TOSHIBA

3.5 type Disk Drives

MG03ACA400
MG03ACA300
MG03ACA200
MG03ACA100

Product Specification

株式会社　東芝

TOSHIBA CORPORATION

No.
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TOTAL 50　CONT.ON　2　PAGE No. 1

Revision History

TOSHIBA

TITLE: 3.5 type Disk Drives MG03ACA400-100 Product Specification

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*1 Section(s) with asterisk (*) refer to the previous edition when those were deleted.

Preface

This manual describes the 7,200 rpm MG03ACA400-100 3.5 type hard disk drives with an embedded Serial ATA (SATA).

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

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

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

Overview of Manual

This manual consists of the following seven chapters:

Chapter 1 General Description

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

Chapter 2 Specifications

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

Chapter 3 Installation Requirements

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

Chapter 4 Installation

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

Chapter 5 Maintenance

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

Conventions Used in this Manual

The MG03ACA400-100 series are described as "the HDD" in this manual.

Decimal number is represented normally.

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

Binary number is represented as "010".

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**	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. Toshiba 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 by a START STOP UNIT command. It takes about 30 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. Just in case, stop dismounting once and wait until the spindle motor stops (about 30 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.
 **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 manual 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)	American national Standards Institute (ANSI)
T13/1321D Revision 3	Information technology - AT Attachment with Packet Interface-5 (ATA-5)	American national Standards Institute (ANSI)
T13/1410D Revision 3b	Information technology - AT Attachment with Packet Interface-6 (ATA-6)	American national Standards Institute (ANSI)
T13/1532D Volume 1 Revision 4b T13/1410D Volume2 Revision 4b T13/1410D Volume 3 Revision 4b	Information technology - AT Attachment with Packet Interface-7 (ATA-7)	American national Standards Institute (ANSI)
T13/1699-D Revision 4b	Information technology - AT Attachment 8 - ATA/ATAPI Command Set (ATA8-ACS)	American national Standards Institute (ANSI)
Serial ATA Workgroup Revision 2.6	Serial ATA: High Speed Serialized AT Attachment	Serial ATA International Organization (SATA IO)
Serial ATA Workgroup Revision 3.0	Serial ATA: High Speed Serialized AT Attachment	Serial ATA International Organization (SATA IO)

Compliance with Administration on the Control of Pollution Caused by Electronic Information Products of the People's Republic of China

电子信息产品污染控制管理办法（第 39 号）

这标记是按照 2006 年 2 月 28 日公布的[电子信息产品污染控制管理办法]以及 SJ/T11364-2006[电子信息产品污染控制标识要求]在中国销售的电子信息产品的环保使用期限。如遵守关于这产品的安全或使用上的注意，在这期限内(从生产日期起算)不会因产品中的有害物质漏到外部、或发生突然变异，而引起环境污染和对人体或财产的重大影响。

产品中有毒有害物质或元素的名称及含量

部件名称	有毒有害物质或元素					
	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)	×	○	○	○	○	○

○：表示该有毒有害物质在该部件所有均质材料中的含量均在 SJ/T 11363-2006 规定的限量要求以下。
×：表示该有毒有害物质至少在该部件的某一均质材料中的含量超出 SJ/T 11363-2006 规定的限量要求。

This product is shipped as a component to manufacture the final products. Therefore, the packaging material code provided in GB18455-2001 is not marked on any packaging part of this product.

MANUAL ORGANIZATION

PRODUCT MANUAL (This manual)	1. General Description 2. Specifications 3. Installation Requirements 4. Installation 5. Maintenance
SATA INTERFACE MANUAL	1. Serial ATA (SATA) Interface 2. Command Processing 3. Command Specifications 4. Disk Management

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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 2.6/3.0:Serial ATA: High Speed Serialized AT Attachment and, ANSI T13/1699-D Revision 4b Information technology - AT Attachment 8 - ATA/ATAPI Command Set (ATA8-ACS) 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: 1.5Gbit/s, 3.0Git/s, 6.0Gbit/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 initiator 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 65536 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 64MBytes. 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 64 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 initiator after being corrected in the data buffer. The initiator 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; approx. 3.1 Bels at ready. This makes it ideal for office use.

1.2 Hardware Structure

The HDDs have a disk enclosure (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 95 mm (3.74 inch).

(2) Heads

The heads have MR (Magnet-Resistive) read element 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 give examples of the SATA system configuration.

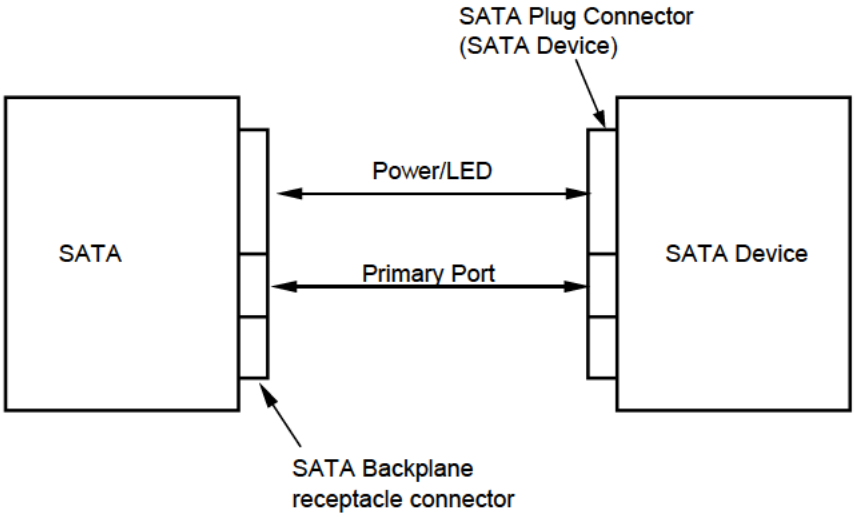


Figure 1.1 Example of SATA system configuration

CHAPTER 2 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 and order number.

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

Table 2.1 Model names and order numbers

Model number	Interface type	Capacity (user area)
MG03ACA400	SATA-2.6/3.0(1.5Gbit/s, 3.0Gbit/s, 6.0Gbit/s)	4TB (*1)
MG03ACA300	SATA-2.6/3.0(1.5Gbit/s, 3.0Gbit/s, 6.0Gbit/s)	3TB (*1)
MG03ACA200	SATA-2.6/3.0(1.5Gbit/s, 3.0Gbit/s, 6.0Gbit/s)	2TB (*1)
MG03ACA100	SATA-2.6/3.0(1.5Gbit/s, 3.0Gbit/s, 6.0Gbit/s)	1TB (*1)

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

2.1.2 Function Specifications

Table 2.2 shows the function specifications of the HDDs.

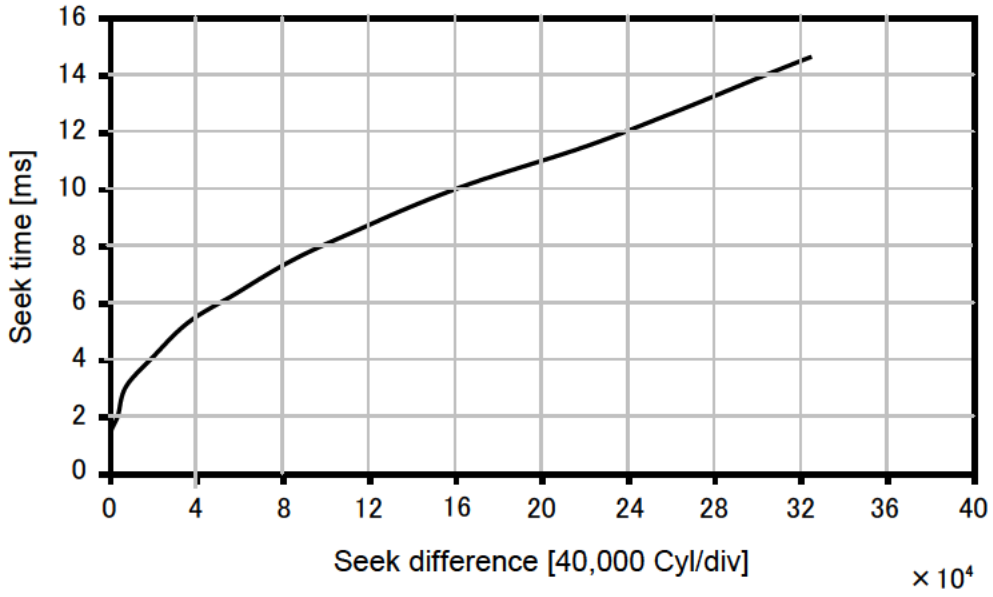
Table 2.2 Function specifications

Item		Specification			
		MG03ACA400	MG03ACA300	MG03ACA200	MG03ACA100
Formatted capacity (*1)		4TB (*2)	3TB (*2)	2TB (*2)	1TB (*2)
Recording method		Iterative-Noise Predictive PR+NLV			
Seek time (*3) (Read/Write)	Track to track	0.8 ms / 1.0 ms			
	Average	8.5 ms / 9.5 ms			
	Full stroke	15.1 ms / 16.1 ms			
Rotation speed		7,200 rpm ± 0.1 %			
Average latency time		4.17 ms			
Start/stop time (*4)	Ready up time	25 s Typ. (30 s Max.)			
	Stop time	20 s Max.			
External dimensions	Height	26.1 mm Max			
	Width	101.6 mm ±0.25 mm			
	Length	147 mm Max			
Weight		0.72 kg Max			
Power consumption (*5)	Low Power Idle	6.0 W Typ.			
	Performance Idle	7.5 W Typ.			
Power consumption	Standby	1.5W Max			
Data transfer speed (*6)	Sustained	165 MB/s	155 MB/s		
	External	1.5 Gbit/s, 3.0 Gbit/s, 6.0 Gbit/s			
Logical data block length		512 B (fixed length)			
Data buffer		64MiB FIFO ring buffer (*9)			
Acoustic noise (Ready)		31 dB Typ.			

(*1) The formatted capacity can be changed by changing the logical block length and using spare sector space. See Chapter 3 for the further information. The formatted capacity listed in the table is an estimate for 512 bytes per sector.

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

(*3) The seek time is as follows (Example;MG03ACA400)

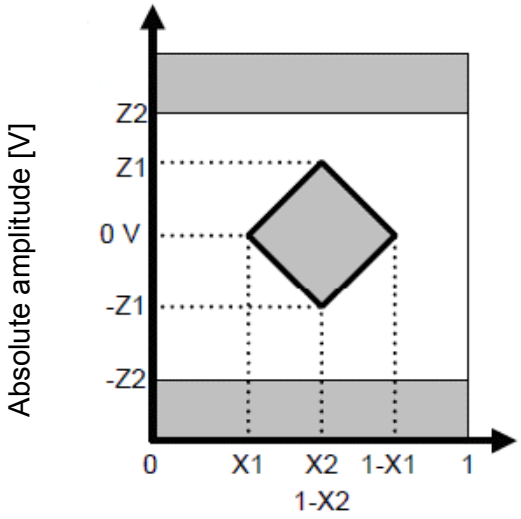


(*4) The start time is the time from power on or start command to when the HDDs are ready, and the stop time is the time for disks to completely stop from power off or stop command.

(*5) Power supply at nominal voltage ±1%. 25°C ambient. Refer to Subsection 4.3 “Adaptive Power Mode Control” of the SATA INTERFACE MANUAL for details of idle and ready states.

(*6) The maximum data transfer rate may be restricted to the response speed of initiator and by transmission characteristics. 1 MB/s = 1,000,000 bytes/s.

(*8) The eye mask is as follows:



Parameter	Unit	1.5Gbit/s	3.0Gbit/s	6.0Gbit/s
2xZ2	mVp-p	1,600	1,600	1,200
2xZ1	mVp-p	325	275	84
X1	UI	0.275	0.275	0.3
X2	UI	0.5	0.5	0.5

(*9) 1 MiB = 1,048,576 bytes.

2.1.3 Environmental Specifications

Table 2.3 lists environmental and power requirements.

Table 2.3 Environmental/Power requirements

Item			Specification			
			MG03ACA400	MG03ACA300	MG03ACA200	MG03ACA100
Temperature (*1)	Operating		5 to 55 °C			
	Non-operating		–40 to 70 °C			
	Transport		–40 to 70 °C			
	Enclosure surface temperature at operating		5 to 60 °C			
	Gradient		20 °C/h or less			
Relative humidity	Operating		5 to 90 %RH			
	Non operating		5 to 95 %RH			
	Transport		5 to 95 %RH			
	Maximum wet bulb temperature		29 °C (no condensation)			
Vibration (*2)	Operating (*3)		7.35 m/s^2 {0.75G} (5 to 300Hz, linear) or less 2.45 m/s^2 {0.25G} (300 to 500Hz, linear) or less			
	Non-operating (*4)		49 m/s^2 {5G} (5 to 500Hz) or less			
	Transport (packaged)		49 m/s^2 {5G} (5 to 500Hz) or less			
Shock (*2)	Operating		686 m/s^2 {70G} / 2 ms duration			
	Non-operating		2,940 m/s^2 {300G} / 2 ms duration			
	Transport (packaged)		2,940 m/s^2 {300G} / 2 ms duration			
	Non-operating rotational		25 krad/s^2 (ss-2, 1.0 ms) , 20 krad/s^2 Class-2, 2.0 ms)			
Altitude	Operating		–305 to +3,048 m (–1,000 to +10,000 feet)			
	Non-operating		–305 to +12,192 m (–1,000 to +40,000 feet)			
Power requirement (*5)	+12V DC	Regulation	±5%			
		Ready (average)	0.53 A			
		Spin up	2.4 A (peak) / 4.0 A (less than 100µs)			
		Peak operating current Maximum (peak) DC (*6)	2.2 A			
		Peak operating current DC (reference) (*6)	0.80A			
	+5V DC	Regulation	±5% (*7)			
		Ready (average)	0.23 A			
		Peak operating current Maximum (peak) DC (*6)	1.3 A			
		Peak operating current DC (reference) (*6)	0.36 A			
	Ripple (+5V, +12V)		70mVp-p (5V) / 120mVp-p (12V) or less (*8)			

(*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) At power-off state after installation

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

(*6) Operating currents are values under random W/R operation of full partition.

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

(*8) High frequency noise (over 20MHz) is less than 100 mVp-p.

2.1.4 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.

2.1.5 Reliability

(1) Mean Time to Failures (MTTF)

MTTF of the HDDs during its life time is 1,200,000 hours (operating: 24 hours/day, 7 days/week average HDA surface temperature: 50°C or less). Continual or sustained operation at case HDA surface temperature above 50°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.

(2) Mean Time to Repair (MTTR)

MTTR is the average time taken by a well-trained service mechanic to diagnose and repair an HDD malfunction. The HDD is designed for a MTTR of 30 minutes or less.

(3) 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.

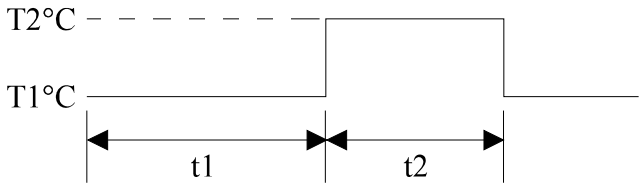
• HDA surface temperature:	from 5°C to 40°C	5 years
• HDA surface temperature:	from 41°C to 45°C	4.5 years
• HDA surface temperature:	from 46°C to 50°C	4 years
• HDA surface temperature:	from 51°C to 55°C	3.5 years
• HDA surface temperature:	from 56°C to 60°C	3 years
• HDA surface temperature:	more than 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.

The maximum storage period without turning the power on is six months.

Note:

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



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

(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.

2.1.6 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 as one of the idle modes of the drive.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.

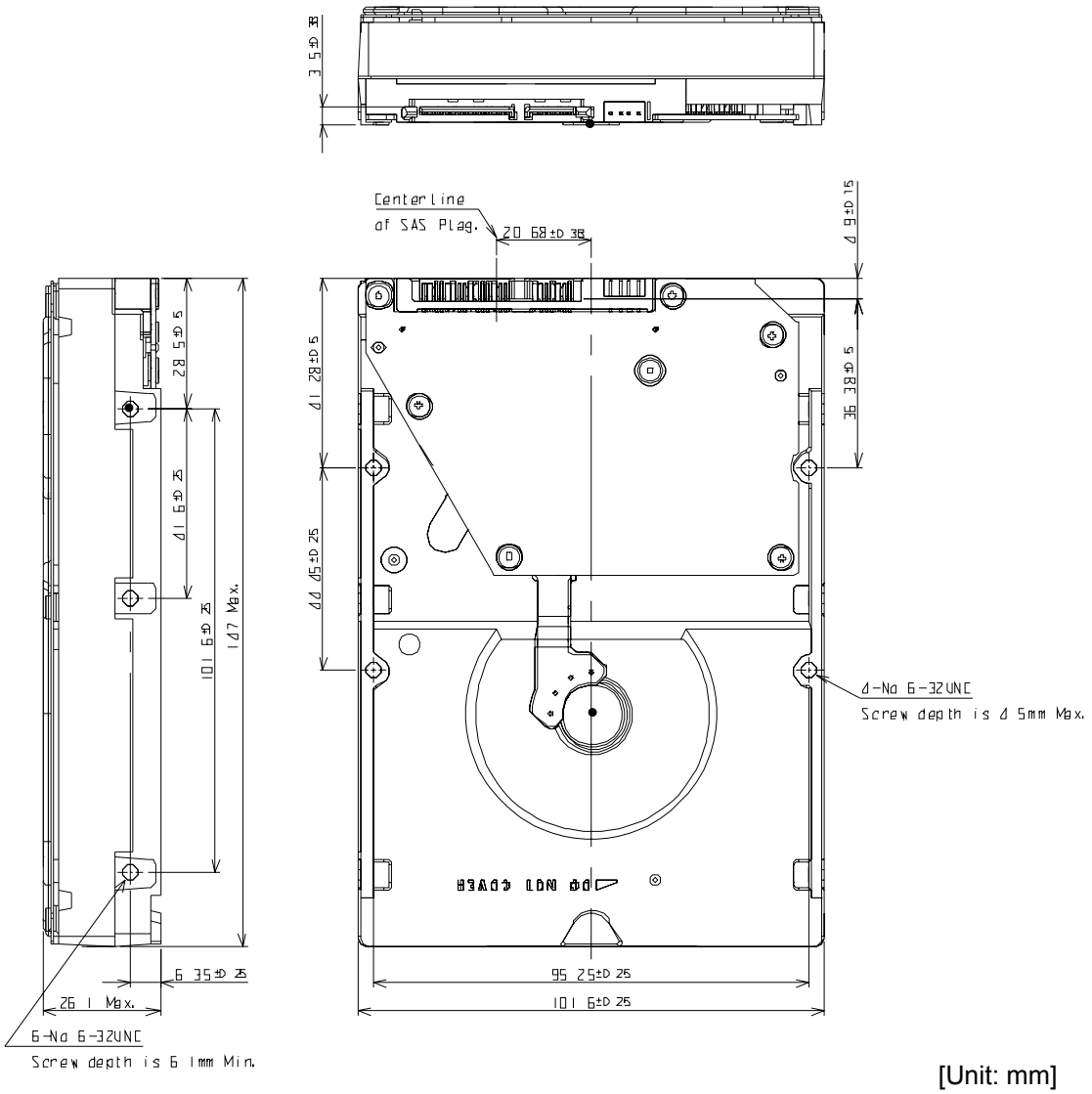
CHAPTER 3 Installation Requirements

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

3.1 Mounting Requirements

3.1.1 Dimensions

Figures 3.1 show the dimensions of the HDDs and the location of the mounting screw holes.



[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°.

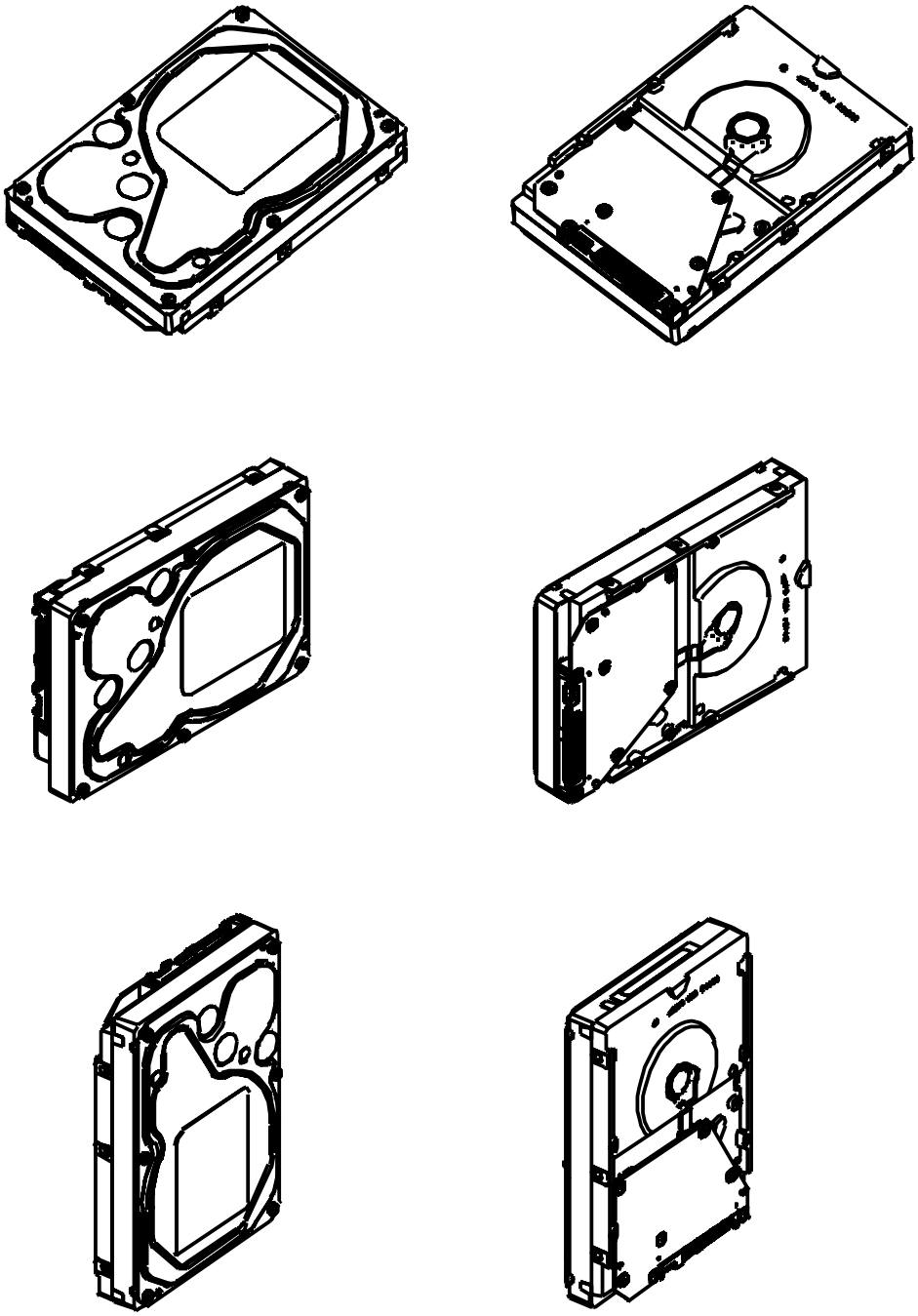


Figure 3.2 HDD orientations

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 4.5mm on the bottom mounting, 3 to 6.1mm 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.

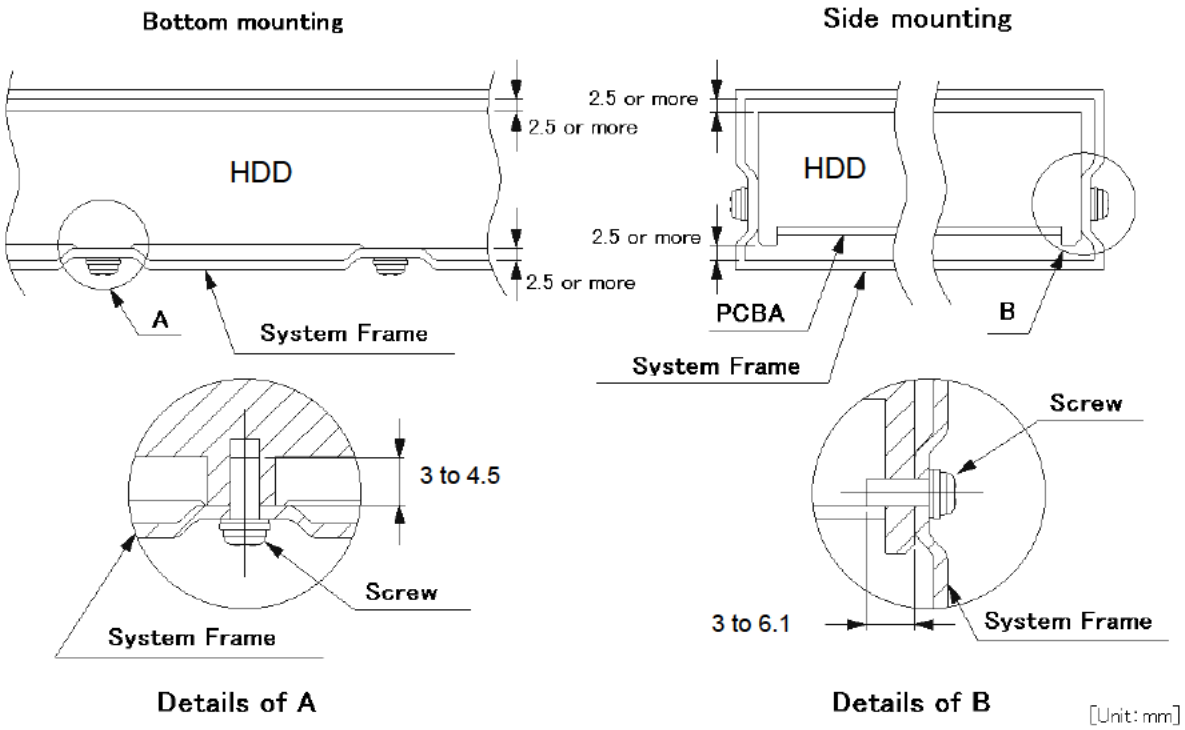


Figure 3.3 Mounting frame structure example

(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)

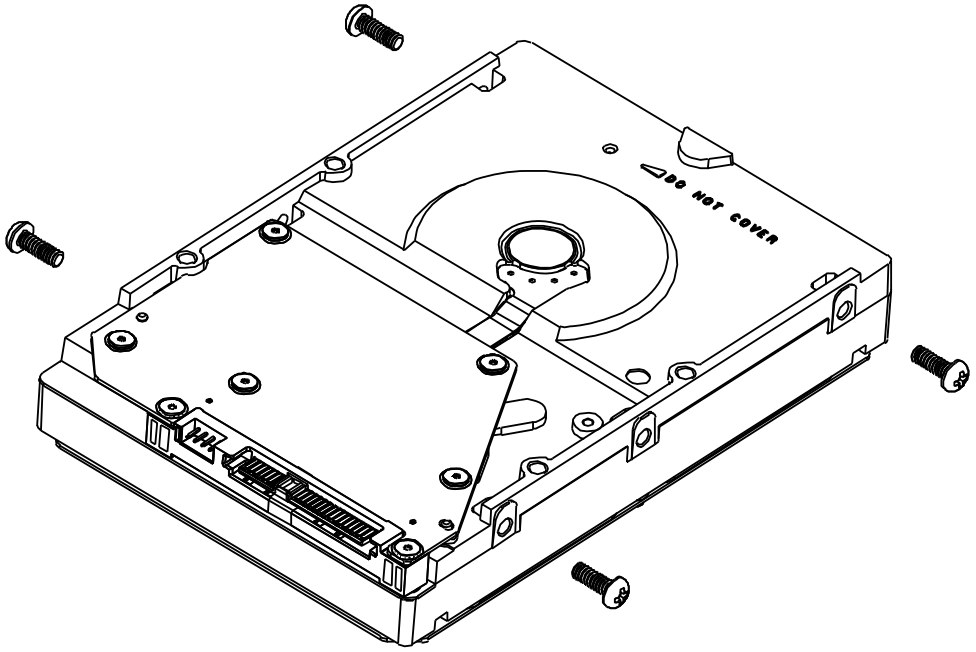


Figure 3.4 Limitation of side-mounting

(4) Limitation of bottom-mounting

Use all 4 mounting holds on the bottom face.

(5) Breathing hole

Do not cover the breathing hole as shown in Figure 3.5.

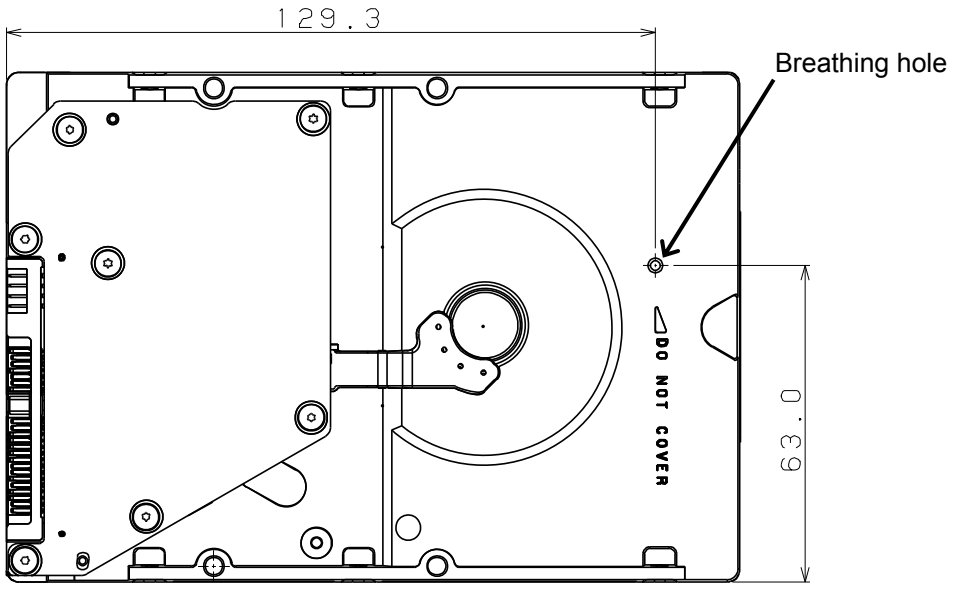


Figure 3.5 Limitation of side-mounting

(6) 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 50°C or below to meet the condition for assuring an MTTF of 1,200,000 hours. An air flow of 0.5m/s or more is required at ambient temperature 30°C.

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

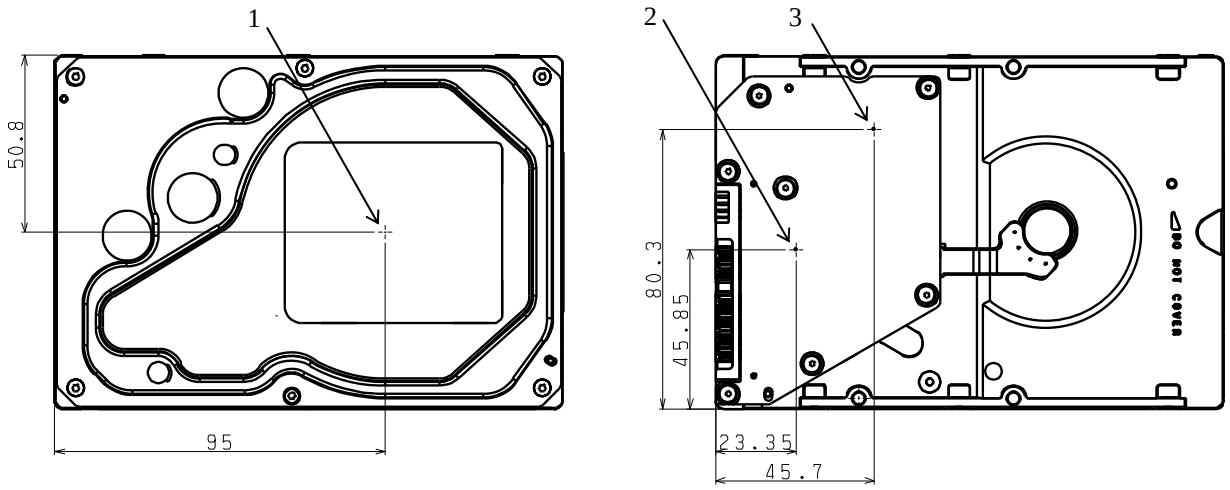


Figure 3.6 Surface temperature measurement points

(7) Environmental magnetic field

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

(8) 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 2.1.3. (For other requirements, see Items (4) below.)

(2) Current waveform (reference)

Figure 3.7 shows the spin-up current waveform of +5V DC and +12V DC.

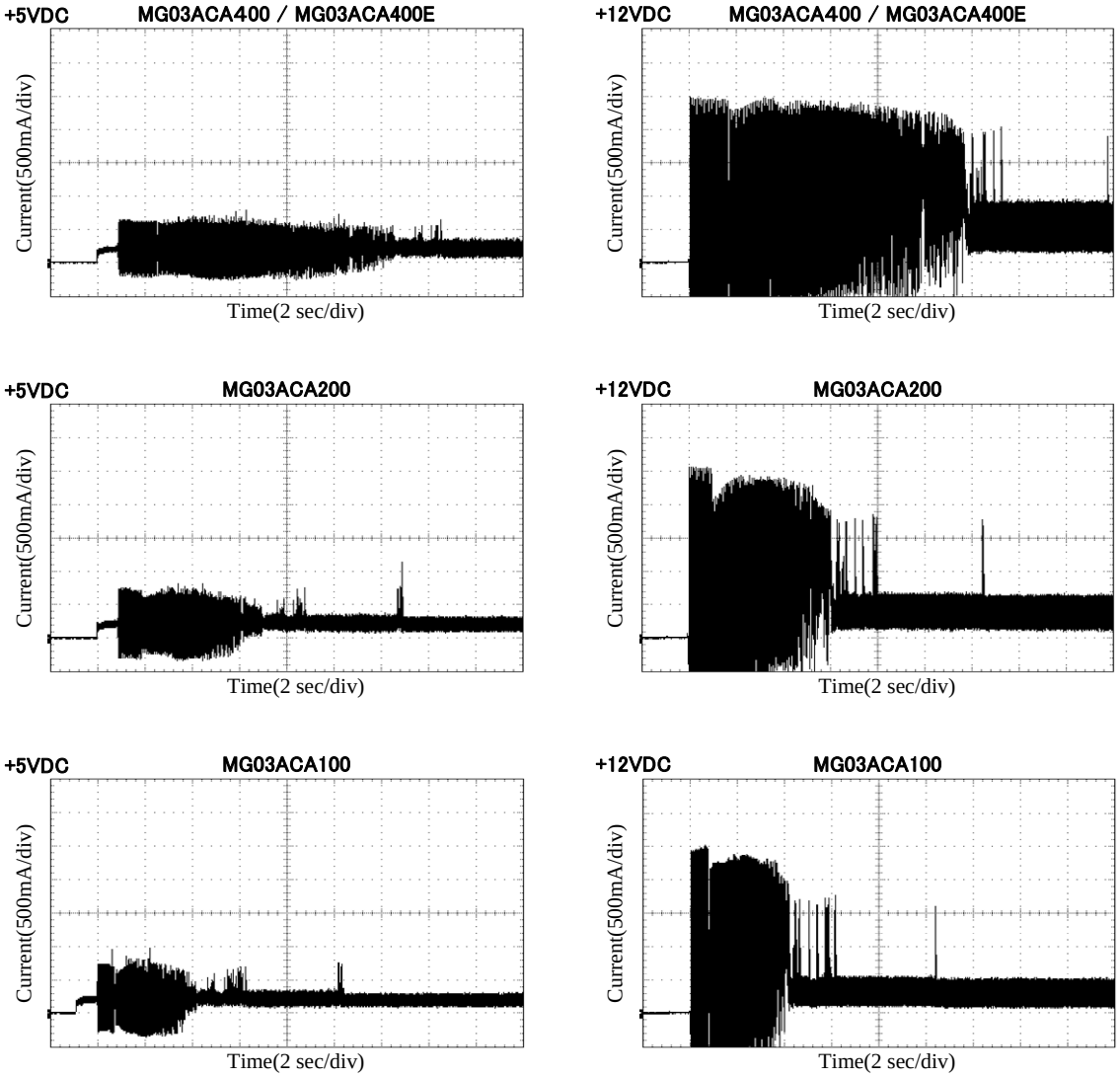


Figure 3.7 Current waveform (Spin-up)

Figure 3.8 shows the Max Seek current waveform of +5V DC and +12V DC.

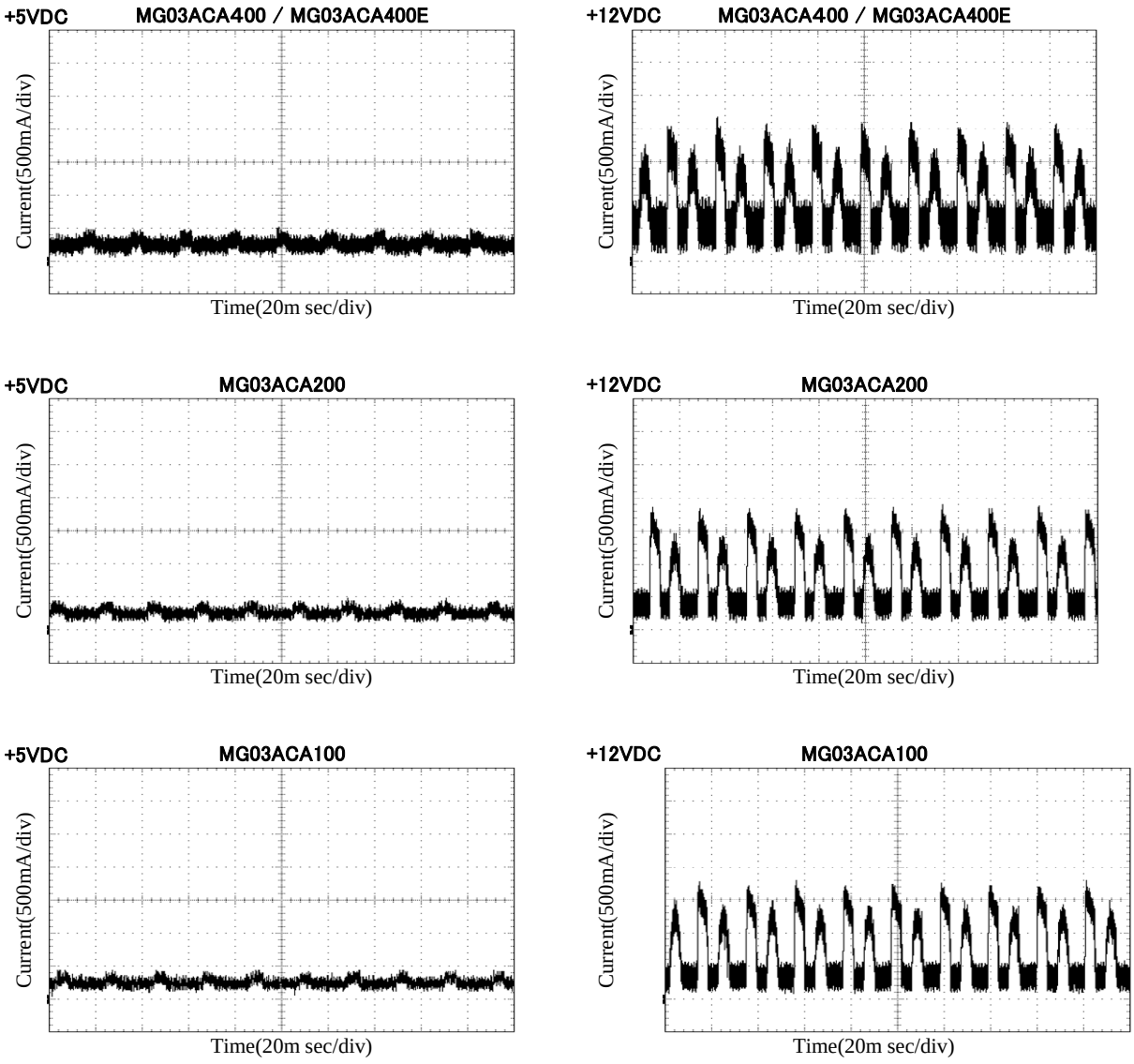


Figure 3.8 Current waveform (Max seek)

(3) Power on/off sequence

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

(4) Sequential starting of spindle motors

After power is turned on to the HDDs, a large amount of current flows in the +12V DC 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 NOTIFY (ENABLE SPINUP) primitives in intervals of 12 seconds or more so that the spindle motors of individual HDDs are started sequentially.

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

(5) 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 3.9 is recommended.

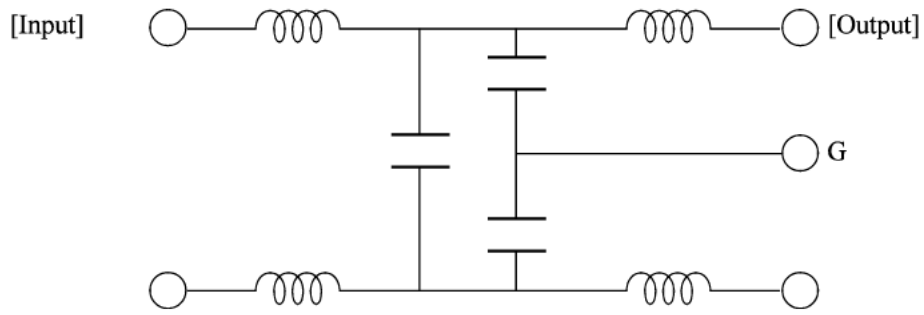


Figure 3.9 AC noise filter (recommended)

3.3 Connection Requirements

3.3.1 Connector Location

Figure 3.10 shows a location of the interface connector.

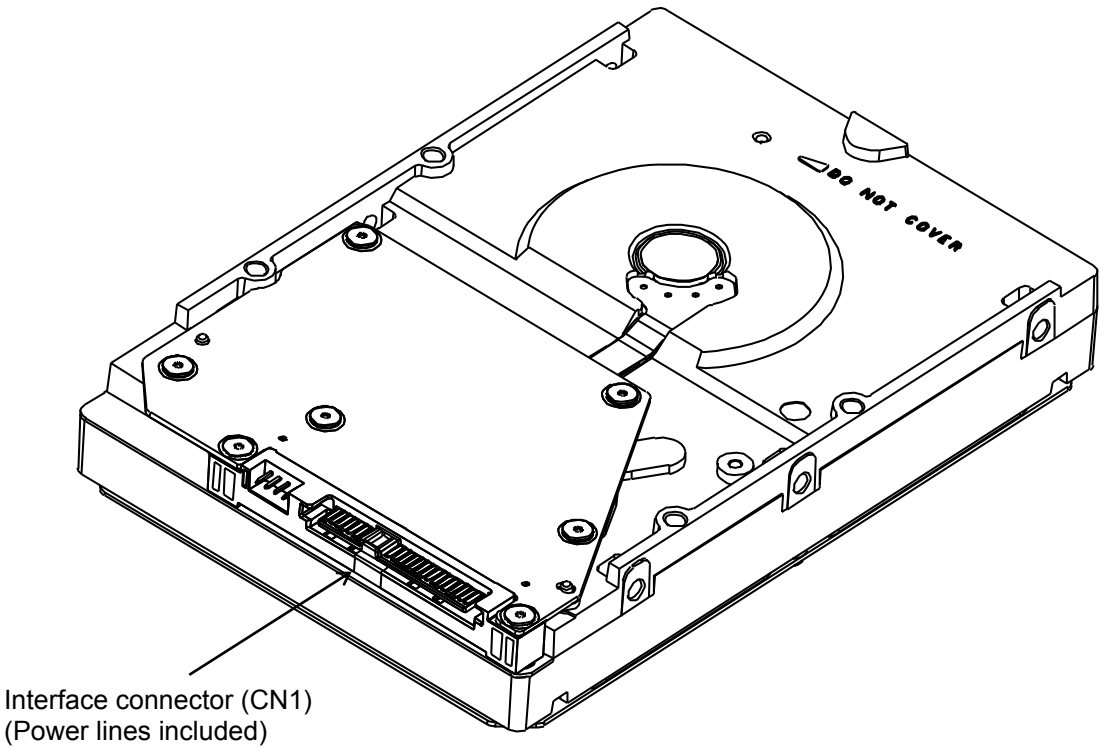


Figure 3.10 Connector location

3.3.2 Interface Connector

Figure 3.11 shows the SATA type interface connector (SATA plug) overview.

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

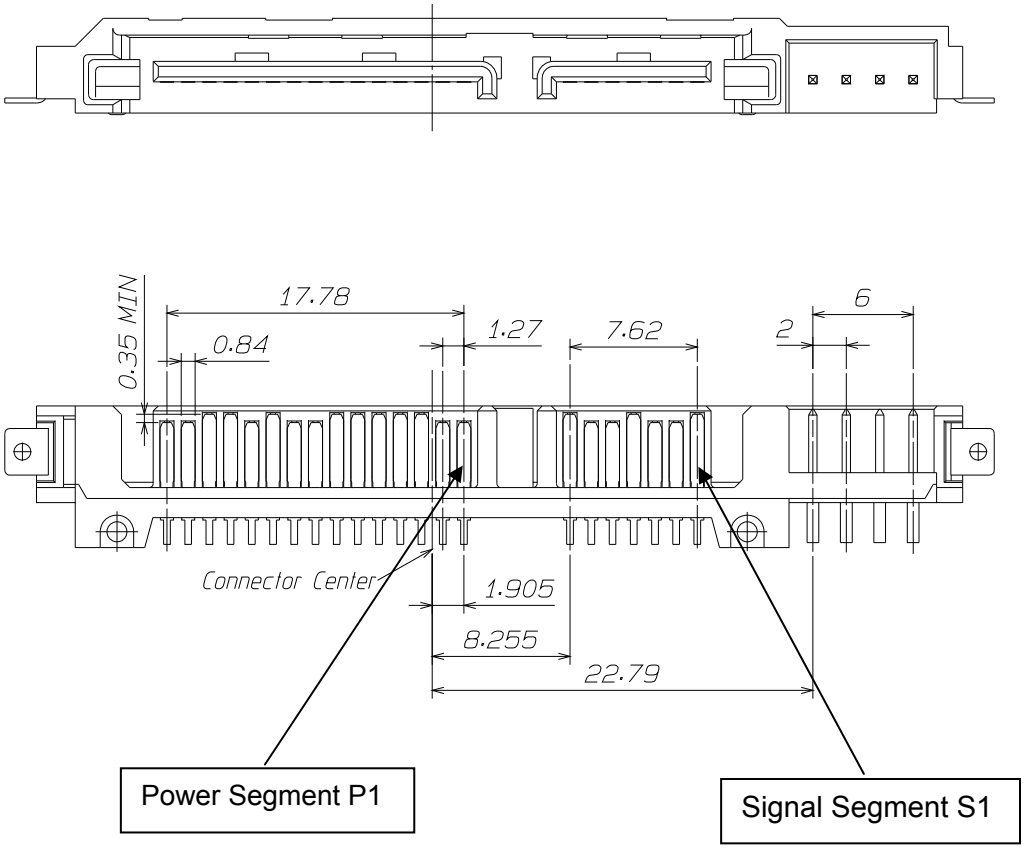


Figure 3.11 SATA plug connector overview

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
	S3	A-	
	S4	GND	2nd mate
	S5	B-	Differential Pair B from PHY
	S6	B+	
	S7	GND	2nd mate
Signal segment "L"			
Central connector polarizer			
Power segment "L"			
Power segment	P1	V33	3.3V power (Unused)
	P2	V33	3.3V power (Unused)
	P3	V33	3.3V power pre-charge 2nd mate (Unused)
	P4	GND	1st mate
	P5	GND	2nd mate
	P6	GND	2nd mate
	P7	V5	5V power pre-charge 2nd mate
	P8	V5	5V power
	P9	V5	5V power
	P10	GND	2nd mate
	P11	Spin/ ACT	- Staggered Spin-up mode detect (input) - Activity LED drive(Output) *Reference 1.2 "Electrical Specification" of the SATA INTERFACE MANUAL
	P12	GND	1st mate
	P13	V12	12V power pre-charge 2nd mate (Unused)
	P14	V12	12V power (Unused)
	P15	V12	12V power (Unused)
Power segment key			

(* 1) P1 to P3 are +3.3V power supply input and pre-charge signals, and not used on the MBFD2 series.

3.3.3 Connector Requirements

Table 3.6 lists the recommended connectors for the host system.

Table 3.6 Recommended connectors

Drive side connector		DDK: SAT-PG22-S1A-FG 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)

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 in Table 2.3 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.

⚠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.

(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 30 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 4.5mm / the side mounting : 3 to 6.1mm 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 2.5mm of clearance is required between the HDA and the frame (see Figure 4.3).

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.

⚠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 by a START STOP UNIT command. It takes about 30 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. Just in case, stop dismounting once and wait until the spindle motor stops (about 30 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..
 **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. Toshiba 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 "(3) Service life," in Subsection 2.1.5.

(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

Toshiba has the service system and repair facility for the HDD. Contact Toshiba 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 Toshiba.
- 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 manual 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 Toshiba, 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 (±5%). For +5V DC, measure the voltage between pin 20 (+5V) of the interface connector and the nearest PCBA mounting screw (GND) from the interface connector, and confirm the value is from 4.75 to 5.25 VDC. For +12V DC, measure the voltage between pin 2 (+12V) of the interface connector and the nearest PCBA mounting screw (GND) from the interface connector, and confirm the value is from 11.4 to 12.6 VDC.
Electrical noise	Make sure the maximum ripple peak-to-peak value of +5V DC is within 250 mV and +12V DC is within 250 mV. Make sure the high frequency noise (over 20 MHz) is less than 100 mVp-p.
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 Toshiba for repair. A media defect list must be included with the HDD returned to Toshiba.

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

⚠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 manual 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 manual 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

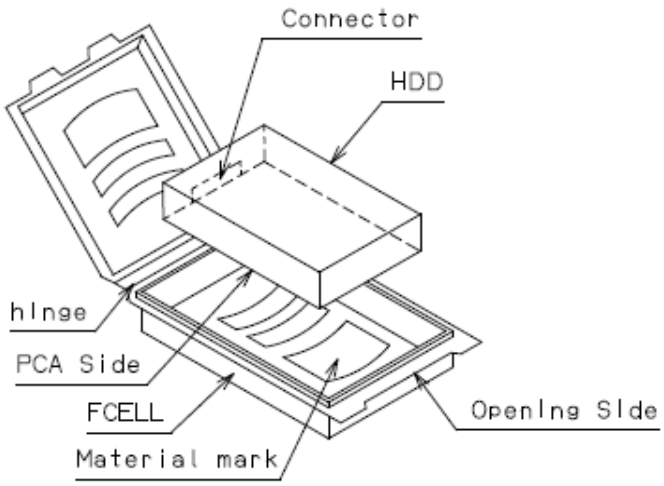


Figure 5.1 FCELL packaging

(1) Put the HDD into FCELL.

- At this time, the connector of the HDD is directed to the hinge side of FCELL.
- The PCBA is put in the side with the material mark of FCELL.

(2) Push from two corners of FCELL on the hinge side previously, push two corners of the opening next, and lock FCELL surely.

5.3.2 Box Packaging

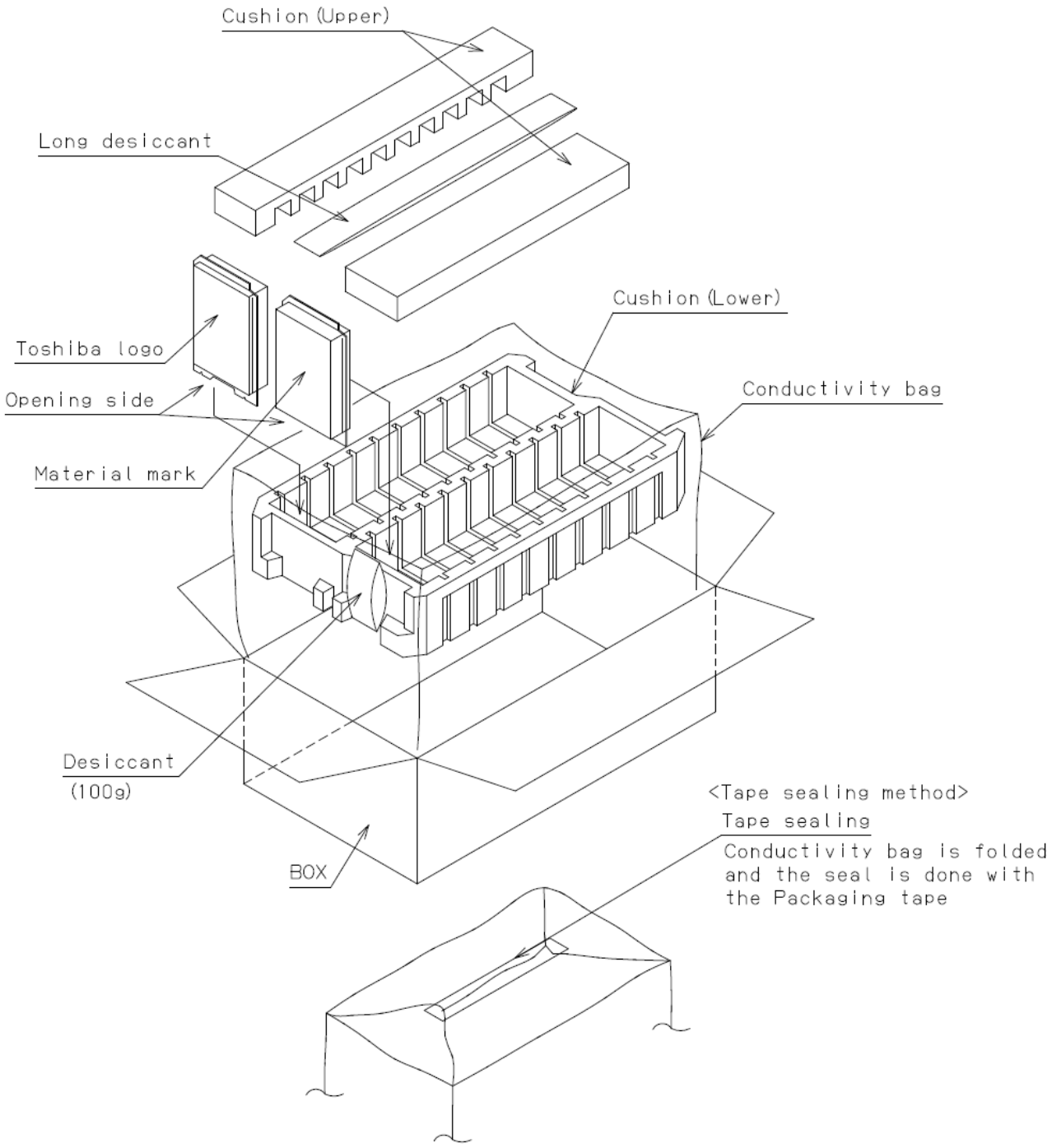


Figure 5.2 Box packaging

(1) Put the conductivity bag into the multi-box, in addition put the cushion (lower) into the bag.

(2) Put unitary packaging (FCELL) in the cushion (lower).

- At this time, FCELL is put in the cushion (lower) so that the FCELL opening may become downward. The I/F connector may become upward.

- For less than 20 HDDs, insert the HDDs starting from the slot with the smallest number in Figure 5.3. Then place the empty FCELL in the empty slot.

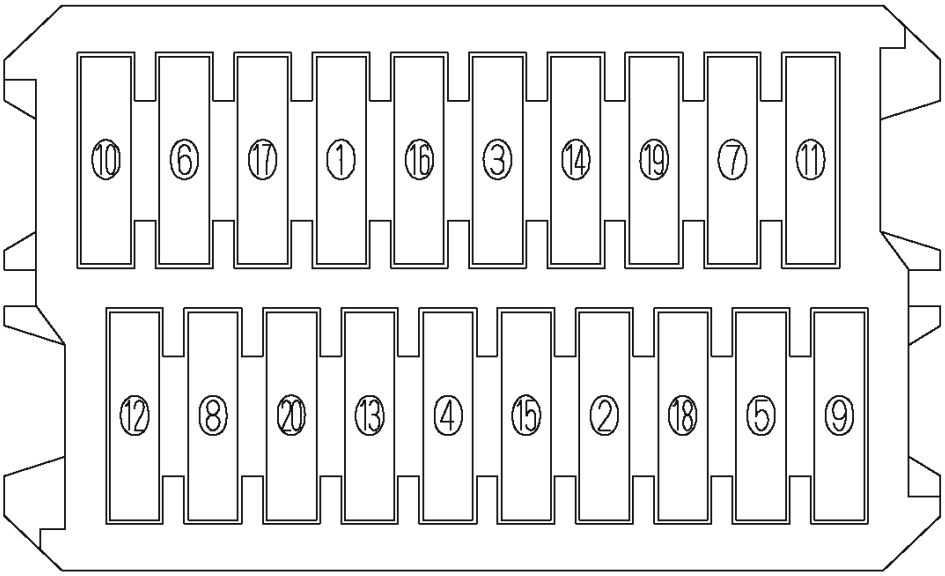


Figure 5.3 Fraction packaging

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

(4) Put the desiccant (100g) into the conductivity bag

(5) Put the long desiccant between the cushion (upper)

(6) Seal the conductivity bag with the packaging tape

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

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