
RSJ CD Writer

Version 1.6

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Preface

The RSJ CD Writer File System provides an interface between OS/2 and the CD Recorder. Unlike existing mastering software, the CD Recorder is mapped to a standard OS/2 drive letter which can be used to access the CD for both reading and writing. Most file management commands available under OS/2 (e.g. COPY, XCOPY, ...) can be used to access the CD.

This documentation is divided into eight sections:

Installation	Installation of the RSJ CD Writer File System
Operation	General operating instructions (tutorial)
Reference	Detailed information about each component
Technical Details	Background information about CDROMs and Writable CDs which might be useful to gain maximum performance
Programming API	Description of the programming interface used to access the CD Recorder from third-party applications
Problem Determination	Information about possible error conditions and how to handle them
System Requirements	A list of hardware and software components needed to run the RSJ CD Writer
Appendix	Supported hardware, supported standards, restrictions, ...

Table of contents

Preface.....	3
Installation.....	9
Starting the Installation.....	9
Options in the Installation Program.....	9
Start Installation.....	11
Changing CD Writer Options.....	11
Operation.....	13
Starting the Error Log.....	13
Attaching the CD.....	13
Formatting the CD.....	14
Writing to the CD.....	14
Getting Information about the CD.....	15
Detaching the CD.....	16
Accessing a Previous Session.....	17
CD-View.....	19
Fundamental Knowledge.....	19
Tracks, Table of Contents and Sessions.....	19
Data CDs (CDROM).....	19
Audio CDs.....	20
Starting CD-View.....	20
CDROM.....	20
Hard Disk (Temporary Cache).....	21
CD Recorder.....	21
CD-View Interface.....	22
Toolbar.....	23
Track Directory.....	24
Status Bar.....	24
CD Labels.....	24
Copying Tracks.....	25
Finalize Session.....	27
Recording Speed.....	28
Track Size and Disk Space.....	29
Reference.....	31
Commands for CONFIG.SYS.....	31
RSJSCSI.SYS.....	31
CDWFS.IFS.....	32
LOCKCDR.FLT.....	33
OS/2 Commands.....	34
FORMAT.....	34
CHKDSK.....	34
RECOVER.....	34
SYS.....	34
Command Line Utilities.....	35
CDATTACH.....	35
CDCOPY.....	37
CDSPEED.....	38

CDWPOPUP.....	39
Technical Details.....	41
ISO9660.....	41
Internal Structure of a CD.....	41
Track.....	41
Multisession CDs.....	42
Track Modes.....	42
Audio.....	42
Mode 1, Form 1.....	42
Mode 1, Form 2.....	42
Mode 2, Form 1.....	43
Mode 2, Form 2.....	43
XA, Photo-CD, Multisession.....	44
XA.....	44
Photo-CD.....	44
Multisession.....	44
Programming API.....	45
CDWFSCTL.H.....	45
ATTACH.....	49
Example.....	49
DETACH.....	50
Example.....	51
CHKDSK.....	52
Example.....	53
CACHE_INFO.....	54
Example.....	54
SET_SPEED.....	55
Example.....	56
FORMAT.....	57
Example.....	57
CopyToCD().....	58
Syntax.....	58
Parameters.....	58
Example.....	58
XCopyToCD().....	59
Syntax.....	59
Parameters.....	59
Example.....	59
XCopyToCD2().....	60
Syntax.....	60
Parameters.....	60
Example.....	60
Problem Determination.....	61
CDWPOPUP.....	61
Error Display.....	61
Detailed Information.....	62
Error Table.....	62
CDATTACH.....	64
CDCOPY.....	64
Further Errors.....	65

System Requirements.....	67
Hardware.....	67
Software.....	67
CDROM.....	67
Appendix.....	69
Supported Hardware.....	69
SCSI Host Adapter.....	69
CD Recorders.....	70
Standards.....	71
ISO9660.....	71
High Sierra.....	71
ECMA-168.....	71
CDI.....	71
OS/2.....	71
Restrictions.....	72
Mastering.....	72
Conditions of Use.....	73
Index.....	75

Installation

An installation program, *INSTALL*, is used to install the RSJ CD Writer File System.

The installation program copies the program files to the desired location and updates the system file *CONFIG.SYS*.

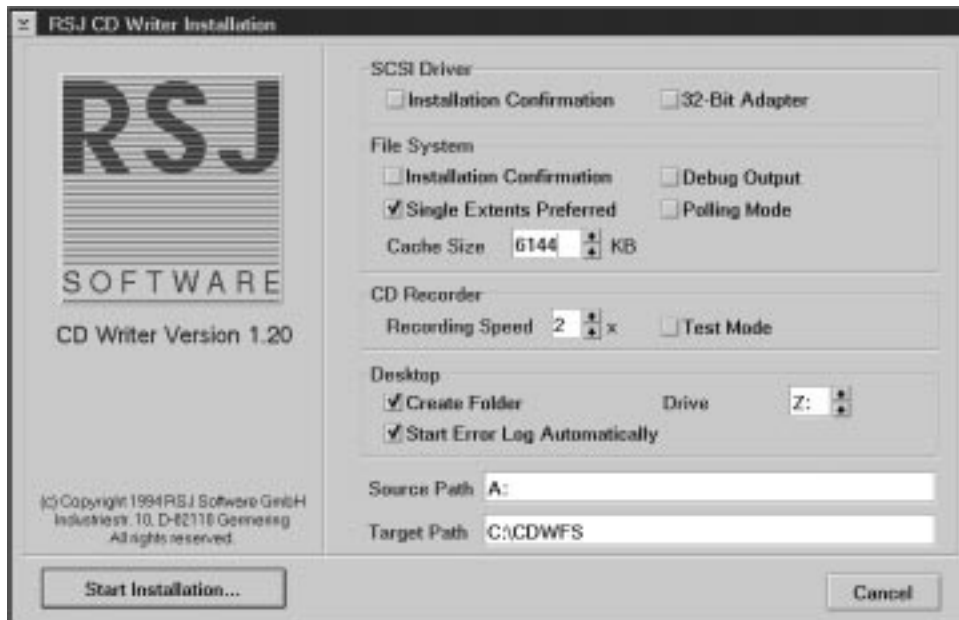
Note: Upon successful installation, the computer must be rebooted.

Starting the Installation

Enter the following command to start the installation program:

```
a:install
```

The installation dialog window appears:



Options in the Installation Program

The options in the installation dialog are used to customize the RSJ CD Writer File System:

- | | |
|----------------------------------|---|
| Installation Confirmation | Selecting this option causes the operating system to ask for confirmation before loading the according component. Not selecting this option will load the according component automatically (default). |
| 32-Bit Adapter | This option controls whether the device driver will use memory above the 16MB boundary. This works only with true 32-bit adapters (e.g. EISA and PCI adapters); Further information about adapters which have already been tested can be found in the appendix. |
| Single Extents Preferred | Select this option to prevent spreading files over multiple tracks. Further details about this option can be found in the reference section. |

Debug Output

This option determines whether all file system requests should be sent to the serial interface COM1. This option is particularly useful for debugging purposes.

Polling Mode

SCSI commands like the one used to close the current session might take a couple of minutes to complete. Without increasing the *SCSI Command Timeout*, the SCSI driver will start its built-in error recovery. Depending on the adapter/recorder combination, the error recovery procedure may interrupt the currently running command, causing recorder malfunctions or even unusable CDs.

Some SCSI adapters don't support increasing the *SCSI Command Timeout* value. In case of problems, try selecting this option to use a different approach for SCSI commands like the one discussed above: Instead of waiting for the command to complete, the file system just starts the command, then polls the recorder in short intervals (e.g. 1 second) to find out whether the command has completed.

Note: Using the *Polling Mode* will disable error processing for the affected SCSI commands, that means, errors which occur while a session is being closed might be either incorrectly reported or suppressed. For that reason, this option should be selected in case of problems, only.

Cache Size

In order to maintain the minimum transfer rate during write operations (usually 300KB/s), all files have to be cached before they are actually written. The size of this cache can be specified in this entry field. The basic rule of thumb for the cache size is: The greater the cache, the less tracks will be needed to write the same amount of data. Since a CD can manage only 99 tracks, a minimum cache size of 6MB or more is required to fill a 600MB CD.

Note: A cache size of about 7000KB is recommended for systems with less than 24MB RAM. Otherwise, transferring the cache contents to the CD Recorder might fail.

Recording Speed

The number in this entry field determines the recording speed factor which will be used by default (1 = single speed, 2 = double speed, 4 = quad speed, ...). If the recording speed factor is set to 0, the default recording speed of the device will be used. In most cases, this will be the fastest speed supported by the CD recorder.

This option can be used to prevent medium damage when fast CD recorders (quad speed or faster) are used with standard CD recordables.

Note: The recording speed can be changed at any time with the *cdspeed* command. Refer to the reference section for further information about this command.

Test Mode

This option switches the CD recorder into a so-called *Test Mode* which is used to determine whether the data transfer rate from the computer to the CD recorder meets the requirements of a specific recording speed. Most recorders will flash the *Write* or *Busy* LED to indicate that no data is actually written.

Some recorders produce error messages when the current session is to be closed in test mode. Therefore, the test mode should only be used to verify the data transfer rate, not the operation of the CD Writer File System. To prevent this error, close the CD with the *-c* option (see *cdattach* for further details).

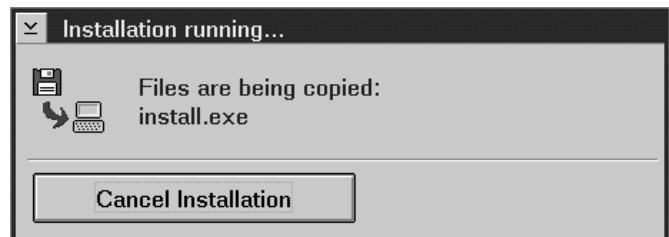
Create Folder	If this option is selected, a folder will be created on the Desktop which contains frequently used program objects.
Drive	<p>This option specifies the drive which should be used to access the CD Recorder.</p> <p>Note: This option is used to build the parameter strings for the program objects in the CD Writer folder. The CD Recorder can be mounted to any available drive letter from the OS/2 command line.</p>
Start Error Log Autom...	This option determines whether the error log utility should be started automatically. Further details about the error log can be found in the reference section.
Source Path	Location of the installation files
Target Path	Drive and subdirectory where the CD Writer File System should be installed.

Start Installation

Once all options have been set, the installation is started by pressing the *Start Installation* button.

During installation, the installation status is displayed in a progress window. This window can also be used to cancel the installation at any time.

Note: In case of installation errors, the progress window can be used to determine which file or operation has caused the error.



Once the message *Installation complete* is displayed in the progress window, the installation is complete and the installation program can be closed. The computer must be rebooted after the installation has completed.

Note: Before rebooting the computer, be sure that the CD Recorder is turned on and connected properly.

Changing CD Writer Options

The installation program can also be used to change the settings of the CD Writer afterwards. In order to start the installation program, enter the following commands in an OS/2 command window:

```
cd <Installation Path>
install
```

where <installation path> is to be replaced by the path which has been specified together with the first installation. The current settings are displayed as described in the previous chapter and can be changed according to your needs.

Notes: If you select the option *Create Folder*, the current CD Writer folder on the desktop, if any, will be replaced. This can be used to change the drive letter after the initial installation.

The entry fields *Source Path* and *Target Path* will be disabled. If you want to reinstall the file system or install a new version, the installation program must be started from the distribution disk.

Operation

This section serves as a tutorial to the operation of the CD Writer File System. Detailed information about each command can be found in the reference section.

Warning: Most CD Recorders are sensitive to power failures, interruptions during write operations, forcibly ejecting the CD (e.g. by switching off the CD Recorder) and similar procedures.

If you want to eject a CD without saving the information previously written to it, use the command "cdattach <Drive> -no_flush" to unlock the drive tray. Otherwise, information on the CD might be lost or the CD might be unusable for further write operations.

Starting the Error Log

The error log utility, *cdwpopup.exe*, provides detailed information about SCSI errors from the CD Recorder. The error log waits in the background until an error has been detected, then pops up an error message which can be used to classify the error.

Enter the following command to start the error log:

```
start cdwpopup
```

Note: The error log saves all error messages in a file named *cdwpopup.log* in the current directory. For that reason, the program must always be started in a directory with write permission, first of all somewhere on a local hard disk.

Further information about the error log can be found in the section *Problem Determination*.

Attaching the CD

In order to associate a drive letter to the CD Recorder, the following command must be specified:

```
cdattach <Drive>
```

Example:

```
cdattach z:
```

Note: The drive tray will be locked while the recorder is attached to a drive letter, that is, the CD cannot be ejected until the recorder has been detached as shown below.

This example assigns the drive letter Z: to the CD recorder. Enter the following command to see what's on the CD:

```
dir z:
```

If there are no files on the CD and the label is *UNFORMATTED*, the CD is not formatted and must be formatted with the OS/2 command *FORMAT*.

Formatting the CD

Formatting a CD is actually done by reserving a track with a specific length. The existence of this track is used to determine whether the CD is considered writable or not.

Enter the following command to format the currently inserted CD:

```
format <Drive>
```

Example:

```
format z:
```

Now the CD is formatted. This can be verified by typing the following command:

```
dir z:
```

The root directory (".\" and "..\") has been created; furthermore, the available space on the CD (about 600MB, depending on the CD) is displayed below the root directory.

Writing to the CD

Once the CD has been formatted, any OS/2 command can be used to write to the CD.

Examples:

```
copy c:\config.sys z:\config.sys
xcopy c:\* z: /s
...
```

Theoretically, you could even install applications on the CD and work directly from the CD. However, since each track on the CD can be written only once, the CD would be filled by temporary files and repeatedly saving the same file while the amount of data on the CD would remain basically constant.

Please note that only one file can be open for writing at the same time, so some commands (such as *BACKUP*) or applications might show errors like *Access denied* when they want to open the second file in write mode. The number of files opened for reading is not limited.

Note: In order to maintain compatibility with DOS, long file names and extended attributes are not supported. Files having more than 8 characters in the file name or more than 3 characters in the extension can't be copied to the CD without renaming them in advance. Extended attributes are automatically discarded.

Getting Information about the CD

The OS/2 command *CHKDSK* can be used to get detailed information about the CD..

Example:

```
chkdsk z:
```

In addition to the well-known *CHKDSK* information, some CD-specific information is displayed at the end of the information output. This includes the number of tracks already written (max. 99), the number of sessions and the current status of the CD.

The additional parameter */V* tells *CHKDSK* to provide additional information about the creator of the CD, the software used to write the CD and further information defined by the *ISO9660* standard.

Example:

```
[C:\]chkdsk z:

The type of file system for the disk is CDWFS.
The CDWFS file system program has been started.

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  644.868 kilobytes total disk space
    2 kilobytes are in 0 directories
  10.810 kilobytes are in 2 user files
    0 kilobytes are in extended attributes
    0 kilobytes are reserved for system usage
  435.364 kilobytes available for use

CD-Writer specific information:
    7 finalized sessions; open session: 8
   28 tracks; reserved track: 28
=> CD is formatted, writing enabled (CD is clean)
```

This example shows the output generated by a partially written CD. The CD contains 7 sessions and 28 tracks.

Note: Although only 10MB disk space is used by files (*10.810 kilobytes are in 2 user files*), the CD has only 420MB left. This is the result of repeatedly deleting or overwriting files on the CD: Since each piece of information can be written only once, deleting files does not reveal any free-space.

Detaching the CD

Before the CD can be ejected, it must first be detached from the associated drive letter. This can be done with one of the following commands:

```
cdattach <Drive> -no_flush  
cdattach <Drive> -c  
cdattach <Drive> -s  
cdattach <Drive> -x
```

Example:

```
cdattach z: -c
```

This example causes all unsaved information to be written to the CD. Afterwards, the drive tray is unlocked and the CD can be ejected.

Note: Some drives keep track information in their cache until the CD is ejected. As a result, the CD is ejected automatically if the CD has been modified since it has been attached.

The various detach options have the following meaning:

- no_flush** The drive tray is unlocked without writing any cached information to the CD. This option is used primarily to eject a damaged CD which can't be detached with one of the remaining detach options.
- c** The cached information, if any, is written to the CD and the drive tray is unlocked. As yet, the information on the CD can only be used together with the CD Writer File System; in order to use the CD with CDROM drives, the following detach option must be used.
- s** Same as *-c*; however, the current session will be closed as well. This allows reading the CD in standard CDROM drives. Closing a session takes about 12MB disk space, so this option should be used only if the CD is to be read by CDROM drives.
- x** Like *-s* but, the CD will be "sealed", that is, the CD becomes write protected. The write protection can be removed at any time by using the command "*format <Drive> /UNSEAL*".

Note: Old CDROM drives can only access the first session on a CD. If you plan to read the CD in old CDROM drives, make sure you close the current session after all required data has been copied to the CD. You can, however, close the CD at any time (e.g. to interrupt the copy operation temporarily) with the detach option *-c*.

Accessing a Previous Session

The command *cdattach* has an additional option to skip one or more sessions when the CD is attached to a drive letter. This option allows accessing files which have been deleted or modified in the currently active session.

Note: If the CD has been created by the CD Writer File System, this option can also be used to skip write operations which have been completed with the detach option *-c*. CDs created by another mastering software (e.g. Photo CDs) allow skipping physical sessions, only.

Example:

```
cdattach z: -11
```

This example skips one session; thus, a file which has been deleted or modified in the current session is now again available in its original status.

If more than one session is to be skipped, increase the number behind the option *-l*:

```
cdattach z: -13
```

This example skips 3 sessions at once.

CD-View

The PM application *CD-View* is used to deal with the tracks on a CD. It can be used to copy audio tracks to (or from) CDs in arbitrary order. Furthermore, *CD-View* can also be used to copy data CDs much like *DISKCOPY* is copying diskettes.

CD-View should be considered a separate product and needs exclusive access to all devices it is dealing with. Therefore, any currently active drive letter assignment must be deactivated (e.g. by calling "*cdattach -c*") before accessing the CD recorder with *CD-View*.

Note: Working with tracks requires fundamental knowledge about the make up of music and data CDs. To prevent mistakes or data loss, the following section **should be read in any case**.

Fundamental Knowledge

Please read this section carefully before using *CD-View*.

Tracks, Table of Contents and Sessions

- Each (non-blank) CD contains between 1 and 99 tracks.
- Each track can save a single data format. Audio tracks can only save digital audio data, while data tracks can only store data.
- The *Table of Contents (TOC)* of a CD solely contains information about the number of tracks, their starting position on the CD and the basic track type (audio or data). *CD-View* uses this information to display the track directory, thus cannot display any information about the contents of the according track.
- CDROM drives don't return detailed information about all sessions on the CD. For that reason, ***CD-View* is not suitable for copying multisession CDs.**

Data CDs (CDROM)

- Data CDs usually contain only a single data track. Exception: *Photo-CDs* as well as CDs written by the *RSJ CD Writer File System*.
- The directory of the files on the CD is located at a certain position in the data track.
- Data tracks must always start at the same address, that means the track order of a Data CD must be maintained when being copied to another CD. Furthermore, the target CD must be empty to make sure the first track will start at address 0.
- *CD-View* cannot copy multisession CDs. The number of sessions can be determined by running *CHKDSK* after attaching the CD to a drive letter with *cdattach*.
- Most Data CDs contain copyrighted material which may only be copied for private backup purposes.

Audio CDs

- Audio CDs contain one or more music titles, each of which is stored in a separate audio track.
- Most CDROM drives are not able to read audio tracks. Please note that reading audio tracks is different from playing audio tracks (which is supported by most CDROM drives).
- OS/2 does not offer a dedicated interface for reading audio tracks. Although some CDROM drives are explicitly supported by *OS2CDROM.DMD* or additional filter device drivers (???.FLT), don't expect to be able to read audio tracks with a specific CDROM drive.
- Audio tracks, in contrast to data tracks, don't contain any reliable positioning information. For that reason, every time a specific position in an audio tracks is requested, the resulting position might differ between two requests.
- Due to the previously mentioned limitation, audio tracks must be read contiguously. If the audio data can't be processed fast enough, the resulting track might contain cracks or repetitions. In most cases, however, these errors will be beyond the capabilities of a human ear.
- All audio tracks must be located in the first session of the CD. Audio CDs are always single-session CDs, no matter whether the playback device is a multisession capable CDROM drive or not.
- Music titles are protected by copyright law. Digital copies of audio tracks are only allowed for private use.

Starting CD-View

CD-View is started together with the desired device path name. This path name either points to a CDROM drive letter, a directory on a hard disk or the name of a CD recorder.

The installation program automatically creates program objects for each of the following devices:

- CD recorder
- hard disk (in a subdirectory of the installation path named "*Tracks*")
- all available CDROM drives

In order to support additional devices, either start *CD-View* manually or copy one of the existing program objects and edit the device name in the parameter field.

CDROM

In order to start *CD-View* on a CDROM drive, specify the drive letter of the CDROM drive.

Example:

```
cdview e:
```

This example starts *CD-View* and displays the track directory of the CDROM drive *E:*.

Hard Disk (Temporary Cache)

If there's no CDROM drive available (or the CDROM drive does not support reading audio tracks), *CD-View* supports using a subdirectory on a local hard disk as a temporary cache. This is done by emulating a CD recorder which saves each track in a file called *TRACKxx.TRK* or *TRACKxx.WAV* (*xx* represents the track number from 01 to 99).

Notes: The subdirectory should only be modified by *CD-View*. If one of the track files is deleted manually, all following track files must be renamed accordingly.

Although audio tracks are saved in a format compatible to the commonly known *.WAV* files, it is not possible to copy self-made *.WAV* files to a CD. This feature is planned for future versions.

The emulation driver saves the track information in the extended attributes of the track file. For that reason, the target directory must point to a drive which supports extended attributes.

Data tracks are saved with the extension *.TRK*, while audio tracks are saved with the extension *.WAV*. Playing audio tracks is supported if the system has a sound card which is able to play audio files with 44.1KHz, 16 Bit stereo.

Example:

```
cdview c:\cdwfs\tracks
```

This example emulates a CD recorder in the directory *c:\cdwfs\tracks*. The tracks will be saved in files named *TRACKxx.TRK* or *TRACKxx.WAV*, respectively.

CD Recorder

In order to run *CD-View* together with a CD recorder, use the device name "*CDR:*". If multiple CD recorders are attached to the system, the SCSI ID of the desired recorder can be appended after the colon at the end of the device name in the format "*a.i*". *a* represents the adapter index (0 = first adapter, 1 = second adapter, ...) while *i* selects the SCSI ID of the CD recorder.

Notes: Due to a limitation in the device driver *RSJSCSI.SYS*, only one recorder can be used at the same time. This limitation is subject to change in a future version.

If the CD recorder identifies itself with an unknown device name, the environment variable *CDR_DEVICE_NAME_x* can be used to add a new device name to the list of already supported devices. The *x* represents the device group; further information about supporting unknown CD recorders can be found in the description of the *CDWFS.IFS* command. Please note that the device name must be specified without quotation marks.

Examples:

```
cdview CDR:
```

This example starts *CD-View* for the first supported CD recorder.

```
set CDR_DEVICE_NAME1=YAMAHA CDR102
cdview CDR:0.4
```

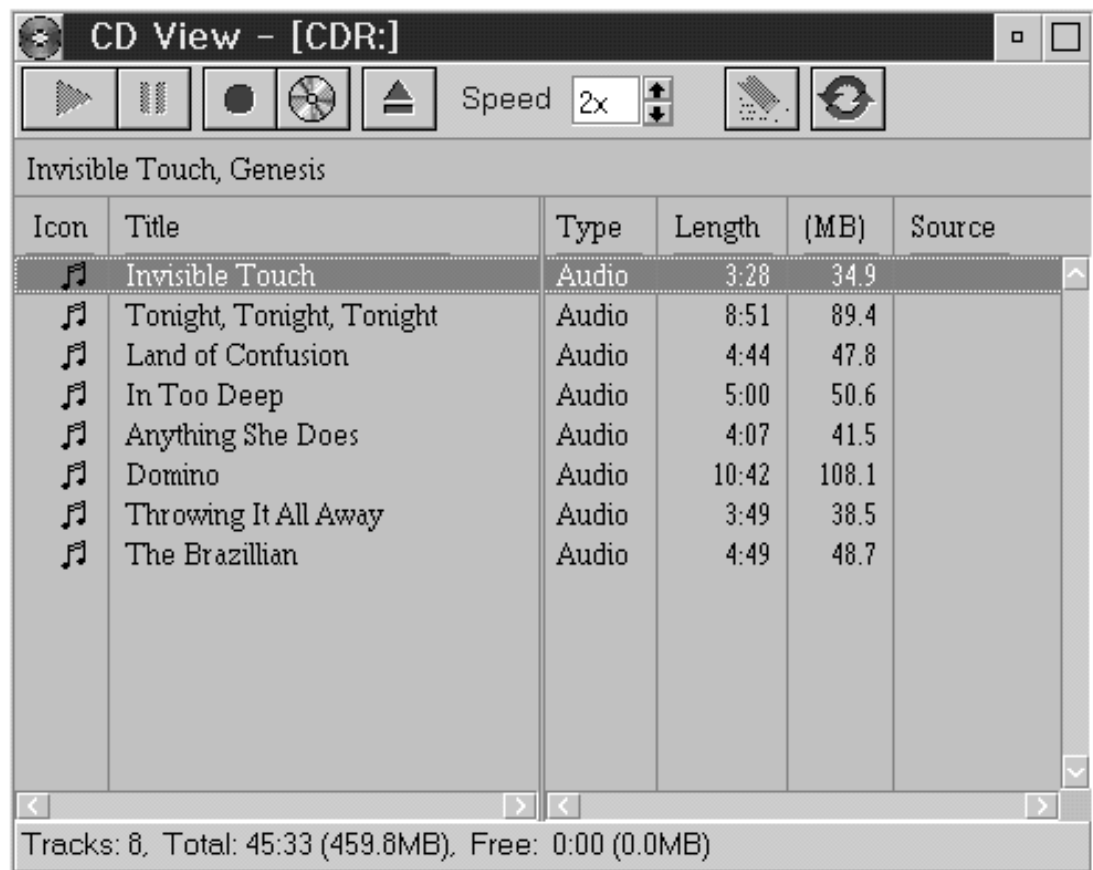
This example tells *CD-View* to address the recorder with the SCSI ID 4 on the first adapter. Additionally, the device name of the Yamaha CDR102 recorder is added to device group 1 (which includes all Philips and Yamaha recorders).

CD-View Interface

CD-View is a Presentation Manager application which behaves much like the well-known *Workplace Shell*. It has three main areas: a toolbar at the top, the track directory and a status bar at the bottom.

To change the background color or the font of the track directory, just drag a color or font from the according palette into the track directory.

Color, font and position information are saved in an .INI file named *cdview.ini* in the installation directory. The information is saved on a per-device base, that is, each device has a separate entry in the .INI file.

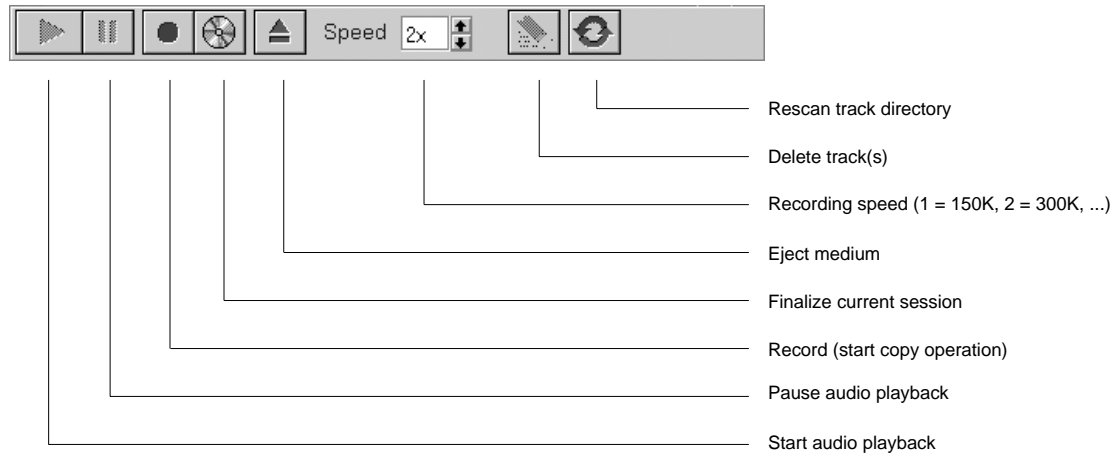


CD-View can be closed by double-clicking the system menu or by selecting *Close* in the system menu.

Toolbar

The toolbar resembles the controls of a CD player or video recorder and is used to operate *CD-View*. Like a CD player, the toolbar contains controls to start or stop audio playback, eject the CD, ...

The following graphic explains all available controls:



Start audio playback	Plays the currently censored audio track. If the drive's line-out jack is connected to a sound card, the volume can be controlled by the sound card mixer; otherwise, a headphone or amplifier should be connected to the CD drive.
Pause audio playback	Stops all currently active audio playback operation. As long as no other playback operation has been started by the <i>Play</i> button and the CD has not been replaced or used for copying, the playback operation can be resumed by pressing this button again.
Record	After one or more tracks have been prepared for copying via <i>Drag & Drop</i> , this button is used to start the copy process.
Finalize current session	Once all tracks have been copied to the CD, the current session can be finalized by pressing this button. Please read the chapter <i>Finalize Session</i> before finalizing a session.
Eject	This button causes the currently inserted medium to be ejected.
Recording speed	This control is used to adjust the recording speed of the CD recorder in multiples of 150KB/s. The available speed factors depend on the capabilities of the CD recorder. Adjust the recording speed before pressing the <i>Record</i> or <i>Finalize</i> button. Please read the chapter <i>Recording Speed</i> carefully before adjusting the speed factor.
Rescan track directory	This button forces a rescan of the track directory (e.g. after a new medium has been inserted). All tracks prepared for copying will be discarded if this button is pressed.

The controls in the toolbar are enabled or disabled according to the capabilities of the target device (CDROM, CD recorder or hard disk). For example, a hard disk cannot be ejected, while a CDROM drive cannot be used to write tracks.

Furthermore, the currently censored track will exert influence on the status of some controls. For example, it is not possible to play a data track.

Note: Clicking the track directory with the right mouse button brings up a popup menu which includes all controls of the button bar.

Track Directory

The track directory lists all tracks on the current CD. Additionally to the track name, the directory contains the track type (Audio, CDROM or CD-XA) as well as the length of the track in minutes and megabytes.

The area right above the track directory contains the CD label. If the CD is unknown, the CD will be labeled *Unknown CD* (if there's at least one track) or the track title area is displayed as a narrow, empty row.

The first column contains a musical note for audio tracks or a diskette symbol for data tracks. This icon has an additional purpose: if a track has been prepared for copying, the icon will be displayed as a half-tone bitmap. Once the track has been copied successfully, the icon is displayed with full contrast.

To change a track title or the CD label, hold the *Alt* key while clicking the track title with the left mouse button. The track titles and the CD label are saved in the .INI file *cdwfs.ini* under a key which is generated from the length of all tracks on the CD.

In order to copy tracks from a source window to a target window, select one or more tracks in the source window, grab the tracks with the right mouse button and drag them to the target window. If some of the tracks have been dragged accidentally, they can be removed from the track directory by dragging them to the *Shredder* of the OS/2 Workplace Shell as long as they have not been written to the CD.

Note: The driver for hard disk directories permits deleting tracks even if they have already been copied. This allows using the hard disk as a temporary track cache.

Status Bar

The status bar displays information about the currently inserted CD as well as the status of *CD-View*.

Usually, the status bar contains information about the number of tracks on the CD, the disk space used by these tracks and the free disk space left for new tracks.

Note: The calculation of the remaining disk space needs to make assumptions about the tracks which will be copied to the CD. Therefore, it may be inaccurate especially if many audio tracks are to be copied to a hard disk directory. Please read the chapter *Track Size and Disk Space* for further information.

CD Labels

As mentioned in the chapter *Track Directory*, each track can be given a name. Furthermore, the disk label can be changed in the title area of the track directory. This is done by holding down the *Alt* key while clicking the title to be changed with the left mouse button.

The track titles and the CD label are saved in the .INI file *cdwfs.ini* under a key which is generated from the length of all tracks on the CD. Thus, two CDs with exactly the same track layout will be treated equal, no matter whether the track contents are different or not. However, it is unlikely to have two CDs with the same track layout and different track contents.

Each time a copy operation has completed, the track directory is saved in the .INI file under a new CD key. The old track directory, however, is not deleted from the .INI file since another CD might still be using it. Thus, it's recommended to copy as many tracks as possible in a single copy operation to prevent the .INI file from growing unnecessarily.

Note: Unmodified track titles will not be saved in the .INI file. For that reason, the .INI file won't become any bigger if the original track titles (such as *Track 01*, *Track 02*, ...) are not changed.

Copying Tracks

Before any tracks can be copied, *CD-View* must be started for both the source and the target drive.

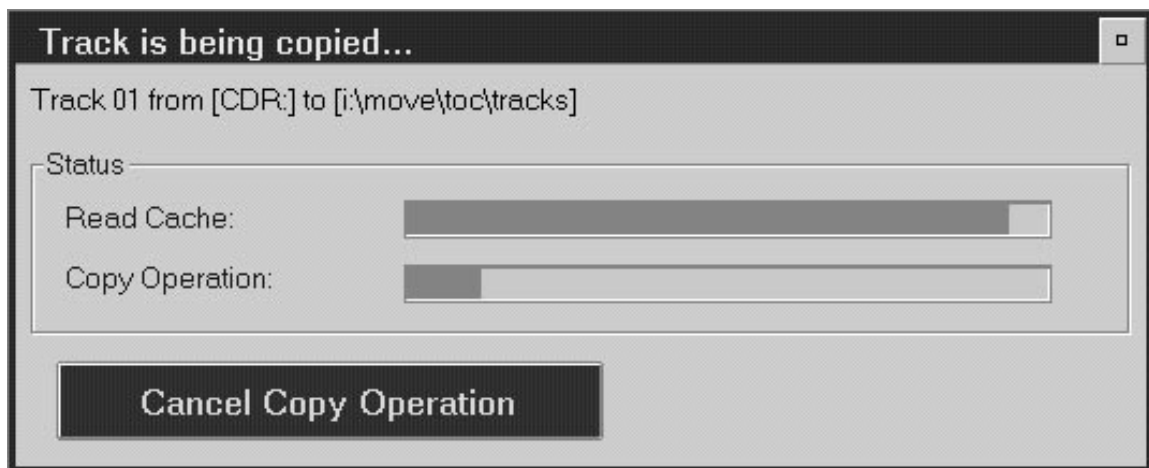
First of all, the desired tracks must be selected in the source window. Once selected, the tracks are prepared for copying by dragging them with the right mouse button to the target window. The tracks will show up in the target directory with a halftone icon, indicating that they are not yet copied but prepared for copying. Please note that the *Source* column will always show the complete source path of the track in case you get confused after reordering the tracks a couple of times.

Note: The tracks to be copied are inserted right before the track the mouse pointer had been pointing at when the right mouse button was released. Since it is not possible to change the order of the tracks which have already been copied to the CD, new tracks must be dropped either onto a track which has not yet been copied or the empty area below the track directory.

The order of the new tracks can be changed at will by picking up some tracks once again and dropping them at another location.

Before the copy operation is started, the recording speed can be adjusted in the toolbar. Depending on the speed of the source drive and the quality of the writable CDs, a higher or lower speed might be necessary. Further information about determining the optimum recording speed can be found in the chapter *Recording Speed*.

The copy operation is started by pressing the *Record* button in the toolbar. A new window appears which displays the copy progress:



The status window contains two progress indicators which display the number of buffers in the read cache as well as the progress of the copy operation.

The read cache is used to compensate short delays in read commands and/or to maintain a minimum transfer rate when reading audio tracks. Depending on the track being copied and the source and target drives, the read cache should have the following status:

Track type	Source	Target	Read cache full	Read cache empty
Data	*	CD	Minimum recording speed is maintained.	Copy operation might have to be aborted.
Data	*	HD	unimportant	unimportant
Audio	HD	CD	Minimum recording speed is maintained.	Copy operation might have to be aborted.
Audio	CD	HD	Hard disk cannot maintain minimum read speed for audio tracks. The audio file is possibly damaged.	Minimum read speed is maintained.
Audio	CD	CD	The target might not be able to maintain the minimum speed for reading audio tracks.	The source might not be able to maintain the minimum recording speed.

As this table shows, copying audio tracks from a CD to a CD recorder cannot guarantee successful completion: the source and the target drive must use exactly the same speed to maintain both the minimum read speed for reading audio tracks as well as the minimum recording speed for writing to a CD recorder. If the recording speed is lower than the read speed, the copy operation does not necessarily have to be aborted, but the resulting audio track might contain cracks or repetitions due to the lack of positioning information in audio tracks.

Note: Most CD recorders have an additional cache buffer which is sometimes bigger than the read cache used by *CD-View*. In this case, the read cache will run empty at the moment the write operation begins and, depending on the speed of the source drive, will fill up slowly or remain empty. This does not indicate an error as long as the copy operation is not aborted.

The copy operation can be cancelled at any time by pressing the read button labeled *Cancel Copy Operation*. Please note that a partially written track will be useless in most cases.

Finalize Session

Once all tracks have been copied, the current session must be finalized to write the *Table of Contents* to the CD. The *TOC* is used by CDROM drives and audio CD players to access the track directory; CD recorders don't need it because they save a copy of the track information in a special area which can only be accessed by CD recorders.

It might be useful to increase the recording speed to the maximum before finalizing the current session as long as the resulting speed is supported by the medium.

Caution: Choosing a speed factor above double speed (2x) may destroy standard CDs if they are not labeled accordingly. Please make sure the medium supports the desired speed factor by looking for a speed indication label such as *Multispeed*, *Quadspeed*, *4x speed*, ...

The current session can be finalized by pressing the *Finalize* button in the toolbar. This will take a couple of minutes, depending on the previously selected speed factor.

Note: Maintaining data integrity on multisession CDs requires analyzing the contents of the tracks on the CD. Since *CD-View* does not look into the track it is copying, it should be used for single session CDs, only. Further sessions can be added with the file system after the CD has been unsealed by calling "*format <Drive> /UNSEAL*".

Audio tracks must be located in the first session. If audio and data tracks are to be mixed on a single CD, make sure the data tracks are copied first while maintaining their original order. Audio tracks can then be added to the end of the CD.

Recording Speed

When writing CDs with the *RSJ CD Writer File System*, the recording speed can easily be adjusted afterwards in case of problems without destroying the CD. This is possible because the file system knows the internal structure of the CD according to ISO9660 and can write the files into a new track after the speed has been adjusted.

CD-View, however, has been designed to copy audio and data tracks without any knowledge of the internal track structure. If a copy operation has to be aborted due to insufficient read performance, the resulting CD will be useless and will have to be discarded; a new CD has to be written from scratch.

In order to determine the optimum recording speed, please pay attention to the following points:

- If the source is not able to read the data with the selected recording speed, the copy operation will have to be aborted.
- *CD-View* tries to measure the read performance while the read cache is being filled. This might result in error messages when copying from a CDROM to a CD recorder if the read performance is just below the selected recording speed. Sometimes, a second try might be necessary to copy the track if the source drive is reading exactly with the same speed as the target drive is writing.
- Since it is not possible to address the very same position in an audio track twice, audio tracks must be read contiguously. Copying an audio directly from a CDROM to a CD recorder might lead to cracks and/or repetitions in the resulting audio track if the source drive is reading faster than the selected recording speed. In most cases, however, the disturbances can't be noticed by a human ear.
- The speed of CDROM drives can't be adjusted under OS/2. Moreover, most CD recorders and CDROM drives don't read audio tracks with the same speed as data tracks. For that reason, it might be necessary to experiment with the recording speed if it is desired to copy directly from a CDROM drive to a CD recorder. Since inadequate read performance will be detected before the track is actually written, it is recommended to start with the highest available recording speed until the copy operation succeeds. Please note that, depending on the size of the read cache in the CDROM drive, the performance test might pass while the read performance is still way below the requirements. To clear the read cache, eject and reinsert the CD before starting the copy operation with a new recording speed.
- If possible, the read performance of a CD recorder is set to the maximum allowed value.
- If a CD recorder is using an unknown device name and has been declared compatible to a specific device group as described in *Starting CD-View*, the recording speed cannot be changed.

Track Size and Disk Space

The track size is specified in two different units:

- Playback length of the track (in minutes)
- Size of the track (in megabytes)

The playback length of a track is independent of the track type since playback will always occur at 75 sectors per second. As the sector size in audio tracks (2352 bytes) is larger than in data tracks (2048 bytes), an audio track consumes more disk space on a hard disk than a data track with the same playback length.

The free space reported in the status line assumes a sector size of 2048 bytes. Therefore, it is possible that a specific audio track does not fit on the hard disk although the indicated free space should be sufficient.

Each track starts with a so-called *Pregap*. This area shows up on audio CDs as a 2 second pause between two music titles; yet it's present on data CDs as well. If the track type changes between two tracks, another second will be added to the *Pregap* which sums up to a total length of 3 seconds. *CD-View* subtracts the length of the *Pregap* automatically, that is, the reported track length may differ from the length indicated on the CD cover. The total length reported in the status line, however, includes the *Pregaps* between the tracks.

The contents of the *Pregaps* are not copied by default since the contents are unreadable, anyway. This may lead to a 2 second pause between the music titles of live recordings.

The reported track lengths are rounded downwards, thus adding all track lengths together does not necessarily yield the same result as reported in the status line. This is also true when new tracks are added to the CD: the remaining free space might be reduced by another second in addition to the 2 or 3 seconds used by the *Pregap*.

Reference

This section describes all files and commands used to work with the RSJ CD Writer File System:

Commands for CONFIG.SYS

The following commands must be specified in the system file *CONFIG.SYS*. Please note that the computer must be rebooted before any changes can take effect.

RSJSCSI.SYS

The device driver *RSJSCSI.SYS* provides simplified access to SCSI devices. The CD Writer File System uses this device driver to access the CD Recorder.

Syntax:

```
DEVICE=<Path>\RSJSCSI.SYS [-q] [-n<Driver Name>] [-x]
```

where <Path> is to be replaced by the installation path.

The optional parameters have the following meaning:

- q** While booting, ask user for confirmation before installing the device driver.
- x** This option allows using memory above the 16MB line. This works together with true 32-bit SCSI adapters, only (e.g. most EISA and PCI adapters). Further information about adapters which have already been tested can be found in the appendix.
- n** Name of the device driver. The default name, *RSJSCSI\$*, is expected by the file system, although the name can be specified in the *cdattach* command line. This option should only be used if the device driver is to be loaded multiple time.

Example:

```
DEVICE=C:\CDWFS\RSJSCSI.SYS
```

CDWFS.IFS

The file system *CDWFS.IFS* provides the interface between OS/2 and the CD Recorder. It uses the device driver *RSJSCSI.SYS* to transfer commands and data to the CD Recorder.

Syntax:

```
IFS=<Path>\CDWFS.IFS [-c <Cache Size>] [-a] [-x] [-q] [-d] [-s Speed
Factor] [-e] [-i#="ID"]
```

where *<Path>* is to be replaced by the installation path.

The optional parameters are used to configure the behavior of the file system and have the following meaning:

- c** In order to maintain the minimum transfer rate during write operations (usually 300KB/s for double-speed CD recorders), all files have to be cached before they are actually written. The basic rule of thumb for the cache size is: The greater the cache, the less tracks will be needed to write the same amount of data. Since a CD can manage only 99 tracks, a minimum cache size of 6MB or more is required to fill a 600MB CD.

Note: A cache size of about 7000KB is recommended for systems with less than 24MB RAM. Otherwise, transferring the cache contents to the CD Recorder might fail.

If the SCSI adapter supports 32-bit DMA and the computer has more than 24MB of memory, the cache size can be set to 12-15MB.

- a** Disables locking the drive tray, thus allows ejecting the CD even if it is currently attached to a drive letter. This option has been implemented for test purposes and should not be used for normal operation to prevent data loss.
- x** Tells the file system to try keeping files in a single track. This is required if the CD is to be read by MS-DOS or Windows (NT) systems because currently only OS/2 supports reading files spread over multiple tracks (multiple extents). The option *-x* will start a new track each time the file to be copied is larger than the remaining space in the cache buffer. Files which are larger than the total cache size should be copied with the command *cdcopy* to prevent that they are separated into multiple tracks.
- q** While booting, ask user for confirmation before installing the file system.
- d** Specifying this option causes all file system requests to be logged on the serial interface *COM1*. This option has been implemented for test purposes: To find out which operation has caused an error, a terminal with 9600 Baud, 8 data bits and no parity can be connected to the serial interface.
- p** SCSI commands like the one used to close the current session might take a couple of minutes to complete. Without increasing the *SCSI Command Timeout*, the SCSI driver will start its built-in error recovery. Depending on the adapter/recorder combination, the error recovery procedure may interrupt the currently running command, causing recorder malfunctions or even unusable CDs.

Some SCSI adapters don't support increasing the *SCSI Command Timeout* value. In case of problems, try using this option to use a different approach for SCSI commands like the one discussed above: Instead of waiting for the command to complete, the file system just starts the command, then polls the recorder in short intervals (e.g. 1 second) to find out whether the command has completed.

Note: Using the *Polling Mode* will disable error processing for the affected SCSI commands, that means, errors which occur while a session is being closed might be either incorrectly reported or suppressed. For that reason, this option should be selected in case of problems, only.

- s This option determines the recording speed factor which will be used by default (1 = single speed, 2 = double speed, 4 = quad speed, ...). If the recording speed factor is set to 0, the default recording speed of the device will be used. In most cases, this will be the fastest speed supported by the CD recorder.

This option can be used to prevent medium damage when fast CD recorders (quad speed or faster) are used with standard CD recordables.

Note: The recording speed can be changed at any time with the *cdspeed* command.
- e This option switches the CD recorder into a so-called *Test Mode* which is used to determine whether the data transfer rate from the computer to the CD recorder meets the requirements of a specific recording speed. Most recorders will flash the *Write* or *Busy* LED to indicate that no data is actually written.

Some recorders produce error messages when the current session is to be closed in test mode. Therefore, the test mode should only be used to verify the data transfer rate, not the operation of the CD Writer File System. To prevent this error, close the CD with the *-c* option (see *cdattach* for further details).
- i#="ID" This option allows overwriting the CD Recorder ID. The number sign # is replaced by the number of the device group, the SCSI ID is specified between the quotes, including all spaces between the company name and the device identifier.

This option is required if a CD Recorder is actually compatible to one of the supported device groups, but identifies itself with an unknown device identifier. A list of supported device groups can be found in the appendix (=> Supported Hardware).

Example:

```
IFS=C:\CDWFS\CDWFS.IFS -x -c6144
```

This example installs the file system with a cache size of 6MB. Files are writing into single tracks, if possible.

LOCKCDR.FLT

Some CD recorders claim to be CDROM drives. As *OS2CDROM.DMD* allocates all CDROM drives at bootup, those recorders cannot be accessed by additional software, including the *RSJ CD Writer File System*. To correct this behavior, the filter device driver *LOCKCDR.FLT* is added to the file *CONFIG.SYS*; all already known CD recorders will be converted to WORM devices automatically.

In order to add an unknown CD recorder to the built-in list, the parameter *-i:"Recorder Name"* can be used to specify the device name of the unknown CD recorder.

Example:

```
BASEDEV=LOCKCDR.FLT -i:"IMS      CDD2000"
```

In this example, the Philips recorder *CDR2000* is added to the built-in list of CD recorders. During bootup, the OS/2-internal device tables are modified such that the CD recorder is treated as a WORM device instead of a CDROM.

The name of all connected CDROM devices as well as whether they have been converted to WORM devices is printed to the screen while the system is booting.

Note: It is not necessary to specify the complete device name. In the example above, specifying *-i:"IMS"* would do the same job. However, the more complete the device names are specified, the less likely it is that a CDROM drive is converted to a WORM device accidentally.

OS/2 Commands

The file *UCDWFS.DLL* extends the OS/2 file management commands *FORMAT*, *RECOVER*, *CHKDSK* and *SYS*. Hence, it must be copied to a directory which is referenced by the *LIBPATH* statement in the system file *CONFIG.SYS*.

Here's a list of changes/extensions to the well-known OS/2 file management commands:

FORMAT

The *FORMAT* command reserves a track with a special length which will be used to close the current session after one or more tracks with data have been written on the CD. The existence of this track is checked by the file system before the CD is considered writable.

The following options are supported by the *FORMAT* command:

/UNSEAL Remove the write protection from the CD which has been "sealed" by using the detach option *-x*.

CHKDSK

The *CHKDSK* command returns information about the status of the currently inserted CD. In addition to the standard information provided by OS/2, the output contains information about the number of tracks and sessions on the CD.

The following options are supported by the *CHKDSK* command:

/V Return additional information (e.g. about the creator of the CD).

RECOVER

The *RECOVER* command starts a "repair program" in the CD Recorder. This program can sometimes correct minor errors which have been caused by interrupted write operations.

Note: Usually, this command is not required since the file system triggers the execution of the repair program automatically once an error has been detected.

The *RECOVER* command does not support any options.

SYS

The *SYS* command is not supported by the file system.

Command Line Utilities

In the current release, the CD Writer File System is primarily controlled from the OS/2 command line. The most important commands are available as program icons in the *CD Writer* folder; this chapter discusses all available commands and their options in detail.

CDATTACH

The command *cdattach* allows attaching and detaching a CD to an OS/2 drive letter. To *attach* a CD means to associate a drive letter to the CD, while *detaching* refers to removing the association between the CD and its drive letter.

Syntax:

```
cdattach <Drive> [-c|-s|-x|-no_flush|-l<n>]
```

Specifying only the drive letter causes the *cdattach* command to attach the CD to the specified drive. The optional parameters, except *-l<n>*, are used to detach the CD.

The following options control the behavior of the *cdattach* command:

- no_flush** The CD is detached from its drive letter without writing any cached data. This is useful to unlock the drive tray if all other detach commands fail due to hardware errors, such as a damaged CD.
- c** The cached information, if any, is written to the CD and the drive tray is unlocked. As yet, the information on the CD can only be used together with the CD Writer File System; in order to use the CD with CDROM drives, the following detach option must be used.
- s** Same as *-c*; however, the current session will be closed as well. This allows reading the CD in standard CDROM drives. Closing a session takes about 12MB disk space, so this option should be used only if the CD is to be read by CDROM drives.
- x** Like *-s* but, the CD will be "sealed", that is, the CD becomes write protected. The write protection can be removed at any time by using the command "*format <Drive> /UNSEAL*".
- l<n>** Tells the file system to skip *n* sessions on the CD. This option allows recovering a previous CD status; this is particularly useful to recover files which have been deleted or modified in the current session.

Additionally to the parameters described above, the following parameters allow specifying the information in the *Primary Volume Descriptor*. The information specified together with one of the following options can be retrieved with the command "*chkdsk <Drive> /v*"

- vol_id** Volume identifier (sort of detailed volume label).
- pub_id** Name of the institution which has created the CD.
- prep_id** Name of the person which has prepared (collected) the files on the CD.
- app_id** Name of the application which has been used to create the CD.
- copyright** Name of the *Copyright* file in the root directory.
- abstract** Name of the *Abstract* file in the root directory.
- biblio** Name of the *Bibliographic* file in the root directory.

If you don't want to specify the same informational parameters over and over again, the default values can be saved as *environment* strings. This can be done by saving the following commands in a batch file or in the system file *CONFIG.SYS*:

```
SET CDATTACH_VOL_ID=...
SET CDATTACH_PUB_ID=...
SET CDATTACH_PREP_ID=...
```

etc.

Notes: The contents of the *environment* will be overwritten by the according command line parameters, that is, to change a specific field which has been predefined in the command line just add the according option to the command line.

If a field has been specified neither in the command line nor in the *environment*, the previous value – which has been derived from the *Primary Volume Descriptor* at the time the CD has been attached – will be used. If a field is to be deleted, it must be overwritten by a blank, e.g. by typing '*cdattach z: -c -pub_id " "*'.

Examples:

```
cdattach u: -c
```

This command writes all remaining data in the cache to the CD, then detaches the CD and unlocks the drive tray. As yet, the files can be accessed with the CD Recorder, only. To make the files readable by standard CDROM drives, specify the following command:

```
cdattach z: -s
```

After writing all remaining data in the cache to the CD, this command causes the current session to be closed before the CD is detached. This allows reading the CD in standard CDROM drives.

```
cdattach z: -x -pub_id "RSJ Software" -prep_id "Bugs Bunny"
```

This variation writes all cached data to the CD, closes the current session and does *not* reserve a new track. Consequently, the CD will be write protected until the write protection has been removed by typing '*format <Drive> /UNSEAL*'.

Additionally, the information in the *Primary Volume Descriptor* will be partially overwritten with new contents (*-pub_id* and *-prep_id*).

CDCOPY

The command *cdcopy* copies arbitrary files from/to arbitrary drives. The advantage of *cdcopy* to other OS/2 copy commands is its ability to copy very large files – i.e. greater than the cache size – into a single track, bypassing the file system's cache mechanism.

Caution: The currently available CD Recorders require the host computer to maintain a minimum transfer rate of 150KB/s times the speed factor (e.g. 300KB/s for double-spin recorders). That's why the source medium should be either a hard disk or a *fast* network (e.g. a 16MBit Token Ring). If you plan to use a CDROM as source device, be sure the CDROM is at least 50% faster than the CD Recorder.

The command *cdcopy* needs the file *cdwcpy.dll* in a directory which is referred to by the *LIBPATH* statement in the system file *CONFIG.SYS*

Syntax:

```
cdcopy <Source File> <Target File>
```

Wildcards such as "?" or "*" are not allowed here. The source file and the target file must be specified completely.

Example:

```
cdcopy c:\longfile.dat z:\longfile.dat
```

This example copies a file named *longfile.dat* from the hard disk to the CD. Even if the file is larger than the cache size (e.g. 250MB), the file will be copied into a single track. This allows reading the CD under DOS and Windows (NT).

If complete directory trees are to be copied, use the following syntax:

```
cdcopy <Source File> <Target PATH> /s
```

Wildcards are explicitly allowed in the source specification. The target path, however, must point to the desired drive/directory without any wildcards; if the target directory does not exist, it will be created automatically.

Example:

```
cdcopy c:\os2\* z:\os2 /s
```

This command copies all files from *c:\os2*, including all subdirectories (apps, dll, system, ...) into the same directory on the CD.

CDSPEED

The *cdspeed* utility allows changing the recording speed of the CD recorder. It can be used

- to change the speed of the currently attached recorder, or
- to change the default speed which will be applied the next time a drive letter is assigned to the CD recorder.

Syntax:

```
cdspeed [drive] [-s <speed factor>] -e
```

If a drive letter is specified, the recording speed of the according CD recorder will be changed immediately. Otherwise, only the default speed will be changed. Using *cdspeed* without a drive letter has the same effect as changing the *-s* option in the *cdwfs.ifs* command line, followed by a subsequent reboot.

Note: The default speed will be changed in any case. Thus, the new speed factor will remain active until the system is rebooted or it is changed by yet another invocation of *cdspeed*

Examples:

```
cdspeed z: -s2
```

This command changes both the default value for subsequent sessions as well as the current recording speed. The new speed factor is 2 (double speed, 300KB/s).

```
cdspeed -s4 -e
```

This command changes the speed factor for subsequent sessions to quad speed (600KB/s) and turns on write emulation. Please note that the speed of a currently attached CD recorder will not be changed unless the CD is detached, then attached again.

CDWPOPUP

The error log utility *cdwpopup* tracks all SCSI errors which have been returned by the CD Recorder. These errors are usually fatal errors, such as damaged CDs, hardware errors, etc.

The error log runs in the background and is usually invisible. If desired, it can be popped up manually by double-clicking its title in the *Window List*.

Once an error has been detected, the according error message is displayed on the screen. Further details about the error can be viewed by pressing *Detailed Information*. The contents of the detailed information screen are discussed in the section *Problem Determination*.

Enter the following command to start the error log:

```
start cdwpopup
```

Since *cdwpopup* creates an error-log file in the current directory, it must be started on a drive with write permission.

Caution: In no case, attempt to start the error log in a directory which points to an attached CD. Otherwise, changing the CD would also "change" the error-log file. Besides, using the CD as the drive for the error-log file could lead to a "racing condition", that is, once an error has been generated by accessing the CD, *cdwpopup* would access the very same CD to update the error log, which would lead to yet another error, which would cause *cdwpopup* to access the CD again, ...

Technical Details

This section provides some background information about the internal structure of a CD. This knowledge might help optimizing the utilization of the CD Writer File System.

Note: In order to keep the required base knowledge as low as possible, unnecessary details are omitted. Also, the proportions of the graphs in this section might not meet the physical proportions on the CD.

ISO9660

This standard has been defined by ISO (the International Standards Organization) and specifies how the information on a CD has to be organized to allow using the same CD on multiple platforms. The CD Writer File System complies to this standard, so each ISO9660-capable platform should be able to read the CDs which have been written by the CD Writer.

Internal Structure of a CD

Each conventional CDROM has a table of contents (TOC) and one or more tracks.

T O C	Track #1	Track #2	Track #3	Track #4	Track #5
-------------	----------	----------	----------	----------	----------

The table of contents does not contain the name and the position of the files – as the name would imply – but the position and the length of each track on the CD. The directory which contains the name and position of the files on the CD is saved in one of the tracks.

Track

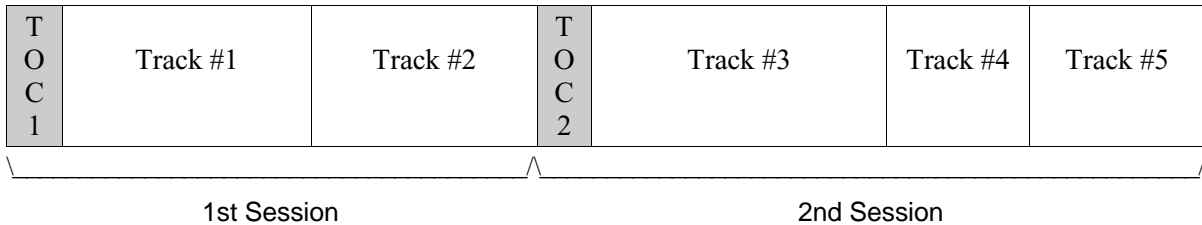
A track is an area on the CD which can hold user data. Music CDs, for example, allocate a separate track for each title. A CD can contain 99 tracks.

The currently available CD Recorders require each track to be written at once. This is the reason why a minimum transfer rate (300KB/s for double-spin recorders) must be maintained while the track is written; stopping and restarting the write operation automatically allocates a new track.

The CD Writer File System collects as many files as possible in its cache memory, then writes the contents of the cache to the CD in a single write operation. Otherwise, the maximum number of 99 tracks would be reached after 99 files have been copied to the CD.

Multisession CDs

The currently available CD Recorders are WORM (Write Once – Read Multiple) devices. Since each area on the CD can be written only once, repeated write operations require multiple TOCs. A CD with more than one TOC is called a *Multisession CD*.



Each table of contents is associated to its corresponding session. Detaching a CD with the option `-c` does not close the current session, thus the information about the new tracks is not written into a new TOC.

Since standard CDROM drives use the TOC to locate each track on the CD, the latest files on CDs which have been modified without closing the current session are not readable in standard CDROM drives. However, the CD Recorder uses a reserved area to save the latest track information and will always be able to access all tracks, even without an up-to-date TOC.

Note: A session requires about 12MB disk space. Hence, a session should only be closed if the CD is to be used in standard CDROM drives.

Track Modes

Each track is divided into sectors with 3234 bytes. Taking away internal data areas such as sector identifiers, 1st-level error correction, etc., each sector yields 2352 bytes of raw data.

Audio

Audio tracks do not contain any additional error correction; the complete user data area is used for digitized music or speech. Additional error correction is not required for audio tracks because the human ear usually can't recognize small errors in the audio data.

Mode 1, Form 1

This is the original CDROM data format. Each data sector contains 2048 bytes; the remaining bytes in the sector are used for system information and a better error correction.

This track format can be read by all CDROM drives.

Mode 1, Form 2

Yet another data format, this time without additional error correction. The error correction data has been stripped to a few bytes to be able to detect data errors, but they can't be corrected anymore. In return, each data sector contains 2336 bytes.

This format has been used by various (older) multimedia applications to store audio and video information.

Mode 2, Form 1

Equal to Mode 1, Form 1, with the exception that 8 unused bytes from the error correction area have been appended to the system data area at the beginning of the sector. This format is used by Kodak's Photo CDs.

Note: This track format can be read by Photo CD compatible CDROM drives, only. Unfortunately, there are a couple of CDROM drivers (and drivers) which assume that a multisession CD must be recorded with *Mode 2, Form 1* tracks. Since Version 1.52, the *RSJ CD Writer* is also using this track mode to remain compatible to those drives.

The extended system data area is used to identify the sector type and allows switching between *Mode 2, Form 1* and *Mode 2, Form 2* sectors within a track.

Mode 2, Form 2

Similar to Mode 1, Form 2. This format is used by modern XA applications to save audio and video information and yields 2324 bytes of user data.

Note: This track format can be read by Photo CD compatible CDROM drives, only.

XA, Photo-CD, Multisession

This chapter describes some of the various keywords which are used in conjunction with CDROM technology and applications.

XA

XA (Extended Architecture) has been introduced by various companies to allow reading audio and video information in a contiguous data stream. Reading different data types at once is made possible by interleaving the information. XA requires Mode 2, Form 1 and Mode 2, Form 2 compatible CDROM drives.

Photo-CD

Beside the additional information for CDI players, a Photo CD, like any other data CD, consists of various files which contain the picture data. An empty Photo CD can be distinguished from Writable CDs only by its label.

Photo CDs use the track format Mode 2, Form 1; hence, old CDROM drives won't be able to read Photo CDs.

Warning: The CD Writer File System recognizes Photo CDs as writable CDs which are currently write protected. Using the command *'format <Drive> /unseal'* will remove the write protection; however, writing to a Photo CD might cause troubles if the CD is to be used together with CDI players. For that reason, writing to partially filled Photo CDs should be prevented.

Multisession

Multisession CDs have been introduced together with Kodak's Photo CD: Each Photo CD which has been sent in the second time automatically becomes a multisession CD.

Note: The CD Writer File System produces multisession CDs as well. Some CDROM drives are capable of reading the new Mode 2, Form 1 track format but cannot handle multiple sessions. Although some vendors claim their drives are Photo CD compatible, these drives will always be restricted to the first session on the CD.

Programming API

In order to allow third-party applications to control the file system, this section describes the Application Programming Interface (API) of the CD Writer File System. This API is also the base of the included file system utilities (such as *cdattach*, *cdcopy*, ...)

Note: The API will be extended in future versions of the file system.

The API has been designed to be compatible to the C compilers from Microsoft (C6.00, 16-bit) and IBM (CSet/2 and CSet++, both 32-bit) at the same time. Both the libraries and the include files can be used by either compiler.

CDWFSCTL.H

Using the programming API requires including the file *cdwfsctl.h*. This file defines the data types and constants used to communicate with the file system. This include file has the following contents:

```
Header      : FSCTL definitions for the RSJ CDWFS file system

Purpose     : defines constants and structures for the application interface
              to the file system through FSCTL calls.

Author      : CM, RSJ Software

Date       : 06/94

Modifications:

    CM 12/94 - new FSCTL call "CDWFS_GET_CACHE_INFO" returns information
    V1.07   about the total cache size as well as the current cache
              position. This information is used by "cdwcpy.dll" to
              optimize copy operations with many files (>10,000).

              - new function 'XCopyToCD2()' adds the parameter 'verbose'
              which, if != 0, causes each file name to be printed
              to stdout

    CM 08/95 - new FSCTL call 'CDWFS_SET_SPEED' allows changing the
    V1.20   recording speed of the CD recorder.

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*****/

#ifdef __IBMC__
#define CDW_LINKAGE APIRET _System
#define _far
#else
#define CDW_LINKAGE USHORT _far _cdecl
#endif

/* ----- FSCTL function codes ----- */

#define CDWFS_FORMAT          0xc771
#define CDWFS_RECOVER         0xc772
#define CDWFS_CHKDSK         0xc773
#define CDWFS_NEXTERROR      0xc774
#define CDWFS_START_WRITETHROUGH 0xc775
#define CDWFS_WRITETHROUGH   0xc776
#define CDWFS_GET_CACHE_INFO 0xc777
```

```

#define CDWFS_SET_SPEED          0xc778

/* ----- typedefs and structures ----- */

#pragma pack(1)

/*****

'FLUSH_MODE' defines the various modes available for the detach request.

*****/

typedef enum {
    FLUSH_NONE,           /* just detach drive (no data written!) */
    FLUSH_CACHE,          /* write cache buffer to disk */
    FLUSH_DIRECTORY,      /* write cache buffer + directory to disk */
    FLUSH_SESSION,        /* write PVD + session header to disk */
    FLUSH_SEAL             /* like FLUSH_SESSION, but make CD read-only */
} enum_FLUSH_MODE;

/* use a short to prevent sizeof(enum) differences */
typedef short FLUSH_MODE;

/*****

'FORMAT_MODE' defines the various format modes which can be used in the
CDWFS_FORMAT request.

*****/

typedef enum {
    FORMAT_EMPTY_MEDIUM,  /* format only if CD is entirely empty */
    FORMAT_UNSEAL         /* make CD writable (works even for 3rd party CDs) */
} enum_FORMAT_MODE;

/* use a short to prevent sizeof(enum) differences */
typedef short FORMAT_MODE;

/*****

'ATTACH_INFO' contains the information which is used to attach a drive
letter to the file system

*****/

typedef struct {
    short    len;          /* length of this structure */
    char device[20];        /* name of the SCSI device */
    short    sessions_to_skip; /* number of sessions to skip (open last...) */
    short    formatted;     /* != 0, if medium is formatted */
} ATTACH_INFO;

/*****

'DETACH_INFO' contains the information which is written into the primary
volume descriptor of the CD when 'flush_mode' is greater than FLUSH_CACHE.

*****/

typedef struct {
    short    len;          /* length of this structure */
    FLUSH_MODE flush_mode; /* type of flush requested */
    char     vol_set_id[128]; /* volume set identifier */
    char     publisher_id[128]; /* publisher identifier */
    char     preparer_id[128]; /* data preparer identifier */

```

```

char      app_id[128];          /* application identifier */
char      copyrght_file[37];    /* name of copyright file in root */
char      abstrct_file[37];     /* name of abstract file in root */
char      biblio_file[37];     /* name of bibliographic file in root */
} DETACH_INFO;

/*****

'CHKDSK_DATA' defines the information which is returned by the
FSCTL_CHKDSK request.

*****/

typedef struct {
    char      copyright[100];    /* copyright string with version information */
    long      file_count;        /* number of files on the CD */
    long      dir_count;         /* number of directories on the CD */
    long      file_disk_usage;   /* volume space occupied by files */
    long      dir_disk_usage;    /* volume space occupied by directories */
    short     finalized_sessions; /* number of finalized sessions on the CD */
    short     open_session;      /* currently open session */
    short     track_count;       /* number of tracks on the CD */
    short     reserved_track;    /* currently reserved track */
    short     fixation_recommended; /* power calibration area almost full */
    short     modified;          /* CD has been modified */
    DETACH_INFO pvd_info;        /* information about the PVD */
} CHKDSK_DATA;

/*****

'SCSI_ERROR' defines the error information which is displayed by the
CDWPOPOPUP program.

*****/

typedef struct {
    char      command[60];       /* command string (e.g. "read sector 16") */
    char      sense[40];         /* sense key (e.g. "unit not ready") */
    char      adl_sense[100];    /* additional sense key (e.g. "tray out") */
    char      sense_buffer[48];  /* complete sense buffer */
} SCSI_ERROR;

/*****

'CACHE_INFO' contains information about the write cache.

*****/

typedef struct {
    long      size;              /* user-specified cache size */
    long      pos;               /* current cache position */
} CACHE_INFO;

/*****

'SPEED_INFO' is used to specify the recording speed as well as the write
mode (emulation write or physical write).

*****/

typedef struct {
    short     speed_factor;      /* 1 = 150K, 2 = 300K, 4 = 600K, ... */
    short     emulation_write;   /* if set, the CD will not be mmodified */
} SPEED_INFO;

```

```
#pragma pack()

/* ----- function prototypes ----- */

extern CDW_LINKAGE CopyToCD   (char   _far *source,
                              char   _far *target);

extern CDW_LINKAGE XCopyToCD  (char   _far *source,
                              char   _far *target);

extern CDW_LINKAGE XCopyToCD2 (char   _far *source,
                              char   _far *target,
                              short    verbose);
```


ATTACH

The *ATTACH* command attaches a CD to an OS/2 drive letter. The structure *ATTACH_INFO* defines the information required by this command:

```

/*****
'ATTACH_INFO' contains the information which is used to attach a drive
letter to the file system
*****/

typedef struct {
    short      len;           /* length of this structure */
    char device[20];          /* name of the SCSI device */
    short      sessions_to_skip; /* number of sessions to skip (open last...) */
    short      formatted;     /* != 0, if medium is formatted */
} ATTACH_INFO;

```

The various fields have the following purpose:

- len** *Input.* Length of the entire structure.
- device** *Input.* Name of the SCSI device driver. Usually, this field should be set to *RSJSCSI\$*.
- sessions_to_skip** *Input.* Number of sessions to be skipped. 0 = current session, 1 = previous session, 2 = the session before the previous session, etc.
- formatted** *Output.* Returns whether the attached CD is already formatted.

Example

```

#include <stdlib.h>

#define INCL_BASE
#include <os2.h>

#include "cdwfsctl.h"

main()
{
    ATTACH_INFO attach_info;
    APIRET ret;

    /* initialize attach info */
    attach_info.len = sizeof(ATTACH_INFO);
    attach_info.sessions_to_skip = 0;

    strcpy(attach_info.device, "RSJSCSI$");

    /* attach drive Z: */
    ret = DosFSAttach("z:",
                     "cdwfs",
                     (void *) &attach_info,
                     sizeof(ATTACH_INFO),
                     FS_ATTACH);

    /* check return code */
    if (ret == NO_ERROR) {
        printf("success\n");
    } else {
        printf("error code: %d\n", (int) ret);
    }
}

```

DETACH

The *DETACH* command detaches the CD from the associated drive letter. The structure *DETACH_INFO* defines the information required by this command:

```

/*****
'DETACH_INFO' contains the information which is written into the primary
volume descriptor of the CD when 'flush_mode' is greater than FLUSH_CACHE.
*****/

typedef struct {
    short    len;                /* length of this structure */
    FLUSH_MODE flush_mode;        /* type of flush requested */
    char     vol_set_id[128];     /* volume set identifier */
    char     publisher_id[128];   /* publisher identifier */
    char     preparer_id[128];    /* data preparer identifier */
    char     app_id[128];         /* application identifier */
    char     cpyrght_file[37];    /* name of copyright file in root */
    char     abstrct_file[37];    /* name of abstract file in root */
    char     biblio_file[37];     /* name of bibliographic file in root */
} DETACH_INFO;

```

The various fields have the following purpose:

len	<i>Input.</i> Length of the entire structure.
flush_mode	<i>Input.</i> The <i>flush_mode</i> can be set to one of the following constants:
FLUSH_NONE	The CD will be detached without writing any cached information to the CD.
FLUSH_CACHE	The cached information will be written to the CD. However, since no directory information is added to the cache, the files will not be accessible after this command has completed. This flush mode is used internally.
FLUSH_DIRECTORY	The cached information will be written to the CD, including the latest directory information. This corresponds to the command ' <i>cdattach <Drive> -c</i> '.
FLUSH_SESSION	The cached information will be written to the CD, including the latest directory information. Then, the currently open session will be closed. This corresponds to the command ' <i>cdattach <Drive> -s</i> '.
FLUSH_SEAL	Like <i>FLUSH_SESSION</i> ; however, after opening the new session no track will be reserved, thus the CD will be write protected. This corresponds to the command ' <i>cdattach <Drive> -x</i> '.
vol_set_id, publisher_id, preparer_id, app_id, app_id, cpyrght_file, abstrct_file, biblio_file	<i>Input.</i> These fields are saved in the <i>Primary Volume Descriptor</i> and can be displayed at a later time by typing ' <i>chkdsk <Drive> /v</i> '.

Example

```
#include <stdlib.h>

#define INCL_BASE
#include <os2.h>

#include "cdwfsctl.h"

main()
{
    static DETACH_INFO detach_info;
    APIRET ret;

    /* initialize detach info */
    detach_info.len = sizeof(DETACH_INFO);
    detach_info.flush_mode = FLUSH_SESSION;

    strcpy(detach_info.vol_set_id, "My first CD");
    strcpy(detach_info.publisher_id, "RSJ Software GmbH");
    strcpy(detach_info.preparer_id, "Bugs Bunny");
    strcpy(detach_info.app_id, "RSJ CD-Writer File System");
    strcpy(detach_info.cpyrght_file, "");
    strcpy(detach_info.abstrct_file, "");
    strcpy(detach_info.biblio_file, "");

    /* detach drive Z: */
    ret = DosFSAttach("z:",
                     "cdwfs",
                     (void *) &detach_info,
                     sizeof(DETACH_INFO),
                     FS_DETACH);

    /* check return code */
    if (ret == NO_ERROR) {
        printf("success\n");
    } else {
        printf("error code: %d\n", (int) ret);
    }
}
```

CHKDSK

The *CHKDSK* command returns the information which is used by the file *ucdwnfs.dll* to extend the OS/2 file system utilities.

The structure *CHKDSK_DATA* defines the information required by this command:

```

/*****
'CHKDSK_DATA' defines the information which is returned by the
FSCTL_CHKDSK request.
*****/

typedef struct {
    char        copyright[100];        /* copyright string with version information */
    long        file_count;             /* number of files on the CD */
    long        dir_count;              /* number of directories on the CD */
    long        file_disk_usage;        /* volume space occupied by files */
    long        dir_disk_usage;         /* volume space occupied by directories */
    short       finalized_sessions;     /* number of finalized sessions on the CD */
    short       open_session;           /* currently open session */
    short       track_count;            /* number of tracks on the CD */
    short       reserved_track;         /* currently reserved track */
    short       fixation_recommended;   /* power calibration area almost full */
    short       modified;               /* CD has been modified */
    DETACH_INFO pvd_info;              /* information about the PVD */
} CHKDSK_DATA;

```

The various fields have the following purpose:

copyright	<i>Output.</i> This field contains the copyright message, including the CD Writer version number, which is displayed by the OS/2 <i>CHKDSK</i> command.
file_count	<i>Output.</i> Number of files on the CD
dir_count	<i>Output.</i> Number of (sub-)directories on the CD
file_disk_usage	<i>Output.</i> Number of bytes used by files
dir_disk_usage	<i>Output.</i> Number of bytes used by (sub-)directories
finalized_sessions	<i>Output.</i> Number of closed sessions on the CD
open_session	<i>Output.</i> Number of the current session. If this value equals 0, the CD is either out-of-disk space or non-writable (CDROM). In any case, this CD is read-only.
track_count	<i>Output.</i> Number of tracks on the CD
reserved_track	<i>Output.</i> Number of the reserved track. If this number equals the <i>track_count</i> , the CD has not been modified since the last session has been closed. If <i>reserved_track</i> equals 0, the CD is either out-of-disk space, has been write protected by calling ' <i>cdattach <Drive> -x</i> ' or is non-writable (CDROM).
fixation_recommended	<i>Output.</i> If this field is non-zero, the CD has been modified so many times that the power calibration area is almost full. Closing the current session is urgently recommended because an exhausted power calibration area prevents writing any data to the CD.
modified	<i>Output.</i> This field specifies whether the CD has been modified (non-zero) since it was attached.
pvd_info	<i>Output.</i> This field contains the user information of the <i>Primary Volume Descriptor</i> which is displayed by the command ' <i>chkdsk <Drive> /v</i> '.

Example

```
#include <stdlib.h>

#define INCL_BASE
#include <os2.h>

#include "cdwfsctl.h"

main()
{
    static CHKDSK_DATA chkdisk_data;
    USHORT data_len = sizeof(CHKDSK_DATA);
    USHORT parm_len = 0;

    /* call CHKDSK entry point in CDWFS */
    ret = DosFSctl((PBYTE) &chkdisk_data,
                  data_len,
                  &data_len,
                  NULL,
                  parm_len,
                  &parm_len,
                  CDWFS_CHKDSK,
                  "z:\\",
                  (HFILE) -1,
                  FSCTL_PATHNAME,
                  0);

    /* check return code */
    if (ret == NO_ERROR) {
        printf("success\n");
    } else {
        printf("error code: %d\n", (int) ret);
    }
}
```

CACHE_INFO

The *CACHE_INFO* command returns information about the total size of the CD Writer cache as well as the current fill level of the latter.

The structure *CACHE_INFO* defines the information required for this command.

```

/*****
 *
 * 'CACHE_INFO()' contains information about the write cache.
 *
 *****/

typedef struct {
    long    size;           /* user-specified cache size */
    long    pos;            /* current cache position */
} CACHE_INFO;

```

The various fields have the following purpose:

- | | |
|-------------|--|
| size | <i>Output.</i> This field returns the total size of the CD Writer cache. The value equals the one specified in the file system option <i>-c</i> , rounded to the nearest sector boundary (2048 bytes). |
| pos | <i>Output.</i> Current write position in the file system cache. This information can be used to determine whether a new track is recommended for writing a particular file. |

Example

```

#include <stdlib.h>

#define INCL_BASE
#include <os2.h>

#include "cdwfsctl.h"

main()
{
    static CACHE_INFO cache_info;
    USHORT data_len = sizeof(CACHE_INFO);
    USHORT parm_len = 0;

    /* call CACHE_INFO entry point in CDWFS */
    ret = DosFSctl((PBYTE) &cache_info,
                  data_len,
                  &data_len,
                  NULL,
                  parm_len,
                  &parm_len,
                  CDWFS_GET_CACHE_INFO,
                  "z:\\",
                  (HFILE) -1,
                  FSCTL_PATHNAME,
                  0);

    /* check return code */
    if (ret == NO_ERROR) {
        printf("success\n");
    } else {
        printf("error code: %d\n", (int) ret);
    }
}

```

SET_SPEED

The *SET_SPEED* command changes the default recording speed of the CD recorder.

The structure *SPEED_INFO* defines the information required for this command.

```
/******  
  
'SPEED_INFO' is used to specify the recording speed as well as the write  
mode (emulation write or physical write).  
  
*****/  
  
typedef struct {  
    short      speed_factor;          /* 1 = 150K, 2 = 300K, 4 = 600K, ... */  
    short      emulation_write;       /* if set, the CD will not be mpdified */  
} SPEED_INFO;
```

The various fields have the following purpose:

speed_factor *Input.* This field contains the new speed factor.

emulation_write *Input.* If this field is not zero, write operations will be emulated (no data is actually written). Set this field to zero for normal operation.

Note: Unlike the other file system control calls, this call allows using two different routes to the file system:

- The standard route (*FSCTL_PATHNAME* with a string containing the drive and the root directory of an attached CD, e.g. "z:\") will change both the default speed as well as the recording speed of the currently attached CD recorder.
- The file system name route (*FSCTL_FSDNAME* with a string containing the name of the file system – "CDWFS") can be used to change the default speed which will be used by the next attach request. This route allows changing the speed while no CD is attached to the system.

Example

```
#include <stdlib.h>

#define INCL_BASE
#include <os2.h>

#include "cdwfsctl.h"

main()
{
    static SPEED_INFO speed_info;
    USHORT parm_len = sizeof(SPEED_INFO);
    USHORT data_len = 0;

    /* use double speed and no write emulation */
    speed_info.speed_factor = 2;
    speed_info.emulation_write = 0;

    /* call SET_SPEED entry point in CDWFS */
    ret = DosFSctl(NULL,
                   data_len,
                   &data_len,
                   (PBYTE) &speed_info,
                   parm_len,
                   &parm_len,
                   CDWFS_SET_SPEED,
                   "z:\\",
                   (HFILE) -1,
                   FSCTL_PATHNAME,
                   0);

    /* check return code */
    if (ret == NO_ERROR) {
        printf("success\n");
    } else {
        printf("error code: %d\n", (int) ret);
    }
}
```


FORMAT

The *FORMAT* command provides write access to new or "sealed" mediums. This command expects a parameter of the type *FORMAT_MODE* which can be set to one of the following constants:

FORMAT_EMPTY_MEDIUM Used to format new CDs

FORMAT_UNSEAL Removes a previously applied write protection.

Example

```
#include <stdlib.h>

#define INCL_BASE
#include <os2.h>

#include "cdwfsctl.h"

main()
{
    FORMAT_MODE format_mode = FORMAT_EMPTY_MEDIUM;
    USHORT data_len = 0;
    USHORT parm_len = sizeof(FORMAT_MODE);

    /* call FORMAT entry point in CDWFS */
    ret = DosFSCTL(NULL,
                   data_len,
                   &data_len,
                   (PBYTE) &format_mode,
                   parm_len,
                   &parm_len,
                   CDWFS_FORMAT,
                   "z:\\",
                   (HFILE) -1,
                   FSCTL_PATHNAME,
                   0);

    /* check return code */
    if (ret == NO_ERROR) {
        printf("success\n");
    } else {
        printf("error code: %d\n", (int) ret);
    }
}
```

CopyToCD()

The function *CopyToCD()* copies a single file to the CD. This function allows writing files which are larger than the cache size into a single track. Further information about this topic can be found in the description of the command *cdcopy*.

The function *CopyToCD()* is located in the .DLL file *cdwcopy.dll*. In order to use this function, the import library *cdwcopy.lib* must be linked.

Syntax

```
#include "cdwfsctl.h"

extern CDW_LINKAGE CopyToCD (char *source,
                             char *target);
```

Parameters

source *Input.* Complete path name of the source file.

target *Input.* Complete path name of the target file.

Example

```
#include <stdio.h>

#include "cdwfsctl.h"

main()
{
    APIRET ret;

    /* copy a huge file into a single track */
    ret = CopyToCD("c:\\data\\largefile.dat", "z:\\largefile.dat");

    /* check return code */
    if (ret == NO_ERROR) {
        printf("success\n");
    } else {
        printf("error code: %d\n", (int) ret);
    }
}
```

XCopToCD()

The function *XCopToCD()* copies complete directory trees to the CD. This function allows writing files which are larger than the cache size into a single track. Further information about this topic can be found in the description of the command *cdcopy*.

Note: The target directories are created automatically, if required.

The function *XCopToCD()* is located in the .DLL file *cdwcpy.dll*. In order to use this function, the import library *cdwcpy.lib* must be linked.

Syntax

```
#include "cdwfsctl.h"

extern CDW_LINKAGE XCopToCD (char *source,
                             char *target);
```

Parameters

source *Input.* Complete path name of the source file. Wildcards ("?" or "*") are allowed.

target *Input.* Complete name of the target **path**. Neither a target file name nor wildcards are allowed here.

Example

```
#include <stdio.h>

#include "cdwfsctl.h"

main()
{
    APIRET ret;

    /* copy complete directory tree to the CD */
    ret = XCopToCD("c:\\os2\\*", "z:\\os2bkup");

    /* check return code */
    if (ret == NO_ERROR) {
        printf("success\n");
    } else {
        printf("error code: %d\n", (int) ret);
    }
}
```

XCpyToCD2()

The function *XCpyToCD()* copies complete directory trees to the CD. This function allows writing files which are larger than the cache size into a single track. Further information about this topic can be found in the description of the command *cdcopy*.

Note: The target directories are created automatically, if required.

The function *XCpyToCD()* is located in the .DLL file *cdwcpy.dll*. In order to use this function, the import library *cdwcpy.lib* must be linked.

Syntax

```
#include "cdwfsctl.h"

extern CDW_LINKAGE XCpyToCD2 (char  *source,
                              char  *target,
                              short  verbose);
```

Parameters

- source** *Input.* Complete path name of the source file. Wildcards ("?" or "*") are allowed.
- target** *Input.* Complete name of the target **path**. Neither a target file name nor wildcards are allowed here.
- verbose** *Input.* If set to a value != 0, each file name will be printed to *stdout* before the file is being copied. This parameter is used by the command *cdcopy*.

Example

```
#include <stdio.h>

#include "cdwfsctl.h"

main()
{
    APIRET ret;

    /* copy complete directory tree to the CD */
    ret = XCpyToCD2("c:\\os2\\*", "z:\\os2bkup", 1);

    /* check return code */
    if (ret == NO_ERROR) {
        printf("success\n");
    } else {
        printf("error code: %d\n", (int) ret);
    }
}
```

Problem Determination

This section provides useful information about determining and correcting common problems.

CDWPOPUP

All SCSI errors from the CD Recorder are logged and displayed on the screen by the error-log utility *cdwpopup*. Using the detailed information provided by the error log, the following table can be used to determine the cause of and possible solutions to the error.

Note: A damaged CD shouldn't be used together with the CD Recorder anymore. However, all previously closed sessions should be accessible by standard CDROM drives.

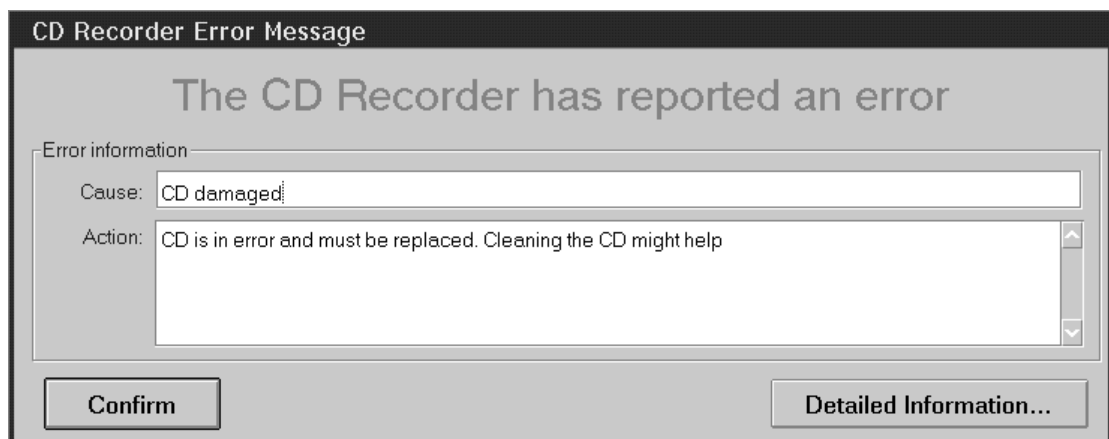
The error log receives errors returned by the CD Recorder, only. All other file system errors are returned with the standard OS/2 error codes and can be displayed by entering the following command:

```
help sys????
```

where the four question marks are to be replaced by the returned error number.

Error Display

If an error occurs in the CD Recorder, a message window will be displayed containing a description of the primary error code along with some help how to correct the problem:



The cause of this error message is a CD which has been "removed" in the middle of a write operation. After removing the CD, it has been attached again, causing the CD Recorder to overwrite the information previously written.

Note: This faked error, along with many other hardware-related problems, can be neither prevented nor corrected by the CD Writer File System because the CD Recorder is responsible for this "misbehavior".

Detailed Information

If you need detailed information about the error being displayed, press the button labeled *Detailed Information*:

RSJ CD Writer Error Log

Error description:

Time: 28.03.95 15:00:44

Command: Start/Stop Unit

Sense Key: Medium Error

Adl. Sense Key: Unable to read TOC, PMA or Subcode

Sense buffer:

```

00000000 F0 00 03 00 00 00 2E 0A-00 00 00 57 00 00 00 .....W...
00000010 00 00 00 00 00 00 00 00-00 00 00 00 00 00 .....
00000020 00 00 00 00 00 00 00 00-00 00 00 00 00 00 .....

```

☒ Enable Popup

Page: 13 of 13

In this example, the error has occurred while the CD was being inserted into the CD Recorder (*Start/Stop Unit*). The message in the line *Adl. Sense Key* shows that the CD Recorder is unable to read the information about the tracks which have already been written, hence can't continue working with this CD. The CD is damaged and must be replaced.

Error Table

The following table contains information about common errors along with possible solutions to the problem:

Sense Key	Adl. Sense Key	Cause/Correction
Illegal Request	N/A	The cache size is too large, causing OS/2 to get into trouble locking the buffer for the write operation. This can be fixed by reducing the <i>-c</i> parameter for the <i>CDWFS.IFS</i> command in the file <i>CONFIG.SYS</i> .
Illegal Request	Invalid Block Address	The CD status does not match the file system status. Detach the CD with the command <i>'cdattach <Drive> -no_flush'</i> .
Medium Error	Unable to read PMA, TOC or Subcode	The CD is either damaged or dirty. If cleaning the CD doesn't help, the CD will have to be replaced.
Medium Error	Absorption Control Error	The track could not be written successfully. Usually, this error indicates that the CD has been removed during write operations. Also, rebooting the computer without detaching the CD first can be the cause for this error. The CD is damaged and must be replaced.

Sense Key	Adl. Sense Key	Cause/Correction
Hardware Error	*	The CD Recorder has detected an internal error. Detach the CD with the command ' <i>cdattach <Drive> -no_flush</i> ', turn the unit off, then on again and retry the write operation. If the error persists, contact the service representative for the CD Recorder.
Unit Attention	*	The CD has been forcibly changed or the CD Recorder has been turned off while the CD was still attached to a drive letter. Retry the same command again.

CDATTACH

The command *cdattach* displays the OS/2 error message associated to the error code returned by the file system. The most common error messages are:

Error Message	Cause/Correction
Device not ready	The CD Recorder is either turned off or no CD has been inserted.
Access denied	The CD Recorder has already been attached to a drive letter or the connection to the CD Recorder cannot be established.
General error	The CD Recorder could not identify the currently inserted CD. The CD might be damaged.
File not found	The SCSI device driver name (default: <i>RSJ/SCSI\$</i>) could not be found. Check the name of the SCSI device driver.

CDCOPY

The command *cdcopy* displays the OS/2 error message associated to the error code returned by the file system. The most common error messages are:

Error	Cause/Correction
Invalid file name	The source or target filename is invalid. Check the command syntax as well as the specified file names.
Invalid directory	see above
The pipe has been ended	<p>The minimum transfer rate of the CD Recorder could not be maintained. The command <i>cdcopy</i> is bypassing the file system cache and relies on fast source drives. Hence, it should only be used if the source file resides on a local hard disk or a <i>fast</i> network (e.g. 16MBit/s Token Ring). If the source drive is a CDROM, the speed of the CDROM should exceed the speed of the CD Recorder by at least 50%.</p> <p>Retry the command with a faster source drive or use standard copy commands such as <i>copy</i> or <i>xcopy</i>.</p>

Further Errors

The following table contains errors which can't be associated to a particular command. Especially a bad configuration can cause the errors described here.

Error	Cause/Correction
The device driver <i>RSJSCSI.SYS</i> prints the error message: <i>can't connect to SCSI device manager</i>	The SCSI device manager <i>OS2SCSI.DMD</i> could not be found. This error occurs if no adapter driver (.ADD) for the host adapter has been installed. Reinstall the SCSI adapter support and make sure the CD Recorder is properly connected and turned on while the system is booting.
CD Recorder can't be attached to a drive letter	<ul style="list-style-type: none"> The CD Recorder is not ready (no CD, drive turned off, improper connections). Drive has been turned off or disconnected while the system has been started. The entries in the system file <i>CONFIG.SYS</i> are incomplete. This can be corrected by reinstalling the CD Writer File System. The adapter device driver (BASEDEV=??????.ADD in the system file <i>CONFIG.SYS</i>) has not been installed properly. The drive has already been allocated by another device driver or device manager (e.g. <i>OS2ASPI.DMD</i>). In this case, the offending device driver must be either removed or configured such that the CD Recorder is not allocated. If you are using <i>OS2ASPI.DMD</i>, try adding the parameter <i>/SHARE</i> to its command line. <p>Note: Changing the load sequence will have no effect to the above problem.</p> <ul style="list-style-type: none"> The CD Recorder is identifying itself with an unknown ID during the <i>SCSI INQUIRE</i> command. If the drive is compatible to one of the supported device groups, the unknown ID can be specified in the file system's command line (=> Reference Section, <i>CDWFS.IFS</i>). The CD Recorder claims to be a CDROM drive. See the chapter <i>LOCKCDR.FLT</i> for more information about converting such CD Recorders to WORM devices. The CD Recorder is malfunctioning.
CD is write protected	<ul style="list-style-type: none"> The CD is a CDROM. Only <i>Writable CDs</i> can be written to. Writable CDs can be distinguished by their golden (sometimes gleaming green) color. The CD has not been formatted. The CD already contains too many tracks. This can be verified with the <i>CHKDSK</i> command. The CD is out-of-disk space. The CD has been write protected with the command '<i>cdattach <Drive> -x</i>'. The write protection can be removed by typing '<i>format <Drive> /unseal</i>'.

Error	Cause/Correction
The previously written files cannot be read in a CDROM drive	<ul style="list-style-type: none"> • The CD has been detached without closing the current session. Attach CD again and detach with the command '<i>cdattach <Drive> -s</i>'. • The CD contains multiple sessions while the CDROM drive is not capable of reading multiple sessions. • The CDROM driver software (e.g. <i>MSCDEX</i>) cannot handle multiple sessions. In this case, try to get an updated version of the software. • There are too many sessions on the CD. Some CDROM drives seem to have trouble handling many sessions. This error doesn't seem to be reproducible; in most cases, reinserting the CD solves the problem.
CD cannot be detached	<ul style="list-style-type: none"> • The last write operation has caused an error. If retrying the operation does not help, detach the CD by typing '<i>cdattach <Drive> -no_flush</i>'. The data written since the CD has been attached will be lost. • Drive is not attach to the expected drive letter. This can be verified by typing '<i>dir <Drive></i>'.
Session cannot be closed	<ul style="list-style-type: none"> • The CD is damaged or dirty. If the problem persists even after CD has been replaced, the following might be appropriate: • The adapter/recorder combination does not support proper timeout processing. Use the option <i>-p</i> to use polling instead of blocking while closing the current session (=> Reference Section, <i>CDWFS.IFS</i>)

System Requirements

This sections lists the system requirements necessary to run the RSJ CD Writer File System.

Hardware

The following hardware requirements must be met:

- IBM PC/AT or PS/2 w/i386 processor or better
- min. 16MB RAM
- supported SCSI host adapter
- supported CD Recorder

A list of supported SCSI host adapters and CD Recorders can be found in the appendix.

Software

The following software requirements must be met:

- IBM OS/2 2.1 or better
- Adapter Device Driver (.ADD) for the SCSI host adapter

CDROM

The CDs created by the RSJ CD Writer File System can usually be read on all currently available CDROMs.

The following restrictions should be considered:

- Reading CDs with multiple sessions requires multisession-capable CDROMs. A list of multisession-capable CDROMs is available from Kodak.
- In addition to a multisession-capable CDROM drive, the CDROM software (e.g. MSCDEX) must be able to handle multiple sessions. Usually, information about the multisession capability of the software can be requested from the software manufacturer.
- Files which are larger than the cache size of the file system are spread over multiple tracks. Although this is part of the ISO9660 standard, most CDROM software seems to have problems with this. The only CDROM driver we've successfully verified being capable of dealing with multiple extents is the OS/2 software.

Note: To prevent spreading large files over multiple tracks, use the file system utility cdcopy.

Appendix

The appendix contains general-purpose information and specifications for the utilization of the CD Writer File System as well as the currently active restrictions.

Supported Hardware

The following tables contain a list of the currently supported hardware:

Note: This list contains only the hardware which has been tested by RSJ Software so far. Theoretically, most SCSI host adapters with OS/2 support and all CD Recorders compatible to the drives mentioned here should work.

SCSI Host Adapter

Caution: Most SCSI host adapters support a special transfer mode called *Synchronous Transfer*. This transfer mode may lead to unpredictable results when used together with today's CD recorders. If possible, change the adapter configuration to make sure the adapter will not use the synchronous transfer mode when talking to the CD recorder. This is especially important for *Adaptec* controllers.

The following SCSI host adapters have been tested so far:

Host Adapter	32-Bit	Test Results
IBM SCSI Host Adapter	yes	<p>Partially usable</p> <p>Once the first test device, a <i>Kodak PCD Writer 200</i>, has been connected to the system, the SCSI bus seems to be completely locked. Even the hard drives have failed to work.</p> <p>The second test device, a <i>Kodak PCD Writer 225</i>, seems to work properly with <i>some</i> versions of the adapter. Sometimes, the SCSI bus is locked during write operations, disabling the operating system's multitasking capabilities.</p>
Adaptec AHA1642	no	<p>O.K.</p> <p>Note: The initial release of OS/2 Warp 3.0 seems to contain incorrect drivers for some Adaptec devices. In case of problems, try to get an updated version or use a driver which has been shipped with a previous release of OS/2 (first of all OS/2 2.1). The name of the adapter device driver for the Adaptec AHA1642 is <i>AHA164X.ADD</i>.</p>
Adaptec AHA154x	no	O.K.
Adaptec AHA2940 PCI	yes	<p>O.K.</p> <p>Note: Some drivers for this adapter seem to ignore the <i>SCSI Command Timeout</i> values. In this case, closing the current session will not work until the file system is told to use the <i>Polling Mode</i> when a session is to be closed (=> Reference Section, <i>CDWFS.IFS</i>)</p>

CD Recorders

The following CD Recorders have been tested:

Recorder	Device Group	Test Results
Philips CDD521	1	O.K.
Philips CDD522	1	O.K.
Kodak PCD Writer 200	1	O.K. (identical to <i>Philips CDD521</i>)
Kodak PCD Writer 220/225	1	O.K.
Yamaha CDR100	1	O.K. Note: The Yamaha recorder does not support reading at the end of the last track if the session has not been closed. For that reason, do not use the option <i>-c</i> when detaching the CD recorder. Instead, always close the current session by using <i>-s</i> or <i>-x</i> .
Yamaha CDR102	1	O.K. (same limitations as CDR100)
Sony CDU920S	1	O.K. Note: The Sony recorder needs additional information for writing CD-XA tracks which cannot be provided by the file system without running into timing problems. For that reason, CDs written by the Sony CDU920S recorder will contain CDROM tracks and might cause multisession problems when used together with some CDROM drives.

Standards

The following standards are supported:

ISO9660

The ISO Standard #9660 is completely supported with a few exceptions:

Section	Support
Extended Attributes	no
Records	no
Interleave Gap	no
Multiple Volume Disks	no
Associated Files	no
Multiple Extents	yes
Type L Path Table	yes
Type M Path Table	no

High Sierra

CDROMs complying to the *High Sierra* standard – the predecessor of *ISO9660* – are not recognized. Since this standard has been replaced by *ISO9660* quite a while ago, it's not likely to find a CD complying to this standard, anyway.

ECMA-168

The definition of the *ECMA-168* standard differs from *ISO9660* in almost every category, thus support for this standard has been left out.

CDI

CDs complying to the *CDI* standard have special data areas and programs which are used by *CDI Players*. As yet, this standard is not supported.

OS/2

The CD Writer drive acts just like any other drive. All OS/2 commands, such as *FORMAT*, *CHKDSK*, etc. are supported.

However, extended attributes and long file names are not supported to maintain compatibility with the currently established CDROM standard.

Restrictions

The current version of the file system has the following restrictions:

- no support for extended attributes or long file names. Otherwise, the CDs might be incompatible with the currently available CDROM software.
- as yet, no multimedia support (e.g. playing and recording audio CDs)
- as yet, no WPS integration (special drive object, ...)
- only one file can be opened for writing at the same time
- max. 1,600 files per directory
- max. 16,000 directories per CD

Mastering

The RSJ CD Writer File System has primarily been designed to create CDs in small quantities, e.g. for backup applications, customer-specific CDs, transferring data with CDs (e.g. for DTP), creating prototypes, etc.

If a CD is to be used for mass production, it is recommended to notify the CDROM manufacturer of the fact that the files on the prototype CD should be copied into a single track on a new CD before a glass master is created. Otherwise, the internal layout of the CD – multiple tracks and sessions, with gaps between each track (caused by the CD Recorder) – could cause problems when producing or using the CDROMs.

Please note that this is not a limitation of the CD Writer File System. Actually, Kodak's Photo CDs have the same basic layout (multiple tracks and sessions), thus will cause the same problems if they are used to print CDROMs.

Conditions of Use

- 1) This software package contains a software product and the according documentation. We would like to emphasize that the current technology cannot guarantee error-free programs, especially if they are used together with programs which have been developed by third-party companies.
- 2) Subject of this license, however, is a generally usable application program. The customer is responsible for the selection, installation and utilization of the software product as well as any intended results.
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Index

3

32-Bit Adapter, 9

A

Absorption Control Error, 62
 abstrct_file, 50
 Access denied, 64
 Accessing a Previous Session, 17
 Adaptec AHA154x, 69
 Adaptec AHA1642, 69
 Adaptec AHA2940 PCI, 69
 Adl. Sense Key, 62
 API, 45
 app_id, 50
 Appendix, 69
 Application Programming Interface, 45
 Associated Files, 71
 ATTACH, 48
 attach a CD, 35
 ATTACH_INFO, 49
 Attaching the CD, 13
 Audio, 42
 Audio CDs, 20

B

BACKUP, 14
 biblio_file, 50

C

C6.00, 45
 Cache Size, 10
 CACHE_INFO, 54
 can't connect to SCSI device manager, 65
 Cancel Copy Operation, 26
 cancel the installation, 11
 CD Labels, 24
 CD Recorder, 21
 CD Recorders, 69
 CD-View, **19**
 CD-View Interface, 22
 cdattach, 35, 64
 -abstract, **35**
 -app_id, **35**
 -biblio, **35**
 -c, 16, **35**
 -copyright, **35**

 -l, 17
 -l#, **35**
 -no_flush, 16, **35**
 -prep_id, **35**
 -pub_id, **35**
 -s, 16, **35**
 -vol_id, **35**
 -x, 16, **35**
 cdcopy, 32, **37**, 64
 CDD521, 70
 CDD522, 70
 CDI, 71
 CDR:, 21
 CDR_DEVICE_NAME, 21
 CDROM, 20, 67
 CDSPEED, 10, **38**
 cdwcpy.dll, 58, 59, 60
 cdwcpy.lib, 58, 59, 60
 cdwfs.ifs, **31**
 -a, **32**
 -c, **32**
 -d, **32**
 -e, **33**
 -i#="ID", **32**
 -p, **32**
 -q, **32**
 -s, **33**
 -x, **32**
 cdwfs.ini, 24
 CDWFSCTL.H, 45
 CDWPOPUP, **39**, 61
 cdwpopup.exe, 13
 cdwpopup.log, 13
 Changing CD Writer Options, 11
 CHKDSK, 15, 34, **34**, 52
 /V, 15, **34**
 CHKDSK_DATA, 52
 COM1, 10
 Command Line Utilities, 35
 Commands for CONFIG.SYS, 31
 Conditions of Use, 73
 CONFIG.SYS, 9, **31**, 34, 36
 confirmation, 31
 Copying Tracks, 25
 copyright, 52
 CopyToCD(), 58
 cpyrght_file, 50

CSet++, 45

CSet/2, 45

D

Data CDs (CDROM), 19

Debug Output, 10

Desktop, 11

DETACH, 50

detach a CD, 35

DETACH_INFO, 50

Detaching the CD, 16

Detailed Information, 39, 62

device, 49

device group, 33

Device not ready, 64

dir_count, 52

dir_disk_usage, 52

Drive, 11

drive tray, 13

E

ECMA-168, 71

EISA, 9, 31

Eject, 23

Ejecting the CD, 16

emulation_write, 55

environment, 36

 SET CDATTACH_PUB_ID=..., 36

 SET CDATTACH_VOL_ID=..., 36

Error Display, 61

Error Log, 11

error log utility, 13

Error Table, 62

Extended Architecture, 44

extended attributes, 14, 21, 71

F

File not found, 64

file system errors, 61

file_count, 52

file_disk_usage, 52

Finalize current session, 23

Finalize Session, 27

finalized_sessions, 52

fixation_recommended, 52

FLUSH_CACHE, 50

FLUSH_DIRECTORY, 50

flush_mode, 50

FLUSH_NONE, 50

FLUSH_SEAL, 50

FLUSH_SESSION, 50

FORMAT, 13, 14, 34, **34**, 54

 /UNSEAL, **34**

FORMAT_EMPTY_MEDIUM, 57

FORMAT_MODE, 57

FORMAT_UNSEAL, 57

formatted, 49

Formatting the CD, 14

Fundamental Knowledge, 19

Further Errors, 65

G

General error, 64

Getting Information about the CD, 15

glass master, 72

H

hard disk, 37

Hard Disk (Temporary Cache), 21

Hardware, 67

Hardware Error, 63

High Sierra, 71

I

IBM SCSI Host Adapter, 69

ID, 33

Illegal Request, 62

INSTALL, 9

Installation, 7

Installation complete, 11

Installation Confirmation, 9

Interleave Gap, 71

Internal Structure of a CD, 41

interruptions, 13

Invalid Block Address, 62

Invalid directory, 64

Invalid file name, 64

ISO9660, **41**, **71**

K

Kodak PCD Writer 200, 70

Kodak PCD Writer 220/225, 70

L

len, 49, 50

LIBPATH, 34

lock, 13, 32

long file names, 14

M

mass production, 72
Mastering, 72
Medium Error, 62
minimum transfer rate, 37, 41
Mode 1, Form 1, 42
Mode 1, Form 2, 42
Mode 2, Form 1, 42
Mode 2, Form 2, 43
modified, 52
Multimedia, 72
multiple extents, 32, 71
Multiple Volume Disks, 71
Multisession, 44
Multisession CDs, 42

N

N/A, 62
network, 37
number of sessions, 15
number of tracks, 15

O

Old CDROM drives, 16
open_session, 52
Operation, 13
Options in the Installation Program, 9
OS/2, 71
OS/2 Commands, 33
OS/2 error codes, 61

P

Pause audio playback, 23
PCD Writer 200, 70
PCD Writer 220/225, 70
PCI, 9, 31
Philips CDD521, 70
Philips CDD522, 70
Photo-CD, 44
Playback length, 29
Polling Mode, **10**, 66, 69
pos, 54
power failures, 13
Pregap, 29
preparer_id, 50
Primary Volume Descriptor, 35, 36, 50
Problem Determination, 61
program objects, 11
Programming API, 45

prototype CD, 72
publisher_id, 50
pvd_info, 52

R

read cache, 26
Record, 23
Recording Speed, 10, 23, 28
Records, 71
RECOVER, 34, **34**
Reference, 23, 24
Rescan track directory, 23
reserved_track, 52
Restrictions, 72
root directory, 14
RSJSCSI\$, **31**
RSJSCSI.SYS, **31**
rsjscsi.sys parameters
 -n, **31**
 -q, **31**
 -x, **31**

S

SCSI errors, 13, **39**
SCSI Host Adapter, 69
Sense Key, 62
Session, 16, 36
sessions_to_skip, 49
SET_SPEED, 55
Shredder, 24
Single Extents Preferred, 9
single track, 32
size, 54
Software, 67
Source Path, 11
speed, 10
speed factor, 27
speed_factor, 55
SPEED_INFO, 55
Standards, 70
Start audio playback, 23
Start Error Log, 11
Start Installation, 11
Starting CD-View, 20
Starting the Error Log, 13
Starting the Installation, 9
Status Bar, 24
Supported Hardware, 69
SYS, **34**
System Requirements, 67

T

Table of contents, 5
table of contents (TOC), 41
Target Path, 11
Technical Details, 37, 39
terminal, 32
Test Mode, 10
The pipe has been ended, 64
third-party applications, 45
Toolbar, 23
Track, 41
track directory, 22, 24
Track Modes, 42
Track Size and Disk Space, 29
track_count, 52
Tracks, Table of Contents and Sessions, 19
transfer rate, 10, 37
Tutorial, 13
Type L Path Table, 71
Type M Path Table, 71

U

UCDWFS.DLL, 34

Unable to read PMA, TOC or Subcode, 62
UNFORMATTED, 13
Unit Attention, 63
Unknown CD, 24
unlock, 16

V

vol_set_id, 50

W

WORM, 42
WPS, 72
Writing to the CD, 14

X

XA, 44
XCopyToCD(), 59
XCopyToCD2(), 60