

TOSHIBA
STORAGE DEVICE DIVISION

SD-R2002
CD-RW/DVD ROM DRIVE
PRODUCT SPECIFICATION

October 2000
REV. 1.0

Specifications are subject to change without notice

DOCUMENT NUMBER
14508

Warnings:

This equipment (an optical disc drive) handled under the conditions out of equipment specifications may cause heavy load, heat generation, malfunction, erroneous operation and performance degradation. Therefore, please handle this equipment properly in compliance with the warnings provided below. In the event that you do not comply with the warnings, Toshiba cannot guarantee the safety, reliability and performance of the equipment expressly provided in the specification. Manufacturers and resellers of the computer system using this equipment and/or this equipment itself shall notify the end-users of the warnings provided herein and ensure them to comply with these warnings in an appropriate manner.

1. This equipment does not involve any over-current protection circuit. Use an appropriate over-current protection in the computer system which this equipment would be connected. Toshiba shall not be liable for any damages to the system which does not have any over-current protection.
2. **DO NOT** disassemble or modify this equipment. Toshiba shall not make any guarantee to the reliability, safety and performance of this equipment expressly provided in the specification and nor be liable for any damages resulting from such unauthorized disassembly or modification.
3. Read carefully and comply with this Product Specification in order to avoid the risk of data error in writing operation. Such possible data error would be made by any factors other than this equipment (i.e., poor storage media, misuse of this equipment, malfunction in a computer system connecting this equipment, etc.). Toshiba shall not be liable for any damages resulting from such data loss. Check whether the original data is correctly copied or stored upon completion of writing operation.
Take any necessary measures to protect your data such as system backup and/or mirroring disk subsystems in order to avoid the risk of unexpected data loss or data corruption resulting from failure in this equipment for some reasons.

Manufacturers and resellers of the computer system using this equipment shall be required to consider the safety of such computer system and data integrity in order to avoid the risk of any consequential damages caused by data loss or data corruption and any problems or accident caused by malfunction of the computer system.

DO NOT use this equipment in the system such as medical equipment which may cause personal injury or property damages resulting from malfunction of this equipment and unexpected data corruption or data error in reading operation.

4. Turn off the power for this equipment and wait more than one (1) minute before you eject the disc using the emergency eject mechanism when a disc cannot be ejected for some reasons in order to avoid the risk of damages to the disc.

Notice

1. Turn off the system power before mounting/removing this equipment in order to avoid the risk of damages to this equipment.
2. Insert the DC power plug in correct direction in order to avoid the risk of damages to this equipment.
3. Handle this equipment only in electrostatically safe environment and **do not** touch connecting terminals with empty hands when you build in or pull out this equipment from other product in order to avoid the risk of malfunction of this equipment.

4. **DO NOT** do any of the following:

- 4.1. **DO NOT** use storage media (CD's / DVD's) that are not the correct size or shape, or do not meet the minimum formatting requirements set forth in section 3.1.(1) of this Product Specification.
- 4.2. **DO NOT** insert more than one (1) CD or DVD disc into the drive at any time. Doing so will damage or destroy this equipment and could damage or destroy the disc or cause data loss or corruption.
- 4.3. **DO NOT** load or eject any CD or DVD disc with force. Doing so will damage or destroy this equipment and could damage or destroy the disc or cause data loss or destruction.
- 4.4. **DO NOT** give a strong shock while load or eject operation is in process. Doing so will damage or destroy this equipment and could damage or destroy the disc or cause data loss or corruption.
- 4.5. **DO NOT** eject a CD or DVD disc while the drive is in operation. Doing so will damage or destroy this equipment and could damage or destroy the disc or cause data loss or corruption.
- 4.6. **DO NOT** insert anything else into the drive other than a CD or DVD disc. Doing so will damage or destroy this equipment.

---- **To OEM Customers:** -----

Please notify below notice to your customers.

Notice

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1. Introduction

This document describes TOSHIBA's SD-R2002 CD-RW/DVD-ROM Drive.

2. Features

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

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

This drive read and records the digital data on CD-R and CD-RW 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 stored on DVD-ROM discs at maximum 6 times faster rotational speed.

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

This drive records (write once) digital data on CD-R disc at 2,4 times faster rotational speed.

This drive writes / rewrites digital data on CD-RW disc at 2,4 times faster rotational speed.

This drive writes / rewrites digital data on Hight-Speed CD-RW disc at 4 times faster rotational speed.

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

This drive supports SFF-8020i of ATAPI (ATA Packet Interface) spec. ,SFF-8090 Ver.3 (Mt.Fuji3) of DVD Commands and MMC of CD-R, CD-RW commands.

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

This drive can be used in a vertical position or horizontal position.

This drive adopts RPC-II for its "Standard Specification Model".

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

Matters to be attended to:

This drive adopts RPC Phase II

This CD-RW/DVD-ROM Drive adopts , the Phase II System of RPC (Regional Playback Control) , called Phase II after here, on the basis of a contract with the CSS (Contents Scramble System) organization.

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

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

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

In the Phase 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."

3. Specifications

3.1. Performance

(1) Applicable Write Format CD-R, CD-RW: Disc at once, Track at once, Session at once, Packet write

(2) Applicable Write Disc *1 CD-R, CD-RW: CD-DA, CD+(E)G, CD-MIDI, CD-ROM, CD-ROM XA, MIXED MODE CD, CD-I, CD-I Bridge (Photo-CD, Video-CD) Multisession CD (Photo-CD, CD-EXTRA, Portfolio)

(3) Applicable Read Disc *2

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

(4) 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=2³⁰ Byte, 1 MB=2²⁰ Byte, 1 KB=2¹⁰ 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)

DVD-R : 3.679 GB (3.950 Billion Byte)

CD (Mode-1): 656.5 MB (688.4 Million Byte) *3

CD (Mode-2): 748.8 MB (785.2 Million Byte) *3

(5) Rotational Speed

DVD :	Approx. 3,792 rpm (2.5-6X CAV)
DVD-VIDEO (CSS Disc) :	Approx. 1,377-2,222 rpm (1.6-2.4X PCAV)
CD :	Approx. 5,100 rpm (10.3-24X CAV)
CD-RW, Video-CD, CD-DA :	Approx. 1,200 - 2,000 rpm (4-5.7X PCAV)
CD-R (Write):	Approx. 850 - 1,980 rpm (4X CLV)
	Approx. 420 - 990 rpm (2X CLV)
CD-RW (Write):	Approx. 850 - 1,980 rpm (4X CLV)
	Approx. 420 - 990 rpm (2X CLV)

(6) Transfer Rate

(1 KByte=2¹⁰ Byte=1,024 Bytes, 1 MByte=2²⁰ Byte=1,048,576 Bytes)

Sustained Block Transfer Rate

DVD: 1,690-4,056 Block/s (2.5-6X CAV)
 DVD-VIDEO (CSS Disc) : 1,082-1.622 Block/s (1.6-2.4X PCAV)
 CD : 776-1,800 Block/s (10.3-24X CAV)
 300-428 Block/s (4-5.7X PCAV)

Sustained Data Transfer Rate

DVD : 3,357-8,112 KByte/s (2.5-6X CAV)
 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 Data 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)

(7) Access Time

Average Random Access Time DVD:*4 120 ms Typ
 CD:*5 110 ms Typ (10.3-24X)

Average Random Seek Time DVD:*6 115 ms Typ
 CD:*7 105 ms Typ (10.3-24X)

Average Full Stroke Access Time DVD:*8 180 ms Typ
 CD:*9 170 ms Typ (10.3-24X)

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

DVD: 2.5 s Typ
 CD: 2.0 s Typ (10.3-24X)

(9) Data Buffer Capacity

2 MByte

*1: This drive write the data on the disc of CD-R, CD-RW format. However, in order to run applications that use these formats you must first have the required software and/or hardware.

*2: All disc written in CD or DVD formats, except CD-DA (audio), 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.

*3: Data capacity when recording depends on the condition of the record and decreases from this occasionally.

*4: 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).

*5: Measured by performing multiple accesses which means reads of data blocks over whole area of the media from 00 min 02 sec 00 Frame to 60 min 01 sec 74 Frame (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).

- *6: 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.
- *7: Measured by performing multiple seek which means seeks of data block over whole area of the media from 00 min 02 sec 00 Frame to 60 min 01 sec 74 Frame more than 3000 times. Includes positioning, setting time which is same definition as HDD.
- *8: Measured by performing maximum accesses which means reads of each data block of 0 (h) Frame and 1E7725(h) Frame alternately more than 100 times.
Includes positioning, setting, latency time and ECC implementation time (if required)
- *9: Measured by performing maximum accesses which means reads of each data block of 00 min 02 sec 00 Frame and 60 min 01 sec 74 Frame alternately more than 100 times.
Includes positioning, setting, latency time and ECC implementation time (if required)

(10) Drawer Load/Release	Load:	Manual
	Release:	(a) Electrical Release (Release Button) (b) Release by ATAPI command (c) Emergency Release
(11) Air Flow		Not Required
(12) Acoustic Noise		40 dB (IEC 179 A weighted at 1 m)
(13) 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 45 °C
(2) Storage Temperature	-10 °C to 60 °C
(3) Shipping Temperature	-40 °C to 65 °C *1
(4) Operating Temperature Gradient	11 °C/hour (max)
(5) Storage Temperature Gradient	20 °C/hour (max)
(6) Shipping Temperature Gradient	20 °C/hour (max) *1
(7) Operating Humidity	8 % to 80 %
(8) Storage Humidity	5 % to 95 %
(9) Shipping Humidity	5 % to 95 % *1
(10) Wet bulb Maximum Temperature	27 °C
(11) Condensation	In all the above conditions there must be no condensation

*1: Packed in Toshiba original shipping package.

3.2.2. Dust and Dirt	unspecified
----------------------	-------------

3.2.3. Vibration

- (1) Operating (CD 10.3-24X Read) (1 Oct/min) ----- no hard error -----
5 to 500 Hz 2.45 m/s² [0.25 G] (0-p)
(excluding resonance point)
- (2) Operating (Write) (1 Oct/min) ----- no hard error -----
5 to 500 Hz 2.45 m/s² [0.25 G] (0-p)
(excluding resonance point)
- (3) Non-operating (1 Oct/min) ----- no damage -----
5 to 10 Hz 5 mm (p-p)
10 to 500 Hz 9.8 m/s² [1 G] (0-p)
- (4) Shipping (Packaged) (1 Oct/min) ----- no damage -----
10 to 25 Hz 9.8 m/s² [1G] (0-p) X Y Z/30 min each

3.2.4. Atmospheric Pressure and Altitude

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

3.2.5. Shock

- (1) Operating (Read) ----- no hard error -----
14.7 m/s² [1.5 G] (Horizontal)
(Half sine wave 11 ms/10 s interval)
- no data loss -----
98 m/s² [10 G]
(Half sine wave 11 ms/10 s interval)
- (2) Operating (Write) ----- no error -----
14.7 m/s² [1.5 G] (Horizontal)
7.8 m/s² [0.8 G] (Vertical)
(Half sine wave 11 ms/10 s interval)
- (3) Non-operating (with no Disc mounted) ----- no damage -----
490 m/s² [50 G] (Half sine wave 11 ms)
- (4) 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

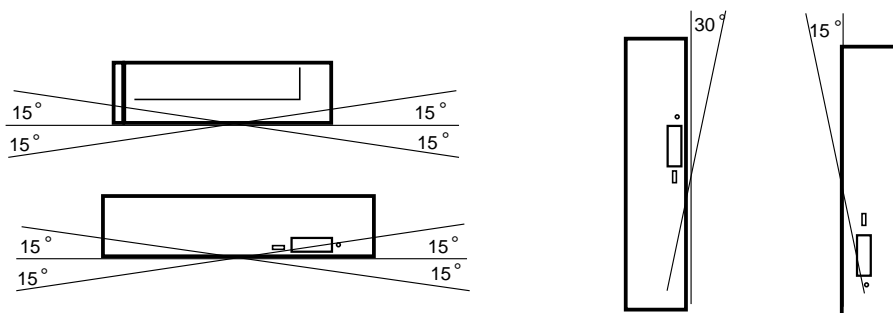


Figure 1 Mounting angle

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 45 °C.

- (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.)

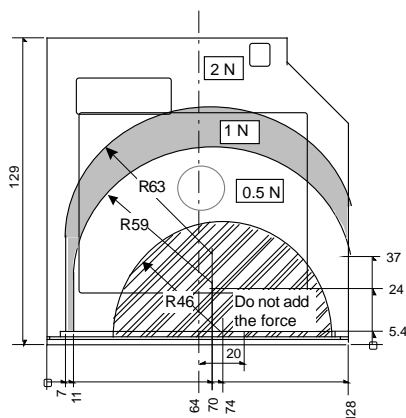
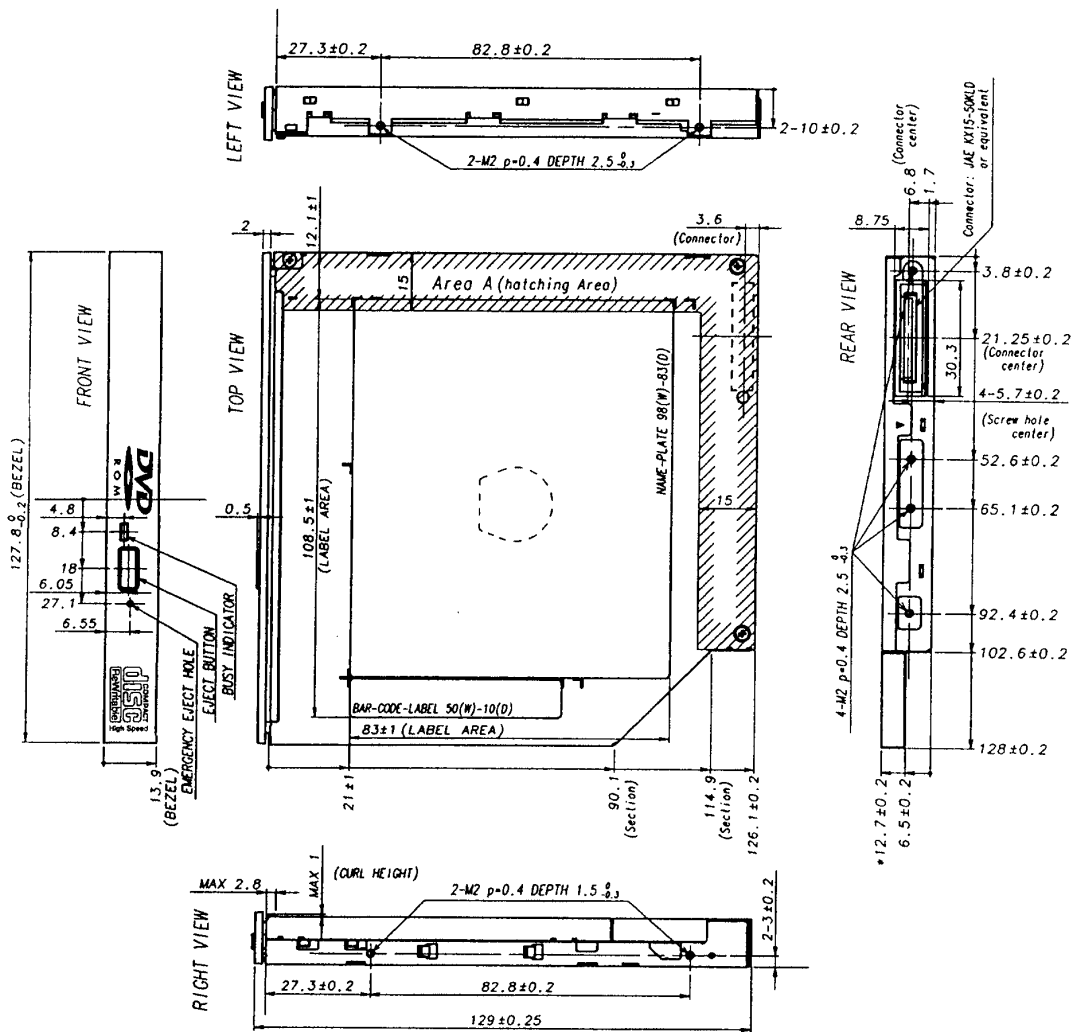


Figure 2 Restricted force range applied for the top cover

- (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 | 0.246 kg (Net)
353 kg (Bulk Packaged 50 pcs)
221 kg (Bulk Packaged 20 pcs) |



(Unit: mm)

Figure 3 External Dimensions

3.5. Reliabilites

3.5.1. Error Rate

(1) Hard Read Error Rate (Byte Error Rate) ----- Allowing 5 Retries(default) -----

DVD:	10 ⁻¹⁵ Max
CD:	Mode 1:10 ⁻¹⁵ Max
	Mode 2:10 ⁻¹² Max

(2) Seek Error Rate --- Allowing 10 Retries (default) 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 (Read)	20 % of Power On Time (Reading/Seeking)
Operating Duty Cycle (Write)	2 % of Power On Time (Writing/Seeking)

3.5.3. MTTR

0.5 h

3.5.4. Drive Life

15,000 h or 5 years (earlier one)

(1) Drawer 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 CSS Descrambler (DVD)
(System Control Circuit, Digital to Analog Converter)
- (6) EFM Demodulator, Error Correction Circuit and DA converter (CD)
- (7) IDE/ATAPI Control and CD-ROM Error Correction Circuit and Copy Protect Circuit (DVD)
- (8) BCA Decoding Circuit
- (9) CIRC Encoder
- (10) EFM Encoder
- (11) ATIP Demodulator
- (12) Disc Moter Control Circuit

4.2. Optical Pickup

1-Lens and 2-Laser System

4.3. Spindle Motor

Brushless DC Motor

4.4. Feed Motor

DC Motor

CD-RW / DVD-ROM DRIVE MODEL SD-R2002 BLOCK DIAGRAM

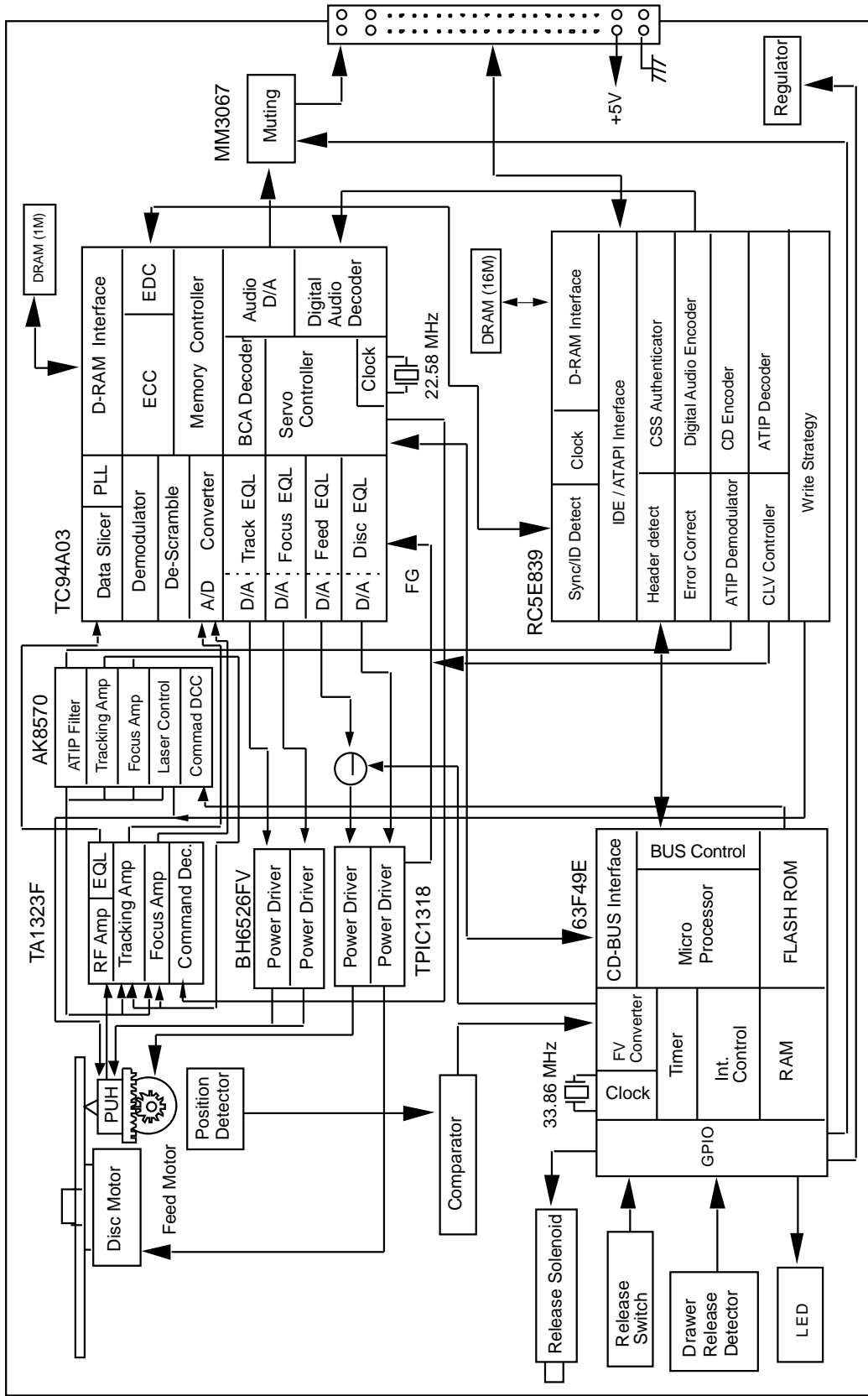


Figure 4 Configuration

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 data DVD disc. The DVD spec defines the single layer, the dual layer/opposite and parallel track disc, that the DVD-ROM drive supports. For details refer to DVD Book Part 1.

1 block=1/676 s

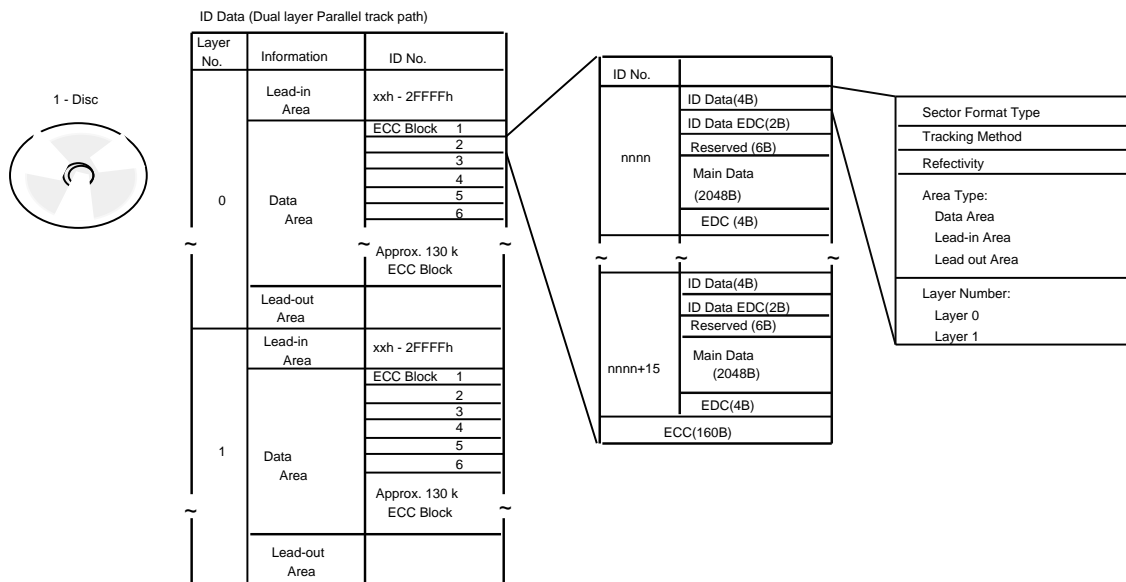


Figure 5 DVD-ROM Disc Data Configuration

5.1.2. CD-ROM Data Configurations

Figure 6 shows how the data is structured in program units

1 block=1/75 s

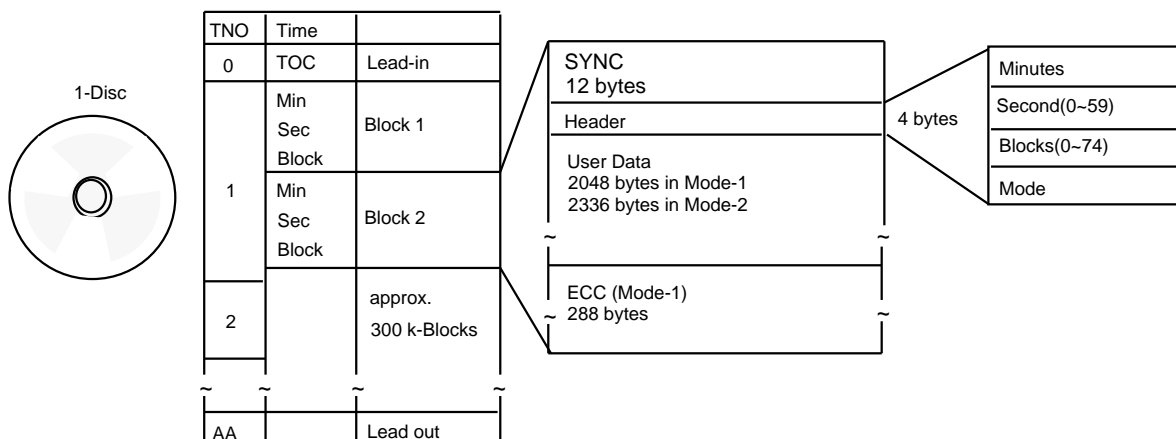


Figure 6 CD-ROM Disc Data Configuration

5.1.3. CD-R / CD-RW Data Configurations

Before writing

CD-R / CD-RW disc contains time-code information called ATIP.

ATIP is abbreviation of "Absolute Time In Pre-groove" in the wobbling groove by modulating the carrier frequency.

(Address information is pre-formatted to ATIP on the CD-R / CD-RW disc and method for the guide groove to wobble by FM modulation.)

Figure 7 shows the composition of ATIP.

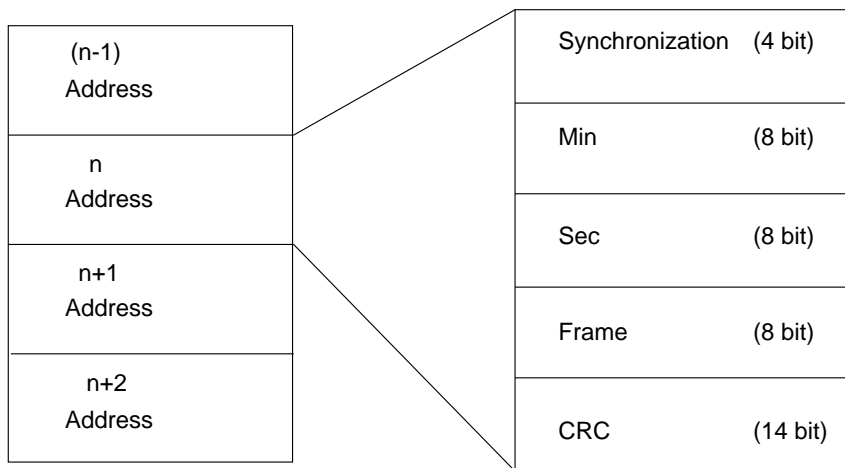


Figure 7 CD-R / CD-RW Disc ATIP Data Configuration

After Writing

Data are written in CD format synchronizing with ATIP.

5.2. Power ON/OFF Timing

Figure 8 shows the initialization sequence

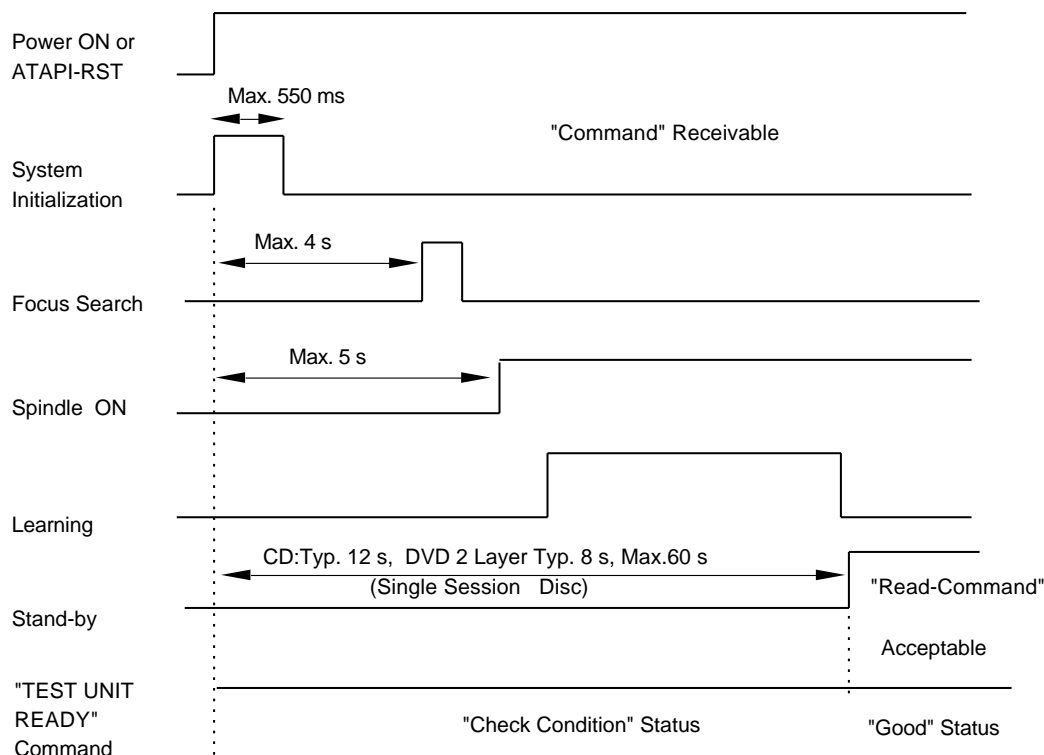


Figure 8 Initialization Sequence

6. Interface

- (1) The interface is based on X3T13/D96153 Revision 18 (Mar. 18, 1997), SFF-8020i (Small Form Factor Committee Specification of ATA-Packet Interface for CD-ROMs) Revision 2.6 (Nov. 27, 1995), SFF-8090 Ver.3, Rev.1.00 ('99-2-10).
- (2) 64 (ATAPI, ATA) commands are usable.
- (3) The 2 MByte 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

Table 1 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 μ A
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 13 and Figure 14 "Interface connector".

6.2.1. Signal Specification

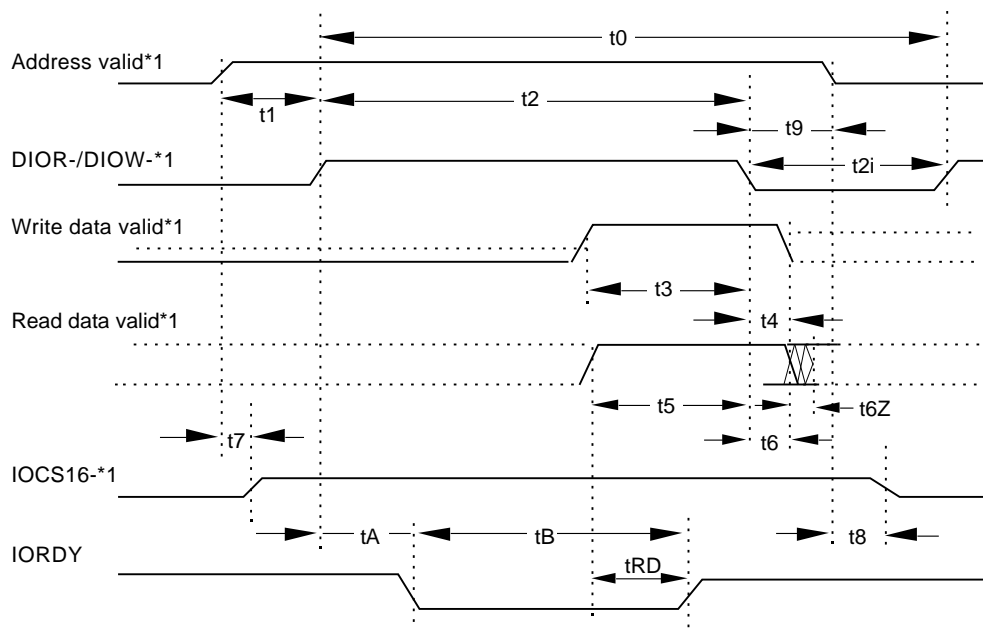
Figure 9 shows the Signal Specifications

Sig. Name	Type	Receivers/Drivers Characteristics without External pullup Resistor				NOTE	
				Min	Max		Condition
HD0 - HD15 /DASP /PDIAG		VOH	Voltage Output High	V _{dd} -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	2.4 V		TTL	
		VIL	Input LOW Voltage		0.6 V	TTL	
		ILI	Input leakage Current	-30 µA	-400 µA	Pullup Resistor(Ri)	
		IOL	Driver sink current	24 mA			
		ILO	Output Leakage Current	-30 µA	-400 µA	Pullup Resistor(Ri)	
		CI	Input Capacitance		15 pF		
		CO	Output Capacitance		15 pF		
/IOCS16		VOL	Voltage Output Low		0.5 V	IOL=12 mA	Open Drain Rx=1.2 kOHM Rs=0 OHM
		IOL	Driver sink current	24 mA			
		CO	Output Capacitance		15 pF		
IORDY		VOH	Voltage Output High	2.4 V		IOH=400 µA	Rx=1 kOHM Rs=22 OHM
		VOL	Voltage Output Low		0.5 V	IOL=12 mA	
		IOL	Driver sink current	24 mA			
		CO	Output Capacitance		15 pF		
/HDRQ /INTRQ		VOH	Voltage Output High	V _{dd} -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	24 mA			
		CO	Output Capacitance		15 pF		
/HWR /HRD HA0 - HA2 /HCS1/HCS3 /HDAK		VIH	Input HIGH Voltage	2.0 V		TTL	Rx=infinity Rs=82 OHM /HWR, /HA0-2, /HDAK Rx=infinity Rs=120 OHM /HRD Rx=10 kOHM Rs=82 OHM /HCS1,/HCS3
		VIL	Input LOW Voltage		0.8 V	TTL	
		ILI	Input leakage Current	-30 µA	-400 µA	Pullup Resistor(Ri)	
		CI	Input Capacitance		15 pF		
RESET		VIH	Input HIGH Voltage	2.4 V			
		VIL	Input LOW Voltage		0.6 V		
		ILI	Input leakage Current	-30 µA	-400 µA	Pullup Resistor(Ri)	
		CI	Input Capacitance		15 pF		

Figure 9 Signal Specifications

6.2.2. Timing of Host Interface (PIO)

Figure 10 shows the Host Interface Timings



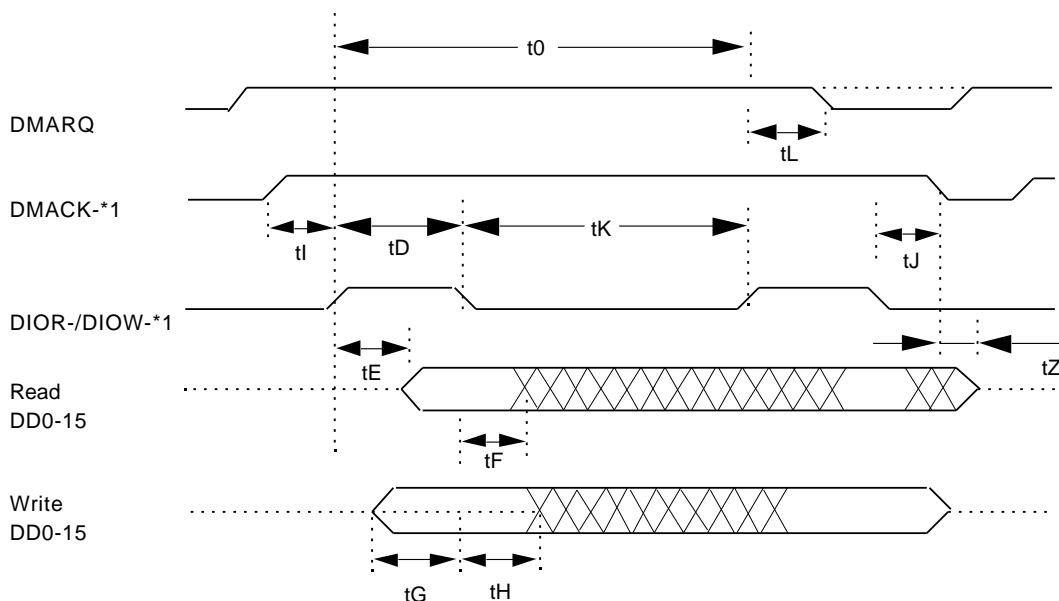
*1: In all timing diagrams, the low line indicator negated, and the upper line indicators asserted.

	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 10 Host Interface Timing (PIO Mode4)

6.2.3. Timing of Host Interface (DMA Multi)

Figure 11 shows the Host Interface DMA multi word Timings



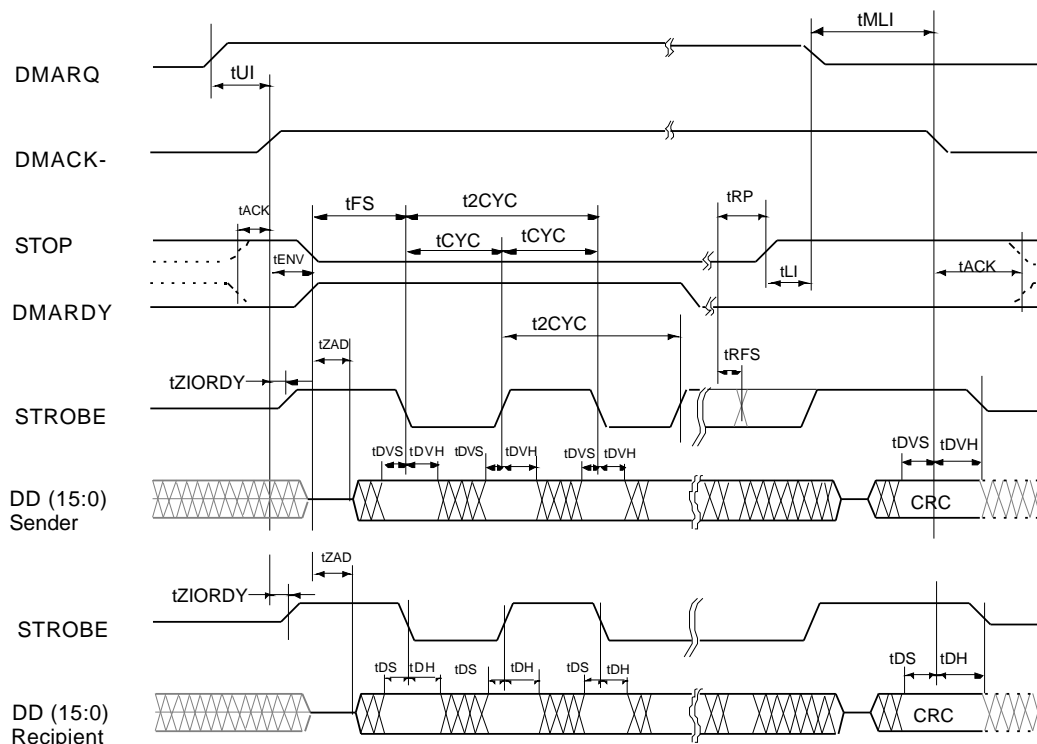
*1: In all timing diagrams, the low line indicator negated, and the upper line indicators asserted.

	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 11 Host Interface Timing (Multi Word DMA Mode 2)

6.2.4. Timing of Host Interface (Ultra DMA)

Figure 12 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	
tZORDY	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 minimum	20	
tDS	Data setup time (at recipient)	7	
tDH	Data hold time (at recipient)	5	

Figure 12 Host Interface Timing (Ultra DMA Mode 2)

6.3. Connector

Figure 13 shows the connector and Figure 14 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.

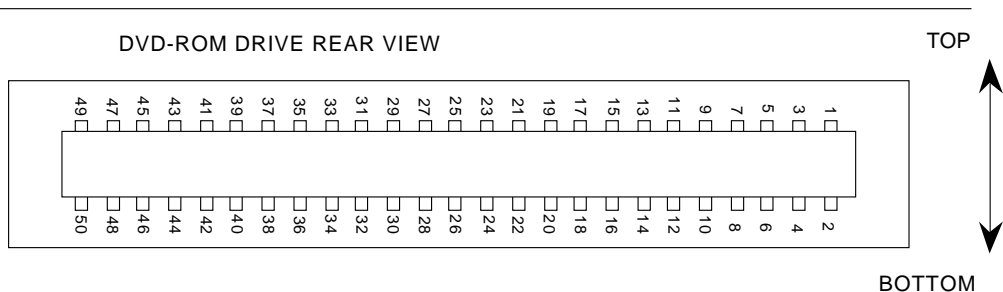


Figure 13 Connector pin assignments

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: 49 PIN

Figure 14 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 Unit
3	03h	Request Sense
4	04h	Format Unit
5	12h	Inquiry
6	1Bh	Start / Stop Unit
7	1Ch	Receive Diagnostics
8	1Dh	Send Diagnostic
9	1Eh	Prevent / Allow Medium Removal
10	23h	Read Format Capacities
11	25h	Read Capacity
12	28h	Read (10)
13	2Ah	Write (10)
14	2Bh	Seek (10)
15	35h	Flash Cache
16	42h	Read Sub-Channel
17	43h	Read TOC / PMA / ATIP
18	44h	Read Header
19	45h	Play Audio (10)
20	46h	Get Configuration
21	47h	Play Audio MSF
22	49h	Play Audio Track Relative (10)
23	4Ah	Get Event Status Notification
24	4Bh	Pause / Resume
25	4Eh	Stop Play / Scan
26	51h	Read Disc Information
27	52h	Read Track / RZone Information
28	53h	Reserve Track
29	55h	Mode Select (10)
30	5Ah	Mode Sense (10)
31	5Bh	Close Track / Session
32	5Ch	Read Buffer Capacity
33	5Dh	Send Cue Sheet
34	A1h	Blank
35	A2h	Send Event
36	A3h	Send Key
37	A4h	Report Key
38	A5h	Play Audio (12)
39	A7h	Set Read Ahead
40	A8h	Read (12)
41	A9h	Play Audio Track Relative (12)
42	ACh	Get Performance
43	ADh	Read DVD Structure
44	B6h	Set Streaming
45	B9h	Read CD MSF
46	BAh	SCAN
47	BBh	Set CD Speed
48	BDh	Mechanism Status
49	BEh	Read CD

ATA Command for ATAPI DVD-ROM Devices

No.	OP Code	Command Description
-	00h	Nop
1	08h	ATAPI Soft Reset
2	20/21h	Read Sector (s)
3	90h	Execute Drive Diagnostics
4	A0h	ATAPI Packet Command
5	A1h	ATAPI Identify Device
6	E0h	Standby Immediate
7	E1h	Idle Immediate
8	E2h	Standby
9	E3h	Idle
10	E5h	Check Power Mode
11	E6h	Sleep
12	ECh	ATA Identify Device
13	EFh	Set Feature

7. Power Requirements

7.1. Source Voltage	+5 V +/- 5 % (Operating) +5 V +/- 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)	<u>+5 V</u>
7.2.1. Sleep	40 mA (DVD/CD)
7.2.2. Standby (Laser off, Motor off)	140 mA (DVD/CD)
7.2.3. Continuous Read (Data/Audio)	780 mA (DVD 2.5-6X) 620 mA (CD 4-5.7X) 920 mA (CD 10.3-24X)
7.2.4. Idle (Laser on, Motor on)	560 mA (DVD 2.5-6X) 600 mA (CD 10.3-24X)
7.2.5. Average (20% Random Access)	740 mA (DVD 2.5-6X) 920 mA (CD 10.3-24X)
7.2.6. Maximum (100% Random Access)	800 mA (DVD 2.5-6X) 1,000 mA (CD 10.3-24X)
7.2.7. Peak in executing Access (Exclude Spike Current) *Spike: Less than 1 ms of duration	1,650 mA (DVD/CD)
7.2.8. Write (CD-R, CD-RW 4X)	760 mA (CD-R/RW)

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' status.

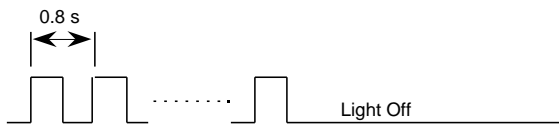


Figure 15 Idle

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

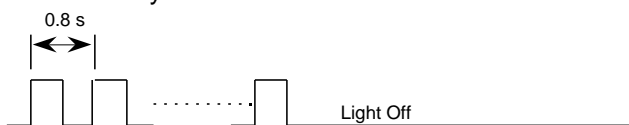


Figure 16 No disc

(1-4) Continuously on when media has problem



Figure 17 Media Problem

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

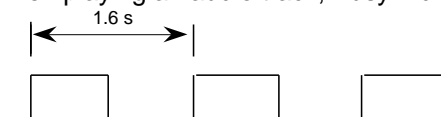


Figure 18 CD-Audio playback

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

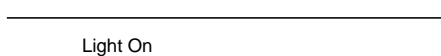


Figure 19 Data Access and Data Transfer

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

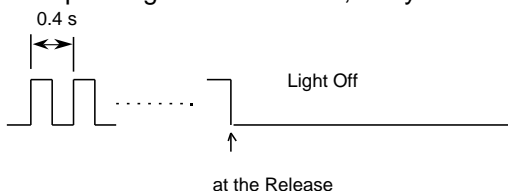
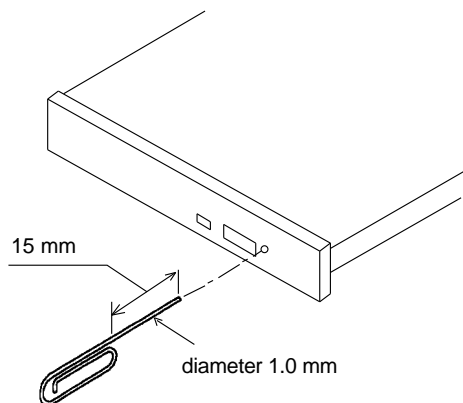


Figure 20 Release

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.21.
Then Drawer will be released.
- (3) After removed the disc, gently push Drawer to close.



Figurer 21 Emergency Release

12. Safety Standards/Agency Approvals

- (1) Safety
 - EN60950
 - UL 1950
 - CAN/CSA-22.2 No.950

- (2) Laser
 - FDA 21CFR (U.S.A./DHHS)
 - EN60825-1 (Europe)

- (3) EMC
 - CE
 - EN50081-1 (EMI) : 1992 [Residential, commercial & light industry]
 - EN55022 : 1998 [Class B (domestic environment including)]
 - EN55024 (EMS) : 1998 [Information Technology equipment-
Immunity characteristics Limits and
methods of masurement]
 - IEC61000-4-2+A1 : 1995+1998 [CD:4 kV, ID: 4 kV, AD:8 kV]
 - IEC61000-4-3 : 1996 [3 V/m, 80-1000 MHz, 1 kHz 80 % AM]
 - IEC61000-4-4 : 1995 [AC-line: 1 kV, I/F 0.5 kV
f: 5 kHz, Polarity: +/-]
 - IEC61000-4-5 : 1995 [AC-line: 2 kV/1 kV, Polarity: +/-]
 - IEC61000-4-6 : 1996 [3 V, 0.15-80 MHz, 80 % AM]
 - IEC61000-4-8 : 1993 [1 A/m, 50 Hz]
 - IEC61000-4-11 : 1994 [>95 % 0.5, 30% 25, >95 250]
 - KOREAN EMC No. 13237
 - TAIWAN EMI CNS 13438

13. Electrostatic Discharge

- Standard IEC61000-4-2
- (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 | 24 bulk packs on one pallet.
(Transportation with bulk package is allowed.) |
| (3) 1 unit in a bulk package | (Transportation 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: CD-RW/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-R2002

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: August 16th, 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-R2222	Page:	1 of 2
[History if issue]	Issued : Aug. 11,2000		
	Revision A :	Ref.:	
	Revision B :	Ref.:	
	Revision C :	Ref.:	
	Revision D :	Ref.:	

TOSHIBA EUROPE GMBH
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GESCHAFTSUHRER
HISATSUGU NONAKA
HRB 3479 AMTSGERICHT NESS

Annex 1

EU-Declaration of Conformity

ED-Directive	Related Standard	Issue	Level/Test condition
89/336/EEC (EMC Directive)	EMC-emission:	EN50081-1	Residential, commercial & light industry Class B (domestic environment including) Information Technology equipment-Immunity characteristics Limits and methods of measurement CD: 4 kV, ID: 4 kV, AD: 8 kV 3 V/m, 80-1000 MHz, 1 kHz 80 % AM AC-line: 1 kV, I/F 0.5 kV f: 5 kHz, Polarity: +/- AC-line: 2 kV/1 kV, Polarity: +/- 3 V, 0.15-80 MHz, 80 % AM 1 A/m, 50 Hz >95 % 0.5, 30% 25, >95 250
		EN55022	
	EMC-immunity	EN55024	
		IEC61000-4-2+A1	
		IEC61000-4-3	
		IEC61000-4-4	
		IEC61000-4-5	
		IEC61000-4-6	
		IEC61000-4-8	
		IEC61000-4-11	

Product/Options	Model	Related EU-Directive 89/336/EEC
CD-RW/DVD-ROM Drive	SD-R2002	X
Manufacturer(s) Location	Address	
Toshiba Multi Media Devices Co, Ltd		
19 Minase, Fukihata Goshogawara-shi, Aomori 037-0003 Japan		

Document No.: YEA-R2222

Revision:

Page: 2 of 2

Deviation List

Page	Item	Rev # 0.5	Rev # 1.0
Page ahead of contents	Notice	-----	All of change
1	1. Introduction	-----	This drive writes / rewrites digital data on High-Speed CD-RW disc at 4 times faster rotational speed.
3	(4) Data Capacity	-----	Add *3
	(5) Rotational Speed	CD-RW, Video-CD :	CD-RW, Video-CD,CD-DA :
4	(7) Access Time		
	Average Random Access Time	DVD: TBD ms Typ CD: TBD ms Typ	DVD: 120 ms Typ CD: 110 ms Typ
	Average Random Seek Time	DVD: TBD ms Typ CD: TBD ms Typ	DVD: 115 ms Typ CD: 105 ms Typ
	Average Full Stroke Access Time	DVD: TBD ms Typ CD: TBD ms Typ	DVD: 180 ms Typ CD: 170 ms Typ
	(8) Spin up Time	DVD: TBD s Typ CD: TBD s Typ	DVD: 2.5 s Typ CD: 2.0 s Typ
	Note	-----	Add *3 and * is changed by sending at the following.
5	3.2.1.Temperature and Humidity		
	(1) Operating Temperature	5 °C to 50 °C (TBD)	5 °C to 45 °C
7	3.3.2.Installation	(3) Care should be.....exceed 45 °C.	(3) Care should be.....exceed 45 °C.
8	Figure 2	TBD	2 N, 1 N, 0.5 N
	3.4. Dimension and Mass		
	(2) Mass	TBD kg (Net) TBD kg (Bulk Packaged 50 pcs) TBD kg (Bulk Packaged 20 pcs)	0.246 kg (Net) 353 kg (Bulk Packaged 50 pcs) 221 kg (Bulk Packaged 20 pcs)
9	Figure 3	-----	All of change
11	Figure 4	-----	Delete the 33.86 MHz
14	Figure 8	-----	Delete the TBD
	6. Interface	(1) The interface is based on X3T10/2008D Revision 6 (dated Oct. 26,1995) ,.....	(1) The interface is based on X3T13/D96153 Revsion 18 (Mar. 18, 1997),
15	Figure 9	-----	Part of change

Page	Item	Rev # 0.5	Rev # 1.0
21	7.2. Current Drain		
	7.2.1.Sleep	TBD mA (DVD/CD)	40 mA (DVD/CD)
	7.2.2.Standby	TBD mA (DVD/CD)	140 mA (DVD/CD)
	7.2.3. Continuous Read	TBD mA (DVD 2.5-6X) TBD mA (CD 4-5.7X) TBD mA (CD 10.3-24X)	780 mA (DVD 2.5-6X) 620 mA (CD 4-5.7X) 920 mA (CD 10.3-24X)
	7.2.4.Idle	TBD mA (DVD 2.5-6X) TBD mA (CD 10.3-24X)	560 mA (DVD 2.5-6X) 600 mA (CD 10.3-24X)
	7.2.5. Average	TBD mA (DVD 2.5-6X) TBD mA (CD 10.3-24X)	740 mA (DVD 2.5-6X) 920 mA (CD 10.3-24X)
	7.2.6. Maximum	TBD mA (DVD 2.5-6X) TBD mA (CD 10.3-24X)	800 mA (DVD 2.5-6X) 1,000 mA (CD 10.3-24X)
	7.2.7. Peak in executing Access	TBD mA (DVD/CD)	1,650 mA (DVD/CD)
	7.2.8. Write	TBD mA (CD-R/RW)	760 mA (CD-R/RW)
24	12. Safety standard..... (3) CE (TENTATIVE)	Tentative	Non-Tentative
26	Annex 1	Tentative	Non-Tentative
27	EU-Declaration of Conformity	Tentative	Non-Tentative