TOSHIBA

STORAGE DEVICE DIVISION

SD-C2502
DVD-ROM DRIVE
PRODUCT SPECIFICATION

JULY 2000

REV. 1.0

Specifications are subject to change without notice

DOCUMENT NUMBER
12444

Notice

1.This product has no over-current protection circuit.
System should have appropriate over-current protection.
Toshiba Corporation makes no warranty of damages caused by no over-current protection.

2.This has a little possibility of errors.
To prevent damages and injury caused by the above, careful consideration for the safety and integrity should be taken in the system design.
Do not use this product in a system that may cause hazard to human being or material loss caused by the failure, loss of data and/or errors of this product.

3.Do not disassemble or modify this product.
Or, reliability, safety and performance can not be guaranteed.

4.Turn off the system power before mounting/removing this product.
Or, it may cause failure or damage.

5.Because the Interface connector of this product allows insertion of only one side direction, ascertain direction carefully to insert the connector.

6.To build this product in an equipment, handle it only in electrostatically safe environment.
Do not touch connecting terminal directly or the product may be damaged by electrostatic energy.

7. This product can playback discs based on the format described in item 3.1.(1). Do not load a disc which is not based on the item (discs of which shaped unevenly and is not a real circle, etc.) or a disc with its weight unbalanced excessively.
A very high speed rotation is carried out inside the product, so abnormal vibration and malfunction may occur if disc described above is loaded.

8. When a disc cannot be ejected because of some troubles, etc., turn off the unit and eject the disc using the emergency release mechanism after passing more than 1 minute.
When the emergency release is carried out while the power is on or immediately after the power off, the disc may be eject in a rotating status. We do not assure if the disc is damaged by this.

9. Do not apply excessive force during the release operation. The disc loaded inside the product may be released in a rotating status.
Should the disc be damaged by the above action, we do not warrant on it.

10. In the instruction manual of your product, statement described in “Safety Instruction Manual “attached to this product, the statement of item 2 and 8 above, and other required statements should be mentioned for thorough understanding by the users.

Contents

1. Introduction

This document describes TOSHIBA's SD-C2502 DVD-ROM Drive.

This drive supports DVD CSS (Contents Scramble Systems) Disc.

This drive reads digital data stored on CD-ROM, DVD-ROM and CD audio discs.

DVD-ROM disc spec (DVD-ROM Book) defines 120 mm and 80 mm in diameter, single and dual layers as recording layer structure and single and double sides as recording side.

Maximum storage capacities are 4.38 GBytes and 15.9 GBytes for single layer/single side and dual layer/double side respectively. (1 GByte=2^{30} Bytes)

Due to these high capacity and high data transfer rate of 1352 KBytes/sec, DVD-ROM discs are capable to store high quality and long duration MPEG-2 moving picture data. (1 KByte=2^{10} Byte)

This drive reads digital data stored on DVD-ROM discs at maximum 8 times faster rotaional speed.

This drive reads digital data stored on CD-ROM discs at maximum 24 times faster rotational speed.

This drive is a new generation drive with highest performance such as 95 ms(DVD)/90 ms(CD) Seek Time.

This drive offers long life and durability because the disc is read by a LASER, thereby eliminating physical contact with the disc.

This drive supports SFF-8020i of ATAPI (ATA Packet Interface) spec. and SFF-8090 Ver.3 of DVD Command.

This drive shows a highest performance such as 60,000 hour MTBF.

This drive adopts RPC-II.

Refer to the precation of the next page for the RPC-II.

Matters to be attended to:

This drive adopts RPC-II.

This DVD-ROM Drive adopts RPC-II, the Phase II System of RPC (Regional Playback Control) for “Standard Specification Model”, on the basis of a contract with the CSS (Contents Scramble System) organization.

The CSS rule requires that all the products not only DVD-ROM Drives but also PC systems installing DVD-ROM Drives sold from Jan.1, 2000 need to support RPC-II described above.

To playback a DVD-Movie Software with the Regional Code specified by using a DVD-ROM Drive with RPC-II adopted, either the hardware or software used as applications on PC system side is also required to meet RPC-II.

Namely, in the status that a hardware or a software for a DVD-Movie Playback Application planned to use in a PC does not support RPC-II, if the "RPC-II (Standard Specification) Drive" is used in combination, DVD-Movie Softwares with the Regional Code specified (most of DVD-Movie Softwares currently available on the market) cannot be reproduced.

However, all the drive manufacturers must obey to the deadline specified by the CSS rule saying; all DVD-ROM Drives have to implement Phase II from Jan.1, 2000. So we recommend that you will change your DVD-Movie Playback Hardware or Software to those applicable to the RPC-II as soon as possible and investigate to combine your system with the RPC-II Specification Drives.

Especially, changing the RPC-II specification drive to the RPC-I is prohibited by the CSS rule.

In the combination of the drive and PC system with RPC-II supported, as far as the Regional Code of a DVD-Movie Software and the code memorized in the RPC-II Specification Drive coincides, the Movie Software is allowed to carry out.

In the RPC-II Specification Drive, the region change by an end user is permitted up to 5 times in total including the initial region set. After change to the fifth region is carried out, the Drive enters Parm State (“no change allowed”status).

The drive with Parm State is permitted up to 4 times of "reinitialization" by a drive manufacturer or a specific service center authorized by the CSS. Since it is considered that the reinitialization is carried out after the completion of the region confirmation through test items in the PC manufacturer’s manufacturing line or the completion of drive repair, etc., the number of reinitialization times may vary from 0 (no reinitialization available) to 4 times. So, we recommend that not to disclose the reinitialization process to end users but only to inform the number of region setting times as "end user’s direct region setting is available up to 5 times in total."

2. Features

(1) 12.7 mm Internal 12 cm/8 cm DVD/CD/CD-ROM Drive
(2) Fast 100 ms (DVD)/95 ms (CD) Random Access Time
(3) Fast 95 ms (DVD)/90 ms (CD) Random Seek Time
(4) Max.8X (DVD) / Max. 24X (CD)
(5) Max. 10,820 KByte/s (DVD)/Max. 3,600KByte/s (CD) Sustained Transfer Rate (1 KByte = 2^{10} Bytes)
(6) CD Multisession Disc Spec (Photo-CD, CD-EXTRA) CD-R and CD-RW Disc Spec. compliant
(7) CD-TEXT Support
(8) Multimedia PC-3 Spec compliant
(9) PC2001 Spec Compliant
(10) RPC-II Compliant
(11) Drawer Type Manual Load / Electrical Release
(12) Emergency Release
(13) Slant Angle : Horizontal +/-15° Vertical 30° /15° (Refer to Figure 1)
(14) Closed Enclosure
(15) PIO Mode-4 ATAPI Drive (Transfer Rate: 16.7 MByte/s)
(16) DMA: Multi word DMA transfer mode-2 (Transfer Rate: 16.7 Mbyte/s)
: Ultra DMA mode-2 (Transfer Rate: 33.3 Mbyte/s)
(17) Support < CD-DA Transfer Over ATAPI > Function (CD)
(18) Subcode P,Q,R-W Transfer over ATAPI (CD)
(19) Built-in Mode-1ECC / EDC (CD)
(20) Embedded CD-ROM XA type ECC / EDC (in addition to standard type ECC / EDC) (CD)
(21) Efficient Data Transmission Throughput via Large 128 KBytes Buffer Memory and Buffer Algorithm
(22) 8X Sampling & Digital Filter for CD Audio (CD)
(23) High Speed Audio Playback System (CD)
(24) Low Power Consumption
Average : 3.5 W (DVD)/ 3.5 W (CD)
Max : 4.0 W (DVD)/ 4.0 W (CD)
Stand-by : 0.18 W
(25) 16-Mode Output for CD Audio (CD)
(26) Software Volume Control (CD)
(27) 60,000 Power on Hours MTBF
(28) Support Vibration Detect Function

3. Specifications

3.1.Performance

(1) Applicable Disc*1

DVD: DVD-ROM (DVD-5, DVD-9, DVD-10, DVD-18),
DVD-R (read, single border)
CD : CD-DA, CD+(E)G, CD-MIDI, CD-TEXT, CD-ROM,
CD-ROM XA, CD-I, CD-I Bridge (Photo-CD, Video-CD)
Multisession CD (Photo-CD, CD-EXTRA, CD-R,
CD-RW), CD-R (read), CD-RW (read)

(2) Data Capacity

User Data/Block

DVD-ROM: 2,048 Byte/Block
CD-ROM : 2,048 Byte/Block (Mode 1)
2,336 Byte/Block (Mode 2)

Data Capacity/Disc: (1 GB=2^{30} Byte, 1 MB=2^{20} Byte, 1 KB=2^{10} Byte)

DVD- 5: 4.377 GB (4.700 Billion Byte)
DVD- 9: 7.959 GB (8.545 Billion Byte)
DVD-10: 8.754 GB (9.400 Billion Byte)
DVD-18: 15.917 GB (17.091 Billion Byte)
CD (Mode-1): 656.5 MB (688.4 Million Byte)
CD (Mode-2): 748.8 MB (785.2 Million Byte)

(3) Rotational Speed

DVD (Single layer)	: 3.3X-8X CAV approx. 4,670 rpm
DVD (Dual layer)	: 2.5X-6X CAV approx. 3,792 rpm
DVD-VIDEO (CSS Disc)	: 1.6X-2.4X PCAV approx. 1.377-2,222 rpm
CD*2	: 4X-5.7X PCAV approx. 1,200-2,000 rpm
	: 10.3X-24X CAV approx. 5,100 rpm

(4) Transfer Rate

(1 KByte=2^{10} Byte=1,024 Bytes, 1 Mbyte=2^{20} Byte=1,048,576 Bytes)

Sustained Block Transfer Rate

DVD (Single layer)	: 3.3X-8X CAV 2,230-5,408 Block/s
DVD (Dual layer)	: 2.5X-6X CAV 1,690-4,056 Block/s
DVD-VIDEO (CSS Disc)	: 1.6X-2.4X PCAV 1,082-1,622 Block/s
CD	: 4X-5.7X PCAV 300-427.5 Block/s
	: 10.3X-24X CAV 775.9-1,800 Block/s

Sustained Data Transfer Rate

DVD (Single layer)	: 3.3X-8X CAV 4,463-10,820 KByte/s
DVD (Dual layer)	: 2.5X-6X CAV 3,380-8,112 KByte/s
DVD-VIDEO (CSS Disc)	: 1.6X-2.4X PCAV 2,163-3,245 KByte/s
CD	: (Mode 1) 4X-5.7X PCAV 600-855 KByte/s
	10.3X-24X CAV 1,552-3,600 KByte/s
	: (Mode 2) 4X-5.7X PACV 684.4-975.3 KByte/s
	10.3X-24X CAV 1,769-4,104 KByte/s

Burst host transfer Rate

16.7 MByte/s (PIO Mode 4)
16.7 MByte/s (Multi word DMA transfer mode-2)
33.3 MByte/s (Ultra DMA transfer mode-2)

(5) Access Time

Average Random Access Time	DVD:*3	100 ms Typ
	CD:*4	95 ms Typ (10.3X-24X)
Average Random Seek Time	DVD:*5	95 ms Typ
	CD:*6	90 ms Typ (10.3X-24X)
Average Full Stroke Access Time	DVD:*7	160 ms Typ
	CD:*8	160 ms Typ (10.3X-24X)

(6) Spin up Time (Focus Search Time and Disc Motor Start up Time)

DVD:	2.0 s Typ
CD:	1.5 s Typ (10.3X-24X)

(7) Data Buffer Capacity 128 KByte

*1: All discs written in CD or DVD formats except CD-Audio disc, require additional specific application software and/or hardware.
This drive referred in the specification is capable of reading these data formats. However, in order to run applications that use these formats you must first have the required software and/or hardware.

*2: 4X-5.7X rotational speed is fixed for CD-Audio, Video-CD and CD-RW Format. For the other Formats, 10.3-24X speed is applied.

*3: Measured by performing multiple accesses which means reads of data blocks over whole area of the media from 0 (h) block to 1E7725(h) (4.089 Billion Byte:87 % of total area) block more than 3000 times. Includes positioning, setting, latency time and ECC implementation time (if required).

*4: Measured by performing multiple accesses which means reads of data blocks over whole area of the media from 00 min 02 sec 00 block to 60 min 01 sec 74 block (552.96 Million Byte:87 % of total area at linear velocity of 1.3 m/s) more than 3000 times. Includes positioning, setting, latency time and ECC implementation time (if required).

*5: Measured by performing multiple seek which means seeks of data block over whole area of the media from 0(h) block to 1E7725(h) block more than 3000 times.
Includes positioning, setting time which is same definition as HDD.

*6: Measured by performing multiple seek which means seeks of data block over whole area of the media from 00 min 02 sec 00 block to 60 min 01 sec 74 block more than 3000 times. Includes positioning, setting time which is same definition as HDD.

*7: Measured by performing maximum accesses which means reads of each data block of 0 (h)block and 1E7725(h) block alternately more than 100 times.
Includes positioning, setting, latency time and ECC implementation time (if required)

*8: Measured by performing maximum accesses which means reads of each data block of 00 min 02 sec 00 block and 60 min 01 sec 74 block alternately more than 100 times.
Includes positioning, setting, latency time and ECC implementation time (if required)

(8) Load/Release	Load:	Manual
	Release	(a) Electrical Release (Release Button)
		(b) Release by ATAPI command
		(c) Emergency Release
(9) Air Flow		Not Required
(10) Acoustic Noise		40 dB (IEC 179 A -Weighted at 1 m)
(11) Power Supply		+5 V (details in Section 7)

3.2. Environmental Conditions

This drive should be used under the conditions listed below.

3.2.1.Temperature and Humidity

(1) Operating Temperature	5 °C to 50 °C
(2) Storage Temperature	-20 °C to 65°C
(3) Shipping Temperature	-40 °C to 65 °C
(4) Operating Temperature Gradient	11 °C/hour (max)
(5) Storage Temperature Gradient	20 °C/hour (max)
(6) Shipping Temperature Gradient	20 °C/hour (max)
(7) Operating Humidity	8 % to 80 % (wet bulb 27 °C max)
(8) Storage Humidity	5 % to 95 %
(9) Shipping Humidity	5 % to 95 %
(10) Condensation	In all the above conditions there must be no condensation

3.2.2.Vibration

(1) Operating (1 Oct/min) ---------- no hard error -----
5 to 500 Hz 2.45 m/s^2 [0.25 G] (0-p)
(excluding resonance point)

(2) Non-operating (1 Oct/min) --------- no damage -----
5 to 10 Hz 5 mm (p-p)
10 to 500 Hz 9.8 m/s^2 [1 G] (0-p)

(3) Shipping (Packaged) (1 Oct/min) ----- no damage -----
10 to 25 Hz 9.8 m/s^2 [1 G] (0-p) X Y Z/30 min each

3.2.3.Atmospheric Pressure and Altitude

(1) Operating	0 to 3,000 m
(2) Shipping	0 to 12,000 m

3.2.4.Shock

(1) Operating (DVD 3.3X-8X/CD 10.3X-24X) ------- no hard error -----
14.7 m/s^2 [1.5 G] (Horizontal)
(Half sine wave 11 ms/10s interval)

---------- no data loss -----
98 m/s^2 [10 G]
(Half sine wave 11 ms/10s interval)

(2) Non-operating (with no disc mounted) ----- no damage -----
490 m/s^2 [50 G] (Half sine wave 11 ms)

(3) Drop (Packaged) ---------- no damage -----

(a) Bulk Package (50 pcs)	1 drop at 0.4 m (Bottom side only)
(b) Bulk Package (20 pcs)	0.6 m drops once for each 6-surface, 1-edge and 1-corner

3.3. Installation Conditions

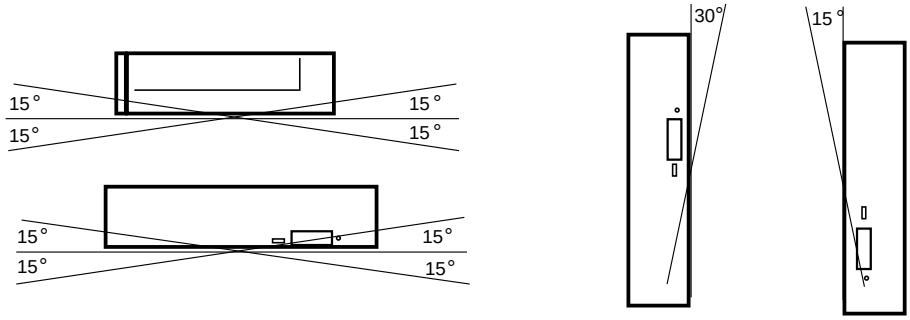


Figure 1 Mounting angle

3.3.1. Equipment

(1) When mounting the equipment, use four M2-P0.4 tapping holes located on the left and right sides of the equipment.

(2) The opposite surface of the bearing surface (fitting surface when mounting) of the tapping holes must be kept flat so that the bearing surface can be fit evenly.

(3) Use the mounting screws which do not enter deeply inside the equipment more than specified value.

(4) When mounting the equipment, the tightening torque of four screws must be even. The recommended screw tightening torque is 0.2 Nm.

3.3.2.Installation

(1) The mounting surface of the equipment must keep good flatness. When mounting, care should be paid that an excessive force which may caused torsional distortion on the equipment does not apply to the equipment. The recommended surface flatness for the mounting surface should be less than 0.2 mm.

(2) Install the equipment with enough space as much as possible in all directions around the equipment. Care should be paid that the equipment does not touch with peripheral instruments even if vibration, mechanical shock, etc. are applied to the equipment. For the maximum dimension of the equipment thickness (12.9 mm), it is recommended that a clearance more than 0.5 mm should be left the thickness direction. For the clearance around the front bezel, it is recommended that the clearance more than 0.8 mm should be left in all directions.

(3) Care should be especially paid for the heat effect. Keep the air ventilation and isolate from heat of the environmental condition. Then, install the equipment where the environmental temperature at the bottom center of cabinet does not exceed 50 ℃.

(4) Do not add the force beyond the indicated force on the top and bottom cover of the equipment. (The restricted force range for the top cover is shown in the Figure 2.) (For the bottom cover, the applied force should be less than 2N on whole area.)

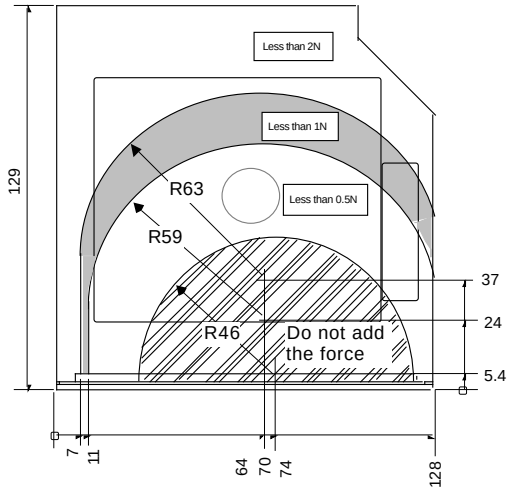
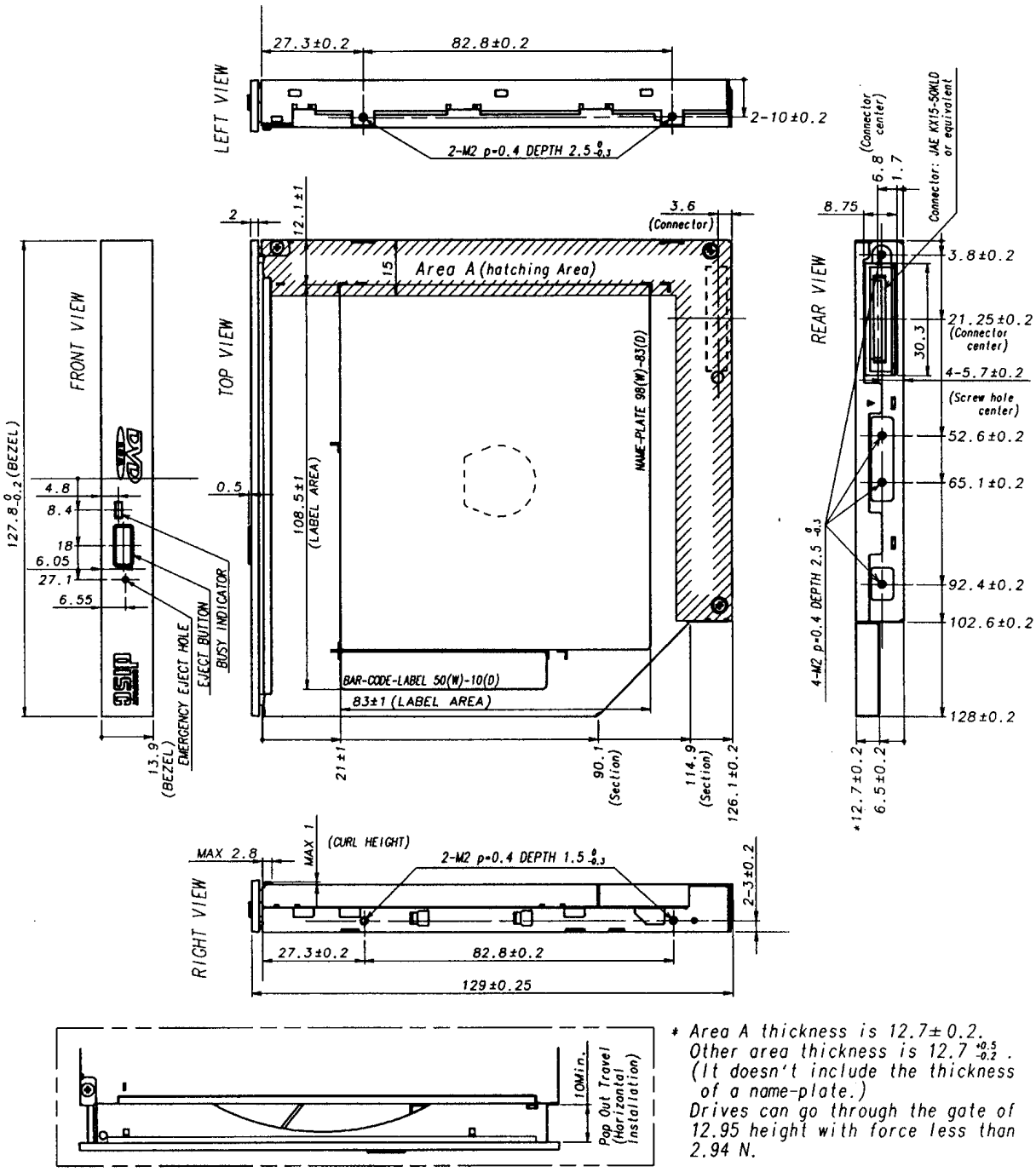


Figure 2 Restricted force range applied for the top cover

(5) The characteristics of EMC (Electro Magnetic Compatibility) are primarily influenced by the mounting method of this equipment. Attach this equipment by considering an appropriate method and structure.

3.4. Dimension and Mass ----- See Figure 3 for details -----

(1) External Dimensions (W x H x D)	128 mm x 12.7 mm x 126.1 mm (excluding bezel)
(2) Mass	0.245 kg (Net) 353 kg (Bulk Packaged 50 pcs) 221 kg (Bulk Packaged 20 pcs)



* Area A thickness is 12.7± 0.2.
Other area thickness is 12.7 +0.5 -0.2 .
(It doesn't include the thickness of a name-plate.)
Drives can go through the gate of 12.95 height with force less than 2.94 N.

Unit: mm

Figure 3 External Dimensions

3.5. Reliabilites

3.5.1. Error Rate

(1) Hard Read Error Rate (Byte Error Rate) -----	Allowing 10 Retries(default) -----	
DVD:	10^{-15} Max	
CD:	Mode 1:10^{-15} Max	
	Mode 2:10^{-12} Max	
(2) Seek Error Rate	10^{-6} Max	
3.5.2. MTBF	60,000 h	
Assumptions: Power On Hours	5,436 h/year	
On/Off Cycles	313 cycles/year	
Number of Access	600,000 accesses/year	
Operating Duty Cycle	20 % of Power On Time (Reading/Seeking)	
3.5.3. MTTR	0.5 h	
3.5.4. Drive Life	15,000 h or 5 years (earlier one)	
(1) Load/Release	10,000 times or more	
(2) Interface connector Attach/Detach	500 times or more	

4. Configuration

See Figure 4 for details of the configurations

4.1. Electrical Circuits

(1) Drawer Release Switch and Release Detection Switch
(2) Optical Pickup Servo Drive Circuit
(3) Feed Motor Drive Circuit
(4) Laser Diode Control Circuit
(5) 8-16 Modulated data Demodulator, Error Correction Circuit and Disc Motor Control Circuit
CSS Authenticator (DVD)
(6) EFM Demodulator, Error Correction Circuit and DA converter Circuit (CD)
(7) IDE/ATAPI Control and CD - ROM Error Correction Circuit
(8) BCA Decoding Circuit

4.2. Optical Pickup	:1-Lens and 2-Laser System Semiconductor Laser and 1-beam System (DVD) Semiconductor Laser and 3-beam System (CD)
4.3. Spindle Motor	Brushless DC Motor
4.4. Feed Motor	DC Motor

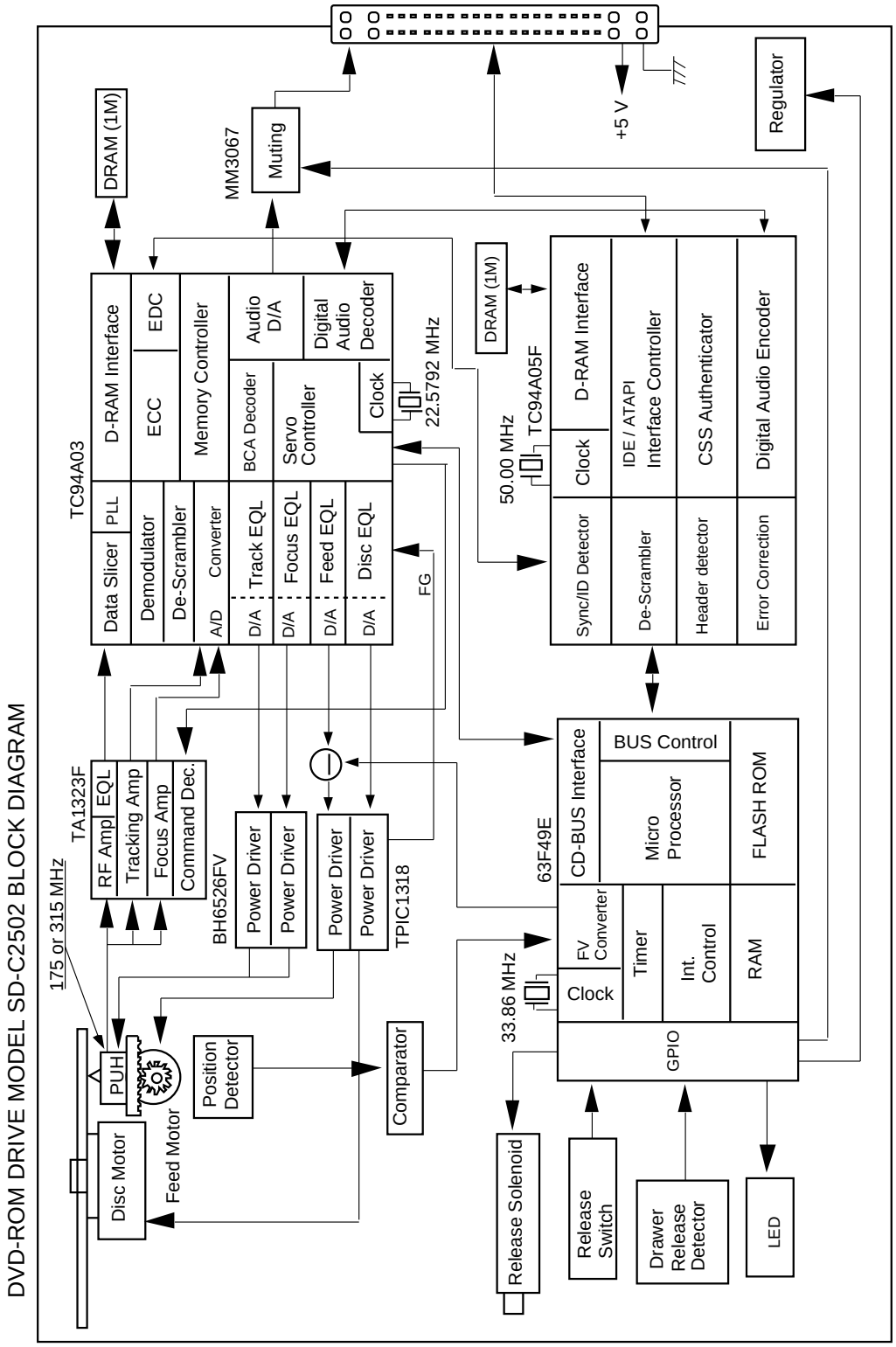


Figure 4 Configuration

5.Functions

5.1. Disc Data Configurations

5.1.1. DVD-ROM Data Configurations

Figure 5 shows how data is constructed in the case of Dual Layer/Parallel Track Path DVD disc. The DVD spec defines the Single Layer, the Dual Layer/Opposite and Parallel Track Path disc, that the DVD-ROM drive supports. For details refer to DVD Book Part 1.

1 block=1/676 s

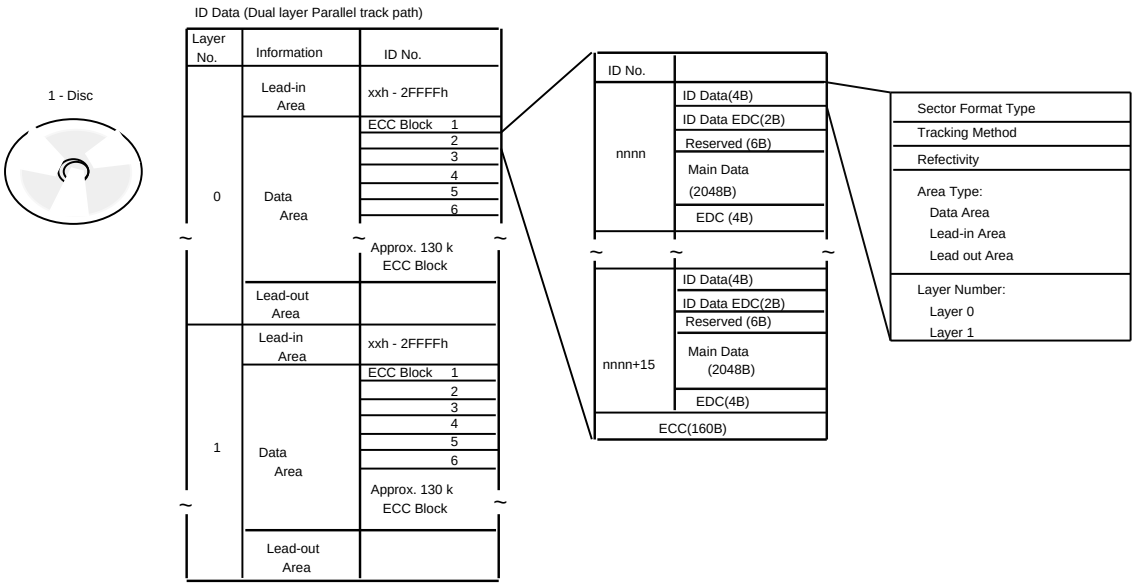


Figure 5 An Example of DVD-ROM Disc Data Configuration (Parallel Track Path)

5.1.2. CD-ROM Data Configurations

Figure 6 shows how the data is structured in program units

1 block=1/75 s

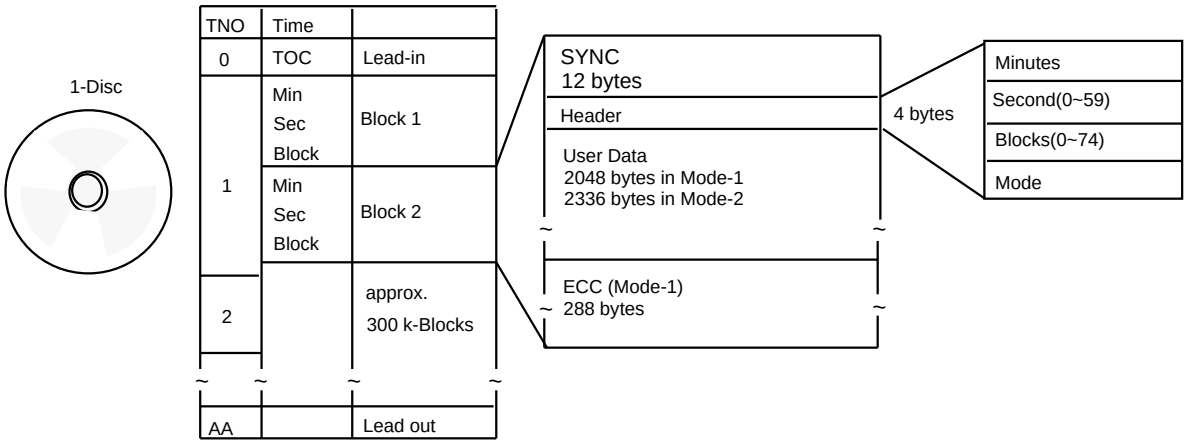


Figure 6 CD-ROM Disc Data Configuration

5.2. Power ON/OFF Timing

Figure 7 shows the initialization sequence

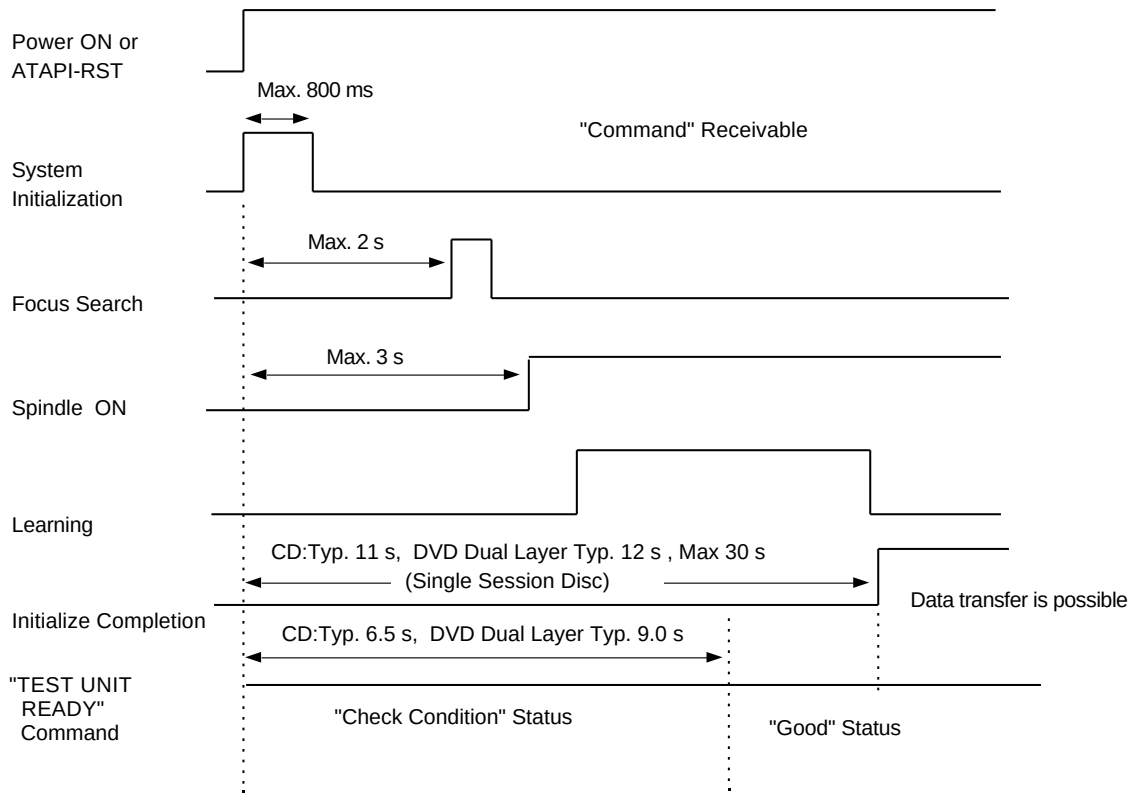


Figure 7 Initialization Sequence

6. Interface

(1) The interface is based on X3T10/2008D (Information Technology - Attachment - 3 Inter face) Revision 6 (dated Oct. 26,1995) , SFF-8020i (Small Form Factor Committee Specification of ATA-Packet Interface for CD-ROMs) Revision2.6, (Nov. 27, 1995) SFF-8090 Version 3 Revision 1.00 (Feb. 10,1999) and T13/1321D Revision 3 (Ultra DMA -- a Proposal for a New Protocol in ATA/ATAPI-4) (Feb.29,2000).

(2) 56 (ATAPI, ATA) commands are usable.

(3) The 128 kByte data buffer handles both high speed and low speed data transmission.

(4) The largest block size on playback is 2,647 Bytes.
The data length for each block is changeable by command.

6.1. I/O Cable

Table1 shows the cable parameters.

	Min	Max
Cable length		0.46 m
Driver IoL sink current for 5 V operation	12 mA	
Driver IoL sink current for 3.5 V operation	8 mA	
Driver IoH sink current		-400 μA
Driver capacitive loading		25 pF

Table 1 Cable parameters

6.2.Signal Summary

The physical interface consists of single ended TTL compatible receivers and drivers communicating through a 50P-connector as shown in Figure 12 and Figure 13 "Interface connector".

6.2.1. Signal Specification

Figure 8 shows the Signal Specifications

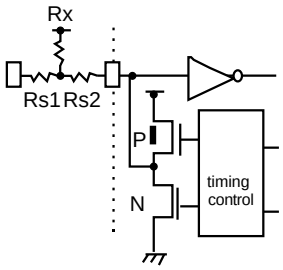
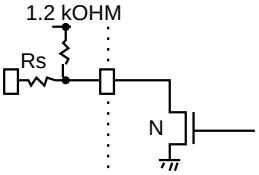
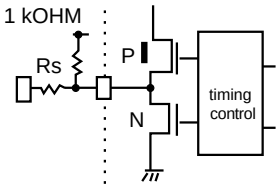
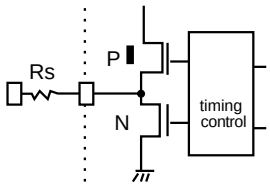
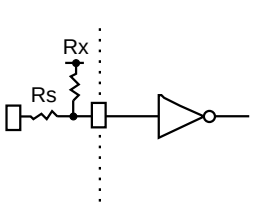
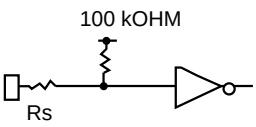
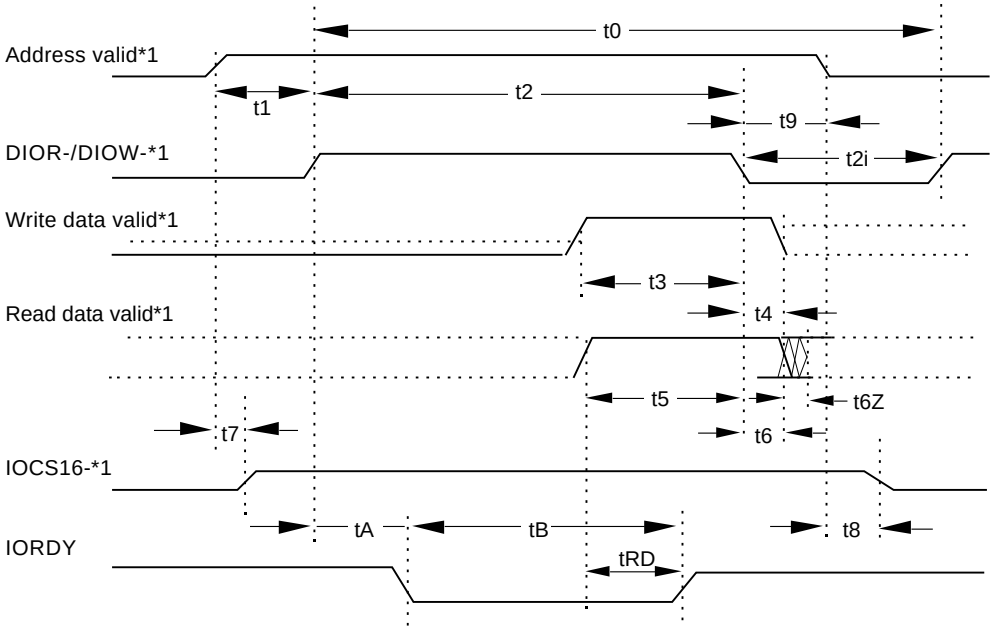
Sig. Name	Type	Receivers/Drivers Caracteristics withoutExternal pullup Resistor					NOTE
				Min	Max	Condition	
HD0 - HD15 /DASP /PDIAG		VOH	Voltage Output High	Vdd-0.4 V		IOH=1 mA	Bidirectional Rx=Infinity Rs1=0 OHM Rs2=33 OHM HD0-HD15 Rx=10 kOHM Rs1=0 OHM Rs2=0 OHM /PDIAG, /DASP
		VOL	Voltage Output Low		0.4 V	IOL=12 mA	
		VIH	Input HIGH Voltage	2.0 V		TTL	
		VIL	Input LOW Voltage		0.8 V	TTL	
		ILI	Input leakage Current	-30 µA	-150 µA	Pullup Resistor(Ri)	
		IOL	Driver sink current	12 mA			
		ILO	Output Leakage Current	-30 µA	-150 µA	Pullup Resistor(Ri)	
		CI	Input Capacitance		8 pF		
		CO	Output Capacitance		8 pF		
/IOCS16		VOL	Voltage Output Low		0.4 V	IOL=24 mA	Open Drain Rs=0 OHM
		IOL	Driver sink current	24 mA			
		ILO	Output Leakage Current	-30 µA	-150 µA	Pullup Resistor(Ri)	
		CO	Output Capacitance		8 pF		
IORDY		VOH	Voltage Output High	2.4 V		IOH=400 µA	Rs=22 OHM
		VOL	Voltage Output Low		0.4 V	IOL=24 mA	
		IOL	Driver sink current	24 mA			
		ILO	Output Leakage Current	-10 µA	10 µA		
		CO	Output Capacitance		8 pF		
HDRQ INTRQ		VOH	Voltage Output High	Vdd-0.4 V		IOH=400 µA	Rs=22 OHM INTRQ HDRQ
		VOL	Voltage Output Low		0.4 V	IOL=12 mA	
		IOL	Driver sink current	12 mA			
		ILO	Output Leakage Current	-10 µA	10 µA		
		CO	Output Capacitance		8 pF		
/HWR /HRD HA0 - HA2 /HCS1/HCS3 /HDAK		VIH	Input HIGH Voltage	2.0 V		TTL	Rx=Infinity Rs=82 OHM /HWR Rx=Infinity Rs=120 OHM /HRD Rx=Infinity Rs=82 OHM /HA0-2, /HDAK Rx=10 kOHM Rs=82 OHM /HCS1, /HCS3
		VIL	Input LOW Voltage		0.8 V	TTL	
		ILI	Input leakage Current	-30 µA	-150 µA	Pullup Resistor(Ri)	
		CI	Input Capacitance		8 pF		
/RESET /Vender Unique (49 PIN)		VIH	Input HIGH Voltage	3.5 V			/RESET Rs=82 OHM /Vender Unique 49 PIN Rs=1 kOHM
		VIL	Input LOW Voltage		1.5 V		
		ILI	Input leakage Current	-30 µA	-150 µA	Pullup Resistor(Ri)	
		CI	Input Capacitance		8 pF		

Figure 8 Signal Specifications

6.2.2.Timing of Host Interface (PIO)

Figure 9 shows the Host Interface Timings



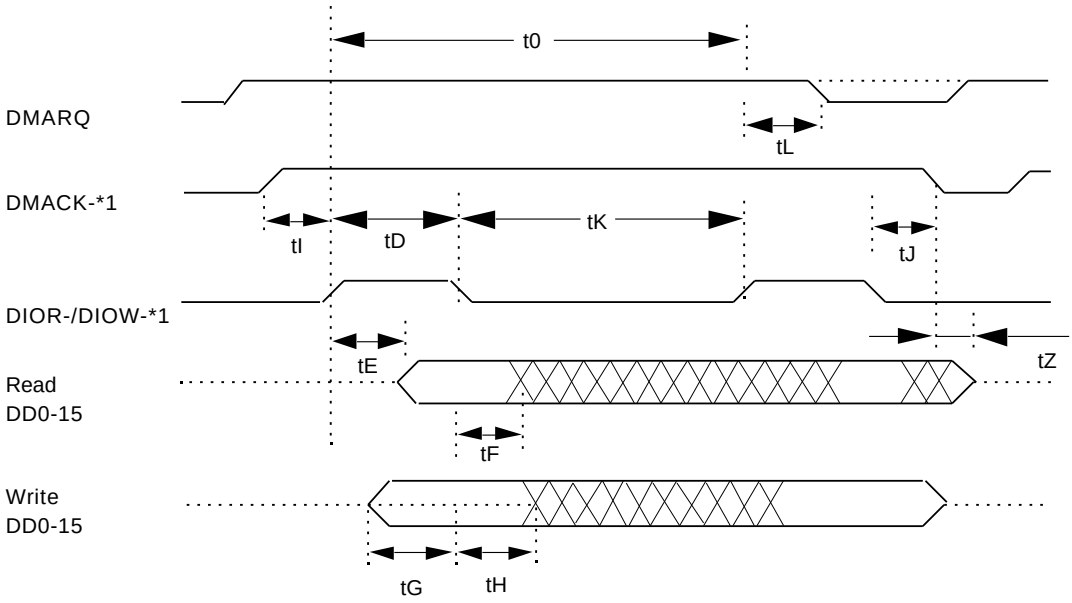
*1: In all timing diagrams, the low line indicator negated, and the upper line indicators asserted.

	PIO timing parameters min (ns) max (ns)	Min Time (ns)	Max Time (ns)
t0	Cycle time	120	
t1	Address valid to DIOR/DIOW-setup	25	
t2	DIOR/DIOW-pulse wide	70	
t2i	DIOR/DIOW-recovery time	25	
t3	DIOW-data setup	20	
t4	DIOW-data hold	10	
t5	DIOR-data setup	20	
t6	DIOR-data hold	5	
t6Z	DIOR-data tristate		30
t7	Addr valid to IOCS 16-assertion		30
t8	Addr valid to IOCS 16-negation		30
t9	DIOR/DIOW-to address valid hold	10	
tRD	Read Data Valid to IORDY active	0	
tA	IORDY setup		35
tB	IORDY pulse wide		1250

Figure 9 Host Interface Timing (PIO Mode4)

6.2.3.Timing of Host Interface (Multi DMA)

Figure 10 shows the Host Interface DMA multi word Timings



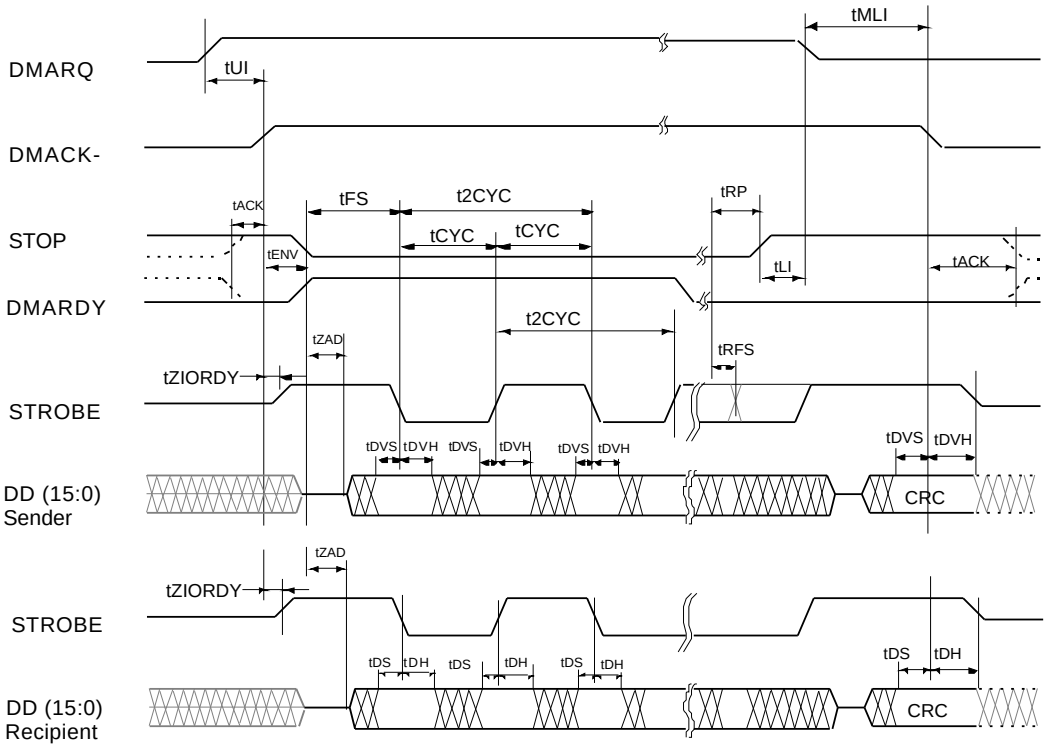
*1: In all timing diagrams, the low line indicator negated, and the upper line indicators asserted.

	Multi word DMA timing parameters min(ns) max(ns)	Min time (ns)	Max time (ns)
t0	Cycle time	120	
tC	DMACK to DMREQ delay		---
tD	DIOR-/DIOW-16-bit	70	
tE	DIOR- data access		---
tF	DIOR- data hold	5	
tZ	DMACK- to tristate		25
tG	DIOR/DIOW- data setup	20	
tH	DIOW- data hold	10	
tI	DMACK to DIOR-/DIOW- setup	0	
tJ	DIOR-/DIOW- to DMACK hold	5	
tKr	DIOR- negated pulse width	25	
tKw	DIOW- negated pulse width	25	
tLr	DIOR- to DMREQ delay		35
tLw	DIOR- to DMREQ delay		35

Figure 10 Host Interface Timing (Multi Word DMA Mode 2)

6.2.4.Timing of Host Interface (Ultra DMA)

Figure 11 shows the Host Interface Ultra DMA word Timings



In all timing diagrams, the low line indicator negated, and the upper line indicators asserted.

	Ultra DMA Mode 2 Timing parameters min (ns) max (ns)	Min time (ns)	Max time (ns)
t2CYC	Typical Sustained Average Cycle time	120	
	Two cycle time (from rising edge to next rising edge of from falling edge to next falling edge of STROBE)	117	
tCYC	Cycle time allowing	55	
tDVS	Data valid Setup time	34	
tDVH	Data valid Hold time	6	
tUI	Unlimited Interlock time	0	
tACK	Setup and Hold Time for DMACK-	20	
tENV	Envelope time	20	70
tZAD	Minimum Delay time for Driver	0	
tZIORDY	Minimum time for DMACK-	20	
tFS	First STROBE time	0	170
tRFS	Ready-to-Final STROBE time		50
tRP	Ready-to-Pause time	100	
tLI	Limited Interlock time	0	150
tMLI	Interlock with minmum	20	
tDS	Data setup time (at recipient)	7	
tDH	Data hold time (at recipient)	5	

Figure 11 Host Interface Timing (Ultra DMA Mode 2)

6.3. Connector

Figure 12 shows the connector and Figure 13 shows the interface pin assignments
Use Japan Aviation Electronics Industry Limited KX15-50KLD L or equivalent.
Conformable connector is Japan Aviation Electronics Industry Limited KX14-50 series.

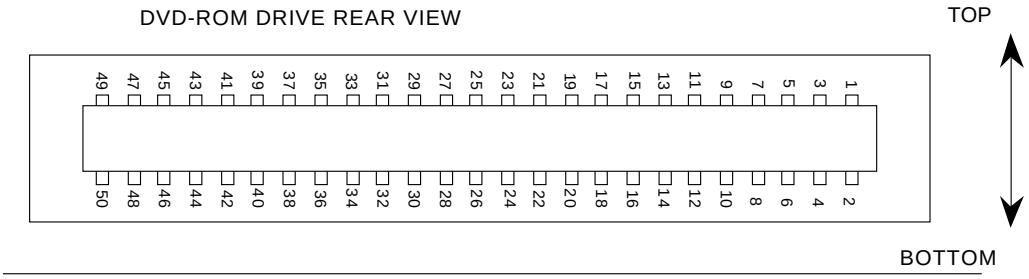


Figure 12 Connector pin assignments

Signal name	I/O	Connector contact		I/O	Signal name
Audio L-CH	O	1	2	O	Audio R-CH
Audio Ground		3	4		Ground
/RESET	I	5	6	I/O	DD8
DD7	I/O	7	8	I/O	DD9
DD6	I/O	9	10	I/O	DD10
DD5	I/O	11	12	I/O	DD11
DD4	I/O	13	14	I/O	DD12
DD3	I/O	15	16	I/O	DD13
DD2	I/O	17	18	I/O	DD14
DD1	I/O	19	20	I/O	DD15
DD0	I/O	21	22	O	DMARQ
Ground		23	24	I	/DIOR: /HDMARDT: HSTROBE
/DIOW :STOP	I	25	26		Ground
IORDY: /DDMARDY: DSTROBE	O	27	28	I	/DMACK
INTRQ	O	29	30	O	/IOCS16
DA1	I	31	32	I/O	/PDIAG
DA0	I	33	34	I	DA2
/CS1FX	I	35	36	I	/CS3FX
/DASP	I/O	37	38	I	+5 V(Motor)
+5 V(Motor)	I	39	40	I	+5 V(Motor)
+5 V(Logic)	I	41	42	I	+5 V(Logic)
Ground		43	44		Ground
Ground		45	46		Ground
CSEL	I	47	48		Ground
Vender unique*	I	49	50	I	Vender unique*

A slash character(/) at the beginning of a signal name indicates it is asserted at the low level (active low).

*Vender unique: Don't Connect (50 PIN)

*Vender unique: Low power mode (active low 49 PIN)

Figure 13 Signal assignments

6.4. Support Command List

ATAPI Packet Command for DVD-ROM Devices

No	OP Code	Command Description
1	00h	Test Unit Ready
2	01h	Rezero
3	03h	Request Sense
4	12h	Inquiry
5	1Bh	Start Stop Unit
6	1Ch	Receive Diagnostics Results
7	1Dh	Send Diagnostic
8	1Eh	Prevent / Allow Medium Removal
9	23h	Read Format Capacities
10	25h	Read C / DVD Capacity
11	28h	Read (10)
12	2Bh	Seek
13	42h	Read Subchannel
14	43h	Read TOC / PMA / ATIP
15	44h	Read Header
16	45h	Play Audio (10)
17	46h	Get Configuration
18	47h	Play Audio MSF
19	49h	Play Audio Track Relative
20	4Ah	Get Event Status Notification
21	4Bh	Pause / Resume
22	4Eh	Stop Play / Scan
23	51h	Read disc Information
24	52h	Read Track / Rzone Information
25	55h	Mode Select (10)
26	5Ah	Mode Sense (10)
27	A2h	Send Event
28	A3h	Send Key
29	A4h	Report Key
30	A5h	Play Audio (12)
31	A7h	Set Read Ahead
32	A8h	Read (12)
33	A9h	Play Audio Track Relative (12)
34	ACh	Get Performance
35	ADh	Read DVD Structure
36	B6h	Set Streaming
37	B9h	Read CD MSF
38	BAh	Scan
39	BBh	Set CD Speed
40	BDh	Mechanism Status
41	BEh	Read CD

ATA Command for ATAPI DVD-ROM Devices

No.	OP Code	Command Description
1	00h	Nop
2	08h	(ATAPI Soft Reset) Device Reset
3	20/21h	Read Sector (s)
4	90h	Execute Device Diagnostics
5	A0h	Packet
6	A1h	Identify Paket Device
7	E0h	Standby Immediate
8	E1h	Idle Immediate
9	E2h	Standby
10	E3h	Idle
11	E3h	Check Power Mode
12	E6h	Sleep
13	E7h	Flush Cache
14	ECh	Identify Device
15	EFh	Set Features

7. Power Requirements

7.1. Source Voltage	+5 V +/- 5 % (Operating) +/- 8 % (Start up)
7.1.1. Spike	100 mV (p-p) Max.
7.1.2. Ripple	100 mV (p-p) Max.
7.2. Current Drain (Typical value)	+5 V
7.2.1.Sleep	25 mA (DVD/CD)
7.2.2.Standby (Laser off, Motor off)	36 mA (DVD/CD)
7.2.3. Continuous Read (Data/Audio)	710 mA (DVD 3.3-8X) 400 mA (CD 4-5.7X) 700 mA (CD 10.3-24X)
7.2.4.Idle (Laser on, Motor on)	400 m A (DVD 3.3-8X) 400 m A (CD)
7.2.5. Average (20% Random Access)	700 mA (DVD 3.3-8X) 700 mA (CD 10.3-24X)
7.2.6. Maximum (100% Random Access)	800 mA (DVD 3.3-8X) 800 mA (CD 10.3-24X)
7.2.7. Peak in executing Access (Exclued Spike Current) *Spike: Less than 1 ms of duration	1,260 mA (DVD/CD)

8.CD Audio (Test condition: Ordinary temperature)

8.1. Analog Out --- in case of the attenuator is set at 0 dB by the command ---

(1) Output Level	0.8 V (rms Typ)+/-1 dB
(2) Type	Unbalanced
(3) Load Impedance	47 kOHM min
(4) Frequency Response	20 Hz to 20 kHz+/-3.0 dB. (at 47 kOHM Load)
(5) Distortion	0.04 % Max. (at 1 kHz w/20 kHz LPF)
(6) Signal to Noise Ratio	80dB Typ (IEC179 A-Weighted)

8.2. Audio Modes

(1) 16 Modes including 'Stereo', 'Lch Mono', 'Rch Mono' and 'Mute' are selectable by command. Default mode is 'Stereo'.

(2) 16 Steps of attenuation level for the Audio Output is selectable by command. Default level is 0 dB.

9. Device Configuration Jumper

9.1. Master Mode Setting

Short-circuit the PIN 47 and PIN 48 of I/O connectors.

9.2.Slave Mode Setting

Open the PIN 47 of I/O connectors.

(Optional)

9.1. Master Mode Setting

Open the PIN 47 of I/O connectors.

9.2. Slave Mode Setting

Short-circuit the PIN 47 and PIN 48 of I/O connectors.

10. Busy Indicator

The LED at Front Bezel (Busy Indicator) indicates the drive status.

Color: AMBER

(1) After Drawer is closed, Busy Indicator start blinking at 0.8 s intervals, and then -----

(1-1) Turns off when the drive in the 'Idle' and 'Stand by' status.

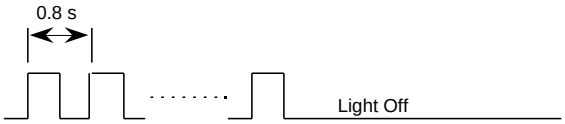


Figure 14 Idle, Stabd by

(1-2) Continuously off when no disc is mounted.

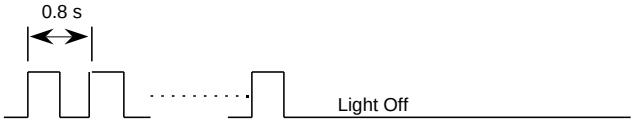


Figure 15 No disc

(1-4) Continuously on when media has problem

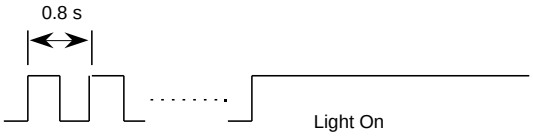
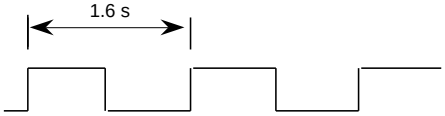


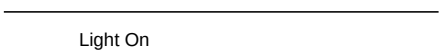
Figure 16 Media Problem

(2) When playing an audio track, Busy Indicator is blinking at 1.6 s intervals.



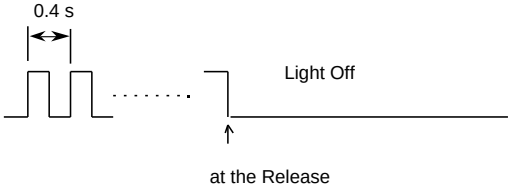
Figurer 17 CD-Audio playback

(3) When performing 'Data Access' and during 'Data Transfer' Busy Indicator keeps turn On.



Figurer18 Data Access and Data Transfer

(4) When pushing Release button, Busy indicator is blinking at 0.4 s intervals.



Figurer 19 Release

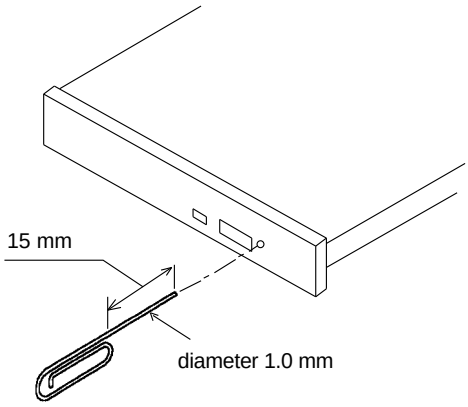
11.Emergency Release

Execute following procedure only in the case of emergency (Drawer will not release and disc can not be removed although pressing Release Button).

(1) Turn the drive supplying power off.

(2) Insert solid bar (like paper clip) into Emergency Release hole and push as shown in Fig.20. Then Drawer will be released.

(3) After removed the disc, gently push Drawer to close.



Figurer 20 Insert the bar

12.Safety Standards/Agency Approvals

(1) Safety	EN60950	
	UL 1950	
	CAN/CSA-22.2 No.950	
(2) Laser	FDA 21CFR, EN60825-1	
(3) CE	EN50081-1	: 1992 [Residential, commercial & light industry]
	EN55022	: 1998 [Class B] (including domestic environment)
	EN50082-1	: 1997 [Residential, commercial & light industry]
	EN61000-4-2+A1	: 1995+1998 [CD:4 kV, ID: 4 kV, AD:8 kV]
	EN61000-4-3	: 1996 [3 V/m, 80-1000 MHz, 1 kHz 80 % AM]
	ENV50204	: 1995 [3 V/m, 900 MHz 200 Hz 50 % PM]
	EN61000-4-4	: 1995 [AC-line: 1 kV, I/F 0.5 kV f: 5 kHz, Polarity: +/-]
	EN61000-4-5	: 1995 [AC-line: 2 kV/1 kV, Polarity: +/-]
	EN61000-4-6	: 1996 [3 V, 0.15-80 MHz, 80 % AM]
	EN61000-4-8	: 1993 [1 A/m, 50 Hz]
	EN61000-4-11	: 1994 [>95 % 0.5, 30% 25, >95 250]
(4) EMI	No. 13237 (KOREAN EMC)	
	CNS 13438 (TAIWAN EMI)	

13. Electrostatic Discharge

Standard	IEC801-2
(1) Operating	8 kV or less
(2) Damage including	15 kV or more

14. Accessories

None

15. Packaging

(1) 50 units in a bulk package	24 bulk packs on one pallet. * All transportation is allowed with pallet. (Transportation with bulk package is not allowed.)
(2) 20 units in a bulk package	36 bulk packs on one pallet. (Transportation with bulk package is allowed.)
(3) 1 unit in a bulk package	(Transporttation with bulk package is allowed.)

16. CE Declaration of conformity

Please refer to attached Annex 1.

TOSHIBA **TOSHIBA EUROPE GMBH**

EU-Declaration of Conformity

Product:	DVD-ROM Drive
Manufacturer(s):	Toshiba Corporation 1-1, Shibaura 1-chome, Minato-ku, Tokyo 105-8001 Japan See page 2 for other locations
Model:	SD-C2502
Options:	None

Toshiba declares that the above mentioned product(s) with or without the listed options comply to the EU-Directives and standards as listed on page 2.

Last two digits of the year in which the CE mark affixed : 00

Responsible for CE-marking:	Toshiba Europe GmbH
Signed by:	Mr. F.Yamashita, President of Toshiba Europe GmbH
Place:	D-41460 Neuss
Date:	May 31, 2000
Signature:	----------

This declaration certifies compliance with the listed directives, but does not constitute an assurance of characteristics.
The safety information in the supplied product documentation must be observed.

Document No.:	**YEA-R2091**	**Page: 1 of 2**
[History if issue]	Issued : May 19, 2000	
	Revision A :	Ref.:
	Revision B :	Ref.:
	Revision C :	Ref.:
	Revision D :	Ref.:

TOSHIBA EUPOPE GMBH
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GESCHAFTSUHRER
HISATSUGU NONAKA
HRB 3479 AMTSGERICHT NESS

Annex 1

EU-Declaration of Conformity

ED-Directive	Related Standard		Issude	Level/Test condition
899/336/EEC (EMC Directive)	EMC-emission:	EN50081-1	1992	Residential, commercial & light industry
		EN55022	1998	Class B (including domestic environment)
	EMC-immunity	EN50082-1	1997	Residential, commercial & light industry
		EN61000-4-2+A1	1995 +1998	CD: 4 kV, ID: 4 kV, AD: 8 kV
		EN61000-4-3	1996	3 V/m, 80-1000 MHz, 1 kHz 80 % AM
		ENV50204	1995	3 V/m, 900 MHz 200 Hz 50 % PM
		EN61000-4-4	1995	AC-line: 1 kV, I/F 0.5 kV f: 5 kHz, Polarity: +/-
		EN61000-4-5	1995	AC-line: 2 kV/1 kV, Polarity: +/-
		EN61000-4-6	1996	3 V, 0.15-80 MHz, 80 % AM
		EN61000-4-8	1993	1 A/m, 50 Hz
		EN61000-4-11	1994	>95 % 0.5, 30% 25, >95 250

Product/Options	Model	Related EU-Directive 89/336/EEC	
DVD-ROM Drive	SD-C2502	X	

Manufactuer(s) Location	Address
Toshiba Multi Media Devices Co, Ltd	19 Minase, Fukihata Goshogawara-shi, Aomori 037-0003 Japan
Toshiba Misawa Media Devices Co, Ltd	3-31-2779, Minami-cho, Misawa-shi, Aomori-ken 033-0036 Japan
EMS Corp.	4-5 Shoubu, Ubayachi Goshogawara-shi, Aomori 037-0015 Japan
Hokuto Communication Industrial Co., Ltd.	207 Aza Koamon, Rokugo, Rokugo-machi, Senboku-gun, Akita 019-1404 Japan
Tsugaru Technica Co., Ltd.	81-87 Iwai, Aiuchi, Shiura-machi, Kitatsugaru-gun, Aomori, 037-0401 Japan
Emusu Itayanagi Co., Ltd.	13-10, Matsumoto, Tsuji, Itayanagi, Kita-Tyugaru-gun, Aomori, 038-3645 Japan
Toshiba Information Equipment (Philippines) Inc	103 East Main Avenue Extension, Special Export Processing Zone, Laguna Technopark, Binan, Laguna Philippines
Integrated Microelectronic Inc.	North Science Avenue Laguna Techno Park Inc. Binan, Laguna Philippines
EMS Kizukuri Corp.	1-2 Aza-Miyazaki, Kizukuri-machi, Nishi-Tugaru-gun Aomori 038-3157 Japan
EMS Fukaura Co., Ltd	24-1 Aza Azumazawa, Ohaza Fukaura, Fukaura-machi, Nishi-Tsugaru-gun, Aomori, 037-0401 Japan

Deviation List

Page	Item	Rev # 0.7	Rev # 1.0
1	1. Introduction	This drive is a new..... as TBD ms(DVD)/TBD ms(CD)	This drive is a new..... as 95 ms(DVD)/90 ms(CD)
3	2. Features	(2) Fast TBD ms (DVD)/TBD ms (CD)	(2) Fast 100 ms (DVD)/95 ms (CD)
		(3) Fast TBD ms (DVD)/TBD ms (CD)	(3) Fast 95 ms (DVD)/90 ms (CD)
		(9) Windows PC99 Spec Compliant	(9) PC2001 Spec Compliant
		(24) Low Power Consumption	
		Averag :TBD W (DVD)/ TBD W (CD)	Averag :3.5 W (DVD)/ 3.5 W (CD)
		Max : TBD W (DVD)/ TBD W (CD)	Max : 4.0 W (DVD)/ 4.0 W (CD)
		Stand-by : TBD W	Stand-by : 0.18 W
5	(5) Access Time		
	Average Random Access Time	DVD: TBD ms Typ	DVD: 100 ms Typ
		CD: TBD ms Typ	CD: 95 ms Typ
	Average Random Seek Time	DVD: TBD ms Typ	DVD: 95 ms Typ
		CD: TBD ms Typ	CD: 90 ms Typ
	Average Full Stroke Access Time	DVD: TBD ms Typ	DVD: 160 ms Typ
		CD: TBD ms Typ	CD: 160 ms Typ
	(6) Spin up Time	DVD: TBD s Typ	DVD: 2.0 s Typ
		CD: TBD s Typ	CD: 1.5 s Typ
9	Figure 2	TBD	Less Than 2N Less Than 1N Less Than 0.5N
	3.4. Dimension and Mass		
	(2) Mass	TBD kg (Net)	0.245 kg (Net)
		TBD kg (Bulk Packaged 50 pcs)	353 kg (Bulk Packaged 50 pcs)
		TBD kg (Bulk Packaged 20 pcs)	221 kg (Bulk Packaged 20 pcs)
9	Figure 3	-----	All of change
10	3.5.1. Error Rate		
	(1) Hard Read Error Rate	Allowing 5 Retries(default)	Allowing 10 Retries(default)
	(2) Seek Error Rate	Allowing 10 Retries(default)	Delete
13	Figure 7	Stand by	Initialize completion
	Initialize completion	CD:Typ. 11 s,..... Max 18 s	CD:Typ. 11 s,..... Max 30 s
	6. Interface	(1) The interface is.....and X3T13/D96153 Revision 4 (Ultra DMA -- a Proposal for a New Protocol in ATA/ATAPI-4) (Mar.18,1997).	(1) The interface is.....and T13/1321D Revision 3 (Ultra DMA -- a Proposal for a New Protocol in ATA/ATAPI-4) (Feb.29,2000).

Page	Item	Rev # 0.7		Rev # 1.0	
20	ATA Command for ATAPI DVD-ROM Devices				
	No.	OP Code	Command Description	OP Cod	Command Description
	2	08h	ATAPI Soft Reset	08h	(ATAPI Soft Reset) Device Reset
	4	90h	Execute Drive Diagnostics	90h	Execute Device Diagnostics
	5	A0h	ATAPI Packet Command	A0h	Packet
	6	A1h	ATAPI Identify Device	A1h	Identify Paket Device
	13	ECh	ATA Identify Device	E7h	Flush Cache
	14	EFh	Set Features	ECh	Identify Device
	15			EFh	Set Features
	7.2. Current Drain				
	7.2.1.Sleep	TBD mA (DVD/CD)		25 mA (DVD/CD)	
	7.2.2.Standby	TBD mA (DVD/CD)		36 mA (DVD/CD)	
	7.2.3. Continuous	TBD mA (DVD 3.3-8X)		710 mA (DVD 3.3-8X)	
		TBD mA (CD 4-5.7X)		400 mA (CD 4-5.7X)	
		TBD mA (CD 10.3-24X)		700 mA (CD 10.3-24X)	
	7.2.4.Idle	TBD m A (DVD 3.3-8X)		400 m A (DVD 3.3-8X)	
		TBD m A (CD)		400 m A (CD)	
	7.2.5. Average	TBD mA (DVD 3.3-8X)		700 mA (DVD 3.3-8X)	
		TBD mA (CD 10.3-24X)		700 mA (CD 10.3-24X)	
	7.2.6. Maximum	TBD mA (DVD 3.3-8X)		800 mA (DVD 3.3-8X)	
		TBD mA (CD 10.3-24X)		800 mA (CD 10.3-24X)	
	7.2.7. Peak in executing Access	TBD mA (DVD/CD)		1,260 mA (DVD/CD)	
22	10. Busy Indicator				
	(1-1) Turns off when the drive in the 'Idle' status.			(1-1) Turns off when the drive in the 'Idle' and 'Stand by' status.	
	Figure 14	Idle		Idle, Stabd by	
23	12. Safety standard.....				
	(4) CE	Tentative		Non-Tentative	
24	15. Packaging				
	(2) 20 units in a bulk package	24 bulk packs on one pallet.		36 bulk packs on one pallet.	
25	Annex 1	Tentative		Non-Tentative	
26	EU-Declaration of Conformity	Tentative		Non-Tentative	