



DiscJuggler™

User's Guide

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Welcome

Welcome to **DiscJuggler**, the first professional, software-only Compact Disc Duplication application for CD-Recordable drives. **DiscJuggler** supports the Windows 95, Windows 98, and Windows NT operating systems. Its feature set is designed to provide CD-R drive owners with a comprehensive set of CD duplication functions and a simple and straightforward user interface. The focus of the CD duplication features of **DiscJuggler** is to make duplicates of most existing standard Compact Discs as fast, easy, and reliable as possible.



About This User's Guide

This user's guide describes how to install and use **DiscJuggler**, including the following information:

- The first chapter, "Introduction", introduces the product and an overview of conceptual and legal issues involved in CD duplication.
- The second chapter, "Getting started", describes the application feature set, the hardware and software requirements for using the program, hardware installation procedures, and troubleshooting information.
- The third chapter, "Copying Compact Discs", presents procedures for duplicating CDs and creating CD Image files in a variety of formats.
- The fourth chapter, "**DiscJuggler** Options", contains a detailed description of all application options.
- The sixth chapter, "**DiscJuggler** Explorer ", contains a detailed description of windows and menu commands.
- The fifth chapter, "**DiscJuggler** Commands Reference ", contains a detailed description of drive properties and capabilities.
- The seventh chapter, "Advanced Concepts", presents a brief introduction to CD technology and CD recording basics.
- The eighth chapter, "Appendices", consists of addendums covering: an introduction to additional CD-ROM and CD Recorders such as juke-boxes and autoloaders, a troubleshooting section, a detailed list of **DiscJuggler** error messages and a complete glossary of terms.



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Padus Incorporated is a privately held firm with headquarters in San Jose, California. With a creative and innovative approach to software development, Padus is focused not only on CD duplication, but also on other optical disc technologies, including CD and DVD mastering, data and multimedia publishing, archiving and retrieval solutions for the industry, business and end-users.

Padus' mission is to deliver professional multimedia products and technologies at reasonable prices. With more than a decade of staff experience in the optical media field, Padus' entire team is committed to the long-term satisfaction of our customers.



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DiscJuggler™

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Getting Started

This section provides information that you should know before working with **DiscJuggler**:

- *Introduction to Compact Discs*
- *System Requirements*
- *Features*
- *Preparing your System*
- *SCSI Interface*
- *IDE Interface*
- *System Setup Tips*
- *The Dongle*
- *Installation & Setup*
- *Starting the Application*
- *Technical Support*



Introduction to Compact Discs

Digital Audio Compact Discs (CD-DA) were first introduced to the consumer audio market in 1980 by Philips and Sony as an alternative to existing records and cassettes. In 1984, Philips and Sony extended the technology to include data storage and retrieval and introduced a new format: the Data Compact Disc (CD-ROM).

Since then, the Compact Disc has dramatically changed the way that we listen music and handle electronic information. With a capacity of 650 megabytes of computer data or 74 minutes of high quality audio, the Compact Disc has revolutionized the distribution of every kind of electronic information.

In 1990, Philips and Sony extended the technology again and the Compact Disc included recordable (CD-R). Before the introduction of the CD-R technology, compact discs were produced in commercial replication plants by stamping the media with a pre-recorded master. Today, discs are produced in replication plants large quantities are required. For small production volumes (up to 300 copies and more, depending on your location and the manufacturers in your market), it can be significantly less expensive to master your own discs using commercially available compact disc recorders.

DiscJuggler is designed to facilitate this task, making the in-house production of small quantities of compact discs as simple and convenient as possible.

Whether a compact disc was stamped at a replication facility or "burned" using a compact disc recorder, it, theoretically, can be read by any available CD-ROM drive. In practice, sometimes, certain usually inexpensive media, and CD players do not work very well together. Only the physical composition of a commercially replicated disc and a CD-R disc is different. The former is coated with a reflective layer of aluminum resulting in a typical silver color. The latter is coated with a thin golden layer resulting in a typical gold color (although, recently, blue, silver, and green CD-R discs have come on the market).

For a more detailed description of Compact Disc technology, see the "Advanced Concepts" chapter.



System Requirements

For successful and reliable use of **DiscJuggler**, you need at least:

- A Pentium class PC of 133 MHz or more running Windows 95, Windows 98, or Windows NT 4.x.
- A 3.5 inch floppy disk drive for installation.
- 16 MB of RAM (32 MB or more recommended).
- A fast, non re-calibrating hard disk (average access time should be less than 15 msec, transfer rate greater than 600 kilobytes per second), large enough to hold your application executables and data (a complete 74 minute Compact Disc image requires between 650 and 780 MB of disk space). Note: most high-quality hard disks manufactured in the last two years are not re-calibrating.
- A bus-mastering IDE/ATAPI device driver if using an IDE CD-ROM drive or CD Recorder (recommended).
- One or more bus-mastering SCSI host adapters (see Support on our web site for a list of supported models and how many recorders of each type per bus) if you are using SCSI devices.
- One or more supported CD-ROM drives (duplication of audio CDs requires a drive capable of transferring audio data over the data bus). See Release Notes or our web site at www.padus.com for a list of supported drives.
- One or more supported CD Recorders of the same type, meaning the same model and firmware (please see our web site, www.padus.com, for current recommendations on the number of recorders per bus). See www.padus.com for a list of currently supported recorders.



Features

- Direct digital-to-digital copying of Compact Discs over the SCSI bus, "on-the-fly" or cached to hard disk, using a variety of popular CD-ROM drives and CD Recorders.
- Support for writing to multiple CD-R drives simultaneously. The number of drives is limited by system performance, a particular CD recorder's characteristics, and the number of SCSI host adapters.
- Support for IDE/ATAPI CD Recorders and CD-ROM drives.
- Support for autoloaders and jukeboxes, devices that automatically load discs to be read and copied (selected versions only).
- Support for the following CD Duplication tasks:
 - Copy using the same CD Recorder as the source and destination drive.
 - Copy CD-ROM directly to CD Recorder.
 - Copy CD-ROM to CD Image file.
 - Copy CD Image file to CD Recorder (supports CD Image files created by **DiscJuggler** or any CD Premastering application).
 - CD Erase (for rewritable discs with R/W recorders)
- Supported CD formats:
 - Audio CD.
 - Data CD (CD-ROM, Yellow Book Mode 1).
 - Data CD (XA format).
 - Mixed mode CD (Data + Audio).
 - CD-i Bridge format CD (Photo-CD, Video-CD).
 - Multisession CD-R and pressed multisession CDs (Enhanced CD, Blue Book).
 - CD+G/ Karaoke (where supported by CD-ROM drive and recorder).

- Some game CDs (this ability may be subject to the copy prevention technology employed by some game devices and CDs).
- Rewritable compact disc (CD-RW).
- Disc At Once (DAO) and Track At Once (TAO) recording.
- "On-the-fly" sector cooking with software regeneration of error correction and detection (ECC/EDC) fields and data scrambling so that even some errors in the original CD are automatically corrected.
- Support for most ATAPI and SCSI CD-Readers and CD Recorders. Note: some readers are not fully ATAPI-compliant and are not possible to use for duplication.
- An intuitive, easy-to-use interface for both novice and expert users.
- Comprehensive Windows help for all program features.
- Test feature to perform a simulated write (hardware pseudo-write) to the CD Recorder. Provides analysis of system data throughput capabilities and aids selection of optimal recording speed and RAM/hard disk caching options.
- Verify feature performs a low-level compare of source CD and destination CD-R to ensure that all duplicated discs are 100% identical to the source CD or CD Image file. Audio discs are verified during copy.
- Sophisticated audio read resynchronization and CD Reader speed control capabilities for excellent reliability in Compact Disc Digital Audio (CD-DA) duplication. Advanced "redundant" audio resynchronization mode attempts "frame accurate" duplication of audio CDs for the most demanding professional applications.
- Optional hard disk caching recording method provides very reliable recording at all recording speeds, even on slower systems. When hard disk caching is enabled, DiscJuggler creates a temporary CD Image file as the first step of the duplication process, transfers the CD Image file to the CD Recorder automatically, then deletes the CD Image file.
- Support for transfer of ISRC/UPC information, PQ index points and R-W subcode information to duplicated discs (where supported by CD-ROM readers and CD Recorders).

- Support for saving of duplication tasks as document files and subsequent use to control duplication operations. Support for multiple CD duplication tasks running simultaneously.
- Powerful status and error reporting capability.
- Control of reading speed for potentially more accurate Digital Audio Extraction (DAE).
- Support for “overburn” (recording beyond a discs standard capacity) where supported by recorder and media and truncation.
- Support for CD-Text (where supported by recorder and reader).
- Explorer function graphically shows information about all compact disc devices and their contents



Preparing your System

It is important that, before installing **DiscJuggler**, you make sure your system is properly configured and meets all the "System Requirements" previously described. Particular emphasis should be put on the SCSI and/or IDE/ATAPI sub-system configuration because these buses are crucial to the success of the entire CD duplication process. The speed of these interfaces is an important element to consider when recording compact discs. If information is not transferred fast enough to the recorder, errors may occur that could ruin the CD-R disc.

DiscJuggler "talks" to SCSI and IDE/ATAPI buses through a software layer called "ASPI" that normally comes with your interface card or premastering software. Particular care should be paid to ensure that this software is installed on your system as described in the installation instructions.



SCSI Interface

SCSI (pronounced "skuh-zee") is an acronym for the Small Computer Systems Interface. This interface is an American National Standards Institute (ANSI) standard for high-speed parallel data communication between computers and their peripheral devices. SCSI allows you to connect, using a technique known as "daisy chaining," up to seven (SCSI 1 & 2) or fifteen (SCSI 3) different SCSI-compliant devices to one SCSI connection in your computer. The SCSI connection is made via a SCSI host adapter. SCSI devices that are commonly used with computers include hard disk drives, tape drives, CD-ROM drives, removable cartridge drives, CD Recorders, juke boxes, scanners, and printers. The disconnect option must be enabled for all system SCSI devices and cards.

The scope of this manual does not include a detailed description of the SCSI standard. For more information, please refer to the documentation provided with your computer and SCSI host adapter.



IDE Interface

The IDE/ATAPI is a data interface that often is provided by PC manufacturers and, is generally included when you purchase a new computer. Usually, the computer motherboard comes with a primary and a secondary IDE bus. Up to two IDE/ATAPI devices, a master and a slave, can be connected to each bus.

Because this interface is less sophisticated than the SCSI one, ATAPI devices are usually more affordable. Note, however, that often IDE/ATAPI devices are slower and, particularly in case of CD-Readers, less accurate. If you are considering using **DiscJuggler** with multiple recorders, SCSI is the preferred bus.



System Setup Tips

The following rules are important to follow before you install **DiscJuggler**:

Windows NT:

1. Log-in with administrator privileges
2. Make sure "Autoinsert notification" is disabled. You can do that by setting the following value in the system registry:

`HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\Cdrom\Autorun = 0x00000000`
3. Using "Disk Administrator" unassign the drive letter of every CD-R drive not used as a CD-Reader.
4. Install the latest ASPI shell (available at Padus web site).
5. If you plan to use an IDE drive, install a bus-mastering IDE device (link available at the Padus web site).
6. Install the latest Windows NT 4.x service pack (available at the Microsoft web site).
7. Reboot the system.

Windows 95/98:

1. Open the "Control Panel" and click on the "System" icon. Select the "Device Manager" tab and click on the CD-ROM icon. For each CD-ROM device in the list do the following:
 1. Select the device.
 2. Select the "Settings" tab.
 3. Disable the "Auto Insert Notification" option.
 4. Enable the "Disconnect" option.
 5. Enable the "Sync Data Transfer" option.
 6. Enable the "DMA" option (if available).

If you add a CD-ROM device to your system or change the ID of an existing device, make sure you re-check all settings.

2. Install the latest Windows 95 or Windows 98 service pack (at Microsoft web site).
3. Reboot the system.

The following are some general rules to help you avoid system configuration problems:

- When you install a new SCSI device, check its address (SCSI ID) to make sure another device in the same chain is not already using that address. Having more than two terminators in a SCSI chain can cause start-up problems, data transmission errors, and possible hardware damage.
- Always make sure that power is off on your computer and on all SCSI and IDE devices when connecting or removing a SCSI or IDE device.
- Always use good quality SCSI and IDE cables.
- Avoid individual SCSI cables longer than six feet, and try to keep the total length of cabling in every single SCSI chain below 15 feet. If you absolutely must have long cabling runs, use an active terminator to boost and clean up signals on the SCSI bus.
- Make sure all the SCSI buses in the system are properly terminated. Only the first and the last device in the chain must be terminated. If the SCSI host adapter is the last device on the chain, make sure it is terminated. Terminators may be internal or external. External terminators are small plugs that attach to the rear-panel of a device. Internal terminators are usually installed on the main circuit board of the SCSI device. Some internally terminated devices provide switches that let you switch the internal terminators on or off.
- If you mix and match narrow (8 bit) and wide (16 bit) SCSI devices on the same SCSI bus, move all the wide devices to the end of the chain and make sure the last device is terminated.
- Use only good quality bus mastering SCSI PCI-bus host adapters.
- If you have more than one SCSI bus, try to balance the SCSI load among all the buses and keep the CD Recorders separated from all the other SCSI devices attached to the system. Generally, you should not daisy chain more than five to six 2X CD Recorders or three to four 4X CD Recorders to the same SCSI bus.

- Periodically check the SCSI and/or IDE bus manufacturer's web page or BBS to download the latest mini-port device driver for the Windows NT, Windows 98, or Windows 95 operating systems.
- If you have a serially controlled device that contains a CD Recorder, **DiscJuggler** will associate the lowest serial port ID (COM port) with the lowest SCSI ID of a CD Recorder to maintain a relationship between the robotics and recorders. Make sure that the SCSI ID that you assign your recorder is consistent with the scheme.



The Dongle

Some **DiscJuggler** configurations, especially those with support for more than three CD Recorders, *may* require the presence of a hardware key (dongle) attached to the system. If the **DiscJuggler** package contains a dongle, please make sure that you properly connect it to a printer port of your computer. The dongle provides a printer port pass-through that you can use to connect a printer to the same port.



Installation & Setup

Once your system is properly configured with all devices functioning correctly, you can install **DiscJuggler**.

If you are installing **DiscJuggler** under Windows NT, make sure you have administrative privileges. Otherwise, Setup will not be able to change the system configuration. Ask your system administrator how to obtain administrative privileges.

To install **DiscJuggler**:

1. If you downloaded **DiscJuggler** from an on-line service like a Web, FTP site or a BBS, locate the CDJSI.EXE file in your system using the mouse and double-click the CDJSI.EXE icon.



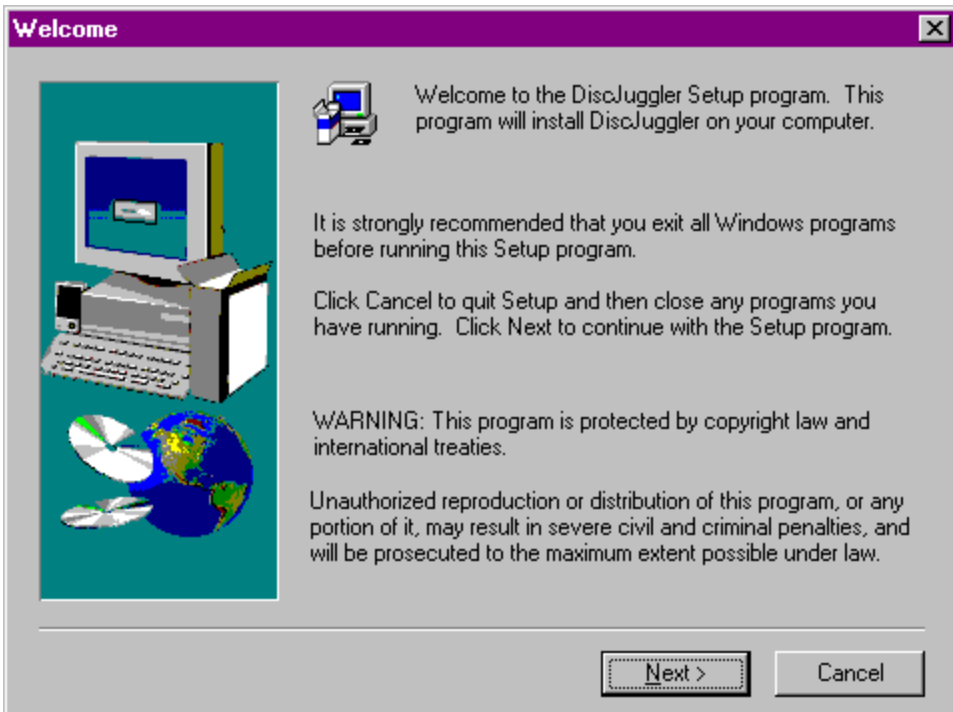
Skip to step 5 of this list to continue the installation of the on-line version of **DiscJuggler** or move to step 2 for instructions on a disk based installation.

2. Insert the **DiscJuggler** distribution floppy disk #1 into the floppy drive or the compact disc into your CD-ROM drive.
3. From the Start menu of the Task bar, choose the Run... command.
4. Enter the following, where "drive" represents the drive letter of your floppy or CD-ROM drive:

drive:\setup

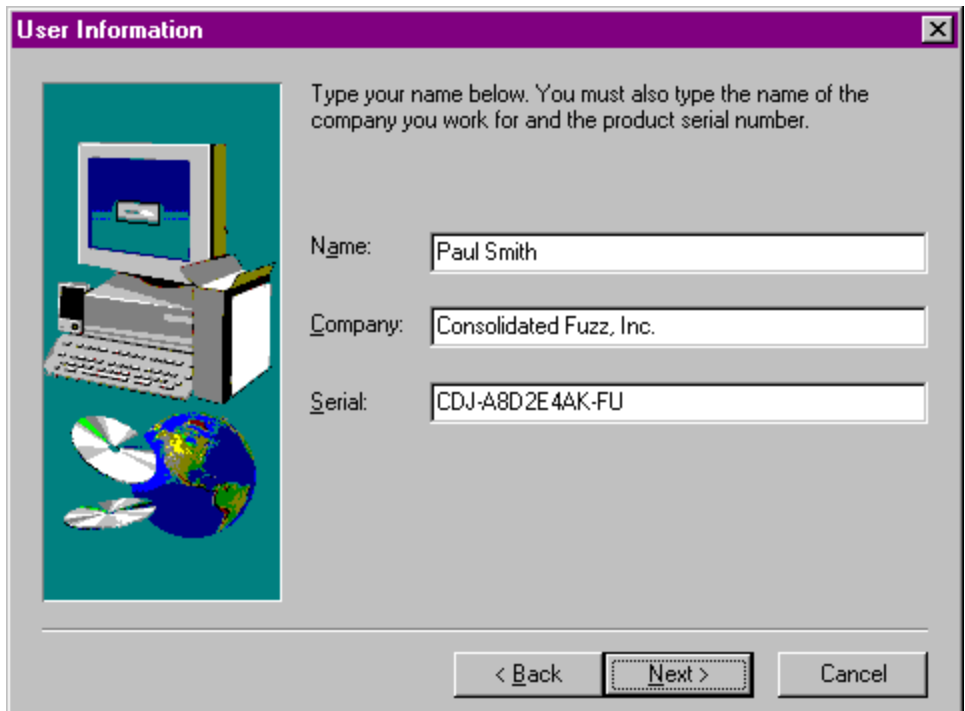
5. A "wizard-like" application will guide you through the entire installation process.

The setup wizard, wherever possible, will supply a default option for most selections. At any point of the setup, you can use the Next and Previous buttons to move back and forth through the entire installation process and customize the selections to best fit your needs.



Choose the Next button from the Welcome panel to move to the next step.

6. Please, carefully read the Software License and if you agree with all terms of the license, click the Agree button; this will enable the Next button and allow you to proceed to the User Registration window.
7. Enter your name, your organization (optional) and a registration key (the edit field is case sensitive) and press the Next button.



The image shows a Windows-style dialog box titled "User Information". On the left is a graphic of a computer monitor, keyboard, and CD-ROMs. On the right, there is instructional text and three input fields. The text says: "Type your name below. You must also type the name of the company you work for and the product serial number." The input fields are labeled "Name:", "Company:", and "Serial:". The "Name" field contains "Paul Smith", the "Company" field contains "Consolidated Fuzz, Inc.", and the "Serial" field contains "CDJ-A8D2E4AK-FU". At the bottom are three buttons: "< Back", "Next >" (which is highlighted with a dashed border), and "Cancel".

User Information

Type your name below. You must also type the name of the company you work for and the product serial number.

Name: Paul Smith

Company: Consolidated Fuzz, Inc.

Serial: CDJ-A8D2E4AK-FU

< Back **Next >** Cancel

DiscJuggler allows you to purchase support for the approximate number of CD Recorders you need.

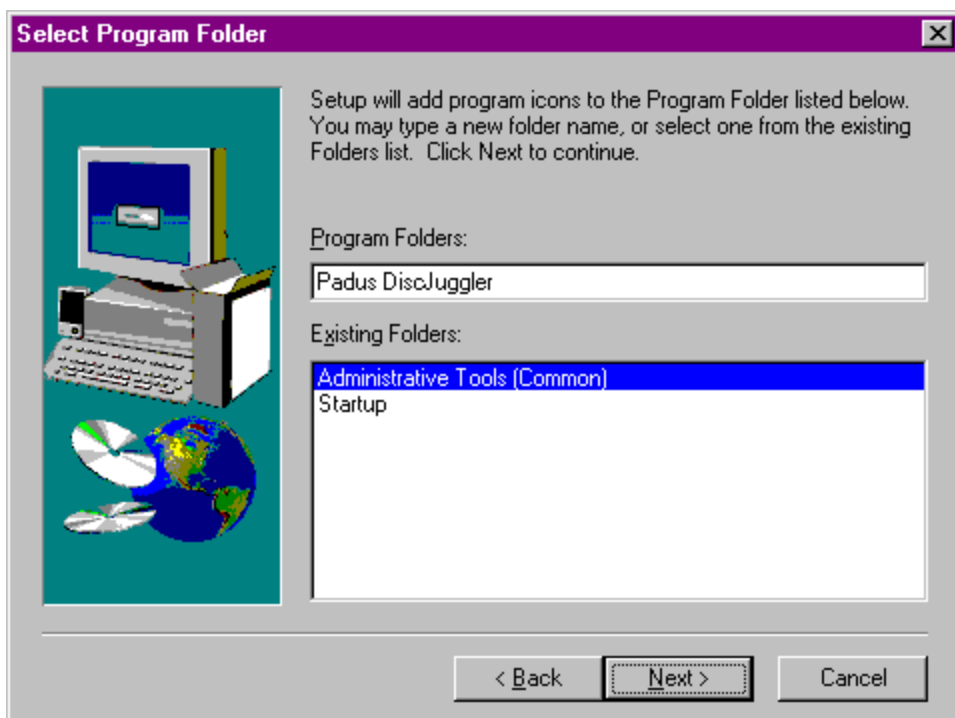
You can start immediately using **DiscJuggler** with your existing CD Recorder(s). Later, you may decide to daisy chain several new CD Recorders to your system:

call your dealer or Padus sales representative and ask to upgrade to a version of the software that supports the number of CD Recorders you have.

8. Choose the Next button to install DiscJuggler in the default directory. Alternatively, you can "browse" to the location in which you want **DiscJuggler** to be installed.

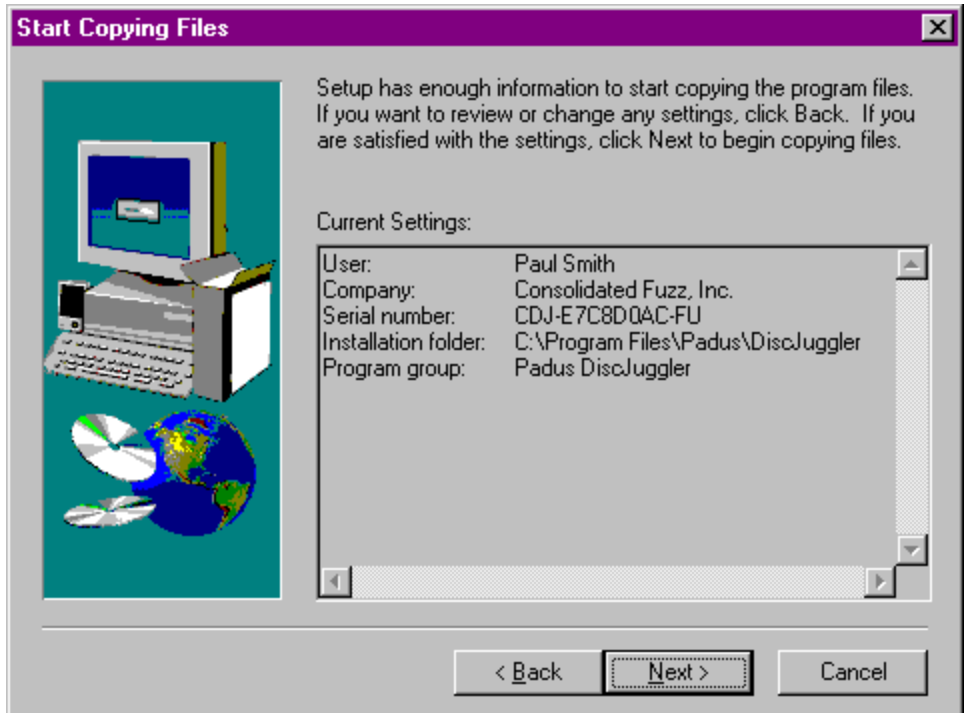
Choose the Next button to continue the installation process.

9. Setup allows you to choose the program group in which it will place the **DiscJuggler** program icons. Accept the default choice, pick or specify a program group name.

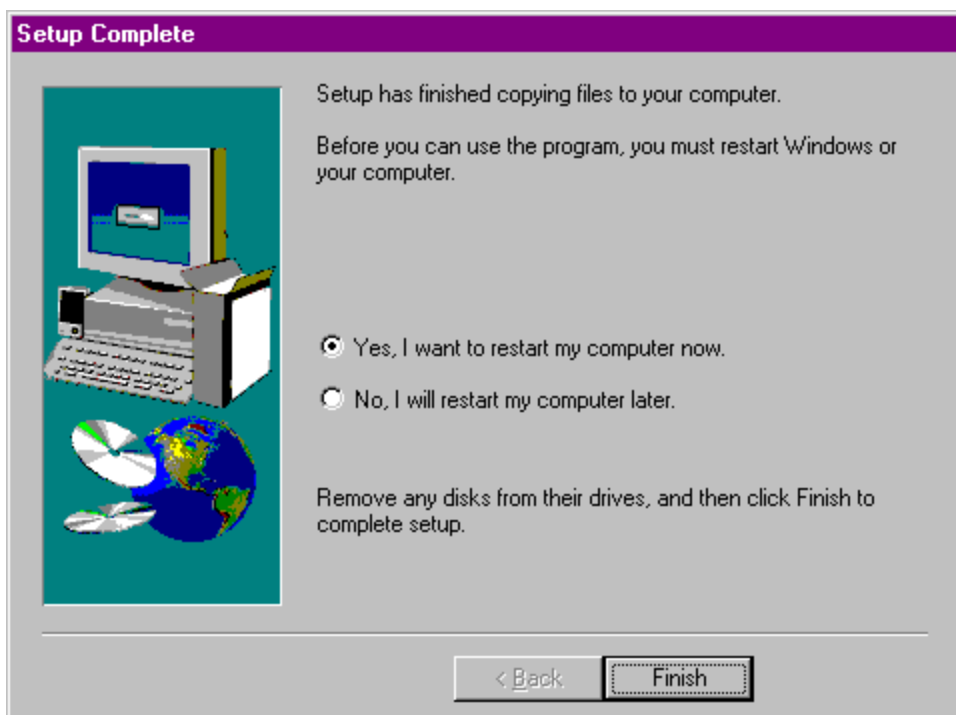


Choose the Next button to continue the installation process.

10. Please review all the installation parameters shown in this panel. If you are satisfied with the settings, choose the Next button to complete the installation.

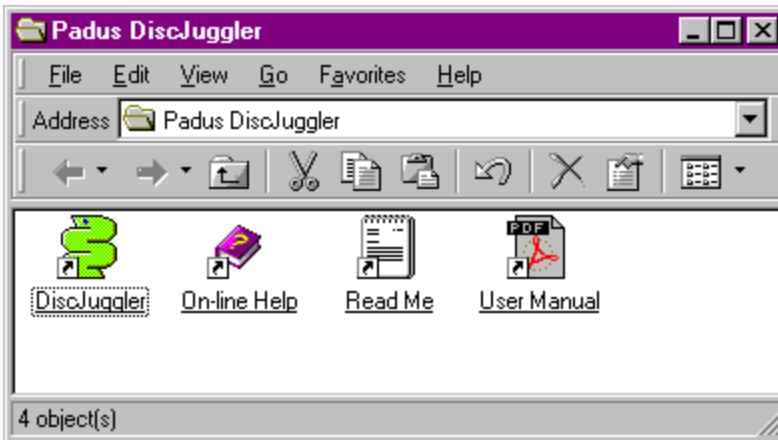


11. Setup starts copying application files to the installation directory and system files to the Windows system directory.
12. Once Setup has completed the installation of all necessary files, choose the Finish button to close Setup and complete the installation process. If necessary, Setup will ask you to restart the system for all the changes to take effect.



Starting the Application

After **DiscJuggler** has been installed on your system, a new program group should be presented on your desktop containing the application's icon.



To start **DiscJuggler**, double-click its application icon.



Technical Support

Padus supplies customer support with the products that we sell. If you encounter technical difficulties, our technical support staff will try to assist you in resolving your problem. In most cases, you will find the answers to problems in the documentation provided with your computer system or with **DiscJuggler**. You are strongly encouraged to contact Padus initially via e-mail with as much information as possible, including the log file demonstrating your problem.

Should you need to contact us for assistance, please use the following addresses (representatives are available from 9:30am to 6:00pm, Pacific Time, Monday through Friday):

Phone: (408) 377-0300

Fax: (408) 377-0303

E-mail: info@padus.com

WWW: <http://www.padus.com>

FTP: <ftp://ftp.padus.com>

Mail: **Padus, Inc.**
Technical Support
3880 South Bascom Ave., Suite 216
San Jose, CA 95124
USA

To help us solve your problems, please make sure you provide as much information as possible regarding your problem (for instance, hardware and software configuration, operating system release, software version and build, and any error messages displayed by **DiscJuggler**).

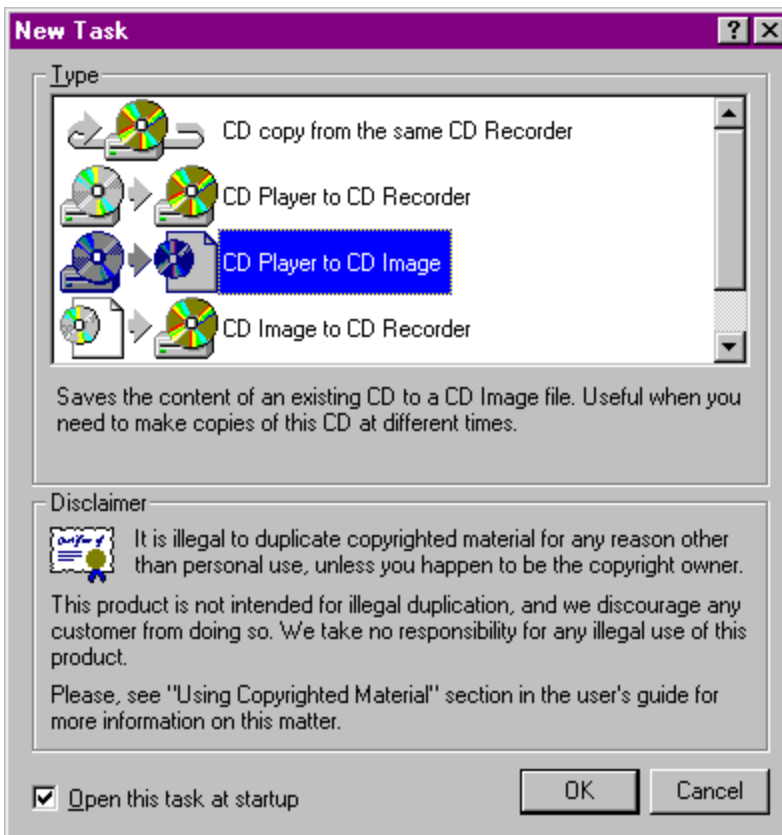
Always be sure to Export the log (.txt) file from the File menu after you experience a problem and include it and your serial number with your correspondence.



Copying Compact Discs

This section presents procedures to make **DiscJuggler** replicate existing CDs as well as generate new CDs from CD Images generated by **DiscJuggler** itself or other CD mastering applications.

DiscJuggler is a document-centric application, implementing a complete MDI (Multiple Document Interface) environment. Conceptually, **DiscJuggler** is similar to a word processor where you create a new document from an existing set of templates, edit it and then save it in a file format that can be opened and reused.



Like a word processor, **DiscJuggler** can create a new task from an existing set of templates (referred as "task plug-ins"), and it can program the task to perform a predetermined sequence of events to solve specific CD recording needs. The task can be saved in a file format that can be reopened to repeat the same programmed CD recording sequence.

DiscJuggler handles "task" documents instead of "document" documents. The definition of "task" in **DiscJuggler** is "a set of actions that need to be performed to complete a CD recording process."

- **Task list**

With the task list, you can choose the task to perform. As you select a task to perform, a detailed description of the task is displayed. Currently, five task templates are available (we use the term "CD Recorder" to indicate any CD recording device, including a recorder, autoloader, or jukebox):

- *Automatically Copy to the Same CD Recorder*

This task automatically copies a CD using the same CD Recorder as both reader and writer. This task type is useful when there is no other supported CD-ROM drive available, when the recorder is supported as both a reader and a writer, or when a CD autoloader device or jukebox is being used.

- *CD Player to CD Recorders*

This task directly copies a CD from a CD-ROM drive to one or more CD Recorders with no intermediate steps. This is the quickest and easiest way to duplicate a CD, but also the most system resource demanding.

- *CD Player to CD Image*

This task dumps the contents of an entire CD into a CD Image file on your hard disk. The image can be used later to generate multiple copies of the same disc at different times. This task, in conjunction with the next one, is also useful to duplicate a CD when the CD-ROM drive is slower than the CD Recorder.

- *CD Image File to CD Recorder*

This task writes a CD Image file created by **DiscJuggler** or other CD Premastering application to one or more CD Recorders.

- *Erase CD*

This task allows for the erasure of rewritable CDs as an independent task. One or multiple identical rewritable CD recorders can be used in this task.

- **Open this task at startup**

By checking this box, you instruct **DiscJuggler** to automatically open a document (of the same type as the selected task), every time the application is first launched. This feature is useful when you mostly use one only task type.

You can use the **New** command in the File menu to create a new task document at any time. A "New Task" window will appear allowing you to choose the type of task to perform.

As you use a task document, **DiscJuggler** saves a complete task log with detailed status and error report about the current CD recording process. You can export this log with the Export command in the File menu. Sending the log (.txt) file to Padus is extremely helpful for technical support.

A task document can be saved in file format with the commands **Save** and **Save As** in the **File** menu. The first time you save a document and each time you choose **Save As**, a standard **Save** dialog will prompt you for a new document name: the default task document extension is .CDJ.

The following data will be saved:

- Source device description.
- Target device(s) description.
- Detailed table of contents of each media duplicated.
- Time stamp of each recording process.
- Method, speed, and cache options used.
- Detailed list of errors generated during each recording process.

With the **Open** command from the **File** menu, you can reload in memory a previously saved task document. All previous settings, including source and target devices as well as cache and speed options, are preserved.

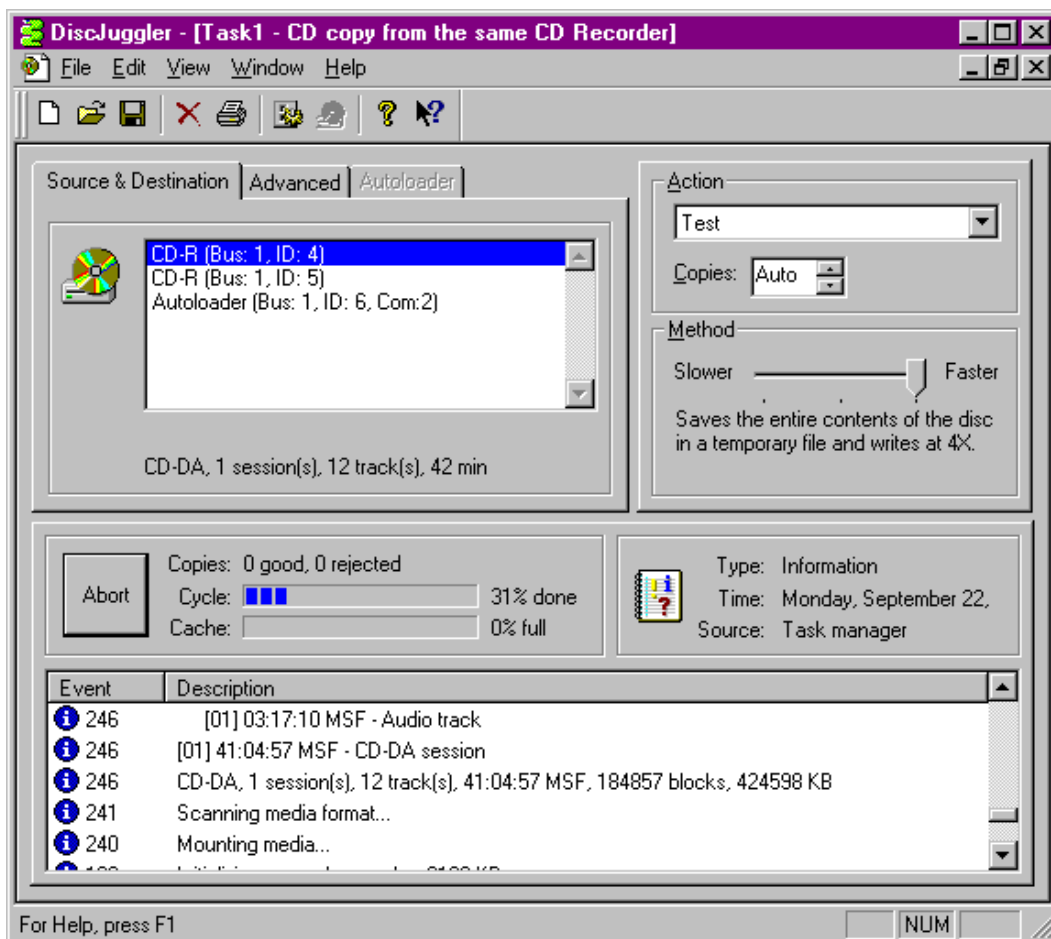
The **Print** command from the **File** menu will generate a complete task report and send it to the printer.

The **Export** command from the **File** menu will generate a complete task report (log file) and export it to a .txt file in ASCII text format.



Automatically Copy to the Same CD Recorder

This task allows the user to copy a CD to the same CD Recorder, using the recorder as both reader and writer. In addition to situations where there is no CD-ROM drive available, this task mode allows jukeboxes and autoloaders to function completely automatically without an additional reader, which is extremely useful for non-attended CD



duplication. When non-blank CDs are inserted into the jukebox or autoloader, **DiscJuggler** reads and maintains each non-blank CD as the effective duplication source until the next non-blank disc is detected. This disc then becomes the source; it will be duplicated on all the blank media until another non-blank disc.

When you select this task, **DiscJuggler** creates a new task document and displays its main window.

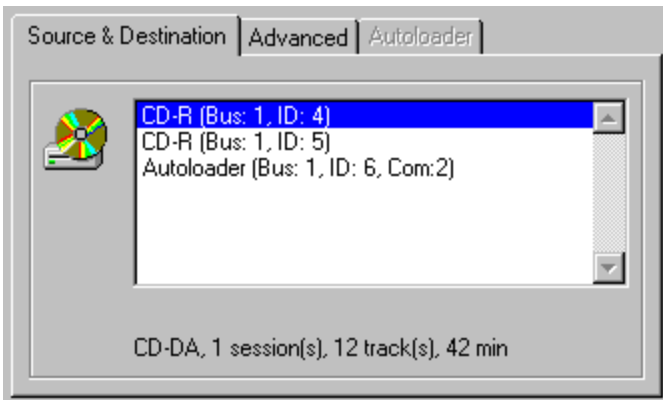
The task's main interface is subdivided into four major panels:

- *Source & Destination*
- *Advanced Panel*
- *Autoloader Panel*
- *Action/Method*
- *Status*



Source & Destination

Each time you execute **DiscJuggler**, it performs a full scan to identify all the supported recorders attached to the system. In the Source & Destination tab, when in Automatic Copy to the Same CD Recorder mode, all CD writers found that are suitable to be used as both input and output devices are listed. You can only select one recorder for this type of task.



In a newly created document, **DiscJuggler** will automatically select the first available CD Recorder. If the document task is being reopened, **DiscJuggler** will try to re-select the same recorder configuration in use when the document was last saved.

After a CD Recorder has been selected, **DiscJuggler** will continuously poll the selected device to read the table of contents (TOC) of the mounted media and display a short description of disc contents under the corresponding selected recorder.

DiscJuggler will not start a duplication session until a non-blank disc is mounted in the selected source CD Recorder.

- **Source & Destination**

Specifies the source CD Recorder drive where the disc to duplicate is mounted.

When the CD has been successfully mounted, **DiscJuggler** displays its contents (TOC) in a brief description at the bottom of the source frame. **DiscJuggler** will prompt for a blank disc at the appropriate time (after a complete image of the

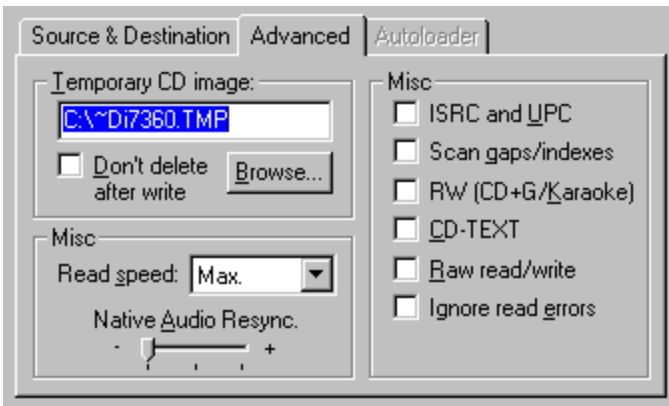
disc has been read to hard disk).

*Clicking on the CD-R icon will eject the medium mounted in the selected drive.
Clicking on the CD-R icon while pressing the <Ctrl> key will load, if possible, the
medium mounted in the selected drive.*



Advanced Panel

The advanced tab contains settings that don't usually need to be changed in a standard CD duplication process. All the controls are initialized to default values at document creation.



The following controls are available for specific duplication needs:

- **Temporary CD Image**

When copying to the same recording device from which the original was read, **DiscJuggler** must first cache the entire contents of the CD to your local hard disk and then send the CD Image file to the CD Recorder.

In addition, the CD Recorder should receive an uninterrupted flow of data for transfer to its internal RAM buffer (level 1 cache) at a speed equal to or greater than its recording speed. In the event the required data rate is not sustained, the CD Recorder will generate a "buffer underrun" error (empty level 1 cache) and the recordable disc will be ruined.

Caching the entire contents of the CD to your local hard disk before sending the CD Image file to the CD Recorder is a convenient way to make the duplication process more reliable (hard disks are usually 10 to 15 times faster than a CD-ROM drive).

See the "Compact Disc Recording & Data throughput" in the "Advanced

Concepts" Chapter for detailed information on CD recording data transfer requirements.

You can choose, from the Method panel, to temporarily cache the entire contents of the CD to your local hard disk, by specifying a CD Image filename and location other than the default. Directly type the new file name in the edit field or use the Browse... button. If you do not enter a fully qualified file location, **DiscJuggler** will consider the location to be relative to itself.

- **Don't delete after write**

After the write process terminates, **DiscJuggler** will automatically delete this temporary CD Image. You can instruct **DiscJuggler** not to delete the image by checking the "Don't Delete after Write" box. This is particularly useful if you later decide to make other copies of the same CD.

- **Browse**

Use this button to browse your file system for a specific location and file.

- **ISRC and UPC**

Conceptually very similar to the ISBN number used for books, the ISRC (acronym for International Standard Recording Code) is a 12-character code defined to uniquely identify a music track song). Unfortunately, over the years very few authors have adopted this standard and currently less than one percent audio CDs use the ISRC.

The UPC (Universal Product Code) is a 13-digit number that uses the UPC/EAN bar coding standard to uniquely identify the whole CD. The same ISRC considerations apply to the UPC code: very few audio CDs currently use the UPC.

These codes are rarely used and they are slow to decode. Furthermore, not all CD Recorders are capable of reading them and not all CD Recorders are capable of writing them. For these reasons, check the ISRC/UPC box only if these codes are required for duplication.

If the selected device does not support ISRC and UPC, this option is grayed out.

See the "Advanced Audio Features " section in the "Advanced Concepts" Chapter for more information.

- **Scan gaps and indexes**

Indexes are a way to subdivide a music track in "sections" and to have variable sized gaps between tracks. Indexes are most often used in classic music CDs to mark a transition, such as between acts of an opera. Indexes are not commonly used because the CD's table of contents does not contain a list of index points. Therefore, the only way to retrieve index transition points and reconstruct the entire CD's index structure is to scan the entire CD; even in fast forward mode, this operation can take several minutes.

DiscJuggler implements a sophisticated algorithm to optimize index point scanning. With a reasonably fast CD-ROM drive, **DiscJuggler** will take less than 1 minute to retrieve the entire CD's index structure. Many CD-ROM drives and consumer CD players do not support index points and, in this case, each music track will appear as a single segment.

By default, the Scan gaps and indexes box is not checked. If you know that the CD you are duplicating contains index points or has variable gaps between tracks, check this box to replicate the same index structure in the copies.

If the selected device does not support indexes, the option is grayed out.

See the "Advanced Audio Features" section in the "Advanced Concepts" Chapter for more information.

- **RW (CD+G/Karaoke)**

RW sub-codes are 96 extra bytes of user data "logically" attached to every sector of the CD. These 96 bytes were originally intended to store text and low-quality graphics for display during an audio track playback. Very few CDs use this extra space; additionally, as for the ISRC and UPC codes, not all CD-ROM drives can read these areas and not all CD Recorders can write them. Furthermore, because of these extra 96 bytes per block, the total data throughput required will be ~ 4% higher than normal. See the "Compact Disc Recording & Data throughput" section in the "Advanced Concepts" Chapter for more information on this topic.

Today, only some implementations of Karaoke CD use this extra area to store Karaoke text.

Do not check this box unless duplication of the RW sub-codes is absolutely necessary.

If either the source or the destination drive doesn't support this feature, this option is grayed out.

See the "Advanced Audio Features" section in the "Advanced Concepts" Chapter for more information.

- **CD-Text**

This option copies the CD-Text information that is present on some audio discs. Both the source and destination must be CD-Text capable for this option to be active.

- **Raw read/write**

In raw mode, the source drive reads data at a fixed block size of 2352 bytes, returning all ECC and EDC fields present in the block and DiscJuggler does not use the recorder's automatic generation of these fields. The only practical use of this functionality is to read intentional errors introduced in the source CD's error correction and error detection fields; however, "real" errors cannot be detected in this mode.

DiscJuggler automatically performs software error correction and detection (ECC/EDC) to insure data integrity if this option has been selected in the Verify Options dialogue.

When raw mode is not selected, DiscJuggler automatically selects the most appropriate read mode based on the contents of the disc currently mounted. In this mode, the application will always try to use the most "conservative" read method applying all available error correction.

- **Read Speed**

Use this control to adjust the reading speed at which data is extracted. Slowing the reading speed can be a valuable means of improving the quality of Digital Audio Extraction (DAE) on some readers. Normally, some experimentation is

needed to determine the optimum setting.

Please be careful to set the read speed at or above the write speed when duplicating directly to a recorder to avoid buffer underrun problems.

- **Ignore read errors**

When DiscJuggler performs error correction and detection in software, you can request duplication to proceed even if errors are detected. Some compact discs will incorporate data that will cause a read error that would normally terminate duplication. This option is useful when you are certain that errors have been introduced intentionally in the source disc or an error may be inconsequential (e.g. on a Video CD). If this box is checked, the copying process will continue regardless of whether a read error is encountered.

Please do not check this box if you do not want to duplicate discs with this type of error.

- **Audio Resynchronization**

The audio CD standard was designed for sequential access (audio streaming) only: digital audio was intended to be read in real time, converted to an analog signal and sent immediately to a stereo amplifier.

Reading audio with random access and moving digital data over the SCSI bus without converting it to an analog signal, is a relatively new feature added recently to CD-ROM drives. However, even the best CD-ROM drive or recorder cannot provide perfect seek accuracy (the drive cannot seek the exact audio frame position two times in a row) because of the way CD audio data are stored (to optimize sequential access).

When reading audio data and the computer is not fast enough, the drive's internal cache gets filled and the drive stops streaming audio and is forced to re-seek. Audible glitches and gaps could be introduced at this point by the drive: here is where a resynchronization of the audio stream becomes necessary.

DiscJuggler offers three levels of audio resynchronization with different impacts in terms of software assistance versus speed. Each method can be selected using the Audio Re-synch slider:

- *Native Resynchronization*

This method relies on the drive's native ability to provide an accurate audio

stream. This algorithm offers the highest reading speed but the smallest software assist to reading accuracy. You should use this setting if you have a very high quality CD reader. With other readers, audible glitches could be present.

- *Overlapped Resynchronization*

DiscJuggler re-reads the last few audio blocks from the previous read operation as part of each new read operation and tries to rematch the audio stream to try to ensure that no data is lost or repeated. A warning message will be issued if accuracy can not be assured at any point. This algorithm can offer the best compromise between reading speed and accuracy. However, the extra time needed to apply the software assist can result in buffer underruns.

- *Redundant Resynchronization*

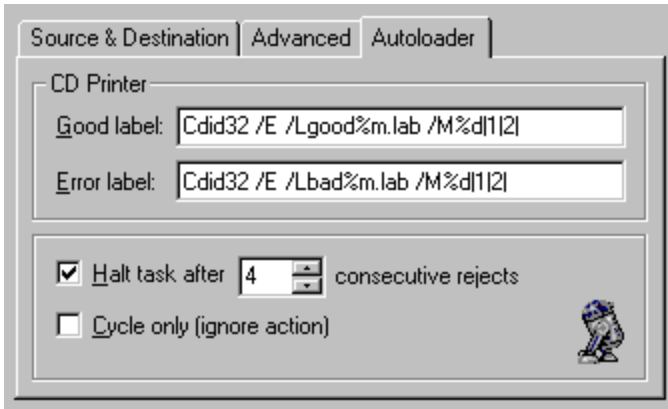
With this method **DiscJuggler** applies statistical correction patterns to try to ensure that the audio stream produced is accurate to the audio frame (~ 0.02 ms). This algorithm offers the lowest reading speed but the highest reading accuracy. However, if it is not possible to produce a very accurate duplicate, the process will be terminated and the disc ruined. Problems with the source disc (e.g. scratches or dirt) or hardware can result in lack of success with this option.

In most cases, the default selection (overlapped resynchronization) will be appropriate. However, with the highest-quality CD readers, you should use Native Resynchronization since the reader has sophisticated logic to avoid resynchronization problems. See the "Advanced Audio Features" section in the "Advanced Concepts" Chapter for more information.



Autoloader Panel

The autoloader panel is only activated if you have a robotic autoloader currently attached to your system and are running the autoloader version of **DiscJuggler**.



The autoloader panel has options that allow you to pass information to a third party printing application if a CD printer is attached, specify a quality control threshold for halting the entire task based on rejects in consecutive duplication cycles, and cycle the mechanical aspects of the autoloader and its CD recorders without recording.

- **CD Printer**

DiscJuggler allows you to specify a string that will be passed to the popular CD printing application, CDID, for printing a label and/or serializing CDs. CDID is a separate program that is widely available and is invoked by **DiscJuggler**. The form of the string can accommodate the %d integer variable which can occur multiple times, assuming the initial value(s) specified at the end of the string between pairs of the character "|". Initial values are assigned to the occurrence of the variables %d in the order that they appear.

When multiple masters are involved in a single duplication task, multiple labels are accommodated in a text file, where each line is a string in the form explained and applies to successive master CDs. In this case, the file name is used to complete the good label and error label fields instead of the string itself.

- **Good label**

A string in the form above that will be used to invoke CDID when a disc has successfully been duplicated.

- **Error label**

A string in the form above that will be used to invoke CDID when a disc has not successfully been duplicated. The form of this field is identical to the good label.

- **Halt task after n consecutive rejects**

A quality control measure to halt the process when producing at least one unacceptable disc on n consecutive cycles of the duplication task. This type of failure could indicate a hardware or media problem.

- **Cycle only (ignore action)**

Allows the mechanics of the autoloader system to be exercised for purposes, such as testing or demonstrating, without performing the action specified in the Action/Method_panel.



Action/Method Panel

With the action panel, located in the upper right corner of the main task window, you can control various aspects of the CD duplication process.



- **Action**

Several combinations of the four actions listed below are selectable using the drop-down list box. When multiple actions are combined together, **DiscJuggler** will perform them in sequence from left to right. Only actions that can actually be performed are active at any given time, so for example the “print” action will not be selectable if a CD label printer is not present on the system where the application is running:

- *Write*

With Write, you instruct **DiscJuggler** to immediately execute a complete CD duplication process. No test action will be performed.

- *Verify*

With Verify, you instruct **DiscJuggler** to perform a bit-by-bit comparison of the disc in the source device with all CD copies in the target devices to certify that the discs are identical. This operation is only useful for non-audio tracks.

- *Test*

By selecting this action, you instruct **DiscJuggler** to execute a complete CD duplication process with the only difference that the CD Recorder's laser is set to read power instead of write power. The result of this action, called "pseudo-write", is to test the ability of the whole system (computer, CD-ROM drives and CD Recorders) to successfully perform the requested task without wasting a blank disc.

The test takes the same time to complete as an actual write. It also will require you to insert blank discs in each selected CD Recorder, to check media integrity.

Make sure you run a test every time you change system configuration or when you increase CD recording speed.

- *Print*

If this action is available (i.e. a CD label printer is connected to the system), when selected, **DiscJuggler** will automatically print the specified CD labels for both good and rejected discs. Please note that a supported autoloader mechanism is required to move the media from the source drive(s) or bin to the CD printer.

- **Copies**

You can use the Copies control to specify the total number of CD duplicates that you want. At the end of every duplication cycle, **DiscJuggler** will ask you to insert new blank discs in the selected CD Recorder until the number of copies required is reached. For example, assume that you need 6 copies of one CD-ROM and you have only 2 CD Recorders available.

With 6 entered in this field, **DiscJuggler** will perform the following cycles:

	Copies	Good	Rejected	Total
1st cycle	2	2	0	2
2nd cycle	2	1	1	3
3rd cycle	2	2	0	5
4th cycle	1	1	0	6

A special "Auto" value is available to instruct **DiscJuggler** to continue to write until a destination drive runs out of blank media. This option is particularly useful when in conjunction with jukeboxes and autoloaders. If the "Ask for more media" option is selected in the "Options" dialog, **DiscJuggler** will prompt the user to reload the destination device with more media and to continue writing.

Directly edit the control field or use the spin-buttons to enter a positive number.

- **Method**

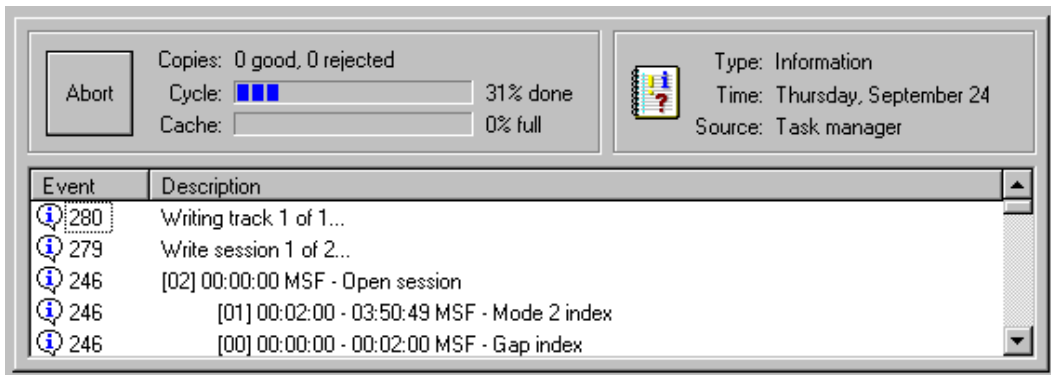
Using the method slider, you can choose the CD recording speed. The slider is automatically initialized with appropriate speeds that **DiscJuggler** calculates by analyzing the performance of the selected source and target. A detailed description of the currently selected method is given underneath the slider control.

Usually the slowest CD duplication method consists of temporarily caching the entire source compact disc in a CD Image file on the hard disk and writing the image to the CD Recorder at one speed. The fastest method consists of duplicating the source compact disc on the fly directly from the source drive to the selected CD Recorders at maximum allowed speed.



Status Panel

The status panel is a user interface component common to all the task documents' main windows and is responsible for displaying and monitoring the status of every task's ongoing operation.



The panel is subdivided into three smaller sections.

The progress section, in the upper left corner, contains a start/abort button to initiate and abort the current task and several gauges to measure the CD duplication status:

- **Start/Abort**

This button is available only when all the task's settings have been properly configured and both source and target drives are ready.

Click the Start button to initiate a CD duplication process.

The button switches to Abort once a duplication process is in progress; it can be used at any time during the duplication process to cancel the operation.

- **Copies Good and Rejected**

Shows the number of duplicate CD produced and rejected for this task.

- **Cycle**

When duplication is in progress, the estimated time to completion of the current cycle (recording physically in progress) is shown here.

- **Progress**

Estimates the percentage of the current duplication cycle completed. This estimate can be inaccurate at times and does not include the overhead time at the beginning and end of a recording.

- **Cache**

Shows the percentage of secondary memory cache full. When the cache is not consistently full, the recording speed is too high and the system cannot sustain the throughput required by the CD Recorders' drives.

The log section, occupying the entire bottom area, displays the complete list of all the events generated by the associated task document. All events are sorted by time in descending order with the most recent event displayed on top of the list:

- **Event**

Unique numeric event identifier.

Use this number to clearly identify an error condition when you call our technical support department.

Click on the event with the mouse to display information that is more detailed.

- **Description**

A detailed event description.

The event detail section, in the upper right corner, displays detailed information about the currently selected event in the log section:

- **Type**

Displays the event type. Four types of events are currently defined:

- *System error*

The underlying operating system generates these errors, usually in situations where the system is running out of resources: memory, hard disk, space, etc.

Refer to the Windows NT, Windows 98, and Windows 95 operating system documentation for a complete list of errors.

- *Application error*

DiscJuggler generates these errors and they can range from CD-ROM and CD Recorder drive failures to user interface invalid procedures.

See the "Error Messages" section in the "Advanced Concepts" chapter for a complete list of application errors.

- *Warning*

DiscJuggler generates these errors in situations that might lead to a defective copy.

- *Information*

These are informative messages displayed to keep the user constantly informed on the status of the application and current process.

- **Time**

Event occurrence time stamp.

- **Source**

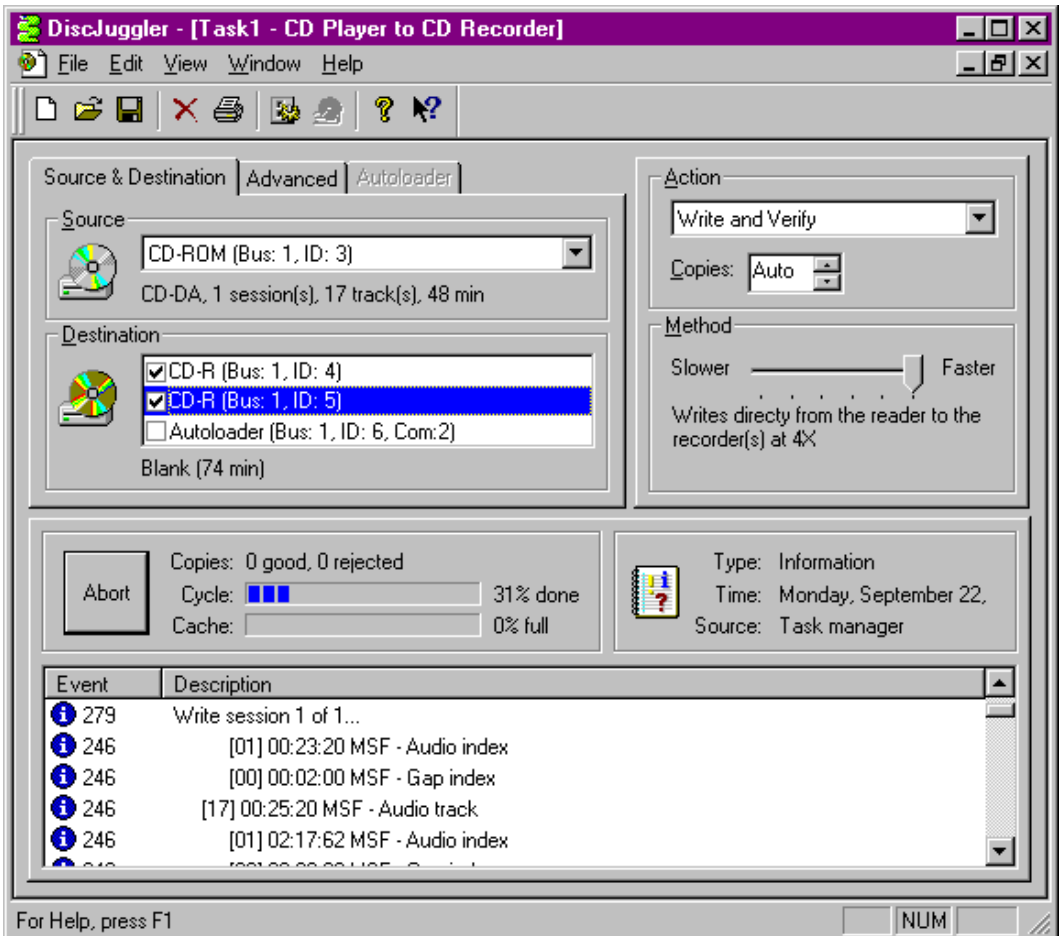
Name of the **DiscJuggler** component that generated the event. Examples are the SCSI CD-ROM driver, the user interface manager and the device driver manager.

Its purpose is to identify the location of an error condition.



CD Player to CD Recorders

This task allows the user to duplicate a CD going directly from the CD-ROM drive to one or more CD Recorders. Usually, this is the quickest and easiest way to replicate an existing CD.



When you select this task, **DiscJuggler** creates a new task document and displays its main window.

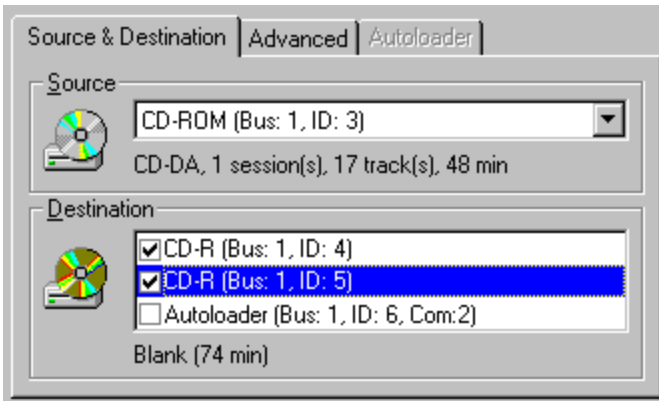
The task main interface is subdivided into four major panels:

- *Source & Destination*
- *Advanced Panel*
- *Autoloader Panel*
- *Action/Method*
- *Status*



Source & Destination Panel

Each time you execute **DiscJuggler**, it performs a scan to identify all supported. The Source section lists all the CD-ROM drives that are suitable as input devices for CD duplication. The Destination section lists all compatible CD Recorders.



You must select at least one source device and one target device. More than one target device of the same brand, model, and firmware version can be selected at the same time to create multiple copies of the same source disc in parallel. Holding the Ctrl key as you select a destination will select all equivalent destination devices. Also, when you select multiple CD Recorders at the same time, use the same media brand and size.

In a newly created document, **DiscJuggler** will automatically select the first available CD-ROM drive and the first available CD Recorder. If the document task is being reopened, **DiscJuggler** will try to re-select the same drive configuration in use when the document was last saved.

After at least one CD-ROM drive and one CD Recorder have been selected, **DiscJuggler** will continuously poll the selected devices to read the table of contents (TOC) of all mounted media. . and display a short disc contents description underneath the selected drive.

DiscJuggler will not start a duplication session until a non-blank disc is mounted in the selected source CD-ROM drive, and a blank or erasable disc is mounted in every selected target CD Recorder.

- **Source**

Specifies the source CD-ROM drive where the disc to duplicate is mounted.

Once the CD has been successfully mounted, **DiscJuggler** describes its contents (TOC), at the bottom of the source frame.

Clicking on the CD-ROM icon will eject the medium mounted in the selected drive.

Clicking on the CD-ROM icon while pressing the <Ctrl> key will load, if possible, the medium mounted in the selected drive.

- **Destination**

Select one or more CD Recorders to be used in the duplication process. Select the checkbox of each drive you plan to use.

Holding the Ctrl key as you select a device will select all equivalent devices.

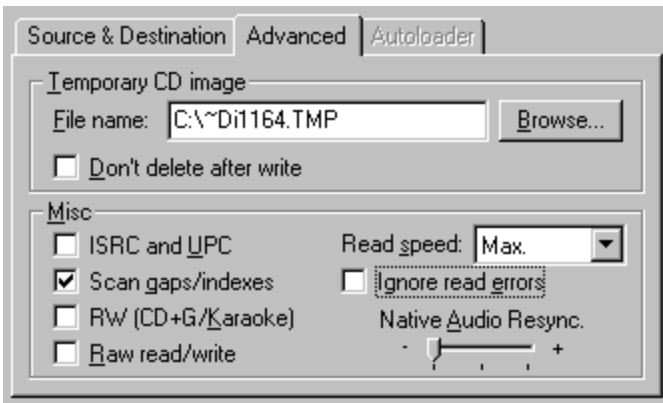
Clicking on the CD-R icon will eject the medium mounted in all the selected drive.

Clicking on the CD-R icon while pressing the <Ctrl> key will load, if possible, the medium mounted in all the selected drive.



Advanced Panel

The advanced tab contains settings that don't usually need to be changed in a standard CD duplication process. The controls are initialized with default values when the document task is created.

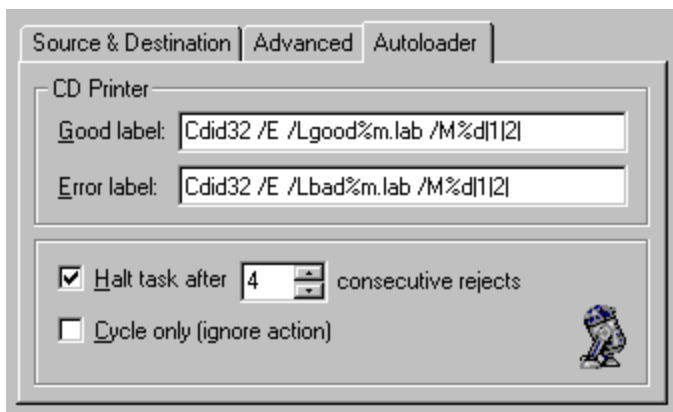


See the "Advanced Panel" in section "Automatically Copy to the Same CD Recorder" for a detailed description of this component.



Autoloader Panel

The autoloader panel is only activated if you have a robotic autoloader currently attached to your system and are running the autoloader version of **DiscJuggler**.

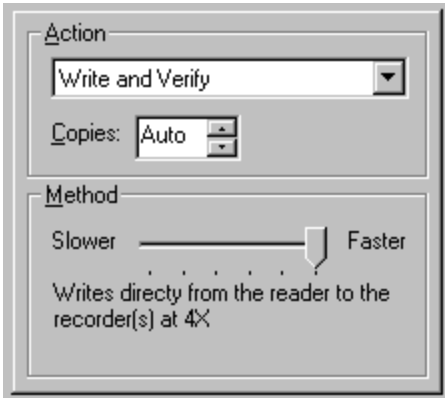


See the "Autoloader Panel" in section "Automatically Copy to the Same CD Recorder" for a detailed description of this component.



Action/Method Panel

With the action panel, located in the upper right corner of the main task window, you can control various aspects of the CD duplication process.

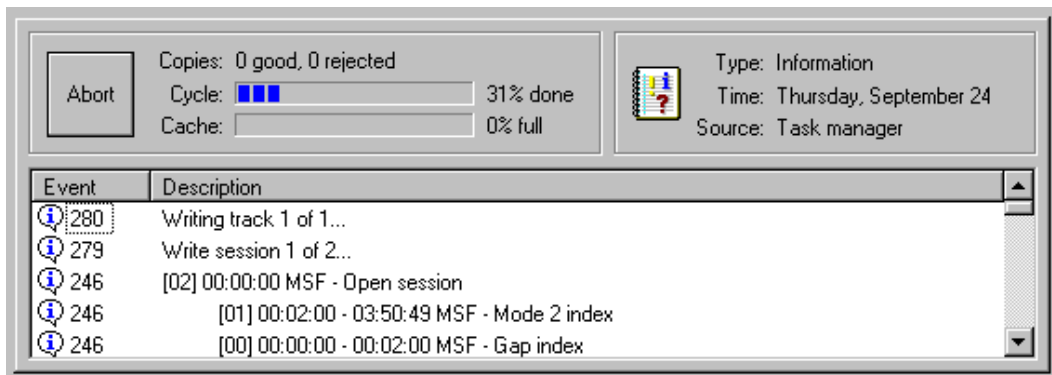


See the "Action/Method Panel" in section "Automatically Copy to the Same CD Recorder" for a detailed description of this component.



Status Panel

The status panel is a common user interface component of all the task documents' main windows and is responsible for displaying and monitoring the status of each task's ongoing operation.

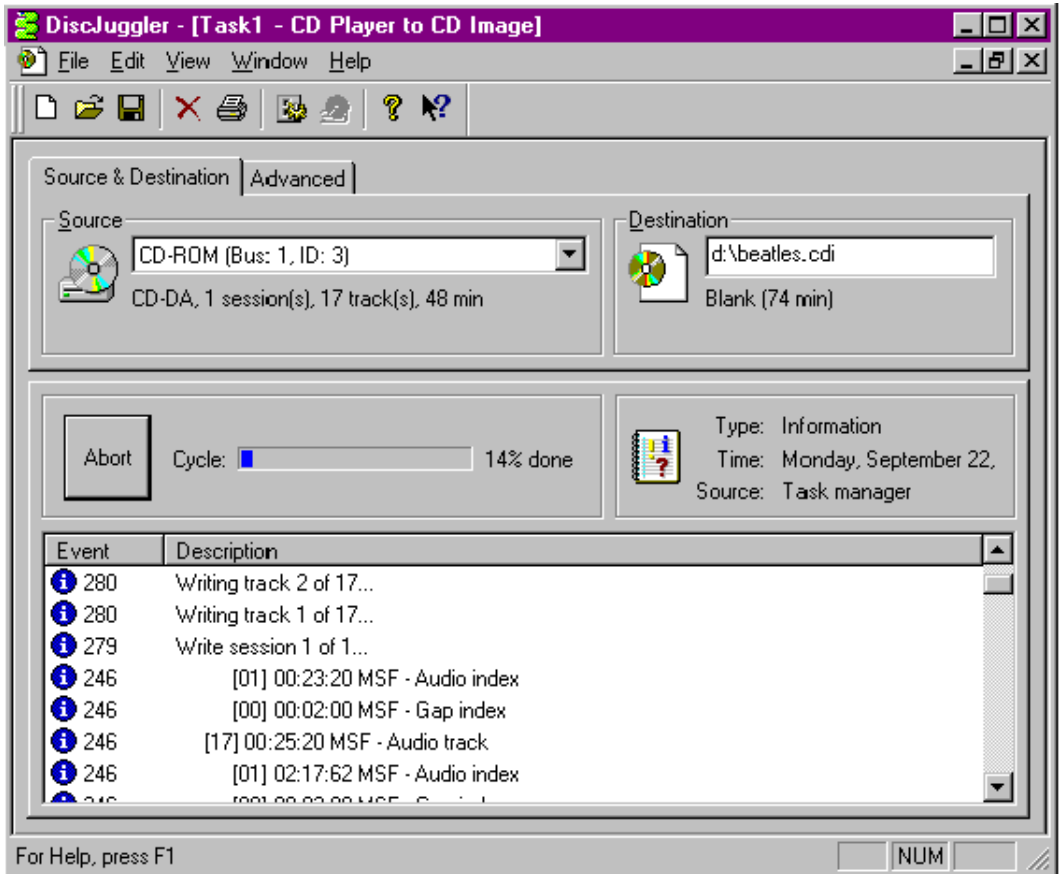


See the "Status Panel" in section "Automatically Copy to the Same CD Recorder" for a detailed description of this component.



CD Player to CD Image

With this task, you can copy the contents of an entire CD into a hard disk file which is useful when you need to make several copies of the same CD at different times. The CD Image file can be conveniently stored on the hard disk and reused whenever required.



When you select this task from the New Task window or you open a previously saved task document, **DiscJuggler** loads a new task document in memory and displays its main window.

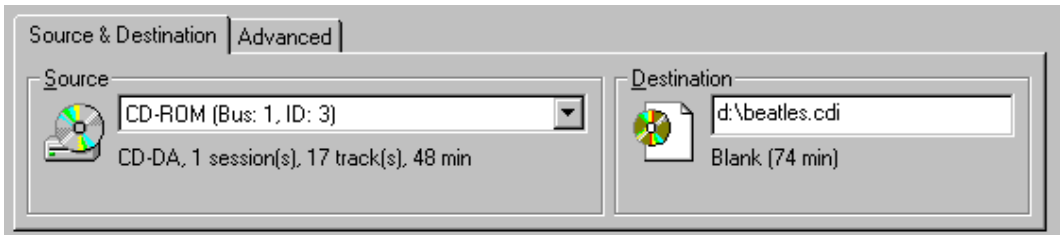
The "CD Player to CD Image" task main interface is subdivided in three major panels:

- *Source & Destination*
- *Advanced Panel*
- *Status Panel*



Source & Destination Panel

In the context of this document task, the destination device is a "virtual" CD Recorder, similar in every aspect to a "real" CD Recorder. The only difference is that, instead of writing discs, this "device" writes files. Following the same analogy, we consider a CD Image file to be a "virtual" recordable disc and an empty file to be a "virtual" blank disc.



If the destination CD Image file already exists, **DiscJuggler** will ask confirmation to overwrite it and delete its contents. The Source section lists all the CD-ROM drives supported by **DiscJuggler** that can be used as input devices during CD duplication. In the destination section, the "virtual" CD Recorder is automatically selected and you must specify a file name and a location to store the CD Image, i.e. mount a "virtual" disc.

In a newly created document, **DiscJuggler** will automatically select the first available CD-ROM drive. If the document task is being reopened, **DiscJuggler** will try to re-select the same drive configuration in use when the document was last saved.

Once one CD-ROM drive has been selected, **DiscJuggler** will continuously poll the selected source and destination devices to read the table of contents (TOC) of all mounted media. It will display a short disc contents description underneath the selected drive.

DiscJuggler will not start a duplication session until a non-blank disc is mounted in the selected source CD-ROM drive.

- **Source**

Specifies the source CD-ROM drive where the disc being duplicated is mounted. Once the CD has been successfully mounted, **DiscJuggler** displays a brief description of its contents (TOC) at the bottom of the source frame.

Clicking on the CD-ROM icon will eject the medium mounted in the selected drive.

Clicking on the CD-ROM icon while pressing the <Ctrl> key will load, if possible, the medium mounted in the selected drive.

- **Destination**

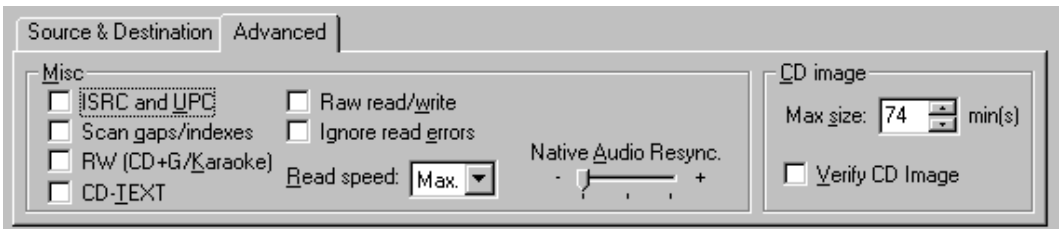
Specifies the location and the name of the CD Image file to be created. To use the CD Recorder analogy, entering a file name in the destination field is logically the same as mounting a disc into a CD Recorder drive. The default CD Image file extension is .CDI.

Click on the image icon to browse your file system for a specific location and file.



Advanced Panel

The advanced tab contains settings that don't usually need to be changed in a standard CD duplication process. All the controls are initialized to a default value when the document task is created.



- **CD Image File Max Size**

Sets the maximum CD Image size. DiscJuggler will ask if you want to truncate the image or continue if the CD Image file is larger than the specified size.

Enter the size in minutes of the blank media you will use to write this CD Image. Standard CD sizes are 21 minutes (8 cm), 63 and 74 minutes (12 cm). If you are using overburn or are recording beyond the official size of a blank CD, please investigate the maximum size under these conditions,

- **Verify CD Image**

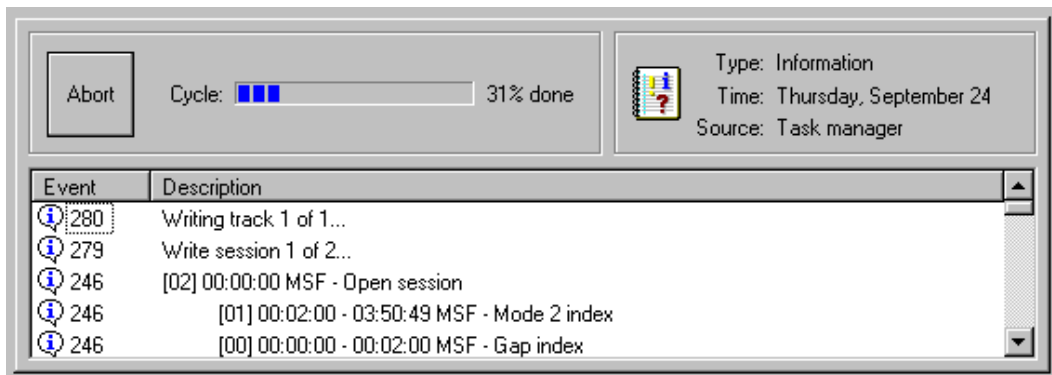
When selected, **DiscJuggler** will perform, after the CD Image file has been completed, a full bit per bit verification between the source disc and the newly created image. This option is very important with badly damaged source discs where read errors are likely. By selecting this option, the total duplication time will double.

For a detailed explanation of advanced controls not listed above see the "Advanced Panel" in section "Automatically Copy to the Same CD Recorder".



Status Panel

The status panel is a common user interface component to all the task documents' main windows. It is responsible for displaying and monitoring the status of each task's ongoing operation.

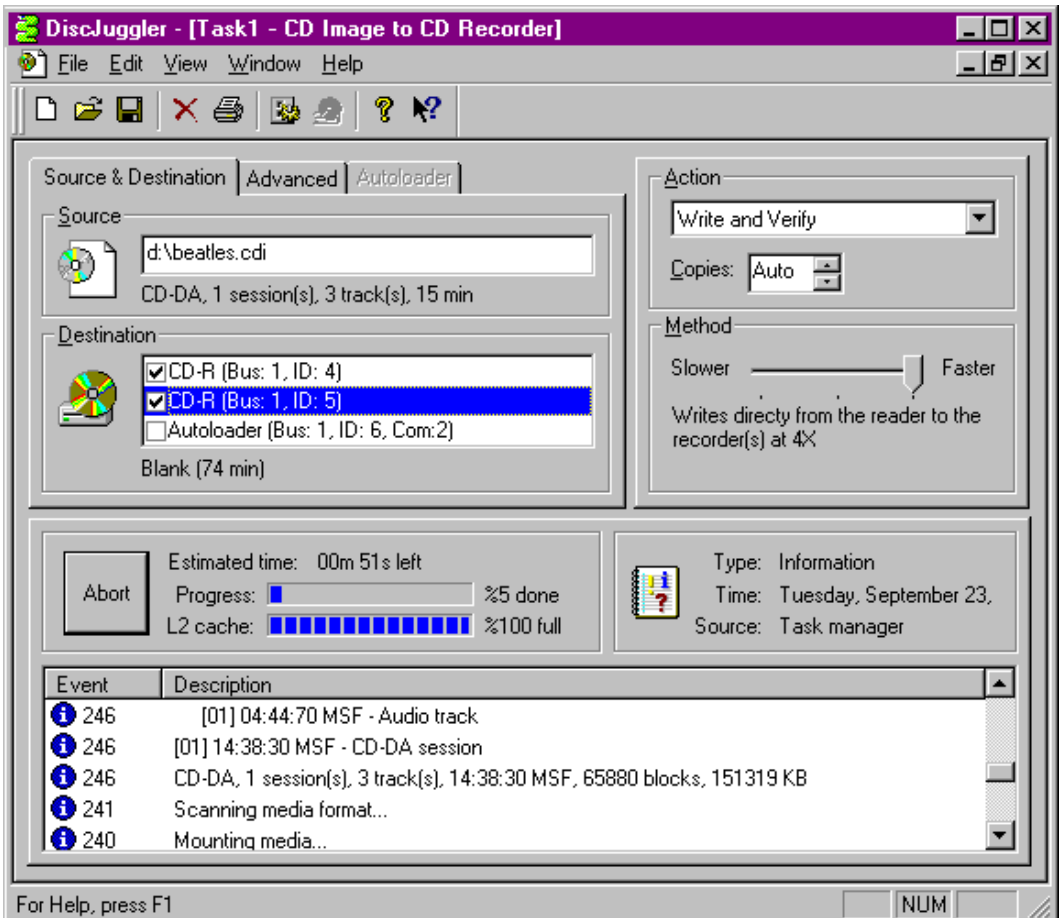


See the "Status Panel" in section "Automatically Copy to the Same CD Recorder" for a detailed description of this component.



CD Image File to CD Recorders

This task is the complement to the "CD Player to CD Image" task. With this task, you can write CD Images previously generated by **DiscJuggler** (or other applications generating an acceptable file) to one or more CD Recorders. This is especially useful when making several copies of the same CD at different times. Simply generate the CD Image with the "CD Player to CD Image" task, store it onto your hard drive and reuse it when you need to make copies of the original CD.



The default CD Image extension is .CDI.

DiscJuggler also supports standard CD Images generated by third party CD mastering applications (usually files with the .ISO extension), regular CD quality Microsoft Wave files (extension .WAV) and raw CD audio files (usually .RAW).

When you select this task from the New Task window or you open a previously saved task document, **DiscJuggler** loads a new task document in memory and displays its main window.

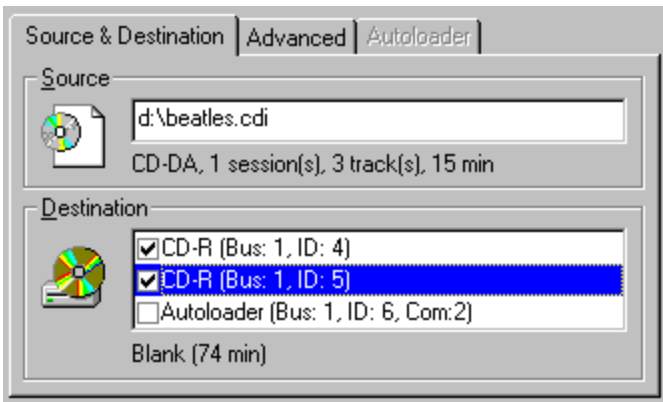
The task main interface is subdivided in four major panels:

- *Source & Destination*
- *Advanced Panel*
- *Autoloader Panel*
- *Action/Method*
- *Status*



Source & Destination Panel

As in "CD Player to CD Image," where you thought of the destination device as a "virtual" CD Recorder similar to a "real" CD Recorder, think of the source device as a "virtual" CD-ROM drive similar to a "real" one. The only difference is that, instead of reading discs, this "device" reads CD Image files in the source section. The "virtual" CD player is automatically selected and you must specify the file name and location of the CD Image (literally mount a "virtual" disc) to use. The source CD Image file must exist and cannot be empty.



The destination section lists all the CD Recorders supported by **DiscJuggler** that can be used as output devices during CD duplication.

In a newly created document, **DiscJuggler** will automatically select the first available CD Recorder. If the document task is being reopened, **DiscJuggler** will try to re-select the same drive configuration in use when the document was last saved.

After at least one CD Recorder has been selected, **DiscJuggler** will continuously poll both source and destination devices to read the table of contents (TOC) of all mounted media and display a short disc contents description underneath the selected drive.

DiscJuggler will not start a duplication session until an existing CD Image file is mounted in the selected source CD-ROM drive and a blank disc is mounted in every selected CD Recorder.

- **Source**

Specifies the location and the name of the CD Image to be used. Following the CD-ROM drive analogy, entering a file name in the source field is logically the same of mounting a disc into a CD-ROM drive. The default CD Image file extension is .CDI.

Once the CD Image has been successfully mounted, **DiscJuggler** displays a brief description of its contents (TOC) at the bottom of the source frame.

Click on the image icon to browse your file system for a specific location and file.

- **Destination**

Selects one or more CD Recorders to be used in the duplication process. Select the checkbox of each drive you plan to use.

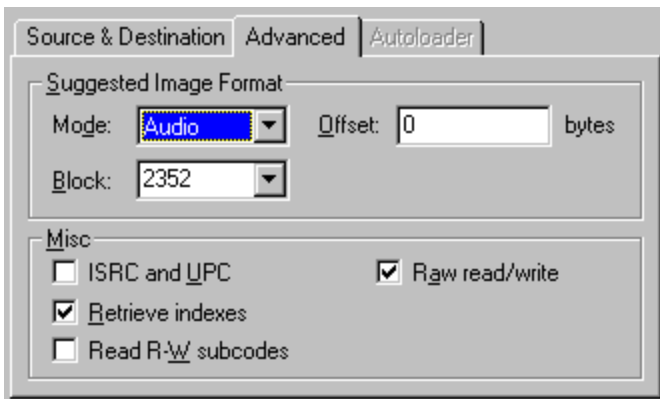
Holding the Ctrl key as you select a device will select all equivalent devices.

Clicking on the CD-R icon will eject the medium mounted in all the selected drive. Clicking on the CD-R icon while pressing the <Ctrl> key will load, if possible, the medium mounted in all the selected drive.



Advanced Panel

The advanced tab contains settings don't usually need to be changed in a standard CD duplication process. All the controls are initialized to a default value when the document task is created.



The following controls are available for specific duplication needs:

- **Mode**

DiscJuggler recognizes most CD Image files (see the "Compact Disc Formats " section in the "Advanced Concepts" chapter for more information). In the unlikely event that **DiscJuggler** cannot detect the currently mounted CD Image contents, with this control, you can suggest the image mode. Three options are available:

- *Audio*

Used for audio CDs.

- *Mode 1*

Used for the vast majority of data CD-ROM discs.

- *Mode 2*

Used for Video-CD, Photo-CD, Game-CD and most multimedia discs.

- **Block**

DiscJuggler recognizes most of the existing CD Image files (see the "Compact Disc Formats" section in the "Advanced Concepts" chapter for more information). In the unlikely event that **DiscJuggler** cannot detect the currently mounted CD Image contents, with this control you can suggest a block size. Five options are available:

- *2048 bytes*

Used for CD Images containing only data. This block size is commonly used for mode 1 tracks.

- *2336 bytes*

Used for CD Images containing data. Commonly with mode 2 tracks.

- *2352 bytes*

Used for CD Images containing audio or data.

- *2368 bytes*

Used for CD Images containing audio plus PQ sub-codes.

- *2448 bytes*

Used for CD Images containing audio plus PQ and R-W sub-codes.

- **Offset**

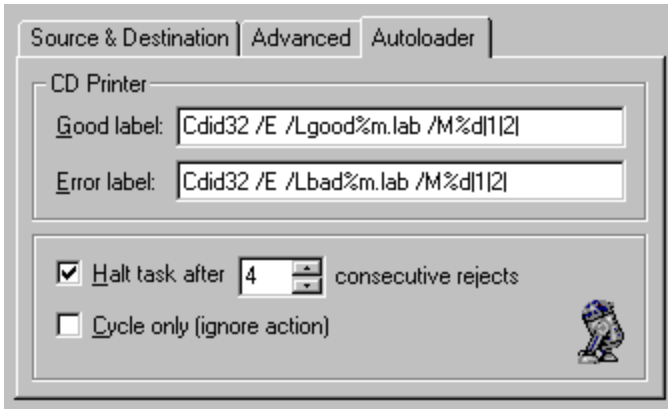
This is useful when you do not want to start recording a CD Image file from the beginning. If the CD Image contents are not recognized and you know that the file has a header, by entering the header size (in bytes), you can instruct DiscJuggler to skip it.

For a detailed explanation of advanced controls not listed above see the "Advanced Panel" in section "Automatically Copy to the Same CD Recorder".



Autoloader Panel

The autoloader panel is only activated if you have a robotic autoloader currently attached to your system and are running the autoloader version of **DiscJuggler**.

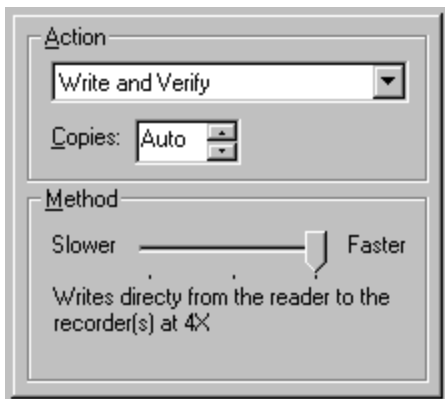


See the "Autoloader Panel" in section "Automatically Copy to the Same CD Recorder" for a detailed description of this component.



Action/Method Panel

With the action panel, located in the upper right corner of the main task window, you can specify the exact number of rewritable discs that you want to erase. There is also a reminder, the erasure method could leave information on the disc that could be readable

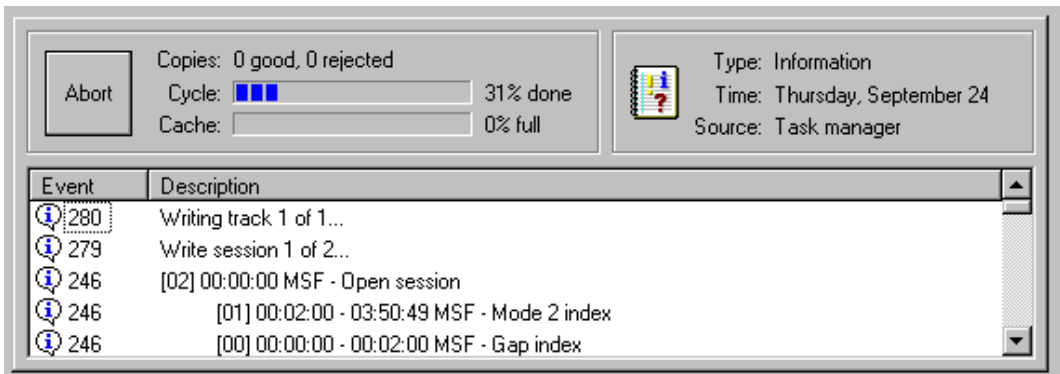


See the "Action/Method Panel" in section "Automatically Copy to the Same CD Recorder" for a detailed description of this component.



Status Panel

The status panel is a common user interface component of all the task documents' main windows and it is responsible for displaying and monitoring the status of every task's ongoing operation.



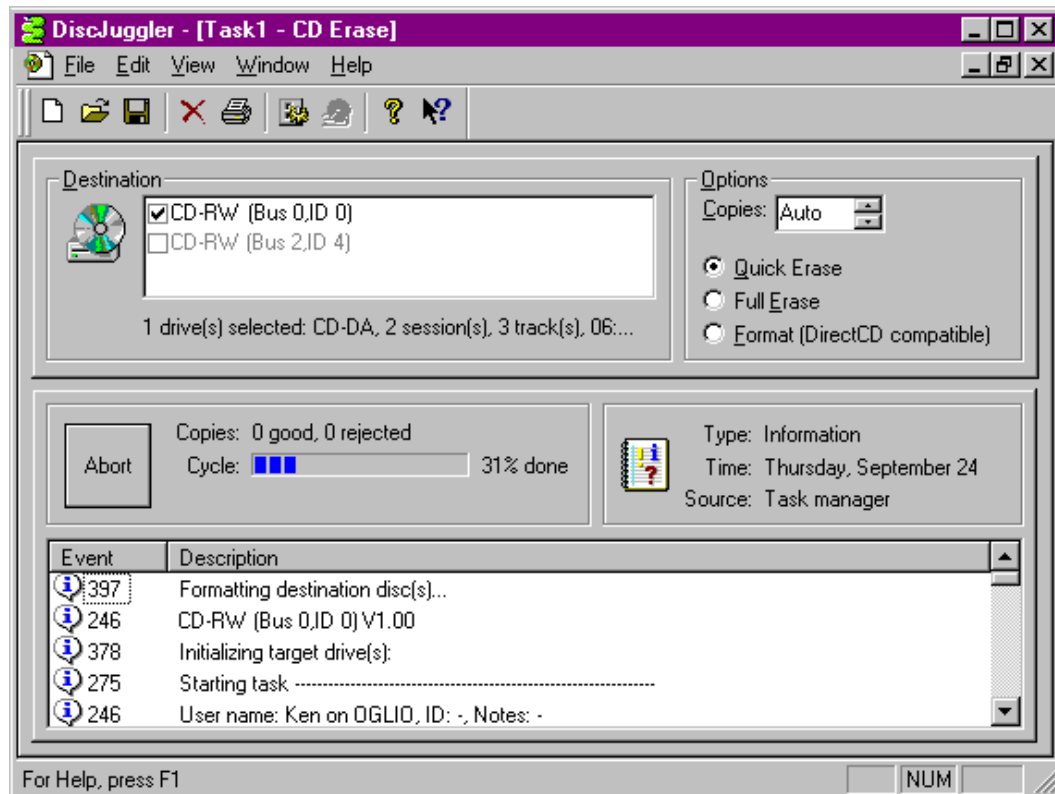
See the "Status Panel" in section "Automatically Copy to the Same CD Recorder" for a detailed description of this component.



CD Erase

With this task, you can erase a CD-RW (rewritable CD). If you attempt to write to a non-blank

CD-RW disc in the course of other tasks, you will be prompted to confirm the erasure of the disc before writing commences.



The task interface is divided into two panels:

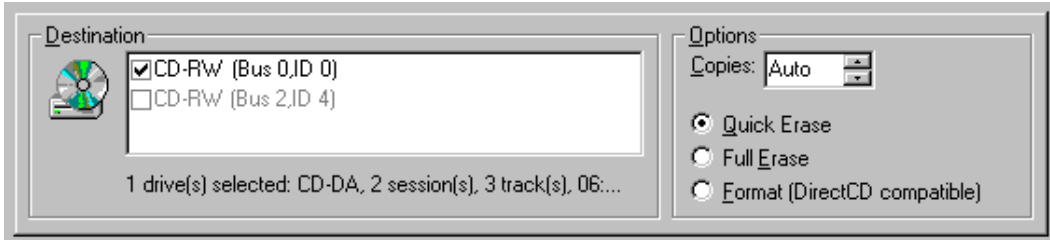
- *Destination*
- *Status*

Just select a CD recorder capable of writing to rewritable CDs as the destination and click the start button. **DiscJuggler** will begin applying a “quick erase” to the disc. Remember that this type of erase may allow access to previously existing data on the disc in some circumstances.



Destination Panel

This is an unusual task in that there is no source device. Rather, **DiscJuggler** applies an erase to all discs in the selected destination recorders.



DiscJuggler will only allow selection of CD Recorder drives of the same kind. If the document task is reopened, **DiscJuggler** will try to re-select the same drive configuration in use when the document was saved last.

The Start button will be enabled only if one or more valid rewritable CD Recorder drives are specified in the destination field and all recorders contain rewritable CDs.

- **Destination**

Selects one or more CD Rewritable to be used in the erase process. Select the checkbox of each drive you plan to use.

Holding the Ctrl key as you select a device will select all equivalent devices.

Clicking on the CD-RW icon will eject the medium mounted in all the selected drive.

Clicking on the CD-RW icon while pressing the <Ctrl> key will load, if possible, the medium mounted in all the selected drive.

You may select from three types of erasures:

- **Quick Erase**

This is the fastest method. It will render the current data contained on the CD inaccessible by only erasing the CD table of content. You should be aware that the data on the CD is actually still there and may be accessible through some advanced techniques.

- **Full Erase**

The full erase process takes longer but completely erases a CD so that data no longer resides on the CD.

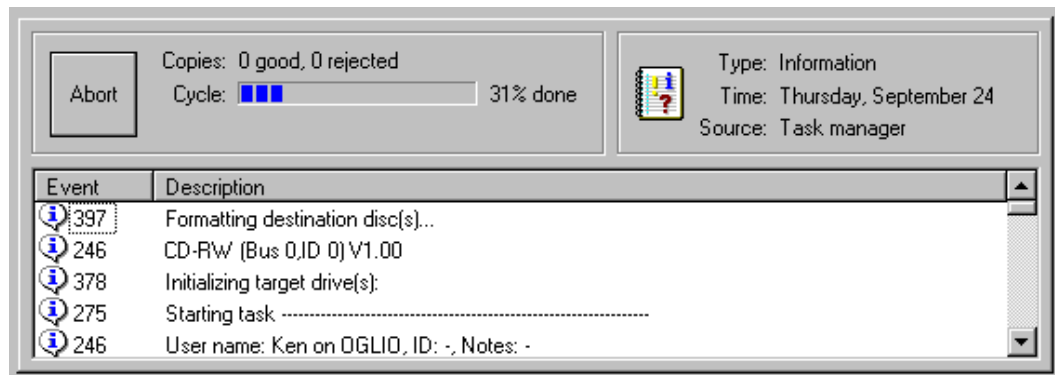
- **Format**

The format process will enable an unformatted CD to be subsequently used by a packet-written CD recording program such as Direct CD. Packet writing programs allow you to write small amounts of data to CDs at a time, emulating the functionality of a hard disk. Performing the formatting process on multiple recorders or in an autoloader can be timesaving.



Status Panel

The status panel is a common user interface component of all the task documents' main windows and is responsible for displaying and monitoring the status of every task's ongoing operation.



See the "Status Panel " in section " Automatically Copy to the Same CD Recorder" for a detailed description of this component.



Options

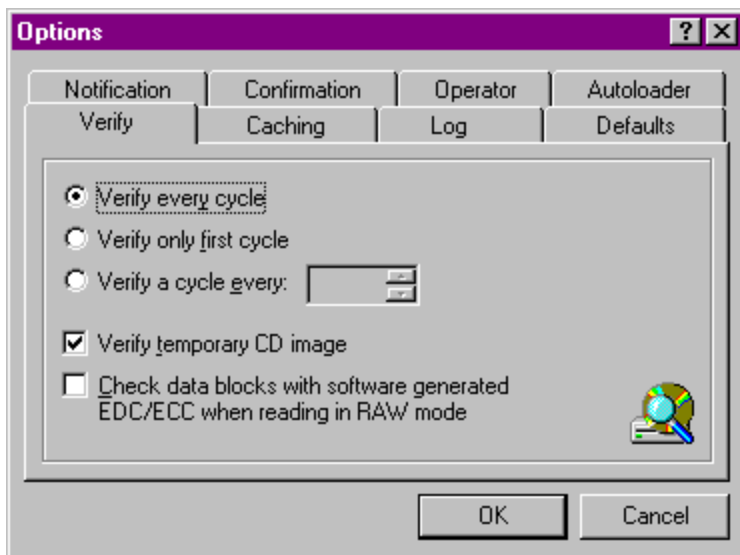
The View/Options menu choice contains a number of tabbed dialog boxes that allow you to set **DiscJuggler**'s default behavior. In some cases, you will be able to override the options that you set in the Options dialogs when performing a particular duplication task. The Options tabs are:

- *Verify*
- *Caching*
- *Operator*
- *Defaults*
- *Log*
- *Notification*
- *Confirmation*
- *Autoloader*



Verify

The Verify dialog allows you to set the normal verification process or bit-by-bit compare of the source CD and the duplicate CD. You can choose to verify every duplicate disc, the first duplicate disc of a multiple disc duplication task, or set the frequency of duplication when duplicating several discs. You can also choose to verify the temporary CD Images, if any, that you create on hard disks. Finally, you have **DiscJuggler** correct errors found when reading Mode 2/Mixed Form information from source discs.



The following options are available:

- **Verify every cycle**

When selected, instructs **DiscJuggler** to perform a bit-by-bit verification of every recorded disc, performing the verification on discs that have been simultaneously recording, i.e. during a “cycle”. Select this option when data integrity is the most important factor. This option will nearly double duplication time. This option is effective only if “Verify” is selected in the action panel; however, no verification is performed for audio discs or tracks since all possible verification is done during the recording process.

- **Verify only first cycle**

When selected, instructs **DiscJuggler** to perform a bit-by-bit verification of the first recording cycle only, where "cycle" means the discs simultaneously recorded in one or more recorders. Select this option to check system integrity and when data integrity is not a crucial factor. This option is effective only if "Verify" is selected in the action panel.

- **Verify a cycle every N**

When selected, instructs **DiscJuggler** to perform a bit-by-bit verification process every N cycles recorded. Select this option to periodically check system integrity. Use the associated edit field to select the verification frequency: enter a number higher than 1. This option is effective only if "Verify" is selected in the action panel.

- **Verify temporary CD Image**

When this option is selected, whenever **DiscJuggler** generates a temporary CD Image, a bit-by-bit verification will be performed between the source disc and the image to ensure that no errors occurred during the read process. This option is effective only if "Verify" is selected in the action panel.

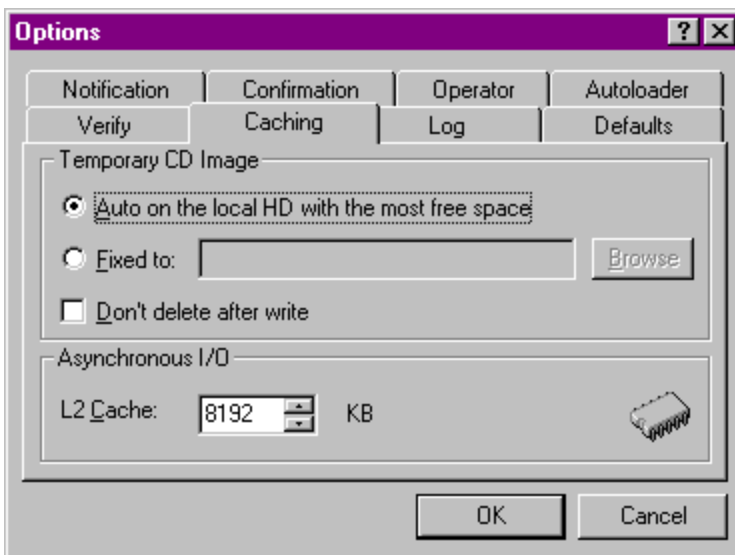
- **Correct Mode 2 data blocks**

When reading a mode 2 track, **DiscJuggler** must disable the source drive error correction that normally generates a read error reading a form 2 block. To ensure the highest data integrity, **DiscJuggler** will perform software ECC/EDC on form 1 blocks and an EDC on form 2 blocks when this option is selected.



Caching

The Caching dialog allows you to specify a location on a hard disk for creating CD Images or to permit **DiscJuggler** to create the image on the local, least-full hard disk. This dialog also lets you choose the amount of system RAM dedicated to duplication for L2 cache. The L2 cache increases the chance that **DiscJuggler** will successfully duplicate discs at the recording speed specified. If you have difficulty successfully completing a test recording, then try increasing the size of the L2 cache. However, increasing it beyond 8 MB will seldom be helpful.



The following options are available:

- **Auto (temporary CD Image location) on the local HD with the most free space**

When selected, will instruct **DiscJuggler** to automatically select the local system volume with the most free space for caching. Slow drives like network volumes or floppies are automatically excluded.

- **Fixed (temporary CD Image location)**

When selected, will force **DiscJuggler** to create any temporary CD Image at the location specified in the associated edit field. Initially, the application will automatically suggest the system temporary sub-directory as a default location. Directly enter the new location in the edit field or use the "Browse" button to select one.

- **Browse**

Use this button to browse your file system for a specific location.

- **L2 Cache**

A way to increase the robustness of the CD recording process is to use a portion of your RAM as an advanced level 2 caching mechanism to buffer interruptions in the data flow. These methods cannot absolutely guarantee the elimination of buffer underrun errors. A number of other factors can adversely affect data throughput and lead to such errors.

The default cache size is set to 4 MB which, when writing at 4X, corresponds to a buffer of approximately 6 seconds.

Make sure you do not allocate too much memory for the L2 cache: leaving the operating system without enough memory can dramatically slow the system.

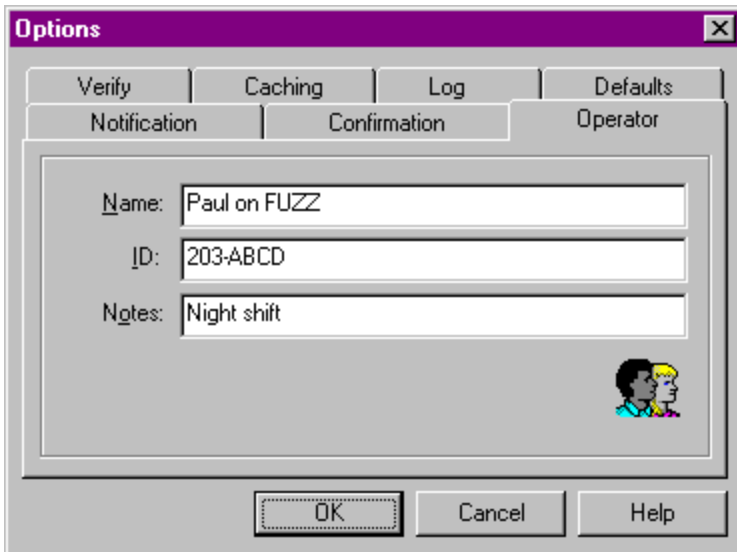
Directly edit the control field or use the spin-buttons to enter a positive number between 0.5 to 32 MB.

See the "Compact Disc Recording & Data throughput" in the "Advanced Concepts" Chapter for detailed information on CD recording data transfer requirements.



Operator

The Operator dialog provides an opportunity to enter information for inclusion in all log files until the fields specified in the dialog change, possibly when a different operator begins to use **DiscJuggler**. This aids record keeping by supplying a uniform way to enter control information concerning whom is making duplicate CDs using **DiscJuggler** and other relevant information. The fields for Name, ID, and Notes can be any combination of characters and are added to the log file.

The image shows a screenshot of the 'Options' dialog box in DiscJuggler, specifically the 'Operator' tab. The dialog has a purple title bar with the word 'Options' and a close button. Below the title bar are four tabs: 'Verify', 'Caching', 'Log', and 'Defaults'. The 'Operator' tab is selected and highlighted. Inside the 'Operator' tab, there are three text input fields: 'Name' with the text 'Paul on FUZZ', 'ID' with the text '203-ABCD', and 'Notes' with the text 'Night shift'. To the right of the 'Notes' field is a small icon of two people's heads. At the bottom of the dialog are three buttons: 'OK', 'Cancel', and 'Help'.

The following options are available:

- **(Operator) Name**

Enter the current operator name; the field accepts any combination of numbers and characters. By default, **DiscJuggler** initializes this field with a combination of the current logged-in user and the system name. This field is not mandatory.

- **(Operator) ID**

Enter the operator ID, if any: any combination of numbers and characters can be used. This field is not mandatory.

- **Notes**

General-purpose text field: any combination of numbers and characters can be used. This field is not mandatory.

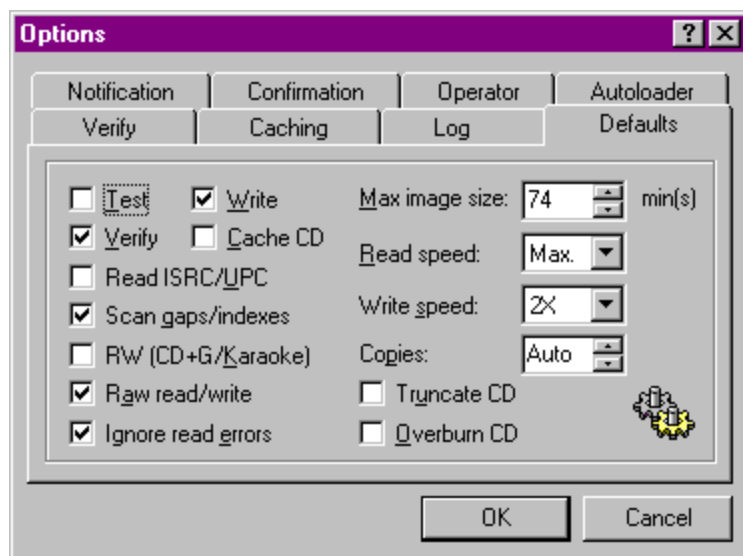


Defaults

The default dialog contains important settings to control the way that **DiscJuggler** routinely duplicates CDs unless an alternative is requested in the course of a specific duplication task. By checking the appropriate box, you can request that **DiscJuggler** perform any combination of the following actions: Test, Write, Verify, and Cache when the Start button is selected. In addition, you can ask **DiscJuggler** to retrieve certain information fields, ISRC/UPC, indexes, and R-W subcodes that may be included on the source CD and duplicate them on the CD copy, if supported by the destination CD Recorders,

In addition, you can help insure routine successful CD duplication by disabling features of your computer system that can interfere with duplication. These features include the screen saver and system agent features of the Windows 95, Windows 98, and Windows NT operating systems.

Another option of the default dialog box lets you to specify the maximum CD Image size acceptable. You should leave this setting at 74 minutes, the maximum recordable CD size, unless you are using smaller blank recording media. You can also set the preferred recording speed and your default number of copies.



The following options are available:

- **Test, Write, and Verify**

Use these three controls to define the default way the "Action" panel will be initialized during a creation of a new task. Any combination is valid except for Test and Verify.

- **Cache CD and Write Speed**

Use these two controls to define the default way the "Method" panel will be initialized during a creation of a new task. Depending on the CD Recorders in use, not all the speeds may be available; in this case **DiscJuggler** will automatically choose a compatible speed.

- **Read Speed**

Use this control to adjust the reading speed at which data is extracted. Slowing the reading speed can be a valuable means of improving the quality of Digital Audio Extraction (DAE) on some readers. Normally, some experimentation is needed to determine the optimum setting. Please be careful to set the read speed at or above the write speed when duplicating directly to a recorder to avoid buffer underrun problems.

- **Read ISRC/UPC, Scan gaps/indexes, and RW (CD+G/Karaoke)**

Use these three controls to define the default way the "Advanced" panel will be initialized during a creation of a new task. Depending on the CD Recorders and reader in use, not all the options may be available.

- **Max image size**

This control will define the default maximum image size automatically selected by **DiscJuggler** in the "Advanced" panel, each time a new "CD Reader to CD Image" task is created. Directly edit the control field or use the spin-buttons to enter a positive number between 21 and 74 minutes.

- **Copies**

This control will define the number of copies automatically selected by **DiscJuggler** in the "Action/Method " panel, each time a new task is created. Directly edit the control field or use the spin-buttons to enter a positive number.

- **Raw read/write**

Raw read will disable source error correction by the reader. Raw write will disable the automatic regeneration of error correction codes and reproduce the source data “as is,” whenever possible (not all recorders allow this option). Checking this box can be useful if intentional discrepancies between the error detection encoding and user data are present in the source. *However, this option should be used with extreme caution since **DiscJuggler** cannot detect legitimate read errors when operating in this mode.*

- **Ignore read errors**

Some compact discs will intentionally incorporate data that will cause a read that would normally terminate when this type of error is found. If this box is checked, the copying process will continue regardless of whether a read error is encountered. *Please do not check this box if you do not want to duplicate discs with this type of error.*

- **Truncate CD**

Check this box if you want to truncate (cut off the end) of your source CD or image so that it fits on a standard size blank CD. Truncation may make sense for an audio CD by may render a data or game CD unusable. **DiscJuggler** will give you the choice of truncating or terminating on a task-by-task basis if you have checked the box for this in the confirmation dialog.

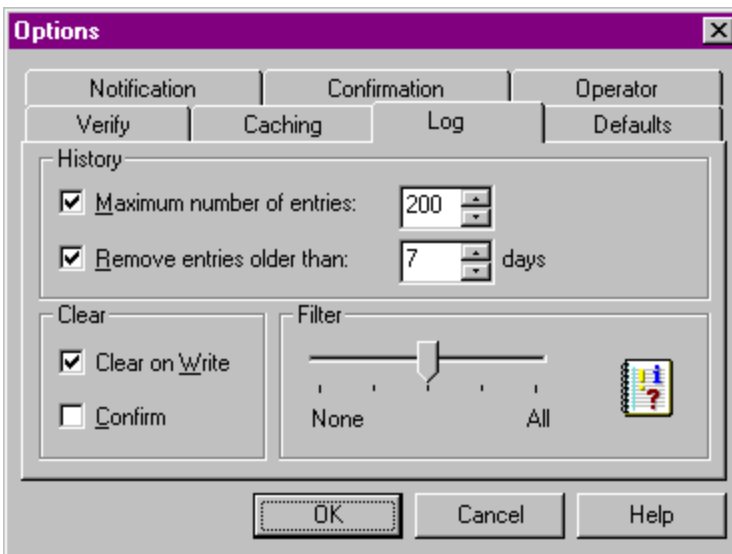
- **Overburn CD**

You can attempt to “overburn” a CD that exceeds the maximum size of a standard CD by checking this box. However, there is no guarantee that you will be successful or how much space, if any, is available beyond the standard maximum size for the CD brand that you are using. **DiscJuggler** will give you the choice of overburning or terminating on a task-by-task basis if you have checked the box for this in the confirmation dialog.



Log

The Log dialog allows you to control the contents of the log file generated by **DiscJuggler** during each duplication session. You can request that **DiscJuggler** maintain the log up to a maximum number of entries (at which point earlier entries are deleted) or to delete log entries that are older than a specified number of days. It is also possible to clear the log each time information from a new task is entered. If this option is selected, then the option to confirm the deletion of existing log information is enabled. Finally, you can choose to "filter" log entries by moving the slider so that only a certain level of logging is included.



The following settings are available:

- **Maximum Number of Entries**

By selecting this checkbox and entering a positive number, you force the **DiscJuggler** Status panel to discard events in excess of the specified number. Older entries will be deleted.

- **Remove Entries Older Than**

By selecting this checkbox and entering a positive number, you force the **DiscJuggler** Status panel to discard events older than the specified number of days.

- **Clear on Write**

When this box is checked, **DiscJuggler** will empty the corresponding Status panel every time a duplication task is started.

- **Confirm (clear)**

If this box is checked, **DiscJuggler** will ask confirmation before erasing the document task log.

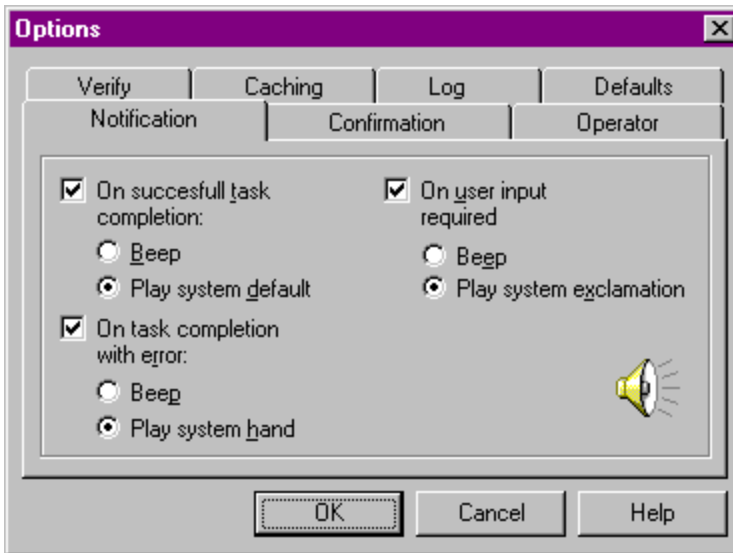
- **Filter**

This slider controls **DiscJuggler** verbosity. It ranges from "Filter None" where all events are displayed and logged, to "Filter All" where only fatal events will be displayed.



Notification

This dialog allows users to control the notification sounds that are emitted by **DiscJuggler** at the events described in the dialog. These sounds help to alert **DiscJuggler** operators that their attention is required.



The following options are available:

- **(Notification) On successful task completion**

When selected, **DiscJuggler** will notify the user when a task completes successfully. A simple beep or the "system default" sound can be played. Systems sounds can be selected using the "system sounds" applet in the Control Panel.

- **(Notification) On task completion with error**

When selected, **DiscJuggler** will notify the user when a task completes abnormally. A simple beep or the "system hand" sound can be played. Systems sounds can be selected using the "system sounds" applet in the Control Panel.

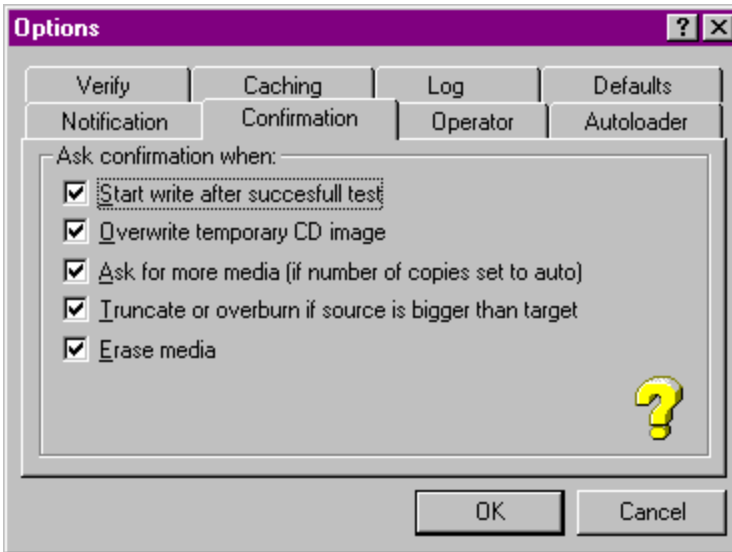
- **(Notification) On user input required**

When selected, **DiscJuggler** will play a simple beep or the "system exclamation" sound when user input is required. Systems sounds can be selected using the "system sounds" applet in the Control Panel.



Confirmation

The check boxes in the Confirmation dialog configure **DiscJuggler** to require operator intervention to continue the actions described: starting to write a CD after a successful Test write, overwriting an existing temporary CD Image, and when more media are required.



The following options are available:

- **Start write after successful test**

After test (pseudo-write) has been successfully completed, if this option is selected, **DiscJuggler** asks the user confirmation before starting the actual write.

- **Overwrite temporary CD Image**

During a temporary CD Image creation, if **DiscJuggler** encounters a temporary CD Image in the current temporary location with the same name and this option is selected, the user must confirm before overwriting the old image with the new one.

- **Ask for more media**

When "Auto" is selected in the copies field of the "Action/Method" panel, and this option is selected, at the end of every write cycle or when an autoloader runs out of blank discs, **DiscJuggler** asks the user to insert more blank media and continue recording. When this option is not selected, the application will simply complete the task when the destination CD Recorder cluster runs out of blank media.

This option is ignored when "Auto" is not selected in the copies field of the "Action/Method" panel.

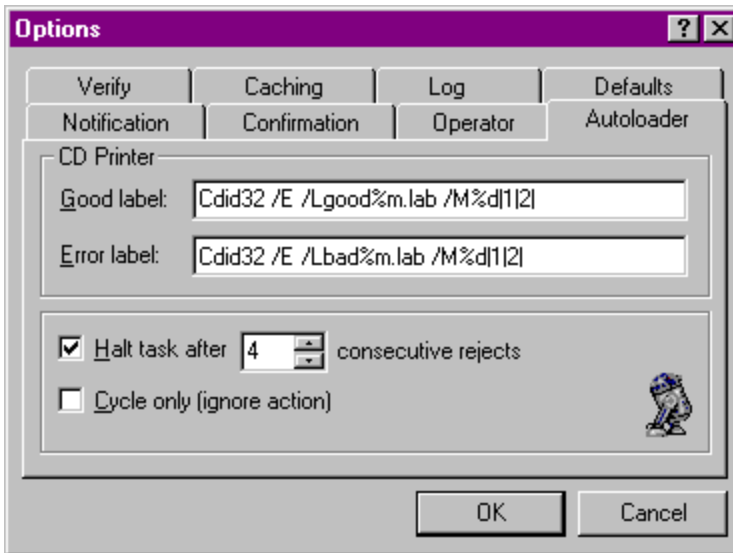
- **Truncate or overburn if source is bigger than target**

When the source is bigger than the target, **DiscJuggler** will ask the user to confirm truncation of the source or overburn of the target CD, if either of these options has been selected in the Defaults dialog. Otherwise, the task proceeds according to the option selected. This option is ignored if neither truncation nor overburn has been selected in the Defaults dialog and duplication is terminated.



Autoloader

The Autoloader options dialog addresses concerns that are appropriate for the production environment in which autoloaders and jukeboxes are used. The values entered here will be used as default values whenever a new job involving an autoloader device is created.



The autoloader options allows you to pass information to a third party printing application if a CD printer is attached, specify a quality control threshold for halting the entire task based on rejects in consecutive duplication cycles, and cycle the mechanical aspects of the autoloader and its CD recorders without recording.

- **CD Printer**

DiscJuggler allows you to specify a string that will be passed to the popular CD printing application, CDID, for printing a label and/or serializing CDs. CDID is a separate program that is widely available and is invoked by **DiscJuggler**. The form of the string can accommodate the %d integer variable which can occur multiple times, assuming the initial value(s) specified at the end of the string between pairs of the character "|". Initial values are assigned to the occurrence of the variables %d in the order that they appear.

When multiple masters are involved in a single duplication task, multiple labels are accommodated in a text file, where each line is a string in the form explained and applies to successive master CDs. In this case, the file name is used to complete the good label and error label fields instead of the string itself.

- **Good label**

A string in the form above that will be used to invoke CDID when a disc has successfully been duplicated.

- **Error label**

A string in the form above that will be used to invoke CDID when a disc has not successfully been duplicated. The form of this field is identical to the good label.

- **Halt task after n consecutive rejects**

A quality control measure to halt the process when producing at least one unacceptable disc on n consecutive cycles of the duplication task. This type of failure could indicate a hardware or media problem.

- **Cycle only (ignore action)**

Allows the mechanics of the autoloader system to be exercised for purposes, such as testing or demonstrating, without performing the action specified in the Action/Method_panel.



Explorer

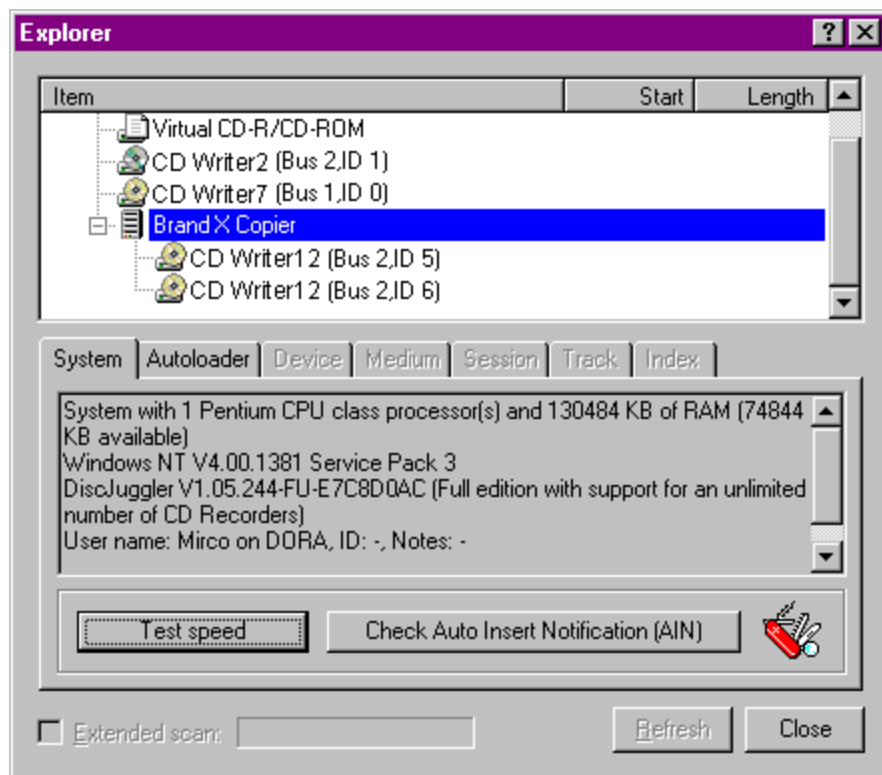
The **DiscJuggler** Explorer is a set of dialogs that hierarchically displays comprehensive information about CD reading and CD writing devices attached to the system, as well as the media and their contents contained in these devices. The main window of the Explorer features a tree-like display of the devices attached to the system. Increasingly detailed information is available by expanding the branches of the tree. With the Explorer, you can determine the properties of all the CD devices in your system and details of any discs that they may contain. The **DiscJuggler** Explorer's interface is similar to that of the Windows Explorer. Detailed information pertinent to the item highlighted in the tree is shown below and includes displays of the following information:

- *System*
- *Autoloader*
- *Device*
- *Medium*
- *Session*
- *Track*
- *Index*



System Tab

Selecting the System Tab of the Explorer displays information concerning the computer system configuration and **DiscJuggler** setup.



- **Test Speed**

This button displays a dialogue that will test the input/output speed of the system, source and target devices so that a source/target combination can be selected without a potential buffer underrun problem.

- **Check Auto Insert Notification (AIN)**

This button will see if any CD device has auto insert notification selected. If so, then auto insert notification must be turned off on all devices to avoid potential disruptions of CD recording.

- **Extended Scan**

Selecting the Extended scan box starts a scan of the entire selected disc to augment the hierarchical tree display with detailed information about ISRC/UPC, variable gap sizes and indexes. The scan can take several minutes. A progress bar is shown during the scan.

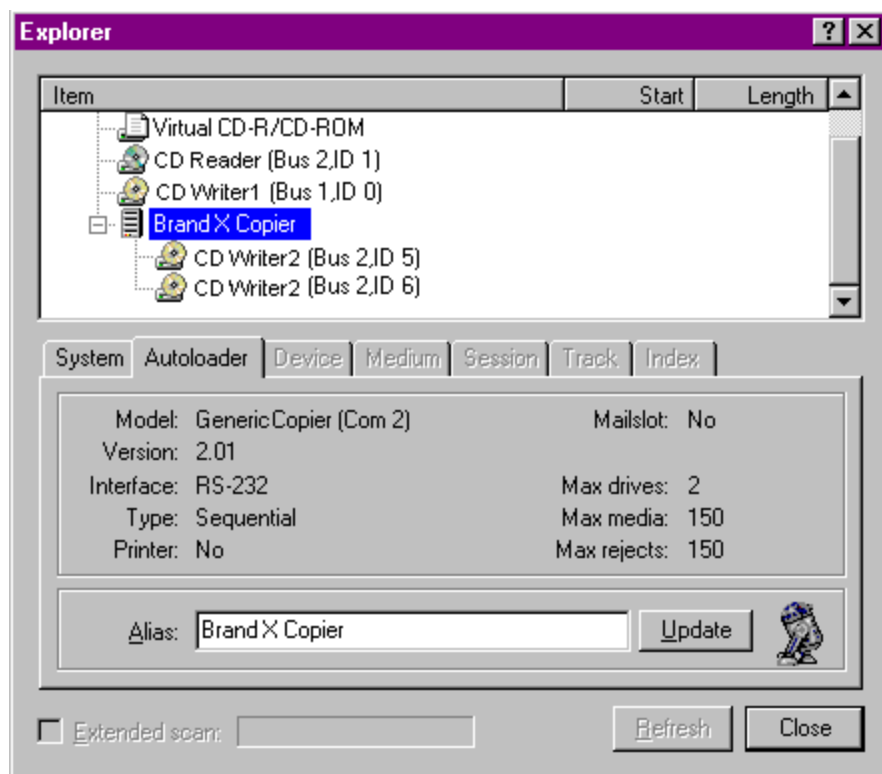
- **Refresh**

Pressing the Refresh button will update the display to include any new discs or devices. Once a scan has been performed on the selected device and its information has been updated, the box is grayed out.



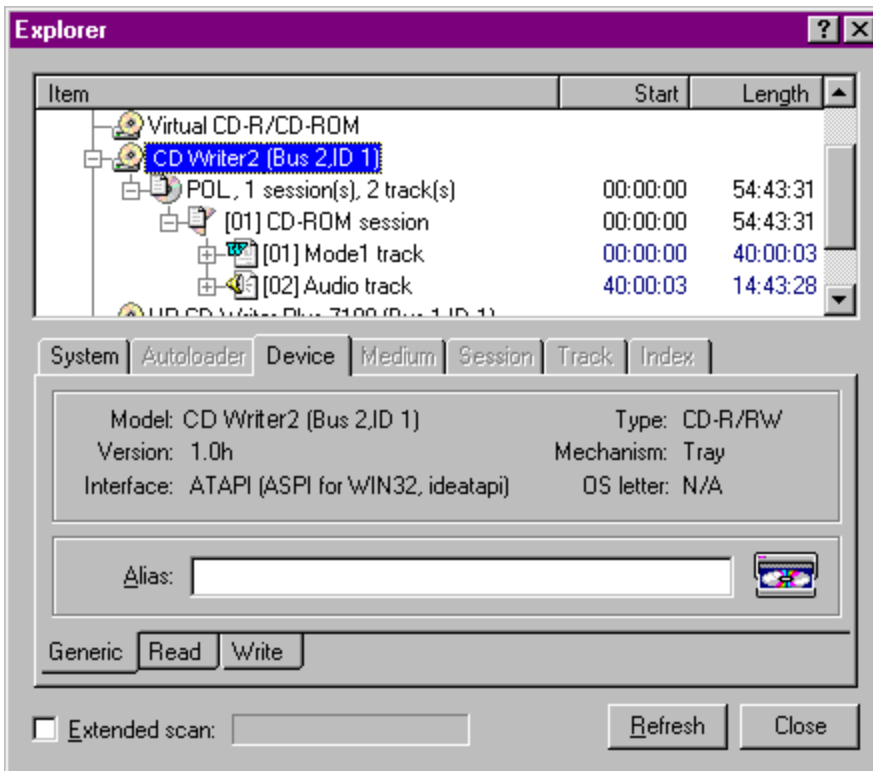
Autoloader Tab

The Autoloader Tab displays information concerning the selected robotics device and associated CD readers and writers. Only special versions of **DiscJuggler** include support for autoloaders or other robotics devices. The information displayed at this level pertains to the robotics device as a whole and includes the capabilities of the autoloader or jukebox, including its capacity for blank media, drives, rejects, mailbox, interface, and printer availability. A capability to “name” the device is also included. Detail about any of the devices within a robotics device can be obtained by clicking on the device.



Device Tab

The Device Tab displays information concerning the CD device selected in the tree. All start times are displayed relative to the beginning of the CD in MSF (Minutes, Seconds, Frames) format. Lengths include the total length for all the substructures of a structure in MSF format. The colors of the times displayed indicate the same level in the Explorer hierarchy.



- **Alias**

You can give any device an easy-to-remember name in the Alias box. From that point, displays of the device in the Explorer and in the **DiscJuggler** tasks will use the alias instead of the device's firmware ID string (usually the brand and model). This mnemonic feature is particularly useful when you have several devices of

the same type and it becomes confusing to remember the SCSI ID of each device.

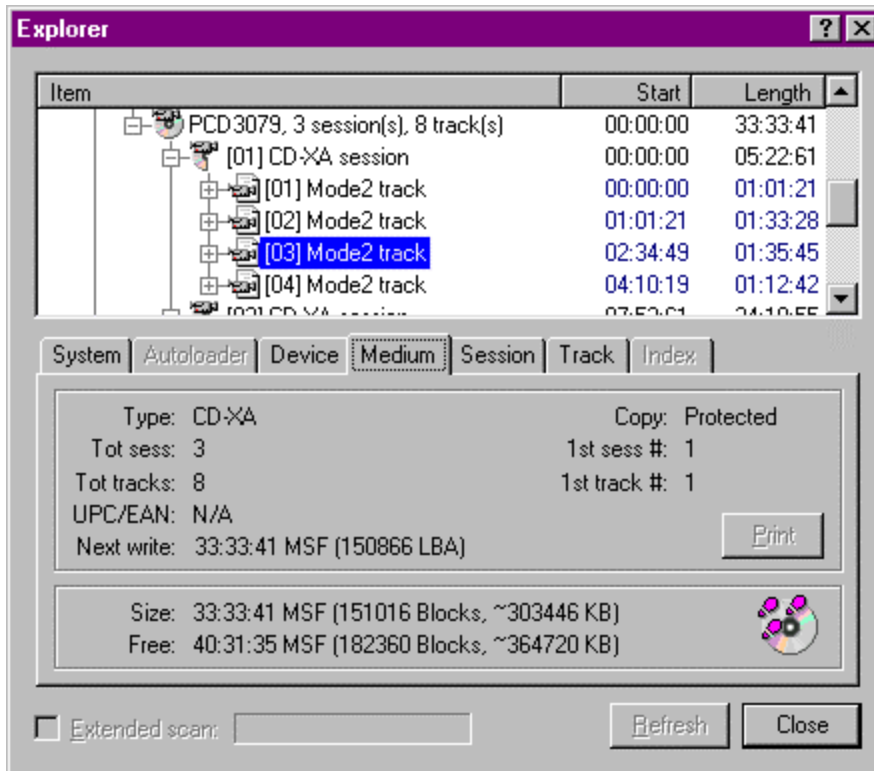
- **Generic/Read/Write Tabs**

Selecting the Read or Write tabs at the bottom of the device information will display more specific information about the reading and writing characteristics of the device. Generic information includes the name of the device, its firmware version number, tray or caddie, device type, and interface. The information for Read includes the read and write speeds, ability to handle R-W subcodes (CD+G), indexes, digital audio extraction, ISRC, and UPC and the size of the device's buffer. For Write, the ability to handle R-W subcodes, audio indexes, ISRC and UPC and buffer size are displayed. Also, all supported writing formats are shown, that is, Disc At Once (DAO), Session At Once (SAO), Packet At Once (PAO), and Track At Once (TAO), as well as the recorder's ability to support Test writing, rewritable media, and the Verify function.



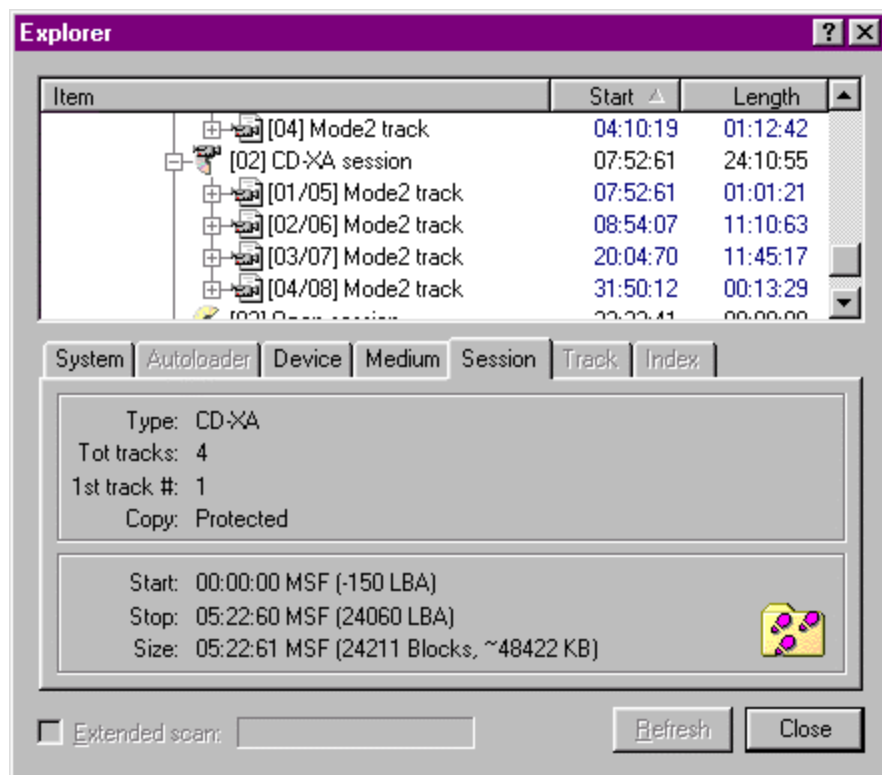
Medium Tab

The Medium Tab displays information about the physical and logical characteristics of the disc in the device selected. Summary information of the disc type and track and session totals is shown here, as well as the total used and free space, Universal Product Code, and whether the copy protection field is on. Track start times and lengths are shown in MSF (minute, second, frame) format. Details concerning sessions and tracks are shown by clicking on the “+” next to the track or double-clicking on the track or session.



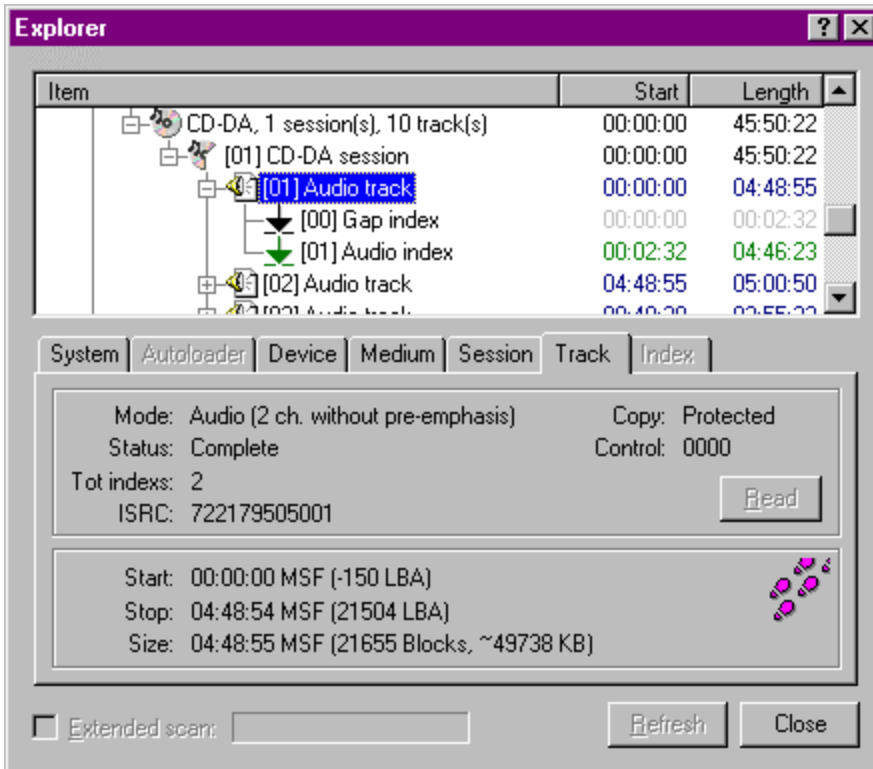
Session Tab

The Session Tab displays information pertinent to the specific session selected, such as, the individual track types and their starting times and lengths, the starting and ending times and size of the session and a summary of the number of tracks and first track number within the session. The track number within a session and relative to the entire CD are shown in square brackets preceding the track description. Information about the tracks within the session is available by clicking on the “+” next to the track or double clicking the track.



Track Tab

The Track Tab displays information concerning the timing and sizes of the track data, indexes, and gaps on the track selected. The individual track components' timing information and track summary information is also displayed. Summary information for the track is displayed including the track's audio quality, pre-emphasis, and copy protection settings, ISRC, logical block address (LBA), and size in kilobytes.



In addition to the start and ending times for the track selected, expressed in MSF format and in logical blocks addresses, the length of the track is shown in MSF format as well in blocks and kilobytes. Information about the track is also shown, including the content type, the total number of indexes in the track, the number of channels (if audio), whether or not there is pre-emphasis set for the beginning of playback, the completion status, whether the copy protection bit is set, the ISRC code, and the control number.

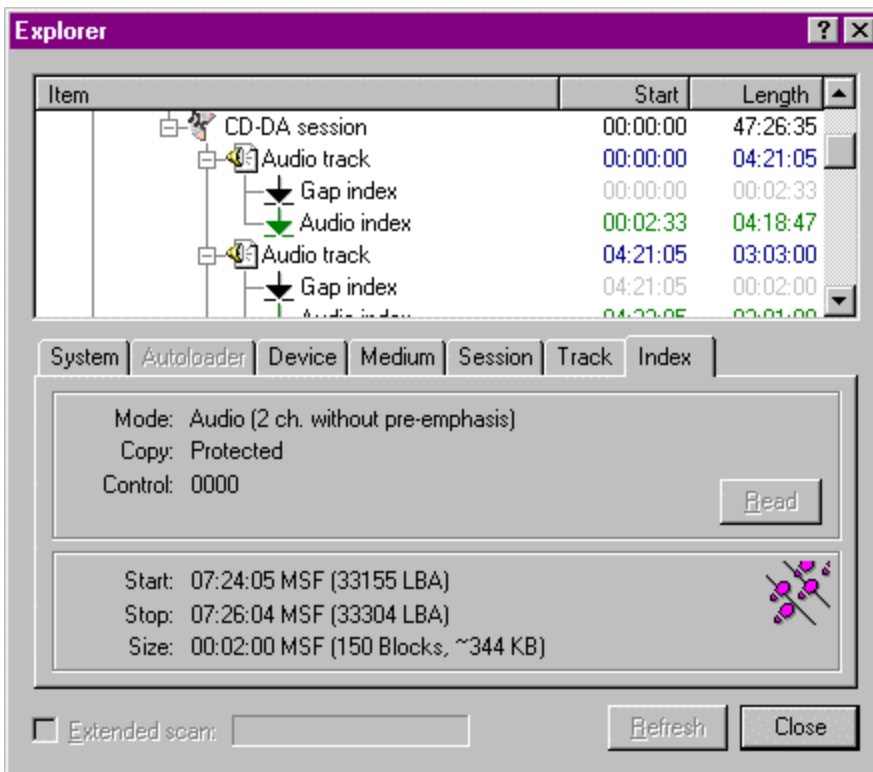
Specific information about the indexed areas of the track is accessed by expanding the tree to display its constituent components and selecting a particular index.



Index Tab

The Index Tab of the Explorer shows the position of each index found in the P-Q subcode channel of the CD as well as its length (the amount of time until the subsequent index). In addition to the start and ending times for the indexed area selected, expressed in MSF format and in logical blocks addresses, the length of the indexed area is shown in MSF format as well as blocks and kilobytes.

Index information is color coded to help distinguish the different levels of the physical structure of the CD. For instance, all audio tracks or audio indexes will have the identical color coding.



Information about the indexed area is also shown, including the content type, the number

of channels, if audio, whether or not there is pre-emphasis set for the beginning of playback, whether the copy protection bit is set, and the control number.



Commands Reference

The following is the complete list of **DiscJuggler** commands. Where applicable, each command is listed with its correspondent shortcut key and tool-bar button.

- *The File Menu*
- *The Edit Menu*
- *The View Menu*
- *The Window Menu*
- *The Help Menu*



The File Menu

Use the file menu to create, open and save task documents, print a detailed task log or quit the program:

- **New**

Displays the "New Task" window and creates a new task document.

Shortcut Key: Ctrl+N

Toolbar button:



- **Open**

Selects a task document to open.

Shortcut Key: Ctrl+O

Toolbar button:



- **Close**

Closes the active task document.

- **Save**

Saves the active task document.

Shortcut Key: Ctrl+S

Toolbar button:



- **Save As**

Saves the contents of the active task document with a new name.

- **Export**

Exports the current log file to a text file. Please email or fax this file when requesting Technical Support. Its file extension is .txt.

- **Print**

Prints the active task document.

Shortcut Key: Ctrl+P

Toolbar button:



- **Print Preview**

Displays the contents of the active task document, as it will be printed.

- **Print Setup**

Displays the Print Setup window.

- **Recent File List**

List of the most recently used task documents. Opens the selected task document.

- **Exit**

Closes all task documents and exits the program.

Shortcut Key: Ctrl+F4



The Edit Menu

Use the edit menu to cut, paste and modify the current task document:

- **Clear All**

Clears the content of the active (focused) edit control. If the task log window is active, this command clears its content.

Toolbar button:



- **Select All**

Selects the content of the active (focused) edit control. If the task log window is active, this command will select all the entries.

Shortcut Key: Ctrl+A

- **Cut**

Cuts the selected content of the active (focused) edit control and moves it into the system clipboard. If the task log window is active, this command will remove all the selected entries.

Shortcut Key: Ctrl+X

- **Copy**

Copy the selected content of the active (focused) edit control into the system clipboard. If the task log window is active, this command will copy into the clipboard all the selected entries.

Shortcut Key: Ctrl+C

- **Delete**

Deletes the selected content of the active (focused) edit control. If the task log window is active, this command will delete all the selected entries.

Shortcut Key: Del



The View Menu

Use the view menu to customize the user interface and display program settings and options:

- **Toolbar**

Use this command to show or hide the program toolbar.

- **Status bar**

Shows or hides the program status bar.

- **Explorer**

Displays a dialog that allows the user to display comprehensive information about CD reading and CD writing devices in the system, as well as the media and their contents in those devices. Please see the Explorer section of this manual for more details.

Toolbar button:



- **Options**

Allows you to set various categories of **DiscJuggler** options. Please see the Options section of this manual for more details.

Toolbar button:



The Window Menu

Use the window menu to rearrange multiple task document window:

- **Cascade**

Arranges all the task document windows to overlap. It is useful when many windows are open at the same time.

- **Tile**

Arranges all the task document windows currently open as non-overlapping tiles.

- **Arrange Icons**

Rearranges all the minimized task document windows at the bottom of the main program window.



The Help Menu

Use the help menu to get information about CD recording and CD duplication procedures. The entire manual for the software is contained in the help system:

- **Help Topics**

Displays **DiscJuggler** Help topics.

- **How to Use Help**

Displays instructions about how to use the Windows on-line help.

- **Context Help**

If you click here, the cursor will become a question mark. If you then click on any area of the application, Help on the relevant topic will automatically open.

Shortcut Key: F1 or Shift+F1

Toolbar button:



- **On the Web**

By using this menu, you will be able to use your Web browser to automatically reference a Web site that provides additional information about CD recording products, updates, and technical information.

Toolbar button:



- **Tip of the Day...**

Displays a dialog with tips on CD duplication and CD recording

- **About DiscJuggler**

Displays the program information, version number and copyright. The dialog contains:

- **DiscJuggler** *version and build.*
- *User and company to which the **DiscJuggler** is licensed.*
- **DiscJuggler** *registration key and status.*

Toolbar button:



Advanced Concepts

This chapter introduces advanced concepts in compact disc technology. This chapter is aimed at advanced users and you are not required to be familiar with these concepts to use **DiscJuggler**.

- *Compact Disc Technology*
- *Compact Disc Recording & Data Throughput*



Compact Disc Technology

- *Storage Capacity*
- *Data Formats*
- *Compact Disc Formats*
- *Advanced Audio Features*
- *Duplicating Digital Audio Disc*



Storage Capacity

Very similar to the "old" vinyl, the compact disc is formatted in a contiguous spiral of blocks (CD sectors) of 2352 bytes each, going from the center hole to the outer diameter. The block at logical address 0 (beginning of the disc) is located near the center of the disc; the last addressable block (end of the disc) is located near the outer edge of the disc.

The common unit of measurement for CD capacity is time. The following are the formulas to convert time in blocks:

1 minute	=	60 seconds
1 second	=	75 blocks (frames)
1 block	=	2352 bytes

Blank discs are usually available in three formats:

21 minutes	=	94500 blocks
63 minutes	=	283500 blocks
74 minutes	=	333000 blocks

The size of the block is a direct consequence of the way the analog audio signal is converted in digital samples.

The audio data is sampled at 44.1 kHz, 16 bits, 2 channels (stereo):

$$(44.1 \times 1000) \times 16 \times 2 = 1,411,200 \text{ bits/sec}$$

$$1,411,200 / 8 = 176,400 \text{ bytes/sec}$$

$$176,400 / 75 = 2352 \text{ bytes}$$



Data Formats

Three different types of data can be recorded on CD. They all share the same physical block size (2352 bytes). However, they have different user block sizes (bytes effectively available to the user) depending on the level of error correction adopted: the lower the read accuracy required, the smaller the error correction code required, the bigger the user data block is. The following is a list of CD compatible data formats:

- *Audio*

No extra error correction is required to read and play back audio. The user blocks size matches the "physical" block size and is 2352 bytes.

- *Mode 1/Form 1*

Mode 1 and Mode 2/Form 1 formats are used to store digital data therefore the highest read accuracy is required. The user block size is 2048 bytes (2KB). The remaining bytes are used to store sync patterns, block headers and error correction and detection codes (ECC/EDC).

- *Mode 2/Form 2*

This format is used almost exclusively to store digital video data, thus requiring only moderate read accuracy. The user blocks size is 2324 bytes. The remaining bytes are used to store sync patterns, block headers and error detection codes (EDC).



Compact Disc Formats

During the last two decades several Compact Disc formats were developed to serve different purposes and uses. Starting with the CD-DA format in 1980, as a way to distribute high quality music in a compact and convenient format, the first compact disc standard was formulated. Then, the idea of storing computer data on the same media, more than 10 years ago, lead to a new format: the CD-ROM (along with CD-DA the most important ever invented). In the last few years, the desire to store a whole new generation of multimedia contents (audio, video, games, pictures etc.) demanded new formats: CD-I, CD-XA, Photo-CD, Video-CD, CD+ etc. were invented.

DiscJuggler supports most of today's existing formats:

- *CD-DA (Red Book)*

Developed in 1980 by Sony and Philips to define the architecture that became known as CD Audio or Compact Disc Digital Audio. It is the original and oldest compact disc standard and the foundation for all the other standards developed later. It's an audio only format and is still used on every music compact disc. The audio on these discs is usually referred to as Red Book audio or CD quality audio. The specifications were published in a book with a red cover, starting the tradition of naming compact disc specifications by color. Index points and variable gaps between tracks are implemented via P-Q subcodes.

- *CD+G (Karaoke)*

This is an audio format augmented by graphics contained in the R-W subcodes. The R-W subcodes encoding specifications are part of the Red Book standard.

- *CD-ROM (Yellow Book)*

Published in 1983 by Sony and Philips to define the architecture that became known as Compact Disc-Read-Only Memory. The introduction of this architecture allowed compact discs to be used as an archival medium for computer data. The Yellow Book defines more error correction than defined by the Red Book: a small error while playing back audio is significantly less damaging than an error in retrieving data files

- *CD-I (Green Book)*

Released in 1986 to extend the definition of the Yellow Book. The architecture

defined in the Green Book helped to improve the synchronization of data retrieval and audio information and established the Compact Disc Interactive format. For example, with the introduction of CD-I, sounds could be better synchronized with graphics than in the standards provided in Mode 2 Yellow Book

- *CD-XA & CD-I Bridge (Extended Architecture)*

Developed in 1991 by Sony, Philips, and Microsoft as a hybrid of the Yellow Book and the Green Book, the CD-ROM XA standards provide synchronized data and audio, as well as a method for the compression of audio information. These added features improve the usefulness of discs for multimedia purposes. However, playing these discs requires additional hardware to uncompress the audio. These CD-ROM drives are designated as "XA-compatible".

- *CD-R (Orange Book)*

Defined in 1990, the major contribution of the Orange book to CD-ROM is its foundation for CD-R technology. In addition, this architecture allows multiple sessions to be recorded on a single disc. Prior to the release of these standards, only one session could be created on each disc. The unused disc space could never be recovered.

- *Photo-CD*

Released in 1990 by the Eastman Kodak Company to provide a standard for storing high-quality images. This proprietary standard is based on CD-ROM XA. It includes multiple session capabilities. Kodak Photo CD discs can be read only by drives that support the CD-ROM XA architecture.

- *Video-CD (White Book)*

Released in 1994 by JVC, Matsushita, Philips and Sony to provide a standard for storing movies and high-quality video presentations. This standard is based on CD-ROM XA. It uses MPEG1 to compress audio and video.

- *CD+/Enhanced-CD (Blue Book)*

This is a multisession format composed by a first session in CD-DA format that contains a regular selection of audio songs and a second session in CD-XA format containing video clips and computer data. Discs following this standard

can be played in a consumer CD player as standard audio discs and in a computer CD-ROM player as multimedia discs.



Advanced Audio Features

DiscJuggler supports many professional-level audio features that are not immediately apparent to the end user but are important for true audiophile-level reproduction. Among these features are the accurate duplication of gaps between tracks and replication of the sub-codes used in digital audio. There are eight possible subcode channels, referred to as P, Q, R, S, T, U, V, and W.

The most important subcode channels for audio are the P and Q subcodes. Subcode channel P (or the "P" sub-channel) contains flags that show where the data or music begins on a track. The "Q" sub-channel has information concerning the time from the start of the CD and for the current track. This information used by CD players for time displays is referred to as "position information". Track/index information is also contained in the Q subcode channel. Finally, the "Q" subchannel can contain an ISRC for each track. The ISRC contains information about the country of origin of the track, year of recording and serial number.

The R-W subcodes were originally intended in the Red Book CD-audio specification to hold graphics information. CDs with this kind of information are referred to as CD+G compact discs. Karaoke, Sega-CD, and Philips ITTS discs are examples of three disc types that use R-W subcodes. Other kinds of information can potentially be stored in these subcodes on Red Book tracks though the Yellow Book specifies that these subcode channels will be zero for data tracks.



Duplicating Digital Audio Discs

The audio CD standard was designed from the beginning for sequential access (audio streaming) only; the digital audio was intended to be read in real time, converted to an analog signal and sent immediately to a stereo amplifier.

Reading audio with random access and moving digital data over the data bus without converting it to an analog signal, is a relatively new feature added only recently to CD-ROM drives.

The main problem with reading CD audio data over the data bus is the low degree of seek accuracy provided by CD-ROM drives when accessing CD audio blocks. This is caused by the fact that CD audio data are stored in a different format than CD computer data.

In a computer data block there are 2,048 bytes of user data plus header and error correction information. The header information in a computer data block contains the precise address of the block allowing the drive to precisely seek the correct block before reading.

In an audio data block, the 2,352 bytes of the physical block are entirely filled up by audio data. There is no header containing the block address, no synch codes and no error correction. This means that the drive must use the Q sub-code information to find an individual block. Unfortunately, the Q sub-code information was only designed to allow consumer audio CD players to provide audio positioning and position display within an accuracy of ± 1 second. As a result, Q sub-code addressing is only approximate.

When searching for a specific audio data block, a CD-ROM drive moves the laser assembly to a position near where the block should be located, starts reading, and compares the Q sub-code information to the desired block address. When a Q sub-code address close to the desired block address is located, the drive begins transferring data (or playing). Most CD-ROM drive specifications state that "the actual starting audio address will be within \pm four (4) Q sub-code addresses of the requested starting audio address", in other words ± 4 audio blocks or $\pm 4/75$ th of a second. As a result, given the address of a single block, a read request might return any one of 9 blocks (according to drive manufacturer specifications). Some drives may be even less accurate than \pm four (4) Q sub-code addresses.

A second problem with CD audio data capture occurs when the computer cannot accept audio data from the drive fast enough. This is referred to as a "buffer overflow", because the CD-ROM drive must write data into its internal buffer before the computer has finished retrieving data already in the buffer. During a CD duplication process, a buffer overflow

condition is usually a direct result of the CD-ROM drive reading faster than the CD Recorder writes. It is common to see 32X or 36X CD-ROM drives while the fastest CD Recorders are usually 4X-6X.

When a buffer overflow occurs, the read operation must be restarted. The next read may not begin transferring data at exactly the same sample (a side effect of the, ± 4 audio blocks accuracy problem) resulting in a few lost or repeated samples. This lost or extra data can create audible artifacts in the resulting sound file.

Because of the previous problems, it is not possible to reliably read accurately an audio stream without a re-matching or re-synchronization procedure. **DiscJuggler** employs three different re-matching methods to read audio reliably. See the "Audio Resynchronization" section in the "Copying Compact Discs" chapter for a detailed description.



Compact Disc Recording & Data Throughput

Because a CD-Writer is a real-time device, it places special demands on a computer and its peripherals. For a CD Recorder to successfully create a compact disc, it must receive an uninterrupted flow of data that must be transferred at a speed equal to or greater than the recording speed of the CD Recorder.

For CD Recorders operating in single-speed (1x) mode, data must be transferred at a continuous rate of 150 KB per second for data, and ~172 KB per second for audio. For CD Recorders operating in double-speed (2x) mode, data must be transferred at a continuous rate of 300 KB per second for data, and ~344 KB per second for audio. For CD Recorders operating in quadruple-speed (4x) mode, data must be transferred at a continuous rate of 600 KB per second for data, and ~689 KB per second for audio.

Data transfer rates in the range of 150 to 600 KB per second are well below the data transfer rates claimed by hard disk manufacturers. However, slow CPU or SCSI bus performance and sub-optimal hard disk performance may combine to reduce the actual sustained data transfer rate below the transfer rate requirement of double-speed or quadruple-speed CD Recorders.

- *Buffer Under-run*
- *Thermal Re-calibration*



Buffer Under-run

Every CD Recorder is equipped with internal memory that the drive uses as a data buffer. The data buffer stores data as they arrive from the computer, then transfers them to disc. The size of the data buffer for an individual CD Recorder is critical to error-free recording. A slow-down in the transfer of data from the CPU caused by high network traffic or the small interruption of hard disk thermal re-calibration, can interrupt recording if the buffer is not large enough to "wait out" the interruption. If the data buffer for staging data before writing them to the disc empties (buffer underrun error), the recording process will abort and the disc be ruined.

If your computer and peripheral devices are fast enough, then you may be able to duplicate "on the fly". When recording on the fly, be certain that the read speed is always equal to or greater than the writing speed. In cases where the speed of the input source is not fast enough to support "on the fly" duplication, an intermediate "CD Image" file may be written to a hard disk. You should also be aware that the read speed for audio tracks (also found in many games) can be considerably less than the "rated" speed of the reader and lead to buffer underruns.



Thermal Re-calibration

Many large capacity hard drives require frequent thermal re-calibration, an automatic adjustment which compensates for the fact that as a drive heats up, its disk surface expands at different rates. Thermal re-calibration is particularly important in high-capacity drives, where the density of data requires very close tolerances. Although the re-calibration process is very fast, typical re-calibration interruptions of from 400 milliseconds to 2 seconds are enough to disrupt the transfer of data to a CD-Writer.

Many drive manufacturers have responded to the thermal re-calibration problem by preventing the re-calibration cycle from starting if the computer is reading from or writing to the disk. However, many drives do not include this safeguard. If you suspect that thermal re-calibration is causing throughput problems during CD recording, power up the drive a few hours before you intend to use it. A cold drive will re-calibrate approximately once every 10 minutes; a warm drive will re-calibrate approximately once every hour.

If you are planning to purchase a drive specifically for CD recording, please contact the drive manufacturer for assistance in identifying drive models that provide advanced thermal re-calibration controls.



Appendices

- Appendix A: Autoloaders

User's guide addendum explaining how to use CD autoloader devices with **DiscJuggler**.

- Appendix B: Troubleshooting

A list of possible solutions to common problems in CD mastering and duplication.

- Appendix C: Error Messages

A list of most common error messages generated by **DiscJuggler** with a brief explanation and a description of possible causes.

- Appendix D: Glossary

A list of definition of terms applicable to CD-ROM technology, multimedia, and general purpose computing.



Appendix A: Autoloaders

DiscJuggler supports CD autoloaders that have recently become available for the purpose of recording and duplicating multiple CDs without operator intervention after a task has begun. A CD autoloader consists of one or more CD Recorders that are able to accept, for consecutive loading into their trays, blank recordable CDs from a stack. In addition to the accurate duplication of the source compact discs which are often interspersed with blank discs, **DiscJuggler** handles the task of controlling the autoloader robotics, so that blank media are correctly loaded into the CD Recorder, defective discs discarded, and successful duplicate discs removed after recording.

Autoloaders are normally a combination of a drive section (with one or more CD Recorder devices) and a robotic section. CD Recorders are usually devices that use a SCSI interface to communicate with the host computer while the robotic section can either use a RS-232 (serial) or SCSI interface (parallel).

Autoloaders can be divided in to major categories:

- *Sequential autoloaders:*

These are serial loading devices so that discs can only come off the input stack and into the drive section. From there, the discs can only go either to an output stack or to a reject bin but cannot be cycled back to the input stack.

- *Random autoloaders (juke-boxes):*

These are devices that can randomly load discs into the drive section and then place them back into position for subsequent reading/writing.

The scope of this manual does not include a detailed description of the autoloader functionality. For more information on how to set-up and operate your autoloader, please refer to the documentation provided by the manufacturer.

This appendix is subdivided in three major sections:

- *Autoloaders Setup Tips*
- *Copying Compact Discs with Autoloaders*
- *Autoloaders FAQ's*



Autoloaders Setup Tips

The drive and robotic sections are often not seen by the system to which they are attached as a single physical unit. Also, several autoloader devices can be used in parallel. Therefore, properly configuring each component to allow **DiscJuggler** to correctly identify each section and establish a logical link between each drive/robotic pair is very important.

To accomplish this task, **DiscJuggler** always attempts to combine the highest robotic section ID with the highest drive section IDs.

For instance, assuming you are using an autoloader with a serial robotic section and n CD Recorders, **DiscJuggler** will forward scan all serial ports (starting from COM1:) and all SCSI buses (starting from bus 0, device 0). It will combine the last robotic section found on a COM port with the last n compatible SCSI CD Recorders.

Otherwise, if you use an autoloader with a SCSI robotic section, **DiscJuggler** will logically link the last robotic section found to the last n compatible SCSI CD Recorders.

The reason to backward-combine robotics with drives is to avoid associating system drives like internal ATAPI CD-ROM with the robotic.

The following are some important rules to follow before you install **DiscJuggler** with a CD autoloader device:

If using a serial (RS-232) robotic section:

- Make sure you use good quality serial cables; usually serial autoloaders require a "null-modem" straight through cable. Use a serial gender-changer, if necessary, to properly connect the device to your system.
- Make sure the COM port to which you are connecting the autoloader is not already in use. Many systems come with an internal modem that is likely using the same COM port that you are trying to use for the autoloader.
- Be certain that the COM port that you select for the autoloader is not using an IRQ that is normally used by another serial port. Many PCs have a default setup where COM1 and COM3 (and COM2 and COM4) share an IRQ; you should choose a COM port that is not inadvertently already sharing an IRQ with another active serial port.

If using a SCSI robotic section, all the recommendations in the "System Setup Tips" section apply.



Copying Compact Discs with Autoloaders

DiscJuggler has been designed from the ground up to natively support autoloader devices and to provide a reliable, professional, and yet easy-to-use, unattended operational mode.

When used in conjunction with an autoloader, **DiscJuggler** automation of complex tasks such as:

- Multiple copies of multiple master CDs at once
- Quality sampling with variable verification frequency
- Automatic and unattended error handling and recovery with only a few clicks of the mouse.

Users don't have to learn and apply complex procedures to effectively make use of these devices. The application will recognize and automatically handle all the additional functionality and, in most cases, the native **DiscJuggler** graphic interface described in the previous chapters applies; therefore, autoloaders are as simple to use as standard CD Recorders.

The following are operational modes available when using **DiscJuggler** with an autoloader:

- Unattended duplication of n copies of one master CD
- Unattended duplication of n copies of multiple master CDs at once



Single Master CD Duplication

When using an autoloader to create multiple copies of a single master disc, the following operational modes are available:

Create n copies from a master CD using the same autoloader:

1. Using the "File" menu, "New" command, create a new "Automatically Copy to the Same CD Recorder" task.
2. Select the autoloader in the "Source and Destination" window.
3. Select "Auto" or the desired number of copies in the "Action/Method" panel.
4. Load the input stack (sequential autoloader) or the magazine starting from the second physical slot and in consecutive order (random autoloader) with enough blank discs to complete the desired number or copies. If the number of copies requested exceeds the autoloader capacity, **DiscJuggler** will request the user to reload the device when no more blank discs are available.

In case "Auto" is selected in the "Action/Method" panel, **DiscJuggler** disables its internal copies counter and will repeat the duplication process until no more blank discs are available. Therefore, make sure you load the autoloader with the number of blank discs exactly matching the number of copies desired.

5. Put the master disc to be copied on top of the stack of blank discs (sequential autoloader) or in the first physical slot (random autoloader).
6. If there is a printer attached, specify in the Autoloader panel, the good and error label strings to be printed on the CDs.

After the task is started, the application will mount the master disc in the first CD Recorder available and generate a complete CD Image on a local hard disk. The disc will then be unloaded and the desired number of copies will be automatically generated from the CD Image.

Create n copies from a master CD using an external CD-Reader device:

1. Using the "File" menu, "New" command, create a new "CD Player to CD Recorders" task.
2. Select the external CD-Reader as a source and the autoloader as a destination in the "Source and Destination" window.

3. Select "Auto" or the desired number of copies in the "Action/Method" panel.
4. Load the input stack (sequential autoloader) or the magazine starting from the first physical slot and in consecutive order (random autoloader) with enough blank discs to complete the desired number or copies. If the requested number of copies exceeds the autoloader capacity, **DiscJuggler** will ask the user to reload the device when out of blank discs.

In case "Auto" is selected in the "Action/Method" panel, **DiscJuggler** disables its internal copies counter and will repeat the duplication process until no more blank discs are available. Therefore, make sure you load the autoloader with the number of blank discs exactly matching the number of copies desired.

5. Mount the master disc to be copied in the selected external CD-Reader.
6. If there is a printer attached, specify in the Autoloader panel, the good and error label strings to be printed on the CDs.

After the task is started, depending on the method selected in the "Action/Method" panel, the application will either save a temporary CD Image to a local hard disk first or immediately generate the number of copies requested directly from the source CD-Reader.

Create n copies from a CD Image previously generated by **DiscJuggler** or by any other pre-mastering application:

Using the "File" menu, "New" command, create a new "CD Image to CD Recorders" task.

1. Select the requested CD Image file name as a source and the autoloader as a destination in the "Source and Destination" window.
2. Select "Auto" or the desired number of copies in the "Action/Method" panel.
3. Load the input stack (sequential autoloader) or the magazine starting from the first physical slot and in consecutive order (random autoloader) with enough blank discs to complete the desired number or copies. If the requested number of copies exceeds the autoloader capacity, **DiscJuggler** will ask the user to reload the device when out of blank discs.

In case "Auto" is selected in the "Action/Method" panel, **DiscJuggler** disables its internal copies counter and will repeat the duplication process until no more

blank discs are available. Therefore, make sure you load the autoloader with the number of blank discs exactly matching the desired number of copies.

4. If there is a printer attached, specify in the Autoloader panel, the good and error label strings to be printed on the CDs.

After the task is started, the desired number of copies will be generated automatically directly from the specified CD Image.



Multiple Master CDs Duplication at Once

To create a variable number of copies of multiple master CDs in a single task in fully unattended mode, use the following procedure:

1. Using the "File" menu, "New" command, create a new "Automatically Copy to the Same CD Recorder" task.
2. Select the autoloader in the "Source and Destination" window.
3. Select "Auto" number of copies in the "Action/Method" panel.
4. Load the input stack (sequential autoloader) or the magazine starting from the first physical slot and in consecutive order (random autoloader). With a mixture of master and blank discs, make sure that the first (top) one is a master, the last (bottom) one is blank, and that there are not two consecutive master discs in the stack.
5. If there is a printer attached to the autoloader, specify in the autoloader panel, the file names where the good and error labels for the CDs are specified.

After the task is started, **DiscJuggler** will automatically generate a complete CD Image on a local hard disk for every master disc detected on the stack. Each master disc will then be unloaded and a new copy generated from the new CD Image for each blank disc detected on the stack, until the next master disc is detected or the bin is empty.



Autoloaders FAQ's

Question: How does **DiscJuggler** know which CD is the source disc?

Answer: If the "Automatic Duplication from and to the Same Recorder" task template has been chosen, **DiscJuggler** will check each compact disc that is loaded by the autoloader. If a non-blank disc is detected, then an image of that disc is created on the hard disk and used for duplication of all subsequent blank CDs until another non-blank CD is encountered. Alternatively, **DiscJuggler** can use a CD-ROM drive that is external to an autoloader or jukebox as the source by selecting the "CD Player to CD Recorder" task template.

Question: What happens if a defective disc is detected during unattended operation?

Answer: The disc is removed from the recorder and placed in the reject bin of the autoloader.

Question: Can **DiscJuggler** control multiple autoloaders simultaneously?

Answer: Yes, however, the user must be careful, as described above, to establish a correlation between the robotic control and the SCSI ID of each autoloader unit. Simply create multiple tasks and in each task select a different autoloader. You must be careful to not create a situation that is causing head contention on your hard disk. You can avoid hard disk head contention by not running more than a two tasks on the same fast hard disk (seek time less than 10ms) and adding additional hard disks to your configuration if you will be running several independent tasks.

Question: What type of quality assurance (QA) support exists for these production devices in **DiscJuggler**?

Answer: Several. First, **DiscJuggler** can verify each disc against the source image after it has been duplicated and reject the few discs that are defective. This procedure, while providing an extremely high degree of assured reliability will nearly double the time needed for duplication tasks. Although, this reliability might be consistently required for some types of duplication tasks, less stringent procedures are available that will allow you to strike a balance between quality assurance and duplication productivity. These

options provide for verifying only the first duplicated disc or one disc every x (where the operator can set x) discs.

An additional QA feature of **DiscJuggler** is the complete logging of each compact disc that is duplicated in a text file. This file can log the operator's name and other task-related data as well as a complete record of the duplication process.

DiscJuggler "Test" feature also provides a valuable insight into the reliability of a particular duplication task before it is begun on a stack of CDs so that all settings can be optimized for the maximum probability of success.

Question: What happens if a CD is improperly loaded into the CD Recorder or dropped?

Answer: **DiscJuggler** is designed to provide a reliable, unattended solution, and, depending on the device in use, it will try to apply all the available recovery procedures. However, in the unlikely event, that a disc cannot properly loaded or unloaded, the application will immediately stop the current process and advise the operator of the problem. This is necessary in order to avoid damaging internal autoloader components.

Question: What percent of blank CDs are normally detected as being defective?

Answer: It greatly depends on the quality of the media used, but under normal circumstances, if the writing speed never exceeds that for which the media was certified, this percentage should not be higher than 1%.

Question: Do I need a special version of **DiscJuggler** to operate an autoloader or jukebox?

Answer: Yes, these are specialized devices that require special software development on the part of Padus and extensive QA by the device's manufacturer, as a result, the software is usually sold with the device as part of a complete solution.



Appendix B: Troubleshooting

- *Device Firmware*
- *Auto-insert Notification*
- *Working with Multiple Tasks*
- *Hardware, Software and Data*
- *Interruption of the CD Recording Process*
- *Hard-disk and Other Data Sources*
- *Copying/Caching to Hard-disk*
- *Recording Speed*
- *SCSI Interface*
- *Compact Discs or CD-R Media*
- *Variable Gap Size*
- *CD+G and Karaoke Discs*
- *Audio Extraction and Duplication*



Device Firmware Version

Many problems can be caused by having an out-of-date CD recorder firmware (and, in some cases, reader firmware). You can determine the firmware version in the log file or status window of **DiscJuggler**. You can also find this information in Window's Device Manager by clicking on CD-ROMs. Then, check the current firmware offered by your device's manufacturer and see if it is newer than your current one. CD recorder vendors often will provide this information on the World Wide Web. In most cases, manufacturers will offer downloads of the software necessary to update your recorder's firmware. All identical model CD recorders should have the same firmware.



Auto-insert Notification

Auto-insert notification is a feature introduced in Windows 95, Windows 98, and Windows NT 4.0 to automatically launch an application or initiate a specific process every time the user inserts a disc into a CD-ROM or CD Recorder. The most common example of "auto-insert" notification is the "CD Player" application that is automatically launched by Windows every time an audio disc is inserted in a CD-ROM drive.

With "Auto-insert" notification enabled while **DiscJuggler** is writing the operating system continuously tries to read the contents of the disc being recorded to determine the appropriate action to take. This device/medium contention is the most frequent cause of CD recording problems.

To disable the "Auto-insert" notification feature, please follow the procedure described in the "System Setup Tips" section of this manual.



Working with Multiple Tasks

One of the most advanced features of **DiscJuggler** is the ability to run multiple CD recording tasks in parallel to minimize recording time and maximize resource usage. Because of the special demands multiple running tasks place on your system's resources, each new task should be carefully planned. The following restrictions should be taken into consideration:

If at least one task is writing to a CD Recorder, be sure no other tasks are trying to use devices sharing the SCSI/IDE bus with devices used by the preceding task. In other words, when running multiple CD recording tasks, never allow two tasks to use devices attached to the same bus.

If at least one task is writing from a CD Image on a hard disk, make sure no other tasks are either reading or writing CD Images from the same hard disk or on the same bus. You may be able to get two disks to share a hard disk successfully if you are using a very fast disk.

DiscJuggler allocates a level 2 cache to optimize asynchronous communication to each running task. If the amount of memory allocated to each task is substantial and many tasks are running at once, the operating system can run out of memory and start paging to the hard disk (to use virtual memory). This can considerably decrease the overall system performance and affect CD recording reliability.

If you plan to run multiple tasks, make sure you properly subdivide the amount of available system physical memory among all tasks. To adjust the amount of L2 cache assigned to each task use the "Caching" tab in the "Options" dialog.



Issues with Your System's Hardware, Software and Data

Many factors in the setup of your computer can impact duplicating CD's with **DiscJuggler**. **DiscJuggler** attempts to transparently account for as many of these factors as possible and successfully duplicate a compact disc or warn you of a potential problem. However, sometimes problems cannot be overcome and you should familiarize yourself with some of the basic system issues to troubleshoot problems.



Interruption of the CD Recording Process

It is better to not have other programs running when you are using **DiscJuggler**. You should be certain that less obvious software, such as screen savers, CD auto-notification, mail checkers, CD packet writing software, alarms, fax reception, or networking traffic, do not interrupt duplication. Also, be certain that **DiscJuggler** has exclusive access to any files, such as CD Images, that will be used in the duplication process.



Hard Disk and Other Source Data Access Issues

CD Recorders must be fed a constant stream of data during the recording process. If the recorder fails to constantly receive data at a rate that is determined by the recording speed and buffer size, the duplication process will fail and **DiscJuggler** will report errors such as "buffer underrun." While **DiscJuggler** can perform checks such as Test recording to minimize the number of such failures, there are some common reasons for this type of error. Your hard disk should have an access speed of under 20 milliseconds and be able to always transfer data faster than the recording speed (where 1x=10 KB/sec). To be on the safe side, a hard disk's average transfer speed should provide a reasonable margin over the recording speed. The same speed requirements are applicable to any other source data device.

Heavy disk fragmentation can also slow the effective transmission rate of data to the recorder, especially when duplicating from a CD Image, so the use of a disk defragmenter is strongly recommended.

If you are duplicating an audio CD, be certain that your CD reader is capable of reading CD Audio (Red Book) as data. This should not be a problem with most new CD readers, but many older 1X and 2X CD readers did not have this capability. You should also be aware that the read speed for audio tracks (also found in many games) can be considerably less than the "rated" speed of the reader and lead to buffer underruns.

Some hard disks will perform a thermal re-calibration in the middle of CD recording and cause it to fail. While all hard disks do thermal re-calibration to adjust for disk surface as the unit heats, most newer disks and those rated as "AV disks" will wait for a lull in I/O operations to avoid interrupting time-critical processes. Generally, most well known brands of hard disks manufactured today will permit CD recording without problems. If you suspect that disk transfers may be getting interrupted as you duplicate disks, ask the disk's manufacturer if thermal re-calibration is possibly happening while you are recording.



Copying/Caching to Hard Disk

The Windows 95/98 disk-caching program, Vcache, adaptively uses free RAM based on recent hard disk activity. Users who repeatedly copy CD images to hard disk either through the "Copy to Same Recorder," "CD Player to CD Image" or "CD Player to CD Recorder" (if you are caching the entire CD image) tasks of **DiscJuggler** may be unable to use sufficient caching RAM to avoid buffer underruns. There may be insufficient RAM because the repeated creation of disk files of greater than 600 MB will skew the algorithm used by Vcache to obtain RAM. If you notice that **DiscJuggler** reports available RAM less than the L2 cache size requested in **DiscJuggler**, you should try requesting a smaller L2 cache in **DiscJuggler** and/or limiting the amount of RAM available to Vcache.

The amount of RAM available to Vcache can be limited by editing the system.ini file with the Sysedit.exe. Find the [Vcache] heading and add a line like:

MaxFileCache = x, where x = the maximum number of KB for use by Vcache.

The actual size will vary depending on the RAM in your system and its software configuration. Monitoring RAM usage with the Microsoft utility, System Monitor (Start/Programs/Accessories/System Tools/System Monitor) may help you select an appropriate maximum RAM size.



Problems with Recording Speed

You will want to use your CD Recorder with **DiscJuggler** to duplicate discs at the fastest speed possible. Sometimes, though, other elements of your system will oblige you to record at slower speeds than your recorder's maximum.

First, a word about recording speed: The term "1X recording" is derived from the historical speed at which CD's were recorded and read. 1X recording is equivalent to 150 KB/sec. Consequently, 2X recording is equal to 300 KB/sec and so on. While compact discs may be recorded at various speeds, the speed at which a CD is successfully recorded does not affect the data on the disc that may be read back at various speeds. However, because the CD Recorder's laser moves over the surface of the media at speeds that may affect the chemical reaction of recording, when you record faster, be certain that the media is rated for the correct recording speed. Media rating is generally only an issue when you record at 4X or faster speed.

When you record at faster speeds, you place greater demands on your system to deliver data quickly enough to the buffer in your CD Recorder. If the buffer runs empty during recording, the duplication will fail. The bigger the buffers size of your recorder and the faster the components of your system, the less likely the buffer is to be empty.

DiscJuggler's Test function will determine if data can be fed fast enough to the buffer of your recorder to insure a successful duplication. **DiscJuggler** may discover that the fastest speed at which you can safely duplicate compact discs is below the highest possible speed of your recorder. Or you may choose to use a slower speed to be certain of a successful duplication at times that you prefer not to Test. Some systems will not be able to provide data to the CD Recorder even at its slowest speed and, unless, the problematic system components or data are corrected, will not be able duplicate CD's with **DiscJuggler**. Your options include upgrading the memory for the buffer of your recorder or buying a faster hard disk or CD Recorder.



SCSI Interface Problems

While the Small Computer System Interface (SCSI) is a high-performance interface for connecting your CD Recorder, hard disk, and other peripherals to your computer, problems with causes that are not obvious can arise, e.g. a drive not ready error. Among the possible SCSI problems that you might encounter are:

- *Duplicate SCSI ID's*

Make sure that each device has a unique ID, set either through a switch on the back of the device or by setting jumpers.

- *Improper termination*

There must be termination at the last device in your SCSI chain and nowhere else. Termination can be either external, through the attachment of a terminator on one of the SCSI connectors on the back of the device, or internal, through setting a resistor in the circuit board of the device. Many problems are caused by the inadvertent internal termination of a SCSI device that is not at the end of the SCSI chain. Sometimes devices are shipped from vendors with internal termination on.

- *SCSI device power problems*

Generally, it is safest if all SCSI devices are powered at hard reboot time. If one or more of your SCSI devices is not recognized, try hard rebooting after you have ensured that all SCSI devices will be powered at the time your computer is turned on.

- *SCSI device order*

For mysterious reasons, sometimes the order of SCSI devices in the SCSI chain will affect device recognition. It may be worthwhile changing the order of your devices and hard rebooting.

- *SCSI cable quality and length problems*

At times, the length of a cable may be the source of your problems. Try a shorter cable. In addition, SCSI cables are available in at a variety of prices and qualities. Or they can be damaged in the normal course of use. Sometimes, substituting a better-known cable brand or a new cable will help.

- *SCSI Bus Mastering*

You must have a supported bus-mastering type SCSI adapter card to use **DiscJuggler**.



Physical Problems with Compact Discs or CD-R Media

Data is recorded on the bottom (unlabeled) side of a CD. Therefore, if this surface is smudged, dusty, or scratched, you may have difficulty in recording to or reading from the disc. Use compressed air to remove the dust. Then, the disc may be cleaned with a soft, static-free cloth with straight strokes from the center of the disc to the outside. Never clean a compact disc with circular motions.



Failure to Accurately Reproduce Variable Gaps

If there is recorder support for this feature, be sure to check “Retrieve Indexes” in the advanced panel or set this feature as default in the Options menu.



Failure to Reproduce the Graphics Portion of a CD+G or Karaoke Disc

Make sure that your reader and writer support this feature, then be sure to check “Read R-W Subcodes” in the advanced panel or set this feature as default in the Options menu.



Inaccurate Audio Duplication

At times, CD readers more accurately extract digital audio when they read at slower speeds. You can set a slower read speed in the advanced panel or set the default read speed in the Options menu. Be certain the your recorder speed is not faster than you are reading if you are duplicating “on the fly.”



Appendix C: Error Messages

DiscJuggler will report many different types of errors in the log file and status windows. SCSI cards, ASPI software, CD readers and CD recorders report many types of errors. Unfortunately, **DiscJuggler** cannot give a detailed explanation of the hundreds of potential errors but the following is a list of the most common errors:

- *"Blank disc detected"*

You have specified a blank CD as your duplication source. Remove the disc and insert one with data or audio.

- *"Buffer under run"*

The recorder is not receiving data fast enough from your system and the duplication task that you are attempting has failed. See the "Troubleshooting" section.

- *"Completed preview write"*

The test write that you selected has completed successfully. You may now perform the actual duplication operation.

- *"Illegal field in command descriptor block"*

If you are using an IDE/ATAPI reader, it is likely that your reader is not fully ATAPI-compliant and will not work with **DiscJuggler** or other professional-quality CD duplication program. If you get this message for your CD recorder, please see if your recorder's firmware has an update available.

- *"Imperfect Audio Resynchronization"*

DiscJuggler was not able to perfectly duplicate the audio track using software algorithms though the imperfections will often not be audible to the human ear. If you have a high-end CD-ROM drive, you can move the resynchronization slider in the Advanced Panel to the "Native Resync" setting to let hardware handle the resynchronization. You can also try setting the Read Speed setting slower. Causes could include a scratched or dirty disc or inadequate reader.

- *"Media is incompatible"*

There is a problem in using the CD-R disc with a particular type of recorder. Insert another type of disc and check with the CD Recorder manufacturer to see which disc types are compatible.

- *"Medium error"*

The inserted disc is bad. Try another.

- *"Not ready"*

The CD Recorder or reader is not ready to perform the selected action. Try again once the unit has had an opportunity to sense or read the inserted disc. If you still get this message, then check your cable connections, termination, power to the units, and the seating of the discs. Make sure that Auto Insert Notification is off for all CD devices. Make sure that no other program, e.g. packet writing software, is using the bus.

- *"One or more units did not certify the disc for recording at selected speed. Continue writing?"*

You are trying to duplicate on a disc that is not rated for the recording speed that you have selected. Either reduce the recording speed or insert a disc that is rated for the currently selected CD-R disc.

- *"PCA area is full or unreadable"*

The CD-R target disc is not completely blank or is flawed in manufacture. Try another blank disc from another manufacturer if possible.

- *"PMA area is full or unreadable"*

The CD-R target disc is not completely blank, is flawed in manufacture, or not rated for the recording speed that you are attempting. Try another blank disc from another manufacturer if possible.

- *"PMA area less disc"*

The CD-R disc to which you are copy is bad. Insert another.

- *"SCSI/ATAPI communication error"*

There is a problem with your SCSI or IDE host adapter, software drivers, or cabling. Check cable and power connections. Also, check that you have a version of the ASPI software that supports the devices that you using. You could also have a problem with installing bus-mastering drivers if you are using IDE devices.

- *"SCSI I/O subsystem error"*

There is a problem with your SCSI host adapter or cabling. Check cable and power connections. Also, check that you do not have different versions of the file winaspi32.dll in your **DiscJuggler** and \system directories.

- *"Selection Time-out"*

One of your SCSI devices, usually a CD Recorder, CD reader, or hard disk is not responding to **DiscJuggler**. Check cable and power connections.

- *"Session not closed"*

The duplication task that you are performing may not have successfully completed. Verify that all data was duplicated.

- *"TOC less disc"*

The source CD-R compact disc has a problem.

- *"Unable to allocate enough memory for the asynchronous SCSI interface queue"*

DiscJuggler does not have access to enough memory to perform the current task. Exit from all programs and try again. You may have to add more memory to your system. See "System Requirements".

- *"Unable to ensure reliable writing at selected speed using the inserted disc"*

The blank disc to which you are copying has not been manufactured to record at the speed that you have selected. Try a slower recording speed or a CD-R disc that is rated at the preferred recording speed.

- *"Unexpected bus free"*

There is a problem in the communication of the host adapter with your CD Recorder, CD reader or hard disk. Check power, SCSI ID settings and cable connections.

- *"Verification Skipped"*

Though you have requested verification, it is not possible to verify this track. Audio tracks are the most common example. This is due to the way that audio tracks are recorded. **DiscJuggler** attempts to maintain the quality of audio replication depending on the type of resynchronization chosen.

- *"Volume overflow"*

You are attempting to copy more data than the CD-R disc can hold. Ensure that the maximum capacity of the disc to which you are recording is sufficient to contain all the data of the source disc.

- *"Write address is EFM area (already written)"*

The CD-R target disc is not completely blank is flawed in manufacture. Try another blank disc from another manufacturer if possible."

- *"Writing session not completed"*

The duplication task being performed may not have successfully completed. Verify that all data was duplicated.



Appendix D: Glossary

Access Time

Total time a storage device requires to find and retrieve a piece of information. For hard drives, access times typically range between 8ms and 20ms. For CD-ROM drives, access times range between 100ms 250 ms. For CD Recorder drives, access times range between 250ms 500 ms.

Analog to Digital Converter (A/D)

A device that samples an analog signal at regular intervals and quantizes each sample, that is, represents each sample's value with a binary number of some predetermined length. Analog-to-Digital conversion samples analog signals to produce a digital signal that describes the original analog signal.

Block

For compact discs, the smallest addressable unit of information. The physical size is 2,352 bytes.

Burst Error

Errors detected in consecutive data bits on compact discs often caused by scratches, fingerprints, or other physical defects on a disc. Error correction codes are designed to compensate for the anticipated frequency and duration of burst errors.

CD-DA

An acronym for Compact Disc Digital Audio which is the industry-wide standard for music publishing and distribution. Compact Disc Digital Audio can store up to 74 minutes of high quality stereo audio. Commonly referred to as the "Red Book" standard.

CD Duplication

The process of making one or more copies of a compact disc.

CD Image File

A file containing an exact representation of the data that will be placed on the CD-ROM. CD Image files are often written as the first step in the pre-mastering process when the complexity of the disc makes "On-the-fly" recording impossible. In these cases the CD Image file is created from the source data on the hard disk then transferred to the CD Recorder.

CD-R

An acronym for compact disc-recordable which is a type of media that allows you to record information using a CD Recorder.

CD-ROM

An acronym for Compact Disc Read Only Memory. By far the most popular standard of publishing and distribution of "non-audio" content. Available in 120 mm and 80 mm in diameter, it can store up to 650 megabytes of information. Commonly referred as the "Yellow Book" standard.

CD-XA

An extension of the CD-ROM format adding essentially improved multimedia functionality. Photo-CD, Video-CD and many Game-CD are examples of formats based on the CD-XA standard.

Compact Disc (CD)

The name for an injection-molded, metallized disc, 8 cm or 12 cm in diameter, which stores high-density digital data in microscopic pits that a laser beam can read. Invented by Philips and Sony, it was originally designed to store high-fidelity music. Because of its data storage capacity, the compact disc now is used as a delivery media for electronic publishing.

Cooking

A process that entails blocking user data and adding information identifying each block. Formatting information includes the data address and synchronization information and may include error correction check sums and data and data type specification.

Cross-Interleaved Reed-Solomon Code (CIRC)

The basic level of error correction provided for Audio CD with one uncorrectable bit out of every 10^9 . CD-ROM provides additional protection for data (ECC/EDC) reducing the error rate to one bit in 10^{13} .

Disk At Once (DAO)

Acronym for Disc-At-Once. A CD recording method in which the disc is written all at once without interruption. It is generally considered the "professional" way of recording a CD. The drawback is that the disc can be written only once and no further updates are allowed. In this mode, variable gaps and indexes optionally can be produced.

Digital to Analog Converter (D/A)

A device (DAC) that converts digital numbers to an analog signal. In a CD Audio player the DAC takes the stream of numbers read off of the disc and produces an analog audio signal.

Error Correction Code (ECC)/Error detection code (EDC)

An additional error recovery layer used by data compact disc with track in Mode 1 and Mode 2 Form 1. Error correction codes consisting of 276 bytes are placed at the end of every block to "protect" the 2,048 bytes of user data.

Host adapter

The SCSI controller card.

Index

A subdivision in a CD track. Up to 99 indexes may be placed in each track. Indexes are generally used in audio tracks to mark different movements. Index zero is a special case known as pause encoding. Index one indicates the start of the data for a given track.

Lead-in/Lead-out

Lead-in and lead-out areas mark the start and end of each session on the disc. The process of writing a lead-in and lead-out is called disc fixation and it generates a new disc session.

International Standard Recording Code (ISRC)

A code optionally assigned to each music track on a CD that uniquely identifies a track by country, year, and serial number. The ISRC is recorded in the Q sub-code channel.

Media

In computing, a substance or object on which information is stored. In the context of CD recording, often used interchangeably with recordable CD disc.

Mode 1

By far the most popular block formatting; Mode 1 has an user block size of 2,048 and provides for a level of error detection and correction beyond the Cross Interleaved Reed-Solomon Code (CIRC), which CD Digital Audio standard uses. Used for software and "non-video" data publishing and distribution.

Mode 2 Form 1/Form 2

Block formatting used by the majority of multimedia discs. Mode 2/Form 1 is similar to Mode 1 with a user block size of 2,048 bytes and extra error correction to ensure a high level of data integrity. Mode 2/Form 2 trades the extra data security for a 15% for the extra space. Form 2 is used for audio and video where small errors are usually not noticeable.

Multisession

A CD-R disc that has been made via multiple recordings. There is an overhead associated with each session that consumes part of the usable storage space on a CD.

PCA or Program Calibration Area

Space at the beginning of the CD for calibrating the laser to read or write to the CD.

PMA or Program Memory Area

A temporary area on a CD that is used to write information about the current recording process. It can include Table of Contents (TOC) and track start and stop points.

Photo CD

A CD format invented by Kodak for the storage of photographs. The specification for Photo CD includes the use of CD-ROM XA and multisession recording.

Post-gap

A short section (~2 sec) following the end of a CD or an area that indicates that a track has changed data mode. The post gap is formatted in the same manner as the track, it follows and ensures that all data can be read before the track changes.

Pre-gap

A short section (~2 sec) at the start of every track. The pre-gap is formatted in the same manner as the new track and gives the CD drive time to adjust to the new type of track. The pre-gap area is indicated with pause encoding.

SCSI (Small Computer System Interface)

A parallel interface that connects peripherals to computers in a daisy-chained fashion. The SCSI interface can be used to connect multiple drives to a computer over a single connection.

Session

A term that refers to the information written to a compact disc during a single recording. A session may include more than one track and may consist of both audio and data information. The start and the end of a session is delimited by two special areas: the lead-in and lead-out, respectively. The lead-in area includes the table of contents. As defined by the "Orange Book" Standard, multiple sessions can be recorded on one single disc.

Sub-Codes

Display and control information stored along with audio data on a compact disc. The compact disc format specifies eight sub-code bits for each CD frame and labels them P, Q, R, S, T, U, V, and W. "P" and "Q" sub-codes are used for CD position information and for the disc table of contents. "R" through "W" may be used for placing low-resolution graphics or MIDI data on a disc.

Synchronization Field

A 12 byte area of a CD data sector that contains synchronization information. In hexadecimal notation, all bytes in this field are FF except the first and last bytes, which are 00. Also called the sync code.

Table of Contents (TOC)

The Table Of Contents (TOC) of a CD contains the number of tracks, the start locations of all tracks, and the length of the entire CD. It is located in the "Q" sub-code channel of the lead-in area.

TAO or Track At Once

Acronym for Track At Once. A CD recording method where the compact disc can be written one track at a time allowing multiple disc updates. The drawback is that in order to implement this incremental track recording mode, several extra blocks must be added at the beginning and at the end of each track, thus modifying the track size and content.

Track

A logical subdivision of information on a CD. Audio CDs usually have a track for each song. There may be up to 99 tracks on a CD.

UPC/EAN or Universal Product Code

Bar Code number which uniquely identifies a CD title. It is located in the "Q" sub-code channel of the lead-in area.

.WAV Sound File

Microsoft Wave file: the Windows standard for audio files.



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