



# CD-R/CD-RW Drive

ATAPI / Enhanced IDE Interface

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Product Name	<b>ASUS CD-R/RW Drive</b>
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# COMPLIANCE

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## ***Federal Communications Commission Statement***

This device complies with FCC Rules Part 15. Operation is subject to the following two conditions:

- This device may not cause harmful interference, and
- This device must accept any interference received, including interference that may cause undesired operation.

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

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment to an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

**WARNING!** Any changes or modifications to this product not expressly approved by the manufacturer could void any assurances of safety or performance and could result in violation of Part 15 of the FCC Rules.

## ***Canadian Department of Communications Statement***

This digital apparatus does not exceed the Class B limits for radio noise emissions from digital apparatus set out in the Radio Interference Regulations of the Canadian Department of Communications.

**This Class B digital apparatus complies with Canadian ICES-003.**

**Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada.**

## ***Electromagnetic Compatibility/Low Voltage Directives***



This digital apparatus is in conformity with the EMC directive and low-voltage directive.

---

## LASER SAFETY

This unit employs a laser. Do not remove the cover or attempt to service this device when connected due to the possibility of eye damage.

## LASER-SICHERHEIT

In das Gerät ist ein Laser eingebaut. Nehmen Sie die Abdeckung nicht ab und versuchen Sie nicht, das Gerät zu reparieren, solange es angeschlossen ist. Es besteht die Gefahr einer Augenverletzung.

## CAUTION

USE OF CONTROLS OR ADJUSTMENTS OR PERFORMANCE OF PROCEDURES OTHER THAN THOSE SPECIFIED HEREIN MAY RESULT IN HAZARDOUS LASER RADIATION EXPOSURE.

## WARNUNG

DIE VORNAHME VON REGELUNGEN ODER EINSTELLUNGEN ODER DIE DURCHFÜHRUNG VON VERFAHREN, DIE NICHT IN DIESEM DOKUMENT (DIESER BESCHREIBUNG; IM NACHSTEHENDEN TEXT) ANGEGEBEN SIND, KANN EINE GEFÄHRLICHE EINWIRKUNG VON LASERSTRAHLUNG ZUR FOLGE HABEN.

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**CLASS 1  
LASER PRODUCT**

**LUOKAN I  
LASERLAITE**

**KLASS 1  
LASERAPPARAT**

**KLASSE 1  
LASER-PRODUKT**

<b>DANGER</b>	VISIBLE AND INVISIBLE LASER RADIATION WHEN OPEN AVOID EXPOSURE TO BEAM
<b>VARO!</b>	AVATTAESSA OLET ALTIINA NÄKYMÄTTÖMÄLLE LASER SÄTTEILYLLE ÄLÄ KATSO SÄTEESEN
<b>VARNING</b>	OSYNLIG LASERSTRÅLNING NÄR DENNA DEL ÄR ÖPPNAD BETRAKTA EJ STRÅLEN
<b>ADVERSEL</b>	USYNLIG LASERSTRÅLING VED ÅBNING. UNDGÅ UNSAETTELSE FOR STRÅLING
<b>DANGER</b>	INVISIBLE LASER RADIATION WHEN OPEN AVOID DIRECT EXPOSURE TO BEAM
<b>VORSICHT</b>	INSICHTBARE LASERSTRAHLUNG WENN ABDECKUNG GEÖFFNET NICHT DEM STRAHL AUSSETZEN

### Laser

Type	Semiconductor laser GaAlAs
Wave length	780–800 nm (at 25° C)
Output Power (measured above the objective lens)	1 mW (Read) 20 mW (Write)
Beam divergence	60 degrees

# I. INTRODUCTION

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## Introduction

The ASUS CD-R/RW Drive is a new generation half height 5.25” internal CD-Recordable/ ReWritable drive with the popular Enhanced IDE interface.

The drive is in fact a multi-function device, since it can be used as:

- Fast CD-ROM reader
- CD-Recorder, e.g., to record your own CD-ROMs or Audio-CDs
- CD-ReWritable device to use as your personal storage medium, by using Incremental Packet Writing

The ASUS CD-R/RW Drive is the ideal tool for publishing large amounts of data in compact form on CD. The new Incremental Packet Writing function will make this drive attractive to the general desktop PC-user for personal data storage.

CD-Recordable discs can be recorded at the supported speed of your drive, and in all standard formats, e.g., CD-Audio, CD-ROM (XA), CD-i and Video-CD. Since these discs are recorded in accordance with the Orange Book (Part II) specification, these discs can be played back on all compatible CD-players.

CD-ReWritable is a new feature that allows reuse of previously written discs by rewriting portions or the complete disc in accordance with the Orange Book (Part III) specification. These discs can also be recorded at the supported speed of your drive in all standard formats.

## Features

- Multi-function device (CD-ROM reader, CD-Recorder and CD-ReWritable drive)
- Supports Incremental Packet Writing for data storage applications and “drag & drop” File System support through the CD-UDF standard (endorsed by Optical Storage Technology Association or OSTA)
- Supports standardised Multi Media Commandset (MMC) as standardised by the American National Standards Institute (ANSI)
- Plug & Play read compatibility under Windows 95/98/2000 and Windows NT
- Interfaces directly to low cost standardized Enhanced IDE connector on PC motherboard
- Supports Fast Format (Background Formatting) depending on the application software, which reduces formatting time of a CD-RW disc to only a few minutes.

# I. INTRODUCTION

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## Unpacking

If the ASUS CD-R/RW Drive package shows evidence of rough handling or damage and the drive does not function properly on initial startup, return the drive and damaged package to your supplier and request a replacement.

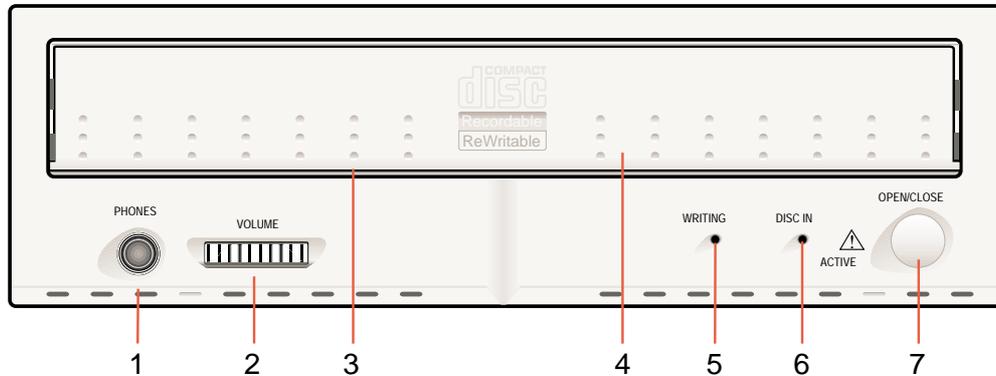
Lift out the ASUS CD-R/RW Drive and remove the packing materials. Check that the package contains the following items :

- ASUS CD-R/RW Drive
- Mounting Screws
- Jumper (Factory-mounted on jumper block)
- IDE Ribbon Cable
- Audio Cable
- This User's Manual

## II. INSTALLATION

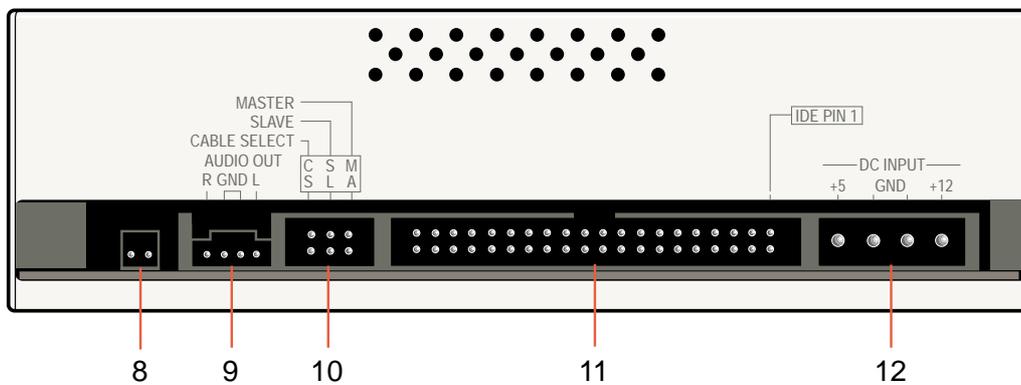
### ASUS CD-R/RW Drive Parts

#### Front View



- |   |                          |   |                                |
|---|--------------------------|---|--------------------------------|
| 1 | Headphone Plug           | 5 | Write Indicator                |
| 2 | Headphone Volume Control | 6 | Disc In/Active/Error Indicator |
| 3 | Emergency Eject          | 7 | Open/Close Button              |
| 4 | Disc Tray                |   |                                |

#### Rear View



- |    |                          |    |                         |
|----|--------------------------|----|-------------------------|
| 8  | Digital Audio Out        | 11 | IDE Connector           |
| 9  | Audio Line Out Connector | 12 | Host DC Power Connector |
| 10 | Jumper Block             |    |                         |

# II. INSTALLATION

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## Installation

### Precautions

This CD-Recordable/Rewritable drive, like all electronic equipment, is static sensitive.

- Take the proper precautions when handling the drive, for example by touching the PC chassis before touching the drive.
- Avoid touching the IDE connector pins, audio-connector pins, and jumper pins.
- Keep the drive in its conductive wrapping until you are ready to install the drive in your computer.

### Safety Precautions

- Europe: This drive shall be installed only with an EN60950 (IEC950) approved Power supply.
- USA/Canada: This drive is for use only with IBM compatible UL listed Personal Computers or Macintosh UL listed workstations weighing less than 18 kg.

**IMPORTANT:** It is a criminal offence, under applicable copyright laws, to make unauthorized copies of copyright-protected material, including computer programs, films, broadcasts and sound recordings. This equipment should not be used for such purposes.

## II. INSTALLATION

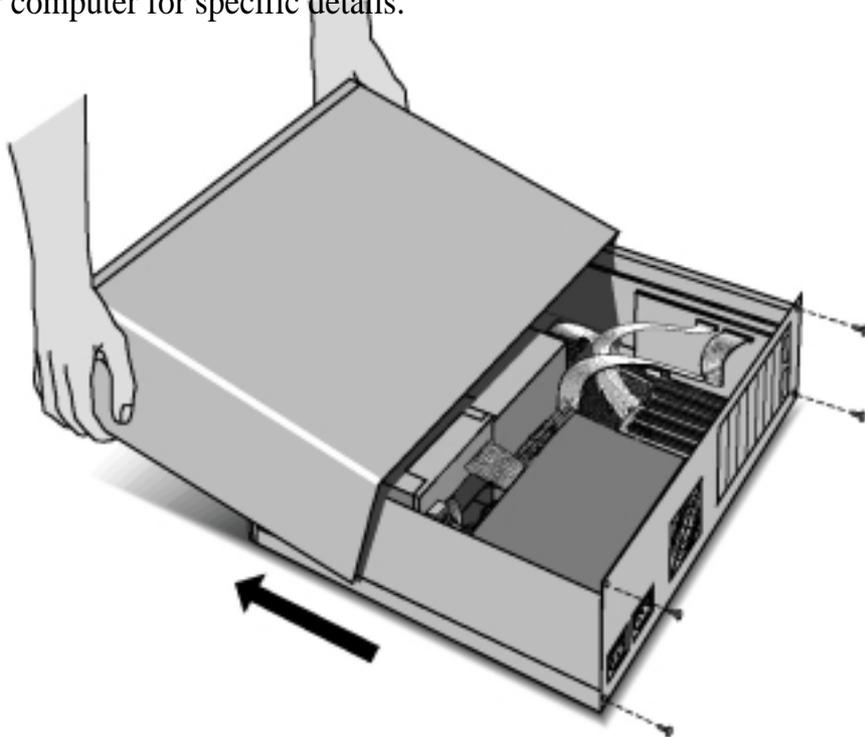
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### Installing the Drive

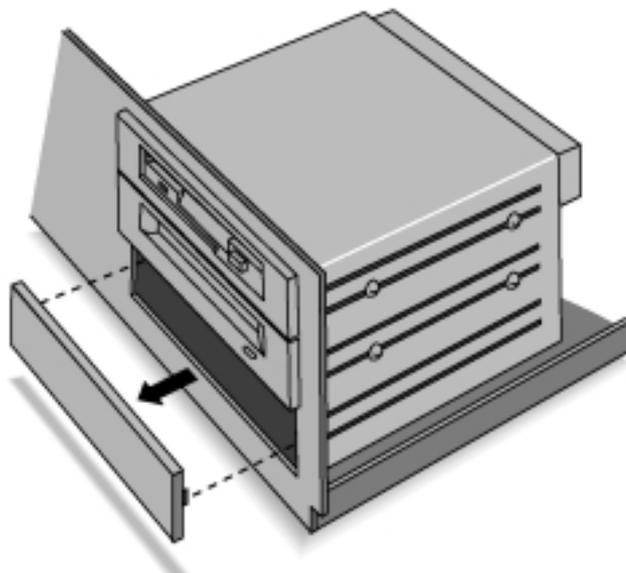
1. Turn off your computer, monitor and other peripherals. To disconnect your configuration completely from the mains, the mains plug has to be disconnected.

**NOTE:** Open the cover flap of this booklet for locating the drive connectors and their orientation.

2. Remove the cover from your computer. Consult the manuals that came with your computer for specific details.



3. To mount the drive inside your PC (or other type of computer), locate a free 5.25" bay and follow the instructions, as provided with your computer systems, for installing the drive.

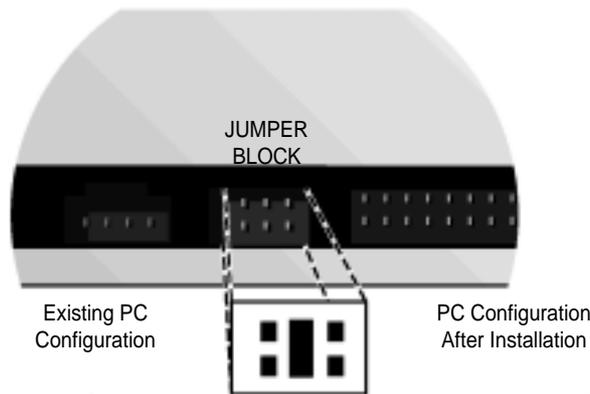


# II. INSTALLATION

When you are planning to use 8 cm discs your drive should be mounted horizontally or you should use an adapter (for information contact your local supplier).

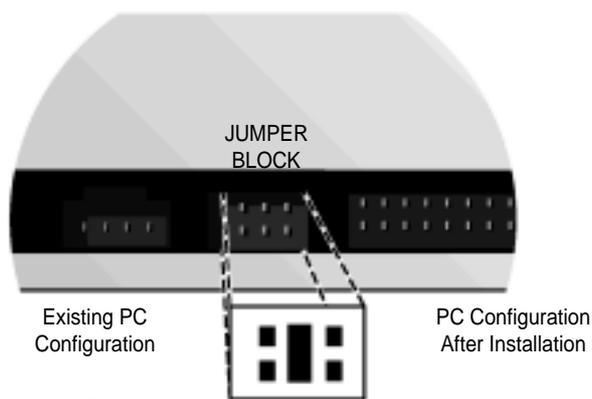
4. You have several possibilities to install your IDE data cable depending on your existing configuration:

A) Hard disk connected as Master to Primary IDE Port, CD-ROM connected as Master to Secondary IDE Port: Connect the CD-R/RW Drive as Slave to Secondary IDE Port.



	Master	Slave		Master	Slave
Primary Port	Hard Disk	—	C S M S	Primary Port	Hard Disk
Secondary Port	CD-ROM	—		Secondary Port	CD-ROM CD-R/RW Drive

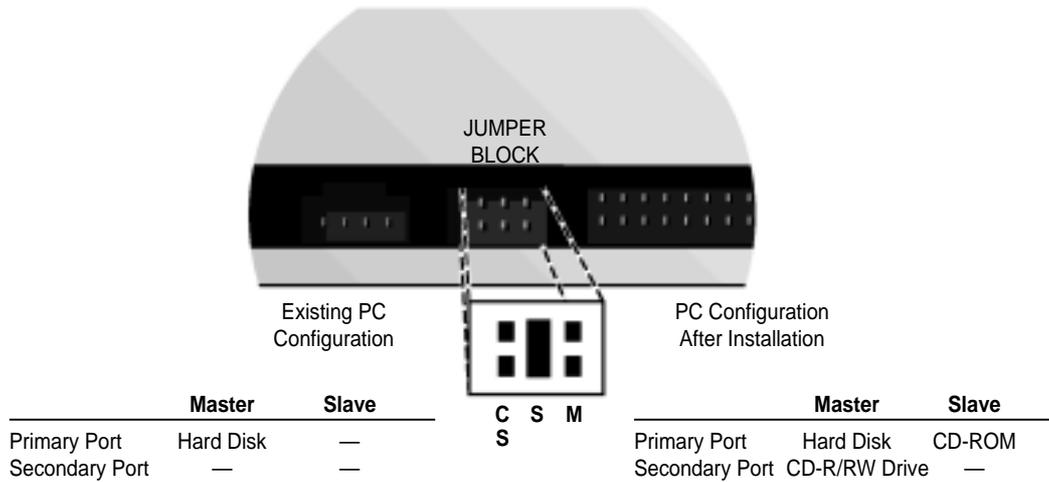
B) Single hard disk connected as Master to Primary IDE Port: Connect the CD-R/RW Drive as Master to Secondary Port.



	Master	Slave		Master	Slave
Primary Port	Hard Disk	—	C S M S	Primary Port	Hard Disk
Secondary Port	—	—		Secondary Port	CD-R/RW Drive

# II. INSTALLATION

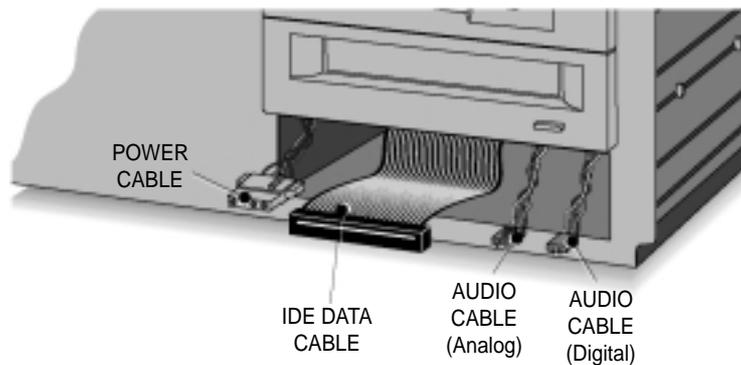
- C) Hard-disc connected as Master to Primary IDE Port, CD-ROM connected as Slave to Primary IDE Port: Connect the CD-R/RW Drive as Master to Secondary IDE Port.



II. INSTALLATION  
Drive

**NOTE:** Installation A is preferred for systems with an ID hard disk and CD-ROM drives. For systems with only and IDE hard disk drive, Installation B is preferred.

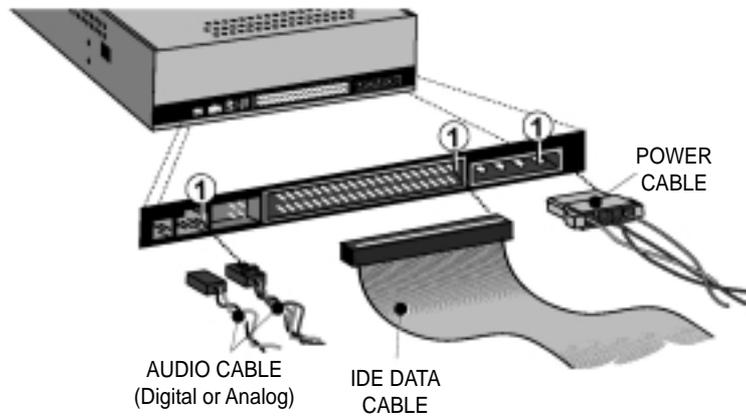
- Locate the free end of the IDE data cable and thread it out through the open drive bay. Do the same with the power cable and the (optional) audio cable (digital or analog). Your system will either be equipped with an analog or digital soundcard connector. Use the appropriate connector on the drive recognizable with the amount of pins.



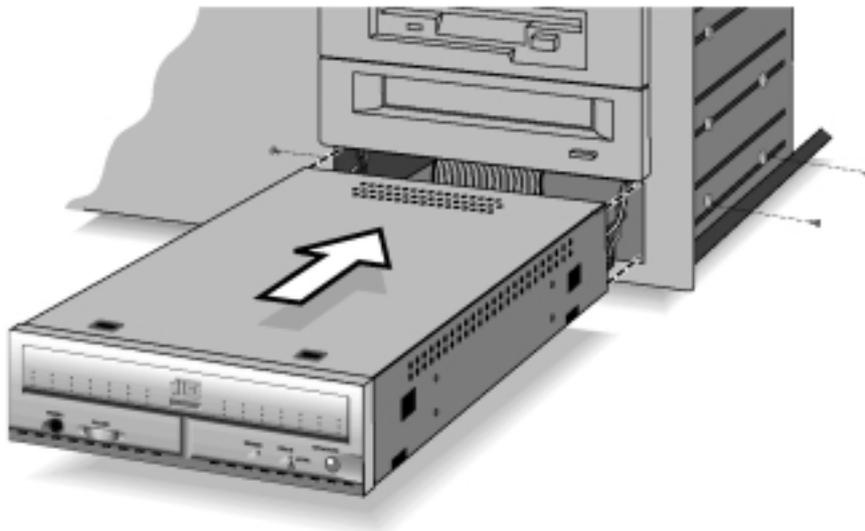
## II. INSTALLATION

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6. Connect your (optional) audio cable, IDE data cable and the power cable into the back of the ASUS CD-R/RW Drive. Make sure you correctly align pin 1 of the cable to pin 1 of the connectors.



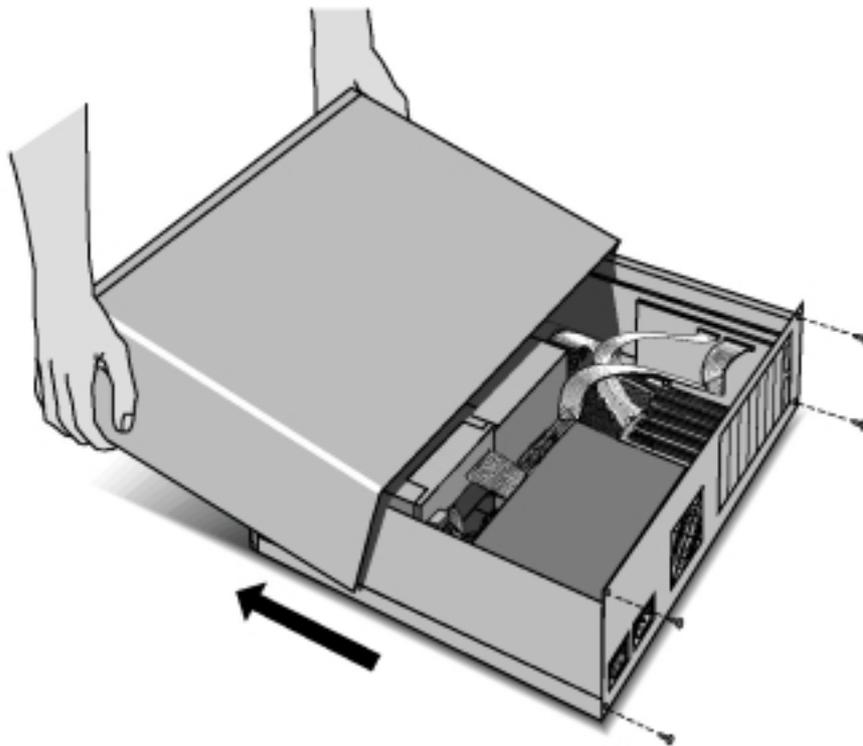
7. Insert the ASUS CD-R/RW Drive into the drive bay. Using all the screws included in the bag to secure the ASUS CD-R/RW Drive into the bay.



## II. INSTALLATION

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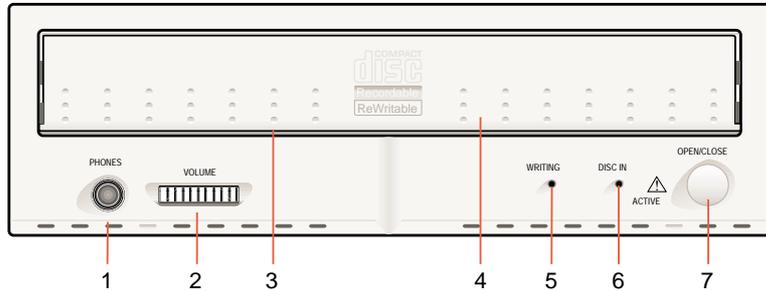
8. Replace the cover. Connect the mains plug of your configuration. When you have successfully installed the drive and established all connections, turn on the PC. You are ready to run the selftest (*see* Appendix) and then install the software (*refer* to the software documentation for installation procedures).



# III. CONTROLS

## Summary of Controls and Connectors

### Front View



#### 1 Headphone Plug

Connect your headphone to listen to audio or music discs (or tracks).

#### 2 Headphone Volume Control

Turn the volume control to the right to increase the audio volume of your headphone.

#### 3 Emergency Eject

In case you are not able to power up your PC, and want to take the disc out of the drive, push with a rod (paperclip) of about 5 cm long through the hole in the front to disengage the gears inside. Then pull the tray out. After taking the disc, gently push it back to its original position.

**CAUTION:** This is only in case of emergency, not meant for normal operations.

#### 4 Disc Tray

#### 5 Write Indicator

Lights ORANGE when writing of a disc occurs. Flashes ORANGE during write emulation.

#### 6 Disc In/Active/Error Indicator (Dual Color LED)

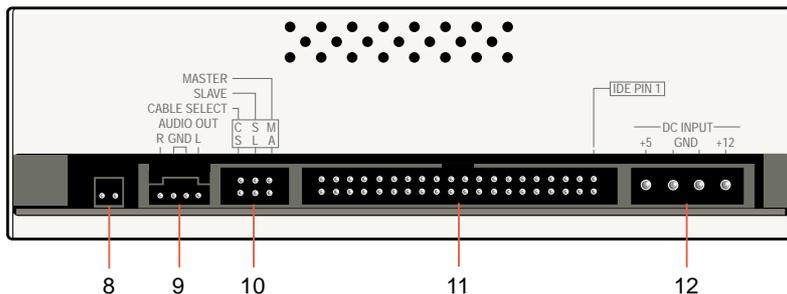
Lights GREEN when a disc is present. Flashes GREEN asymmetrically when data is being read from disc or written to the disc. Flashes GREEN symmetrically when starting up a disc. Lights RED upon error (e.g., after failed selftest).

#### 7 Open/Close Button

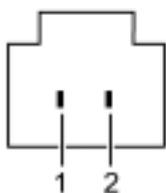
Press the OPEN/CLOSE button to open the disc loading tray. To close the disc loading tray, gently push the front of the tray or press the OPEN/CLOSE button. Using the open/close button to close the tray will calibrate the movement of the tray in case this deviates from the original setting due, for instance, to ageing.

# III. CONTROLS

## Rear View

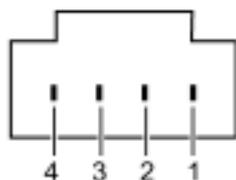


### 8 Digital Audio Out



Pin number	Definition
1	Digital Audio signal
2	Ground

### 9 Audio Line Out Connector



1: Left	3: GND
2: GND	4: Right

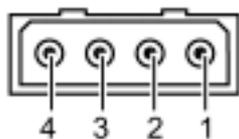
### 10 Jumper Block

These jumpers are used to select Master/Slave mode and Cable Select (*see* Appendix for more information).

### 11 IDE Connector

40-pin IDE ribbon cable connector (*see* Appendix for more information).

### 12 Host DC Power Connector (Type AMP 00641737-1)



1: +12V	3: GND
2: GND	4: +5V

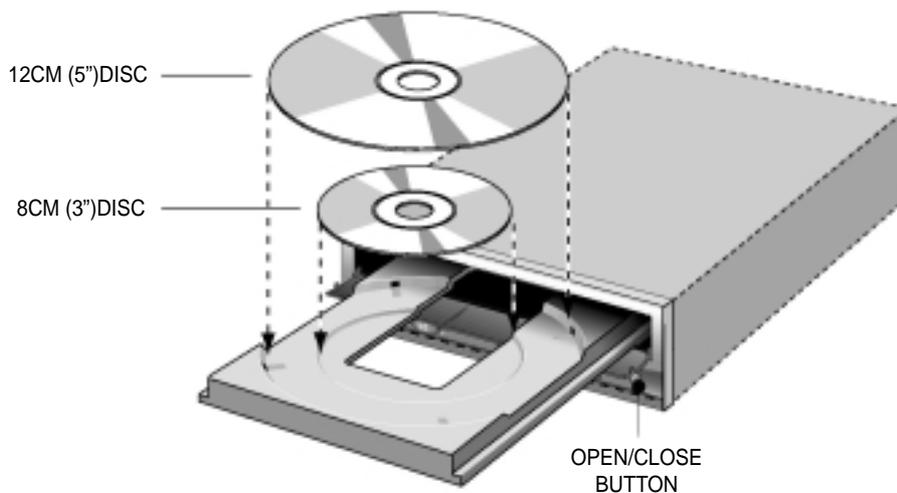
## IV. OPERATION/TESTING

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### Operating/Testing Your ASUS CD-R/RW Drive

#### Loading and Unloading a Disc

1. To open the tray: Press the OPEN/CLOSE button.
2. Load a disc, with the label facing upwards. The tray accommodates discs with 8 cm diameter (CD-Single) or the more usual 12 cm discs (the 8 cm disc can only be used in drives mounted horizontally).



3. To close the tray, either push gently at the front of the tray or press the OPEN/CLOSE button.

- NOTES:**
1. For optimal results, use reliable CD-R or CD-RW media.
  2. Don't use general purpose commercial head cleaning discs.
  3. 8-cm R- and RW-discs cannot be recorded in this drive.
  4. Do not switch off the computer and/or the drive during the recording process because this might result in an unreadable disc. Make sure that the computer has finished the recording process and that the write indicator on the front of the drive is off before switching off your computer or drive.

# IV. OPERATION/TESTING

---

## Operating the ASUS CD-R/RW Drive

Specific application software running on the computer platform in use, designed to work with the ASUS CD-R/RW Drive, must be used to be able to operate the ASUS CD-R/RW Drive correctly.

## Software Installation

The installation and operation of the necessary software is dependent of the computer configuration in which the ASUS CD-R/RW Drive is to be used, e.g., PCs, Windows 95/98/2000, Windows NT, UNIX or other Operating Systems. Contact your supplier for the full list of supported host configurations and available software packages.

All trademarks acknowledged.

# V. ADDITIONAL INFORMATION

---

## Additional Information

### Care of Discs

- When loading a disc, allow time for the door to open and then gently insert the disc.
- Handle discs only by the outer and inner edges.
- Never write with a ballpoint on the surface of the disc.
- Do not store a disc in places with high temperature and humidity. Do not place the disc under direct sunlight.
- Store discs in their cases to prevent dust contamination, scratches, bending and other damages.
- When a disc becomes dirty, clean it with a cleaning cloth. Wipe the disc from the centre out. Do not use solvents, such as benzine, thinner, commercially available cleaners, or anti-static fluids. Using fluids of these types may damage the disc.
- Blank discs are available separately through your dealer or other sources.
- To get the best operating environment for your drive, you should close your PC after installing the drive. In this way the central fan will help cool your drive and keep performance according to specifications.
- Unloading a disc after recording might take some time, because the drive has to update the TOC before the disc can be ejected.

# V. ADDITIONAL INFORMATION

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## Emergency Eject

In case of power failure or if the tray of your CD-R/RW Drive won't open using the Open/Close button or your software, you may have to manually eject the tray.

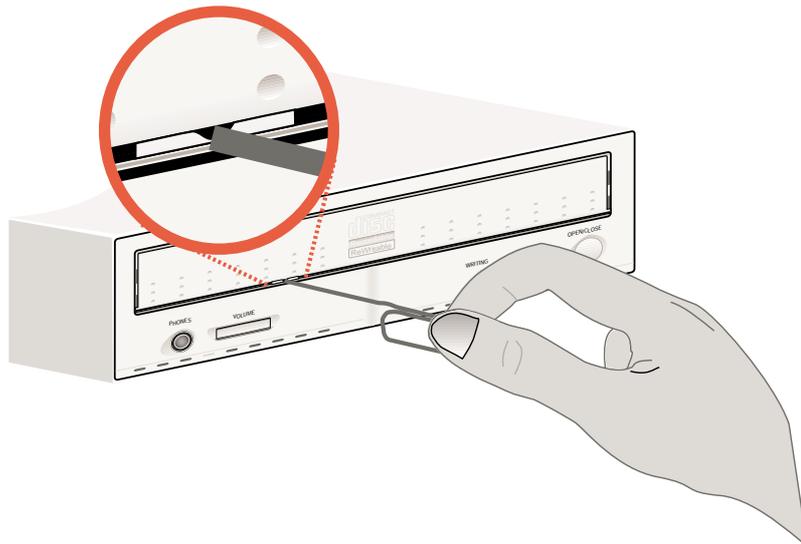
**NOTE:** Use the manual method only when necessary or as a last resort. Do not use this method in lieu of the Open/Close button when, for example, you forgot to eject the tray while the computer is on. Turn your computer back on to eject the tray, if possible.

To manually eject the tray:

1. Turn off your computer.

**WARNING!** If you don't turn off your computer before you attempt to eject the tray using the steps below, you may damage your CD-R/RW Drive.

2. Locate the **Emergency Eject** hole of your CD-R/RW Drive. See **ASUS CD-R/RW Drive Parts** for the location or *see* illustration below.
3. Insert the end of a large straightened paper clip about 3 cm (1.25 inches) into the **Emergency Eject** hole.



4. Push gently but firmly until the disc tray door is released, then carefully pull the tray open.

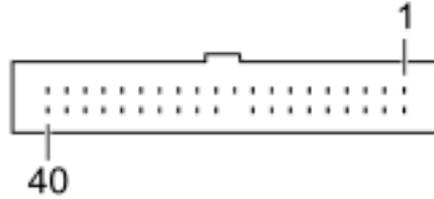
**WARNING!** Do not force the tray open; wait until the paper clip has dislodged it to be sure you don't break the tray's front.

5. Remove the CD disc, turn on your computer, and press the Open/Close button of your CD-R/RW Drive to see if it is working properly.

**NOTE:** If ejecting the tray using a paper clip does not work, your CD-R/RW Drive may be damaged. Contact your dealer for further assistance.

# V. ADDITIONAL INFORMATION

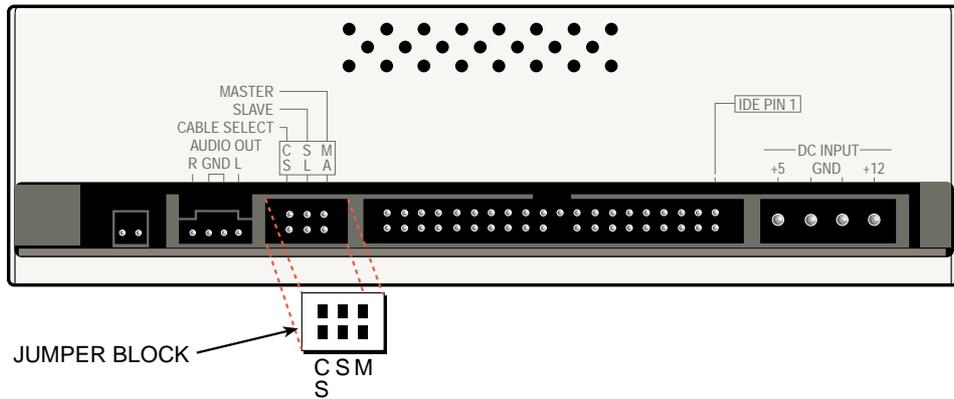
## Interface Pin Table



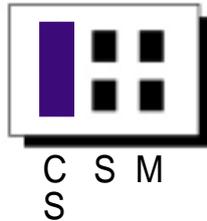
Signal	Pin Number	Signal	Pin Number
RESET	01	DMA REQUEST	21
GROUND	02	GROUND	22
-DB(7)	03	I/O WRITE	23
-DB(8)	04	GROUND	24
-DB(6)	05	I/O READ	25
-DB(9)	06	GROUND	26
-DB(5)	07	I/O READY	27
-DB(10)	08	SPSYNC:CSEL	28
-DB(4)	09	DMACK-	29
-DB(11)	10	GROUND	30
-DB(3)	11	INTRQ	31
-DB(12)	12	16 BIT I/O	32
-DB(2)	13	DA1	33
-DB(13)	14	PDIAG-	34
-DB(1)	15	DA0	35
-DB(14)	16	DA2	36
-DB(0)	17	CHIP SELECT 0	37
-DB(15)	18	CHIP SELECT 1	38
GROUND	19	DASP-	39
Removed	20	GROUND	40

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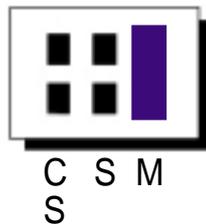
## Jumper Block



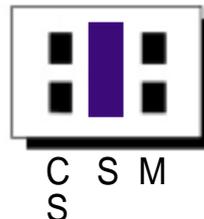
- When a shorting jumper is in the “CS” (CSEL) position, the device will use the host interface signal CSEL to configure the device.



- When the shorting jumper is placed in the “M” (MASTER) or “S” (SLAVE), the drive will be configured accordingly.



or



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## Auto Selftest

- The auto selftest will execute a number of diagnostic tests and will be activated by pushing and holding Open/Close button for one complete Open/Close cycle of the tray.
- The auto selftest can also be executed by holding the Open/Close button for about 4 seconds during power-up.
- The disc-in LED and the write-LED will be tested before the actual selftest:
  - The disc-in LED will flash three times: The first time RED, the second time GREEN and the last time ORANGE.
  - The write-LED will flash ORANGE.

This is repeated once.

- During execution of a particular test 0, the right LED is ORANGE. After execution of this test, the right LED will flash a number of times.

If this part of the test failed, then the LED will flash RED a number of times. The number of flashes, corresponds to the sequence number of the test.

- In case of a failing selftest, it may helpful to report the number of the failing test.

**Example:** Execution of Test 4

- Disc-in LED is ORANGE
  - Test 4 is being executed
- Disc-in LED flashes 4 times GREEN
  - Test 4 is executed successfully

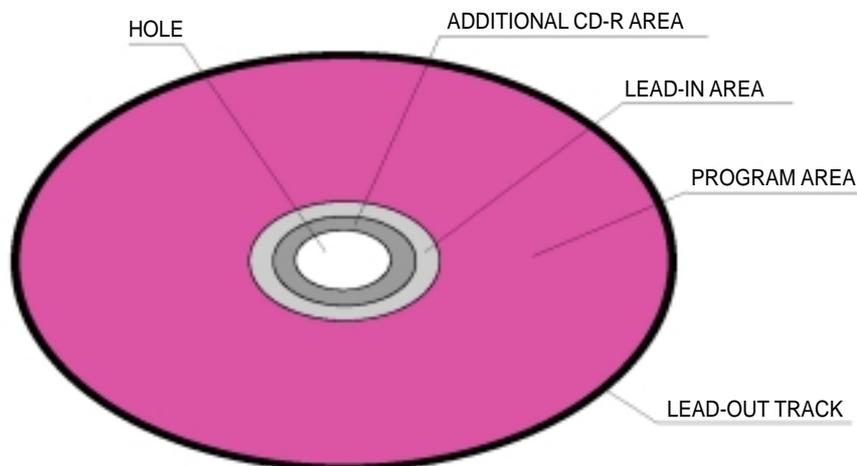
or

- Disc-in LED flashes 4 times RED
  - Test 4 failed
- After completion of the whole selftest, a final indication of the testresults will be given: The LED will flash GREEN-ORANGE for about 3 seconds if the test is successful. Otherwise, the LED will be RED until a new command has to be executed.

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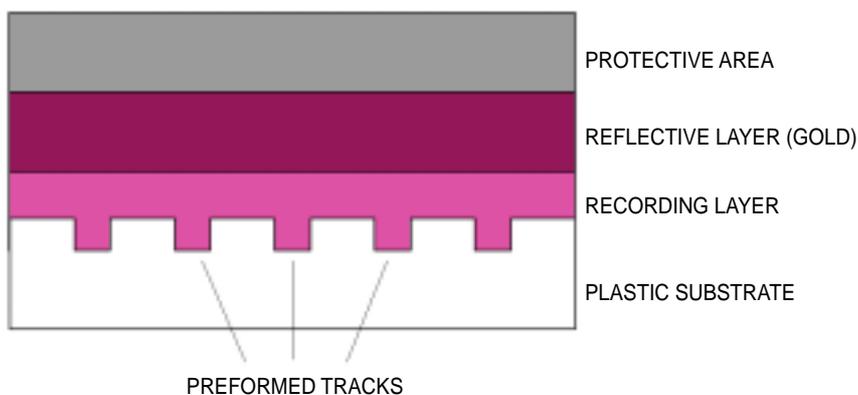
### Basic Principles of CD-R and CD-RW Media

A blank CD-R or CD-RW disc is divided into areas (*see* illustration below). This differs from a prerecorded disc by the additional CD-R/RW area, which lies in front of the lead-in area.



### A Cross-section: A CD-R Disc

A disc comprises different layers.



- Transparent plastic material (the same as conventional CDs) is used as the substrate.
- Onto this a special greenish tinged translucent layer is applied. The substrate has already been provided with a preformed track spiral into which the data will be written during recording.
- On top of the green recording layer is a reflective gold layer and a protective layer of plastic material.

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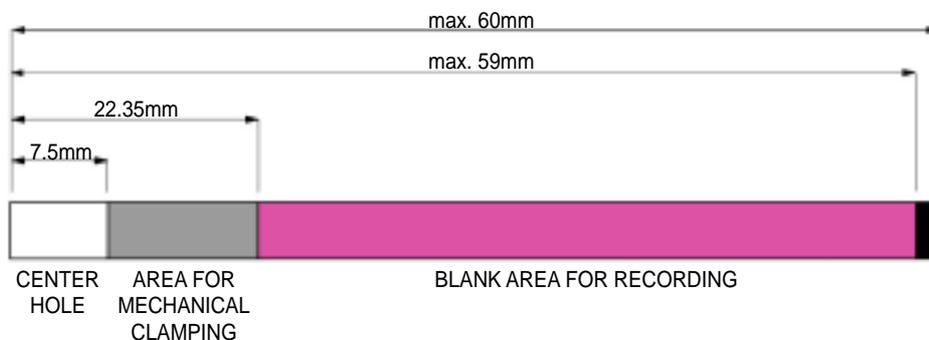
## The Additional CD-R/RW Area of a CD-R and CD-RW Disc

The additional CD-R/RW area is divided into two areas:

- The Program Memory Area (PMA) which mainly contains the track numbers of the tracks recorded with respective start and stop points.
- The Program Calibration Area (PCA). Disc space for the CD writer to calibrate the laser energy needed for recording on the disc by means of a trial recording.

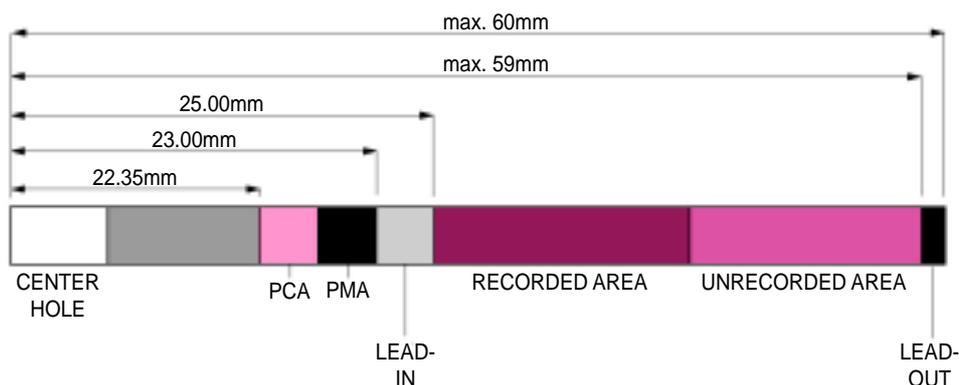
### A Cross-section: Blank CD-R or CD-RW Disc

Next to the centre hole is an area for the mechanical clamping of the disc in the player. Adjacent to this is the unrecorded area of the blank CD-R or CD-RW disc.



### A Cross-section: Partially Recorded CD-R or CD-RW Disc

After the first recording the recording area is divided (*see figure below*).



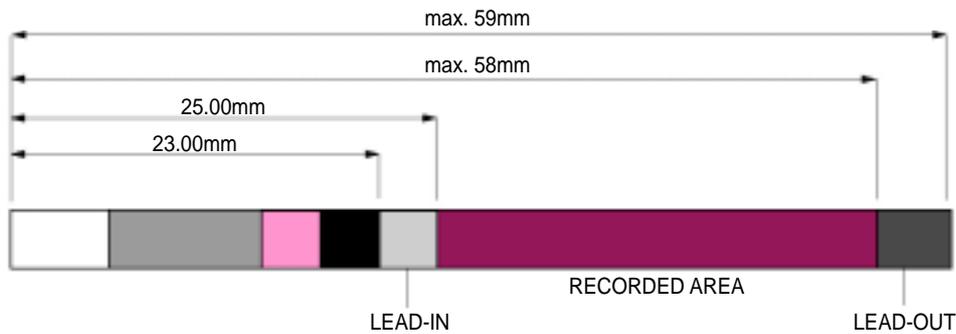
- The “Lead-in”, “program area” and “Lead-out” areas are present on every conventional prerecorded CD.
- For the partially recorded CD-R or CD-RW disc, the PCA and PMA areas are incorporated in front of the Lead-in.
- Track numbers with associated absolute start and stop times are stored in the PMA.

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The possibility exists of making further recordings later. It would also be possible to declare the disc as fully recorded. In which case, the definitive table of contents (TOC) is written into the Lead-in.

## A Cross-section: Fully Recorded CD-R or CD-RW Disc

The fully recorded CD-R or CD-RW disc has a program of 74 or 80 minutes playing time, a lead-in area with table of contents and a lead-out area.



- The areas specific to the CD recorder, the PCA and PMA, are still present but are simply not used by conventional CD players.
- When the lead-in area is provided with the table of contents, the CD recorder uses the information stored here and not the data from the PMA area.
- Identification of the end of the disc is stored in the Lead-out. The CD player stops playback of a disc when reaching this area.

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## CD-RW

### The Best Way to Create Your Own CDs

#### —With Re-usable CD-RW

- CD-ReWritable (CD-RW) gives you the opportunity to create your own CDs, in the best and most cost-effective way. CD-RW is, in fact, the logical extension of CD-Recordable (CD-R). Together, they give you the opportunity to run the media that best suits the job in hand.
- CD-RW supports the recording of small packages of data, using incremental packet writing in the universal (UDF) file format. As with floppy discs, you have the option of writing a disc all at once, or building it up bit by bit - and re-using the disc later for other data.
- CD-RW media can be rewritten hundreds, or even thousands of times. This means that the overall running costs, for hardware and software together, can be very economical indeed.
- CD-RW will greatly extend your personal short-term storage capacity, providing space for large-volume files like Internet downloads, backups, and hard disc dumps. It is also excellent for low-quantity multimedia applications, from one-off disc testing to small-scale distribution.

### Multiread: Making CD-RW Media Compatible with CD-ROM and DVD-ROM

- CD-RW media reflects less laser light than the other CD media. To play all CD media, drives must be able to adapt to these different reflectivities.
- For compatibility, drives need to do this in a standard way. They also need to interface and interact with their host computer systems in a standard way.
- That standard way is MultiRead. And any CD drive can play all CD media—CD-Digital Audio, CD-ROM, CD-R, and CD-RW—provided that it supports MultiRead.
- What is more, MultiRead extends the same compatibility to DVD. All DVD equipment that supports MultiRead will also be able to retrieve CD-RW data. This means that you can go ahead now with storing valuable data on CD-RW media, safe in the knowledge that it will be future-proof.

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## CD-R

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### What is CD-Recordable?

- CD-Recordable is compact disc technology that allows the user to create their own CD's. This is done by means of a recording system that uses “Write once” type optical discs and documented in the “Orange Book, Part II” and a CD recording device that is connected to a host system.

Typically, the host system is a personal computer that also contains recording software.

### What is the Orange Book?

- The Orange Book is a document that describes the specification for CD-Write Once (CD-Recordable) technology.
- It defines both the physical structure and dimensions of a CD-R disc as well as the use of certain portions of the recording surface:
  - To record information (the Program area),
  - To calibrate the recorder laser power (Power Calibration area or PCA),
  - To record track information for all sessions (the Program Memory area or PMA),
  - To record the Lead-in Lead-out areas that precede and follow, respectively, the Program area.
- There are several “parts” to the Orange Book. Part II refers to CD-Recordable.

### What does Orange Book-certified Media Mean and Why?

- The Orange Book, Part II is the primary specification for CD-R media. Accordingly, all CD-R media should meet the Orange Book criteria for recordability and playback.
- Philips and Sony, the originators of the Orange Book, provide Orange Book certification of CD-R media.

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## What is Multisession CD?

The principal purpose of multiple sessions is to allow additional data to be appended to a previously recorded disc.

**NOTE:** Some older cd readers can read only the first session of a multisession disc.

A session is defined as an area including lead-in, program data and lead-out.

- A CD-R recorder that supports multisession recording can write a disc that will have multiple sessions linked together, each containing their own lead-in, program and lead out.
- Any multisession-supported CD reader can access the data, whether it was written in the first session or a subsequent session.

Contrast this to the recording structure of a pressed CD-ROM or a CD-R written in “Disc at Once” mode that contains just one lead-in area and one lead-out area.

## What is the Recording Speed of CD-R?

The “speed” rating of a CD-Recordable/Rewritable determines how fast it can record data to blank CD-R media.

Speed designators, such as “1X”, “2X”, “4X” and “6X” define multiples of the original playback speed of first generation CD-ROM players:

- For a CD-ROM player or CD-Recordable/Rewritable, a 1X speed translates to 153,600 Bytes per second. This is usually rounded down to 150 Kb per second. Therefore, a “1X” recorder writes 150 Kb per second to the CD-R media.
- Likewise, a “4X” recorder records at 600 Kb per second.

- NOTES:**
1. There are some variations in measuring speed, because there are recording modes that provide more than 2,048 data bytes per block (audio is recorded at 2,352 bytes per block).
  2. Some CD-Recordable/Rewritables have a different reading speed than their rated recording speed. For instance, a “4x4x32” CD-Recordable/Rewritable can write at 4x speed and read back at 32x speed.

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## Compact Disc Average Transfer Rates

- NOTES:**
1. The normal CD (at n=1) transfer rate from the disc is 75 blocks per second.
  2. The average transfer rates shown are in Bytes Per Second.

Read/Write Speed	Audio (2,352 Bytes/Block)	CD-ROM Mode 1 (2,048 Bytes/Block)	CD-ROM Mode 2 (2,336 Bytes/Block)
1X	176,000	153,600	175,200
2X	352,800	307,200	350,400
4X	705,800	614,400	700,800
8X	1,411,200	1,228,800	1,401,600
24X	4,233,600	3,686,400	4,204,800
32X	5,644,800	4,915,200	5,606,400

## What is the Difference Between CD-R “Fixation” And “Finalization”?

- Fixation is the process of writing the lead-in and lead-out information to the disc. This process finishes a writing session and creates a table of contents.
- Fixation is required for a CD-ROM or CD-Audio player to play the disc. Discs which are “fixated for append” can have additional sessions recorded, with their own session lead-in and lead-out, creating a multisession disc.
- When a disc is “finalized” the absolute lead-in and lead-out for the entire disc is written, along with information, which tells the reader not to look for subsequent sessions.

This final table of contents (TOC) conforms to the ISO 9660 file standard.

## What is “Disc At Once”?

- Disc at Once is a writing mode that requires data to be written continuously, without any interruptions, until the entire data set is transferred to the CD-R.
- The lead-in, program and lead-out are written in a single event. All of the information to be recorded needs to be staged on the computer’s hard disc prior to recording in the Disc at Once mode.
- This mode is usually preferred for discs that are sent to a CD-ROM replication facility when CD-R is the source media.

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- Recording in the Disc at Once mode eliminates the linking and run-in and run-out blocks associated with multisession and packet recording modes, which often are interpreted as uncorrectable errors during the glass mastering process.

## What is “Track At Once”?

- Track at Once is a writing mode that allows a session to be written in a number of discrete write events, called tracks.
- The disc may be removed from the writer and read in another writer (given proper software) before the session is fixated.

The written sessions contain complete “tracks” of information.

## What is “Incremental” or “Packet” Writing?

- Track at Once writing is a form of incremental write which mandates a minimum track length of 300 blocks and a maximum of 99 tracks per disc.
- A track written “at once” has 150 blocks of overhead for run-in, run-out, pre-gap and linking. Packet write, on the other hand, is a method whereby several write events are allowed within a track, thus reducing the overhead.

These “packets” are bounded by 7 blocks for run-in (4), run-out (2) and link (1).

## What is the Difference Between a “Multisession” Disc and a “Multitrack” Disc?

- A “session” is a unity on a CD which is bounded by lead-in and lead-out. A session contains one or several (up to 99 per disc) tracks.
- There are two types of tracks. A Red Book audio track is usually written in disc at once mode along with several other tracks in one session. These tracks have index numbers in the subchannel which differentiate one from the other and which allow selective playback.
- The other type of track is the incrementally written type described above.