

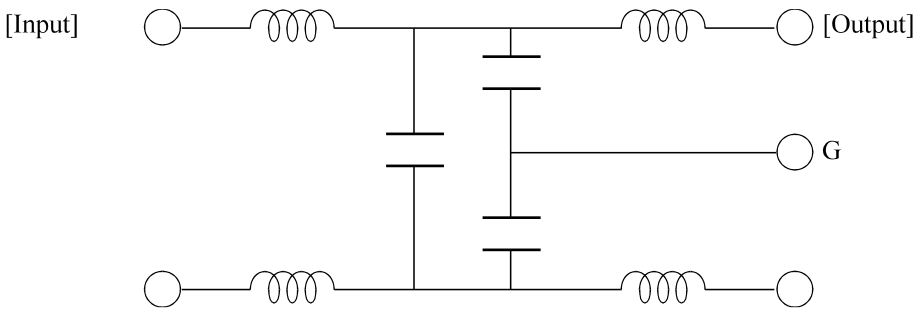


Figure 3.6 AC noise filter (recommended)

3.3 Connection Requirements

3.3.1 Connector Location

Figure 3.7 shows a location of the interface connector.

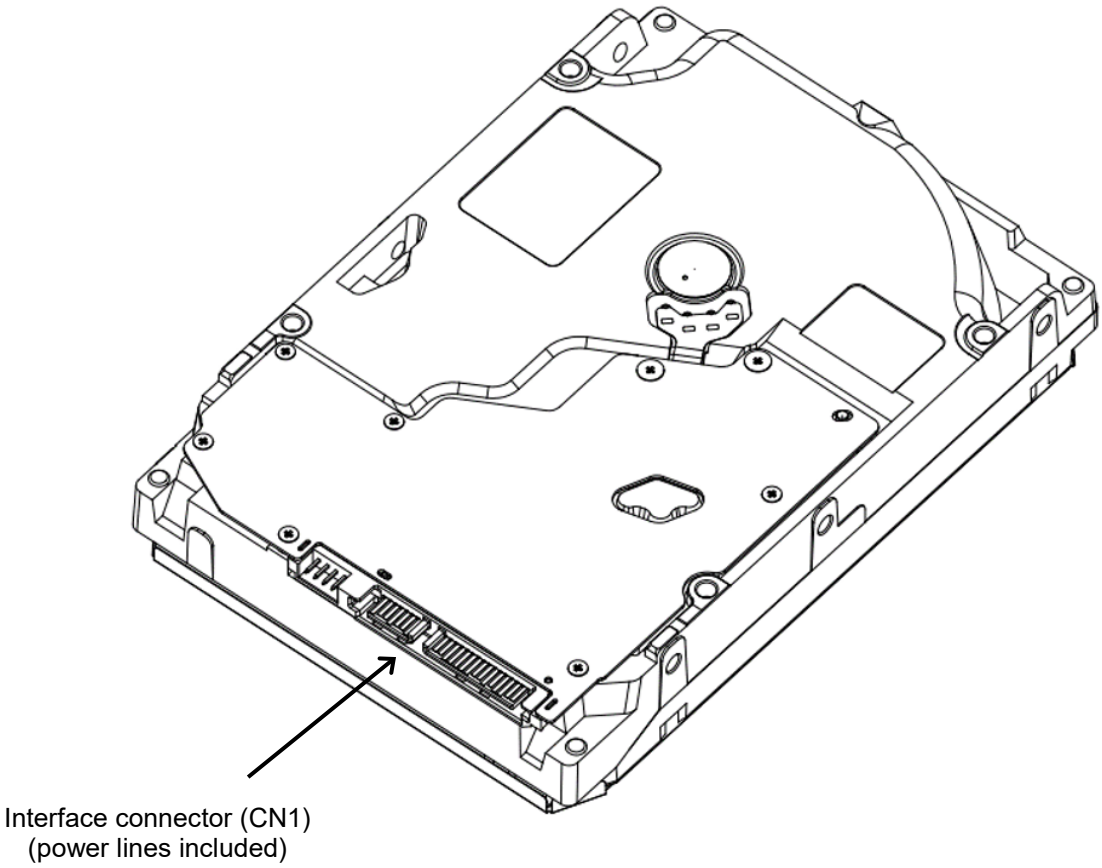


Figure 3.7 Connector location

3.3.2 Interface Connector

Figure 3.8 shows the SATA type interface connector (SATA plug) overview.

Table 3.2 lists the signal allocation of the SATA plug on the HDDs.

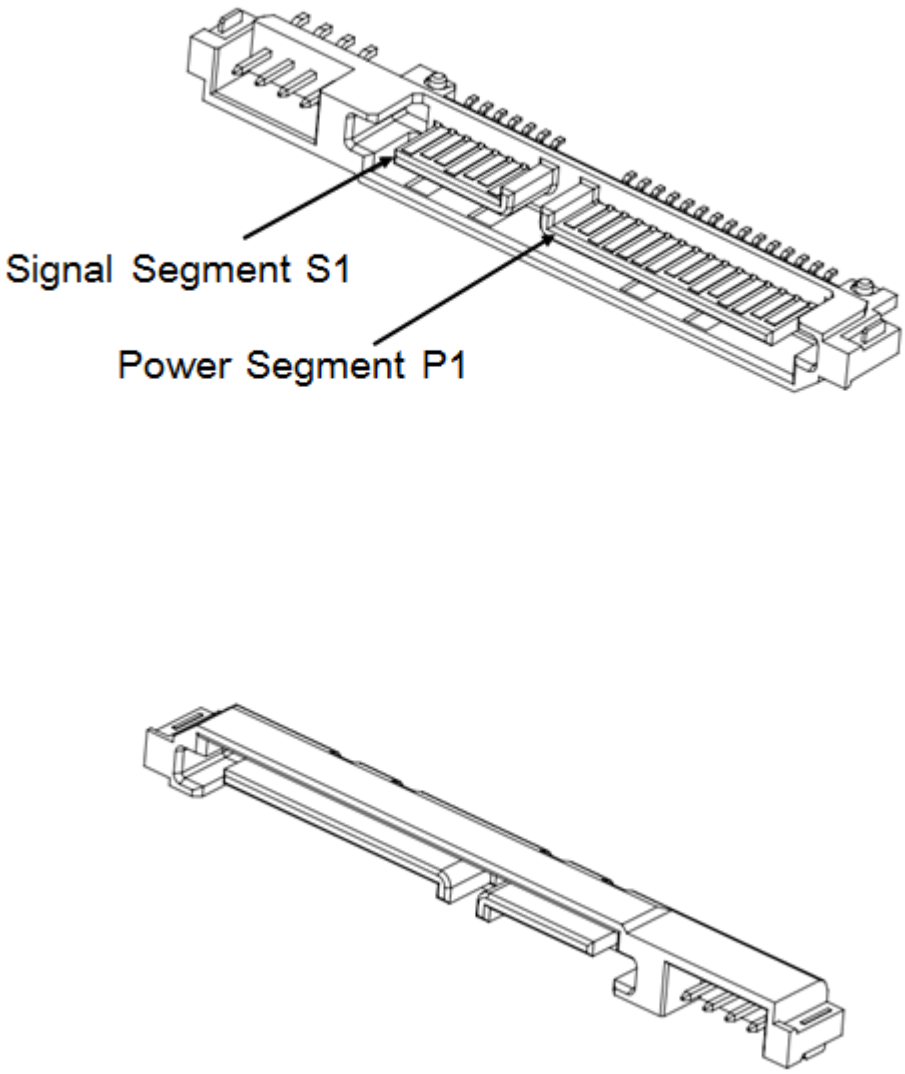


Figure 3.8 SATA plug connector overview

Table 3.2 Interface connector (SATA plug) signal allocation:CN1

Signal segment key			
Signal segment	S1	GND	2nd mate
	S2	A+	Differential Pair A from PHY (Device Rx+)
	S3	A-	Differential Pair A from PHY (Device Rx-)
	S4	GND	2nd mate
	S5	B-	Differential Pair B from PHY (Device Tx-)
	S6	B+	Differential Pair B from PHY (Device Tx+)
	S7	GND	2nd mate
Signal segment “L”			
Central connector polarizer			
Power segment “L”			
Power segment	P1	—	(Unused)
	P2	—	(Unused)
	P3	PWDIS	Enter/Exit Power Disable(Option)
	P4	GND	1st mate
	P5	GND	2nd mate
	P6	GND	2nd mate
	P7	V5	5 V power pre-charge 2nd mate
	P8	V5	5 V power
	P9	V5	5 V power
	P10	GND	2nd mate
	P11	Spin	- Staggered Spin up mode detect (Input)
		ACT	- Activity LED drive(Output) *Reference3.3.3.1 Power Segment Pin 11
	P12	GND	1st mate
	P13	V12	12 V power pre-charge 2nd mate
	P14	V12	12 V power
	P15	V12	12 V power
Power segment key			

Notice: This drive uses 5 V and 12 V power. 3.3 V power is not used.
HDA (Head Disk Assembly) and DC ground (ground pins on interface) are connected electrically each other.

3.3.3 Electrical Specification

3.3.3.1 Power Segment Pin11

Pin 11 of the power segment of the drive connector has two functions One function is used by the drive to provide the host with an activity indication. Another function is used by the host to indicate whether staggered spin-up should be used. To accomplish both of these goals, pin 11 acts as an input from the host to the drive prior to PhyRdy for “staggered spin-up control”. Also pin 11 acts as an output from the drive to the host after PhyRdy for activity indication. The activity indication provided by pin 11 is primly for use in backplane application. A host may only support one pin 11 feature, either receiving activity indication or “staggered spin-up disable control”. If a host supports receiving activity indication via pin 11, then the host shall not use pin 11 to disable staggered spin-up. If a host does not support receiving activity indication via pin 11, then the host may use pin 11 to disable staggered spin-up.

3.3.3.2 Activity Signal & Electrical Definition

The signal the drive provides for activity indication is a low-voltage low-current driver intended for efficient integration into current and future IC manufacturing processes. The signal is NOT suitable for directly driving an LED and must first be buffered using a circuit external to the drive before driving an LED.

Table 3.3 Drive connector pin 11 activity signal electrical parameters

Parameter	Min Value	Max Value	Description & Conditions
V_{Din}	-0.5 V	2.1 V	Tolerated input voltage
V_{Dact}	0 mV	225 mV	Drive output voltage when driving low under the condition I_D less than or equal to 300 µA
V_{Dinact}	-0.1 V	3.3 V	Drive output voltage when not driving low
I_{Dinact}	-100 µA	100 µA	Drive leakage current when not driven

Table 3.4 Drive connector pin 11 Host activity signal electrical parameters

Parameter	Min Value	Max Value	Description & Conditions
V_{Hin}	-0.5 V	3.3 V	Tolerated input voltage
V_{HH}		2.1 V	Host voltage presented to drive when drive not driving signal low.
V_{HL}	-0.1 V		Minimum allowable host voltage that may be presented to the drive.
I_{HAct}		300 µA	Host current delivered to drive when drive driving signal low. Value specified at V_{DAct} voltage of 0 V.

3.3.3.3 Staggered Spin-up Disable Control

Before the drive spins up its media, drives that supported “staggered spin-up disable control” shall detect whether pin 11 is asserted low by the host. If pin 11 is asserted to low the drive shall disable staggered spin-up and immediately initiate media spin-up. If pin 11 is not connected in the host (floating), the drive that supported “staggered spin up disable” through pin 11 shall enable staggered spin-up.
Host staggered spin-up control electrical requirements

Table 3.5 Host staggered spin electrical parameters

Parameter	Min Value	Max Value	Description & Conditions
V_{HENB}	1.8 V	2.1 V	Host voltage presented to drive to not disable staggered spin-up in drives that support staggered spin-up control. Value specified for all allowable I_{Dinact} leakage currents.
V_{Hdis}	-0.1 V	225 mV	Host voltage presented to drive to disable staggered spin-up in drives that support staggered spin-up control. Value specified for all allowable I_{Dinact} leakage currents.

If supported, the drive will sample the staggered spin-up disable condition after the DC power is applied and before PhyRdy is asserted.

3.3.4 Connector Requirements

Table 3.6 lists the recommended connectors for the host system.

Table 3.6 Recommended connectors

Drive side connector		DDK: SAT-PR22-S2A-FA or equivalent
Recommended host side connector	for board	Right Angle Type : DDK SAT-RC22-S23-FG or equivalent
	for cable	DDK SAT-RG07-C2-FG or equivalent (for signal) (No recommendation now for power segment)

3.3.5 Cable

When connecting the drive and host system with Serial ATA cable, use of the Serial ATA 2.6/3.0 specification compliant cable is recommended.

CHAPTER 4 Installation

This chapter describes the notes on handling HDDs, setting, mounting HDDs, confirming HDD operations after installation and preparation for use, and dismounting HDDs.

4.1 Notes on Handling HDDs

The items listed in the specifications (Subsection 2.1.2, 2.1.3 and 2.1.4) must be strictly observed.

(1) General notes

a) Do not give the HDD shocks or vibrations exceeding the value defined in the specifications because it may cause critical damage to the HDD. Especially be careful when unpacking.

b) Do not leave the HDD in a dirty or contaminated environment.

c) Since Electrostatic Discharge (ESD) may destroy the CMOS semiconductors in the HDD, note the following after unpacking:

- Use an antistatic mat and body grounding when handling the HDD.
- Hold the HDA when handling the HDD. Do not touch PCAs except for setting.

d) There are sharp edges, corners and protrusions in a drive. Please be careful with safety when handling.

⚠CAUTION	
 **Prohibited**	Safety Do not touch sharp edges or pins of the drive. Sharp edges and protrusions etc. may cause injury.
 **Instructions**	High temperature To prevent injury such as burn, do not touch the HDD while it is hot. The HDA and LSI become hot during operation and remain hot immediately after turning off the power.

(2) Unpackaging

a) Use a flat work area. Check that the "This Side Up" sign side is up. Handle the package on soft material such as a rubber mat, not on hard material such as a desk.

b) Be careful not to give excess pressure to the internal unit when removing cushions.

c) Be careful not to give excess pressure to the PCBA and interface connector when removing the HDD from the antistatic bag.

d) Do not remove any labels from the HDD. Never open the HDA for any reason.

(3) Installation/removal/replacement

a) Do not move the HDD when power is turned on or until the HDD completely stops (for 20 seconds) after power is turned off.

b) Place and keep removed screws and other parts where they will not get lost or damaged.

c) Keep a record of all maintenance work for replacing.

(4) Packaging

a) Store the HDD in the antistatic bag.

b) It is recommended to use the same cushions and packages as those at delivery. (For details, see Section 5.3.) If those at delivery cannot be used, use a package with shock absorption so that the HDD is free from direct shocks. In this case, fully protect the PCBA and interface connector so that they are not damaged.

(5) Delivery

a) When delivering the HDD, provide packaging and do not turn it over.

b) Minimize the delivery distance after unpacking and avoid shocks and vibrations with cushions. For the carrying direction at delivery, use one of the mount allowable directions in Subsection 3.1.2.

(6) Storage

a) Provide moistureproof packaging for storage.

b) The storage environment must satisfy the requirements specified in Subsection 2.1.3 when the HDD is not operating.

c) To prevent condensation, avoid sudden changes in temperature.

4.2 Mounting HDDs

4.2.1 Mounting Procedures

Since mounting the HDD depends on the system cabinet structure, determine the work procedures considering the requirements specific to each system. The general mounting method and items to be checked are shown below.

See Section 3.1 for the details of requirements for installing the HDDs.

1) Fix the HDD in the system cabinet with four mounting screws as follows:

   - The HDD has 8 mounting holes (both sides: 2 × 2, bottom: 4). Fix the HDD by using four mounting holes of both sides of the HDD or the bottom.
   - Use mounting screws of which lengths inside the HDD mounting frame are the bottom mounting : 3 to 4.5 mm / the side mounting : 3 to 6.1 mm when the screws are tightened (see Figure 3.3).
   - When mounting the HDD, be careful not to damage the PCBA.

2) Confirm the HDA is not touching the frame on the system side excluding the screw installing part after tightening the screws. At least 2.5 mm of clearance is required between the HDA and the frame (see Figure 3.3).

3) When using an electric screwdriver, use the screwdriver that does not apply a force on the HDD that would exceed the HDD specifications.

4.3 Dismounting HDDs

Since the method and procedure for dismounting the HDD for replacement of the HDD, etc. depends on the locker structure of the system, etc., the work procedure must be determined in consideration of the requirements specific to the system. This section describes the general procedure and notes on dismounting the HDD.

Circuit in the PCBA is under operation until the spindle motor stops completely (about 20 seconds). When dismounting HDDs, don't let the metal come in contact with PCBA.

⚠CAUTION	
 **Instructions**	High temperature To prevent injury such as burn, do not touch the HDD while it is hot. The HDA and LSI become hot during operation and remain hot immediately after turning off the power.
 **Instructions**	Damage When dismounting the HDD which is mounted on the system while power is supplied; 1) Stop the spindle motor. It takes about 20 seconds for the spindle motor to stop completely. 2) Then, dismount the HDD using such as the HDD mounting/dismounting mechanism of the system. When removing the HDD, avoid exposing it to shock or vibration or don't let the metal frame come in contact with PCBA. Just in case, stop dismounting once and wait until the spindle motor stops (about 20 seconds) when SATA connector breaks off contact.
 **Instructions**	Damage When dismounting the HDD which is mounted on the system while power is not supplied; Dismount the HDD using such as the HDD mounting/dismounting mechanism of the system. When removing the HDD, avoid exposing it to shock or vibration or don't let the metal frame come in contact with PCBA.
 **Instructions**	Damage When storing or transporting the HDD, put it in the antistatic bag (refer to Section 4.1 and 5.3).

CHAPTER 5 Maintenance

This chapter describes maintenance.

5.1 Maintenance

See Section 4.1 and 5.3 for notes on packaging and handling when returning the HDD.

⚠CAUTION	
 **Instructions**	Data loss Save data stored on the HDD to other media before requesting repair. TDSC assumes no liability if data is corrupted during servicing or repair.

5.1.1 Precautions

Take the following precautions to prevent injury during maintenance and troubleshooting:

⚠CAUTION	
 **Prohibited**	Electrical shock Do not touch the HDDs while power-feeding.
 **Instructions**	High temperature To prevent injury such as burn, do not touch the HDD while it is hot. The HDA and LSI become hot during operation and remain hot immediately after turning off the power.

Take the following precautions to prevent HDD damage during maintenance and troubleshooting:

⚠CAUTION	
 **Prohibited**	Damage 1）Do not use a conductive cleaner to clean the HDDs. 2）Do not remove any labels from the HDD or deface the HDDs in any way. 3）Do not disassemble, analyze, reverse-engineer, alter, modify, translate or copy HDDs, whether in whole or in part. Failure to do so voids any warranty, expressed or implied.
 **Instructions**	Damage Always ground yourself with such as a wrist strap connected to ground before handling. ESD (Electrostatics Discharge) may cause the damage to the device.

5.1.2 Maintenance Requirements

(1) Preventive maintenance

Preventive maintenance is not required.

(2) Service life

See "(2) Service life," in Subsection 2.1.6.

(3) Parts that can be replaced in the field

The PCBA cannot be replaced in the field. The HDA cannot be replaced in the field.

(4) Service system and repairs

TDSC has the service system and repair facility for the HDD. Contact TDSC representative to submit information for replacing or repairing the HDD. Generally, the following information must be included:

a) Model part number (P/N), revision number, serial number (S/N), and date of manufacturing

b) Error status

- Date when the error occurred
- System configuration
- Environmental conditions (temperature, humidity, and voltage)

c) Error history

d) Error contents

- Outline of inconvenience
- Issued commands and specified parameters
- Sense data
- Other error analysis information

5.1.3 Maintenance Levels

If an HDD is faulty, replace the whole HDD since repair requires special tools and environment. This section explains the two maintenance levels.

(1) Field maintenance (HDD replacement)

- This replacement is done at the user's site.
- Replacement uses standard tools.
- Replacement is usually done by the user, retail dealer, distributor, or OEM engineer.

(2) Factory maintenance (parts replacement)

- This replacement can only be done by TDSC.
- Replacement includes maintenance training and OEM engineer support. OEM engineers usually support retail dealers and distributors.
- Replacement uses factory tools and test equipment.

5.1.4 Tools and Test Equipment

HDD troubleshooting and repair in the field require only standard hand tools. No special tools or test equipment are required.

This document does not describe the factory-level tools and test equipment.

5.2 Troubleshooting

5.2.1 Outline of Troubleshooting Procedures

This section explains the troubleshooting procedures for HDD errors.

Depending on the maintenance level, analyze the error to detect a possibly faulty part (HDD, or HDD part).

Full-scale troubleshooting is usually required if the error cause is not known. If the error cause is clear (e.g., abnormal noise in HDA or burning of the PCBA), troubleshooting is straightforward.

5.2.2 Troubleshooting with HDD Replacement in the Field

At this level of maintenance, we recommend replacing the HDD as a unit. If replacing the HDD rectifies the fault, return the removed HDD to TDSC, for test and repair. If the newly installed HDD does not rectify the fault another part of the system is faulty.

Table 5.1 summarizes system-level field troubleshooting. Troubleshooting must be done in the field, to find faulty part (HDD or system).

Table 5.1 System-level field troubleshooting

Item	Recommended work
DC power level	Check that the DC voltage is within the specified range of Table 2.4. For DC +5 V, measure the voltage between P8-P9 (+5 V) of the interface connector and the nearest PCBA mounting screw (GND) from the interface connector, and confirm the value is from range of Table 2.4. For DC +12 V, measure the voltage between P14-P15 (+12 V) of the interface connector and the nearest PCBA mounting screw (GND) from the interface connector, and confirm the value is from range of Table 2.4.
Electrical noise	Make sure the maximum ripple peak-to-peak values of DC +5 V and DC +12 V are within the specified range of Table 2.4. Make sure the high frequency noise (over 20 MHz) is less than 100 mV (peak-to-peak value).
System cables	Check that all system cables are connected correctly.
System diagnostic test	When possible, execute the system level diagnostic routine as explained in the host computer manual. This gives a detailed report of a possible fault.
Intermittent or nonfatal errors	Check the AC voltage from the power supply. Check the DC voltage level at the power connector for the HDD. If the AC voltage level is abnormal or there is a lot of electrical noise, notify the user of the error. If the DC voltage level is unstable, replace the power supply unit. If possible, replace the HDD. If replacing the HDD does not eliminate the error, the removed HDD is probably not faulty. To continue error analysis, refer to the hardware and software manuals supplied with the system.

5.2.3 Troubleshooting at the Repair Site

For maintenance at this level, we recommend additional testing of the HDD and signal checking.

The sense data posted from the HDDs help with troubleshooting. This sense data makes the error type clear (functional, mechanical, or electrical error).

Table 5.2 lists how to detect a faulty HDD subassembly. This fault finding requires a working host computer or HDD test equipment to recreate the error conditions.

If the detected error cannot be recreated in an ordinary test, HDD conditions can be changed to force the error to recur. This is done by changing the DC voltage or the ambient temperature of the HDD.

If the error does not recur with changed conditions, the HDD is not faulty. If no error occurs in the HDD test, notify the user of the test results, and find out from the user the environment conditions where the HDD is used.

Table 5.2 HDD troubleshooting

Item	Recommended action
Frequent or repeated seek errors	Replace the HDD, and check that the test method is correct. If the error recurs, it is likely that the HDD is normal but the test method is incorrect.
Intermittent or nonfatal errors	Replace the HDD, and check that the test method is correct. If the error recurs, it is likely that the HDD is normal but the test method is incorrect. To check performance, change the HDD conditions by changing the voltage or temperature.

If the HDD error recurs or a possibly faulty part is found by troubleshooting, return the complete HDD to TDSC for repair. A media defect list must be included with the HDD returned to TDSC.

If the possibly faulty part is the HDA, return the whole HDD to TDSC for repair. Also if a clear error (erroneous servo track information or noisy HDD) is detected in the HDA, return the whole HDD to TDSC. A media defect list must be included with the HDD returned to TDSC.

⚠CAUTION	
Prohibited	Damage 1) Do not use a conductive cleaner to clean the HDDs. 2) Do not remove any labels from the HDD or deface the HDDs in any way. 3) Do not disassemble, analyze, reverse-engineer, alter, modify, translate or copy HDDs, whether in whole or in part. Failure to do so voids any warranty, expressed or implied.

5.2.4 Troubleshooting with Parts Replacement in the Factory

This document does not cover troubleshooting at the factory level.

5.2.5 Finding Possibly Faulty Parts

Finding possibly faulty parts in the field was explained in Subsection 5.2.3. This document does not cover finding possibly faulty parts at the factory level.

5.3 Packaging

When the HDD is returned, the following methods are recommended.

5.3.1 Bag Packaging

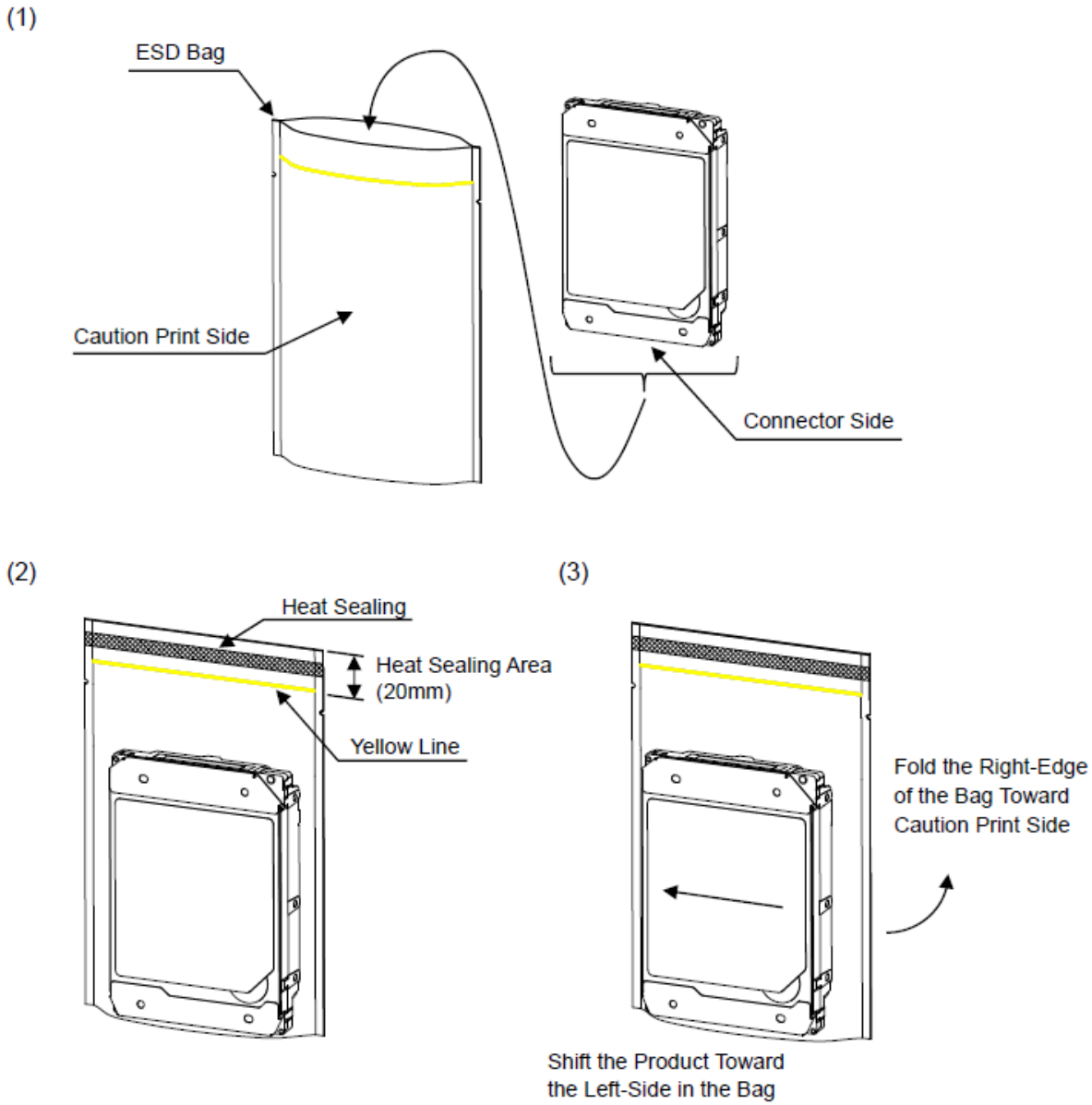


Figure 5.1 Bag packaging

(1) Put the HDD into ESD Bag.

* At this time, the connector of the HDD is directed to the bottom side of ESD bag.
* The caution print side of the bag and the drive label side of the HDD shall be opposite orientation.
* The product shall be put into the bag from the connector side.

(2) The opening section shall be heat-sealed at the specified portion.

(3) After shifting the HDD toward the left-side of bag, the right-edge shall be folded toward Caution print side.

5.3.2 Box Packaging

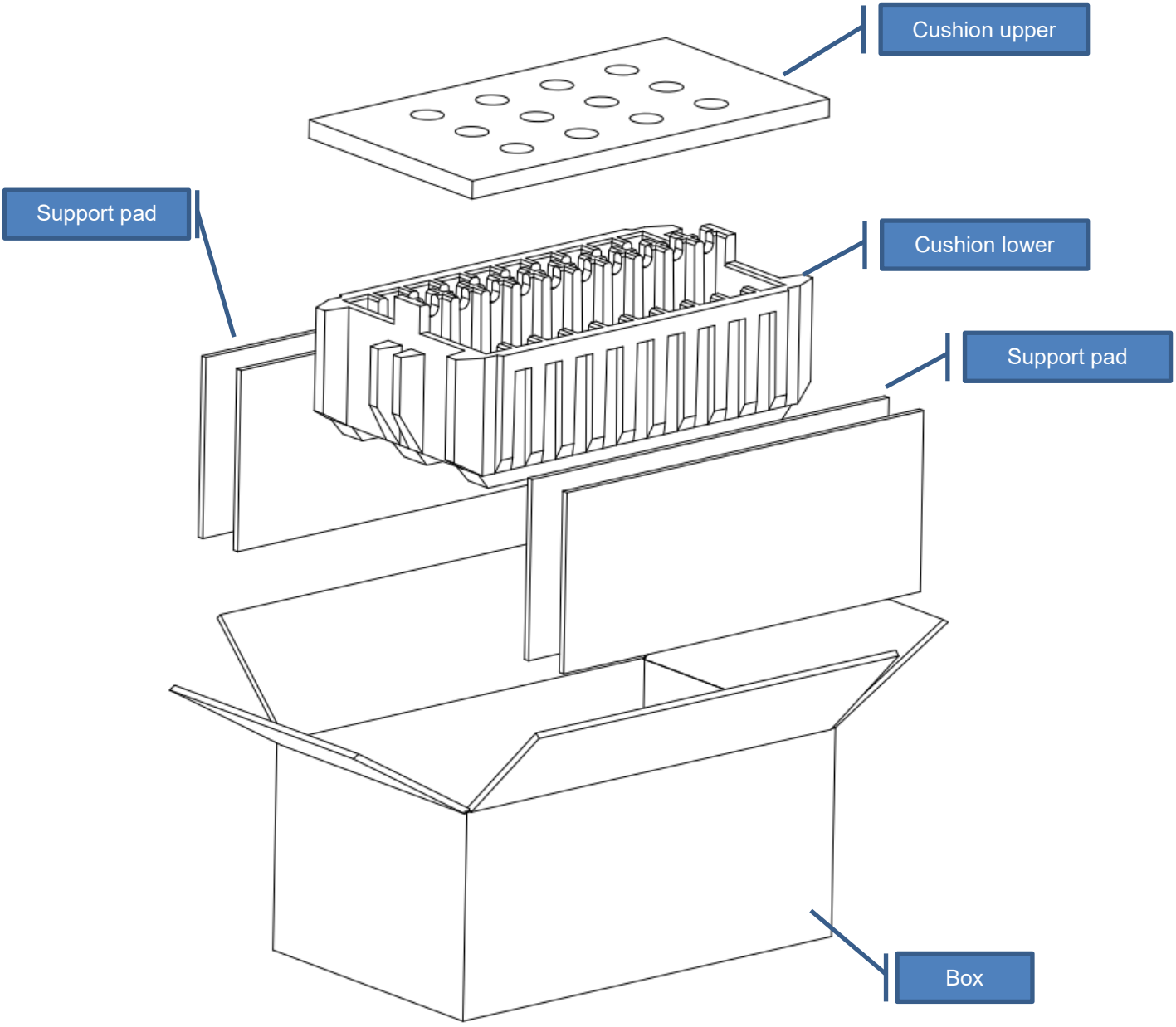


Figure 5.2 Box packaging

(1) The cushion (lower) shall be put into the box then put two piece of the support-pad each at both the long-side of cushion (lower).

(2) The unitary packed HDD (bag packing) shall be put into the cushion (lower).

* At this time, the seal side shall be upward. The I/F connector may become downward.

* For less than 20 HDDs, insert the HDDs starting from the slot with the smallest number in Figure 5.3.

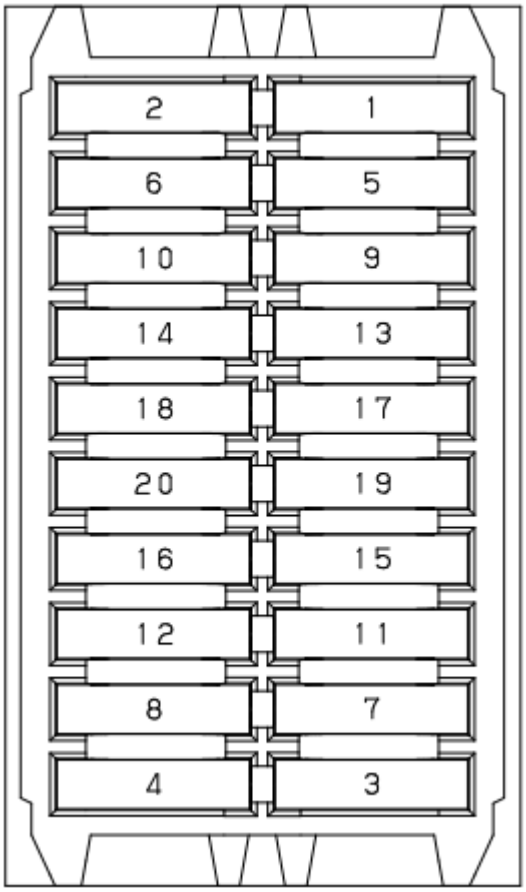


Figure 5.3 Fraction packaging

(3) Hold the HDD with the cushion (upper)

(4) Close the cardboard box with the packaging tape
(Attach the tape in 'H' figure at the tape.)

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