



Diamond Cut
Millennium/
LIVE
User's Manual

Extract of the *Diamond Cut Millennium/LIVE* Manual

Eights edition

(*Diamond Cut Millennium/LIVE* Version 4.x)

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Diamond Cut Audio Restoration Tools Overview

Product Objective: We aim to provide a comprehensive set of tools which will allow the user to remove extraneous noise and also enhance the sound contained on old audio sources without degrading the content contained on the original. Recognizing that there is a tradeoff between the degree of noise removed from a source and the fidelity, transient and frequency response maintained, we have sought to provide the highest level of user control while maintaining ease of use over the variables which effect the Audio Restoration Process.

Diamond Cut Millennium, introduces a „Multi-filter“ and *Diamond Cut LIVE* additionally introduces (feed-through) mode into its feature set. Both products include 4 new powerful Forensics filters. The „Multi-filter“ allows you to cascade at least 24 filters or effects. The „Live“ (feed-through) mode allows systems with full duplex capability to bypass the system hard drive, and use the computer as a „Live“ signal processor. In other words, the signal is applied to your computer's audio input, is processed by the *Diamond Cut* algorithms, and then is presented to its output a few hundred milliseconds later. A tremendous amount of versatility and flexibility has been added, particularly when „Live“ is used in conjunction with the „Multi-filter.“ Additional new and innovative features that have been incorporated into both versions of *Diamond Cut* include the following:

1. 8 to 24 bit support at up to 96 kHz sampling rate
2. Sample rate conversions
3. Variable resolution added to the Continuous Noise Filter
4. Audio Spectrum Enhancer added to the Dynamic Noise Filter
5. Batch File Editor
6. Slot Filter for isolating sounds in Forensics applications.
7. Stereo Wavefile 180 degree phase-inversion
8. X-Y output display for plotting vector waveforms
9. Stereo Channel Blender / Crossover Filter & Effect
10. Speed Enhanced Display Functions (especially on large wavefiles)

11. Improved Reverb
12. Printable 50/60 Hz Turntable Stroboscope discs
13. Additional factory presets
14. Additional Keyboard Accelerators
15. Variable Resolution Spectrum Analyzer

Diamond Cut Productions, Inc. designed *Diamond Cut Audio Restoration Tools* primarily to be used for the restoration of olde phonograph recordings. These recordings often contain priceless performances which are marred by the effects of age, wear, and the limitations of the media on which they were originally recorded. *Diamond Cut* is effective for "cleaning up" old cylinder recordings, hill and dale Edison Diamond Discs (verticals), old 78's (laterals) (both acoustically and electrically mastered), and of course, modern vinyl LP's and 45 rpm records. However, the program can also be used for additional sound restoration, special effects, or professional applications* such as:

1. Single Ended noise reduction of old analog tape recordings.
2. Cleaning up old optical and magnetic movie soundtracks.
3. Improving the intelligibility of surveillance recordings.
4. Improving the intelligibility of recorded telephone conversations.
5. Applying certain special effects or equalizations to any sound recording.
6. Removing static and noise from radio broadcasts, most particularly from signals carried on the AM and Short Wave Bands.
7. Providing a graphical means for analyzing the noise content of audio recordings.
8. Selective manual modification of recording waveforms.
9. Providing special audio effects for movie, radio, television or stage theatrical use.
10. General purpose audio applications in Forensics laboratories.
11. Use as an instructional aid for the teaching of the applied principles of Digital Signal Processing.
12. Cleaning up and enhancing video tape soundtracks.
13. Personal enjoyment and entertainment.

This program has thus far been used on ten of **Diamond Cut Productions** compact disc releases of historical musical material. Its performance can be auditioned on the following Diamond Cut Productions CDs. These CDs are available directly from Digital Broadcast Systems:

- **Unreleased Edison Laterals 1**
- **The California Ramblers - - - Edison Laterals 2**
- **Hot Dance of the Roaring 20's - - - Edison Laterals 3**
- **Ernest Stonemand and his Dixie Mountaineers**
- **Eva Taylor with Clarence Williams - - - Edison Laterals 4**
- **Vaughn De Leath, The Original Radio Girl, Edison Laterals 5**
- **B.A. Rolfe and his Lucky Strike Orchestra, Edison Laterals 6**
- **Hot & Rare - - - Hot Tunes from Rare Bands and Recordings**
- **The Marvelous Melodies of Peter Mendoza**
- **Edison Diamond Discs Fox Trots, 1920-1923**
- **Rudy Vallee and His Connecticut Yankees: 1928-1930**

See page 2 for details on the purchase of the above mentioned CDs.

Other labels such as the **Smithsonian Collection of Recordings** have used this program to clean up several songs on their "American Songbook Series". And **County Records** used *Diamond Cut* to produce their release entitled "**Ernest Stoneman and his Dixie Mountaineers**". It was written by two engineers in their spare time to facilitate the very specific needs which arose in their restoration of the Edison Lateral Collection of Test Pressing Recordings, which is located at the Edison National Historic Site in West Orange, New Jersey. Rick Carlson and Craig Maier developed this program over a four-year period. They have now made it available to the general public with the idea in mind that if it solved some audio restoration problems for themselves, it might also be of use to others confronted with similar problems, particularly for those operating with significant budgetary constraints.

Here is a list of the functions that *Diamond Cut* can perform:

1. Record Audio signals onto your computer's hard drive.
2. Playback Audio signals from your computer's hard drive.
3. Display the Amplitude vs. time waveforms that represent your wave file.
4. Zoom-In and view details of a particular portion of your wave file.
5. Print the electrical waveform representation of your wave file.
6. Perform the following group of non-destructive editing on your wave file including:
 - A. Remove Impulse Noise from a recording including "ticks", "clicks", and "pops."
 - B. Remove "Crackle" from a recording utilizing a Median Filter.
 - C. Remove Continuous Noise from an audio signal.
 - D. Display the frequency domain content of a selected portion of a wave file.
 - E. Perform a Low Pass Filter function with 1st, 2nd or 3rd order slopes.
 - F. Perform a Bandpass Filter function with a Finite Impulse Response (FIR) and an Infinite Impulse Response (IIR) algorithm.
 - G. Perform a High Pass Filter function with 1st, 2nd or 3rd order slopes.
 - H. Perform a Dynamic Filter function to reduce "Hiss" from an audio signal.
 - I. Perform various file conversions such as left plus right, left minus right, etc.
 - J. Perform an Average filter function.
 - K. Attenuate Hum or Acoustical Feedback from a recording.
 - L. Manually interpolate noise events out of your wavfile.
 - M. Frequency Equalize your recordings to create a more pleasing tonal balance with the built-in 10-band Graphic Equalizer.
 - N. Correct the pitch of a recording with the „Change Speed“ Filter, with linear or non-linear time contours.
 - O. Perform fractional speed remastering from a 45 RPM turntable, and then convert it to normal speed with the „Change Speed“ Filter.
 - P. Create a wavfile „Songlist“ with Markers capable of CD data Quantization for glitchless indexing.
 - Q. Attenuate Buzz from a recording using the Harmonic Reject Filter.
 - R. Add „tube-warmth“ or harmonic enhancer effects
 - S. Modify the dynamic range of recording
 - T. Set up a „noise-gate“ function

- U. De-ess an overly sibilant recording
 - V. Create or reverse an RIAA equalization curve with the 10 band Paragraphic equalizer. Also, create various 78-RPM turnover equalization curves.
7. Perform the following group of destructive editing on your wavfile including:
- A. Fade in sequence with either a linear or a logarithmic envelope vs. time.
 - B. Fade out sequence with either a linear or a logarithmic envelope vs. time.
 - C. Crossfade between two Wavfile sources with linear or logarithmic timing.
 - D. Mute a portion of your wavfile. This is useful for ridding a file of stubborn "pops" or "thuds."
 - E. "Gain Ride" to even out variations in the sound level of a recording in non-real time.
- Edit Wave files using any of the following commands:
- 1) Copy
 - 2) Paste Over
 - 3) Paste Insert
 - 4) Cut
 - 5) Interpolate
- F. Undo any of the destructive editing which you have performed with any number of levels of the undo function that you choose to define.
8. Analyze Audio signals for Amplitude and Frequency content utilizing any of three possible methods, including the use of a "built-in" spectrum analyzer.
9. Measure the performance of the electronic components in your audio restoration laboratory with a built-in Audio Signal Generator that is capable of producing Sine and Square Wave signals (tones) of adjustable frequency and amplitude. It is also capable of producing white and pink noise using the Random function. Also included is a burst and linear sweep generator function.
10. Real time "Preview" of all filter functions for instant evaluation of parametric settings.
11. Hear the noise being removed by two of the filters through a „Keep Residue“ mode.

12. Add reverb to „dead“ recordings.
13. Create a Stereo Effect on monophonic recordings.

It is important to emphasize that *Diamond Cut Millennium/LIVE* performs most of its editing in a non-destructive manner. The source file remains non-modified; only the destination file receives the modifications. Not all wavefile-editing programs work in this manner, and some actually modify the source file directly on your hard drive.

It will take some experience to achieve excellent results from the software so don't be afraid to experiment. The **preview** feature will allow you to quickly hear the results of parameter setting changes before you commit your computer resources to the job of a complete file processing. Some PCs are not fast enough to run all of the algorithms in real time, so you may find yourself making use of the preview function often. The minimum system configuration that we recommend that you use to run Diamond Cut 32 is a 100 MHz Pentium. A 166 MHz Pentium or higher will generally run most *Diamond Cut* algorithms in real time or faster in non-preview mode, and for „Run“ mode performance, faster is always better. If you are using „Live“ you will want the fastest computer that you can afford for maximum functionality, performance and versatility.

Most sound restoration jobs will take several passes with different algorithms applied to achieve the best results. Since many of these algorithms are non-linear systems, the order in which some of the various filters are applied will matter. You will find more on this topic in the **Impulse Filter** section of the **Help** file.

Note 1: Diamond Cut Millennium/LIVE utilizes the Wave file format for its file system (.wav). Other sound file formats are not supported at this time.*

Getting Started with Diamond Cut Millennium/LIVE

Installation

Congratulations, you've just purchased another affordable yet powerful Tracer branded product. You have our promise that you'll be satisfied with your results without having to take a second mortgage to get them!

NOTE: Be sure to return the registration card to ensure support, upgrade and bug fix notification.

To Install the software please follow these steps:

Windows 95/98/ME and Windows NT/2000 Instructions

1. Put the install CD into your drive. If Autorun is enabled, installation will begin immediately.
2. Press the Start button, choose Run from the pop-up menu
3. Type in the letter of your CD Rom drive
4. Press the OK button
5. The *Diamond Cut* install program will start. Follow the instructions on the screen.

The software will be installed in a folder called Diamond Cut Productions. A sample wavefile is supplied called demo1.wav.

Configuration

Diamond Cut Millennium/LIVE does not require any special installation, but it does require that your sound card be installed and working properly. If you have more than one sound card in your system, make sure the one you wish to use has been selected in the Device I/O screen (use the *Edit->Device I/O* menu). Check the *Temp File Path* under the *Edit->Preferences* menu. *Diamond Cut Millennium/LIVE* automatically assigns temporary file names for files that are being processed. You should set the temporary drive path for the disk drive that you wish to use for audio editing. This is usually the drive with the most free disk space. Keep in mind that high quality (44.1kHz) stereo recording consumes 10.5MB of disk space per minute.

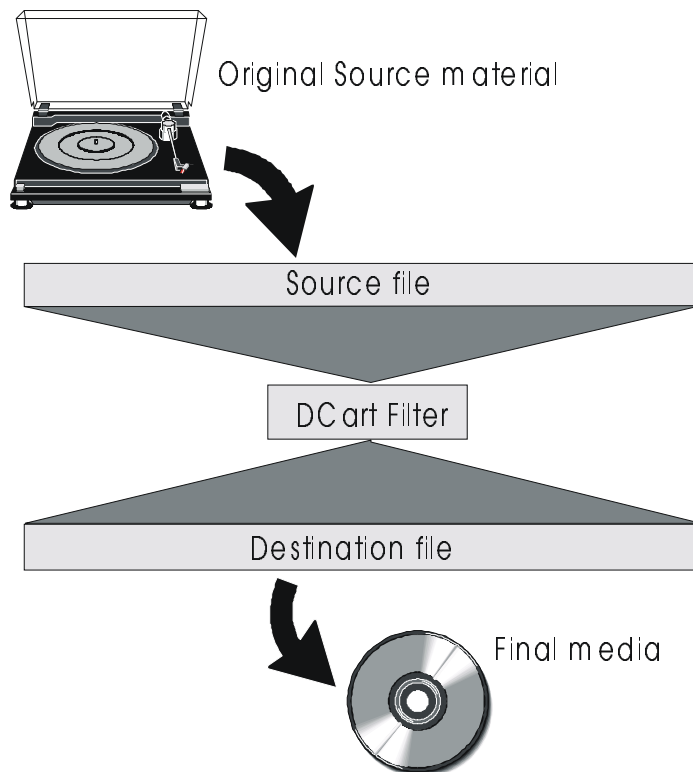
Basic operating mode of Diamond Cut Millennium/LIVE

Diamond Cut Millennium/LIVE always operates in a non-destructive manner. When a file is processed with a *Diamond Cut Millennium/LIVE* filter or effect, the software reads the source file, modifies it with the selected filter or effect, then writes it to the destination file. The main workspace of *Diamond Cut Millennium/LIVE* always has a source and a destination file. This mode of operation has a few important benefits:

1. The original source file is not modified, leaving it available for instant comparisons with the processed version.
2. The original material can always be recovered if the results of processing are unsatisfactory.
3. Selected sections of the file can be reprocessed using different filter parameters or different filters entirely (see sync mode).

Because of the non-destructive nature of the filters in *Diamond Cut Millennium/LIVE*, there is no undo function for the filters. Instead, the original source can be copied back to the destination file if a mistake is made. This method greatly speeds up the program because it does not have to make a copy of the data each time a filter is run.

The following diagram illustrates the filtering process:



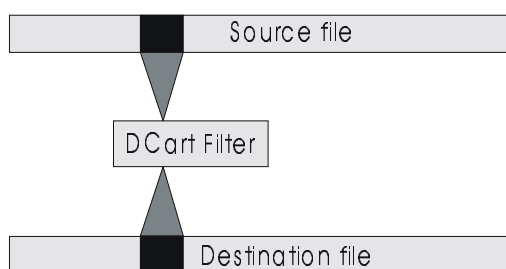
Sync Mode

Sync mode is the default mode of operation for *Diamond Cut Millennium/LIVE*. In Sync mode, both the source and destination files track each other. If you zoom into a section of the source file, the destination file will zoom to the same section. When you process the source file using a *Diamond Cut Millennium/LIVE* filter, the program reads the source file, processes it, and writes it to the destination file at exactly the same position as the source file. This means that if you want to reprocess a section in the middle of a song, just highlight the section in the source file that needs processing and run the filter again.

The filtered section will be written to the correct location in the destination file. This mode of operation is useful for changing the filter parameters for only a

section of a song, or for removing noise from a small section of the song without having to process the entire file.

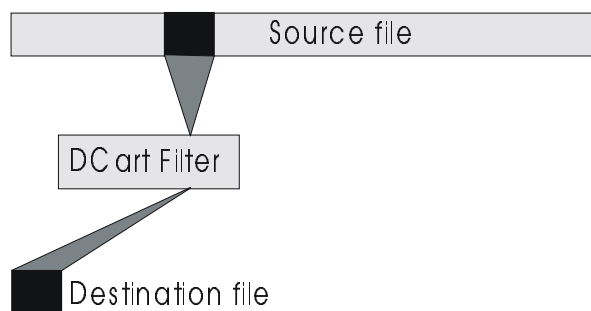
Note: Sync mode assumes that a destination file exists, and that it is the same size as the original file. This is usually accomplished through the application of one of the Diamond Cut filters to the entire file. For example, the file conversion filter can be used to make the destination file into an exact copy of the source file.



Sync Mode Operation

Non-Sync mode of operation

In non-sync mode, the highlighted section of the source file is read and processed by the *Diamond Cut Millennium/LIVE* filter. The processed section is then written to the destination file, starting at the beginning of the file. If a destination file already exists, it will be overwritten (a prompt warns you of this). This mode is useful when only a section of the source file needs to be extracted, or for testing a filter's settings before processing an entire file.



Non-sync mode operation

Single file operations

Because of the nature of several operations, the Cut, Copy, Paste, and Fade menu items operate on the file that is currently selected. This means that a Cut will delete a section of the source file if it is the currently selected file in the workspace. Likewise, a Fade operation will modify the highlighted section of the selected file (Source or Destination).

All single file operations can be undone by using the Undo menu item. The default number of undo levels is 10. The number of undo levels is selectable in the Preferences dialog box. The maximum number of undo levels is limited to 100. When you close *Diamond Cut Millennium/LIVE* (Exit the program) all undo information will be lost.

Preview Mode

All the filters in *Diamond Cut Millennium/LIVE* have a preview mode. Preview mode lets you hear the result of a filter before writing the changes to the Destination file. In Preview mode, you will hear the results of the filtered file as it is being processed. If your computer is fast enough to keep up with the calculations, the entire file can be previewed in this manner. All of the filters have live controls, which means that adjustments made to a filter's slide control will be immediately heard in the preview output. If your computer cannot keep up with the calculations, you will hear stuttering in the preview output. This is because the playback is being paused while the computer calculates the next section of music. This stuttering can be minimized by increasing the number of "Preview Buffers" in the Preferences Dialog box (Edit->Preferences).

Restoring a Recording

While there are many ways to use *Diamond Cut Millennium/LIVE*, the general steps are outlined below. Keep in mind that any of the filters may be skipped if the particular recording does not suffer from the kind of noise the filter is designed for. You should always use the least amount of processing that will get the job done. See the section on Filters for a brief description of each filter's function. The tutorial on restoring the Demo wave file later in this booklet describes some of these steps in detail.

1. **Record the source material**

The source material is recorded from an external source into a Wavefile using the Record function of *Diamond Cut Pure Audio*.

2. **De-Click**

The Impulse noise filter is used to remove ticks, pops, and other transient noises from the recording.

3. **DeHiss**

You can use either the Continuous Noise filter or the Dynamic noise filter to remove constant background hiss or other wideband noise from a recording. This type of noise is the most difficult to remove without effecting the music.

4. **Filter (HP, LP, Notch, Harmonic Reject, Equalizer)**

The High Pass, Low Pass, Notch, Harmonic Reject, and Equalizer are all filters that modify the frequency response of the recording.

Some examples are:

- High Pass filter for removing rumble
- Notch or Harmonic Reject filter for removing hums, buzzes or feedback.
- Equalizer for adding bass or emphasizing the vocal range.

This step may be performed before the continuous noise filter to remove rumble or high frequency noise. See the help file for additional examples of which filter to use for a particular problem.

5. **Trim, Fade-in/Fade-out**

After the processing is done and you are satisfied with the results, you can use the Cut, Fade-in and Fade-out functions to remove any noise that occurs before and after the recording, such as the sound of the record needle being dropped on the lead-in groove. Keep in mind that the Cut and Fade functions operate on the selected file. This means that, unlike the filters, you can modify the source file if you want to.

6. Transfer to final format (CD, Cassette, DAT)

After the restoration process has been completed the file should be transferred to a portable format such as CD, cassette or DAT. To transfer to cassette or DAT, simply set up the cassette or DAT machine to record from the computers sound card and play the wavefile. If you are restoring an entire album or want to create a master tape, use the *Playlist* feature.

This allows you to create a list of wave files and play them back in sequence, thus eliminating the time consuming steps of starting and stopping the recorder between each song.

CD recorders usually have special software that must be used to record the file onto the CD. *Diamond Cut Millennium/LIVE* has a CD quantization feature that lets you perform special processing to ensure glitch free CD masters.

Filters and Effects

The filters are at the heart of the operation of *Diamond Cut Millennium/LIVE*. They are used to reshape the sound from its original form into a more pleasing and noise-free result. The following section lists all of the filters available in *Diamond Cut Millennium/LIVE* along with a description of the type of filtering they perform.

- **Impulse Noise Filter**

This filter is used to remove pops, ticks, clicks, and crackle from audio recordings. It is also useful for the elimination of "static" interference from AM or Short Wave radio broadcasts. An Impulse looks like a spike or fast change in the audio signal that is not related to the music. The filter monitors the audio signal for ticks or pops and replaces them with an approximation of the signal which would have occurred during the tick or pop.

- **Continuous Noise Filter**

This filter is useful for reducing background “Hiss“ and other constant noise from a recording or from a noisy FM radio transmission. It is referred to as a “Continuous“ noise filter because unlike Impulse noise, Hiss is present at all times. When adjusted properly, this filter can almost completely eliminate all residual noise from a recording. However, it is easy to overuse this filter and leave the recording sounding dead and lifeless, and also introduce digital artifacts into the music.

To use this filter, you must first take a sample of a section of noise. This noise template will then be used to decide what is noise and what is music during the filtering process. It is important to sample a section of the wavefile that does not contain any music so that the filter does not remove signals that contain musical information.

The filter graphically shows a frequency spectrum of the sampled noise. This spectrum represents the amount of noise at each frequency band in the recording. You can use the mouse to move the blue threshold line to tailor the kind of noise reduction that the filter performs.

This filter should only be used on recordings that have little or no impulse noise, or on recordings which have already been processed through the Impulse Noise filter.

- **Harmonic Reject Filter**

The Harmonic Reject filter is used to remove harmonically rich noise from a recording. Noises such as hums and buzzes from electrical mains, or buzzes from broadcast signals are the most common types. A loose or bad ground connection on a turntable is a common cause of hum that can be removed with this filter.

The filter removes the fundamental frequency along with a selectable number of harmonics. Harmonics are multiples of the fundamental frequency that are present in all signals that are not a sine wave. For the US, a hum caused by a faulty ground will have a fundamental frequency of 50Hz in Europe.

- **Dynamic Noise Filter**

This filter is another form of the “Continuous noise“ filter, but it operates on a different principle than the previous filter. It is also useful for removing “Hiss“ from recordings, but unlike the “Continuous Noise Filter,“ will not introduce any digital artifacts into the recording. It is much more forgiving of incorrect settings at the expense of less overall hiss reduction.

The Dynamic Noise filter can also be placed in another mode of operation producing a spectral enhancer. Signals above the threshold value will be incrementally amplified in this mode.

The Dynamic Noise filter's operation is based on a moveable Low Pass filter. This low pass filter will attenuate the high frequency Hiss only when there are no high frequency signals present in the music. This filter should also only be used on recordings that have no impulse noise.

- **Low Pass Filter**

This filter is called a Low Pass filter because it only passes through signals that are lower than its set corner frequency. It attenuates high frequency signals above the corner frequency.

The effect can be similar to turning down the treble control on a home stereo except that the Low Pass filter is much more flexible. This filter can be somewhat useful for reducing hiss in a recording, but care must be taken not to reduce the „presence“ of a recording by eliminating too much of the high end musical content at the same time.

It is most useful where a recording does not contain any musical information above a certain frequency, and you wish to eliminate the high frequency noise that would otherwise be present.

- **Bandpass Filter**

Bandpass filters are essentially a combination of a low pass filter and a high pass filter. It attenuates both the high frequency and the low frequency portions of the audio spectrum. It is useful where the recording contains extraneous noise in the low frequency region such as rumble or thumps, and high frequency noise such as hiss.

This filter can also be very useful for improving the intelligibility of audio recordings, especially speech, by eliminating the unnecessary portion of the audio spectrum that is not used by speech frequencies to carry useful information to the listener.

- **High Pass Filter**

A high pass filter only passes signals that are above or “higher“ than the corner frequency. It reduces the level of low frequency signals that are below the corner frequency. The effect can be similar to turning down the bass control on a home stereo. This filter is very useful for reducing turntable rumble, muddiness, and any other extraneous low frequency noise in a recording.

- **Notch Filter**

A notch filter attenuates signals that are near its center frequency setting. The degree to which it attenuates frequencies near the center frequency is determined by the bandwidth setting. This filter is useful for removing 50 or 60 Hz hums from a recording. It is also useful for decreasing any sound system acoustic feedback that may be found on some live recordings. A „Slot“ filter is also provided within the Notch filter menu item for Forensics applications. Multiple slots can be constructed using the *Diamond Cut Millennium/LIVE* Multi-filter.

- **Equalizer**

The equalizer is a familiar filter that acts like an expanded tone control. The audio spectrum is broken into 10 bands, each being one octave wide. Each band's gain (volume) can be independently adjusted to achieve the desired audio result. This filter is useful for tonal shaping of the finished audio product or to enhance the bass or treble of a recording. It is also useful for improving the intelligibility of recordings or “Bringing Out“ a particular instrument or vocal.

- **File Conversions**

The file conversion filter is not really a filter at all but a way to convert mono files to stereo and visa-versa. It can also be used to adjust the channel balance or reverse the channels of a stereo recording, or convert a mono source into a stereo file. It is useful in converting stereo recordings made out of phase (such as old vertically recorded acoustic discs) into a stereo or mono file that is compatible with modern systems. File conversions also includes two controls. One set allows you to adjust the gain levels for each channel. The second control, called Time-Offset, provides a means for azimuth correction, Forensics audio enhancement, and stereo simulation. A final important use of the file conversion filter is to simply copy parts of the source file over the destination file. This is one way to revert back to the original source file (undo) following a bad filter application.

- **Change Speed**

The change speed filter is used for either fractional speed mastering or for correcting the pitch of an off-speed recording. If your record skips when played at normal speed, consider playing it at a slower speed and use the change speed filter to restore the original pitch. If your recording is off-pitch, or contains momentary pitch deviations, use the graphical pitch vs. time contour graph to correct these deviations.

- **Reverb**

The Reverb effect is used to add a realistic room sound to a recording. The reverb is capable of simulating different size rooms, with different kinds of reflective surfaces and decay times. The reverb filter lets you control the overall room size, decay time, early reflection level, and mix between the original material and reverb sound. Unlike most of the other filters in *Diamond Cut Millennium/LIVE*, the Reverb filter is really an effect, rather than a restoration tool.

Demo File Tutorial

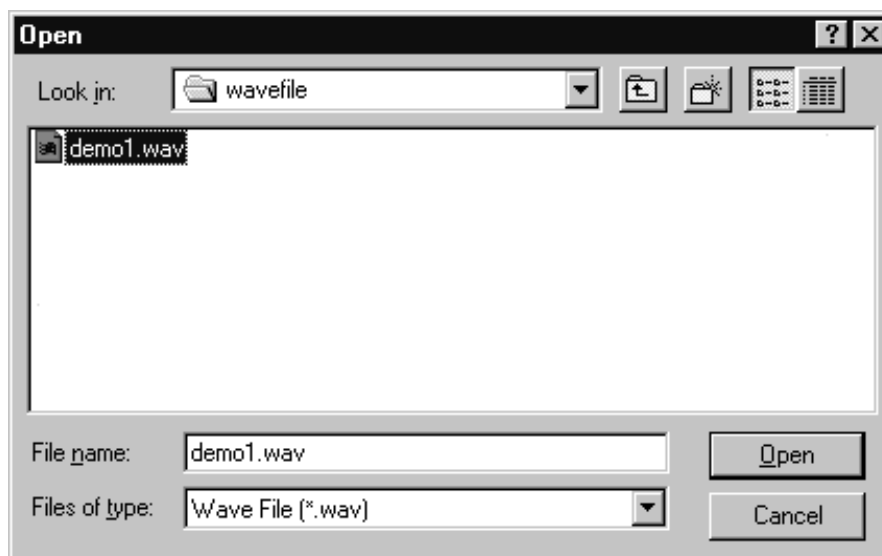
Restoring the Diamond Cut Millennium/LIVE Demo Wavefile

The following is a description of a “basic“ procedure that will restore the *Diamond Cut Millennium/LIVE* Demo Audio Wavefile, including settings that will give reasonable (not optimal) results. Its intention is to step you through an audio restoration process in order to familiarize you with some of *Diamond Cut Pure Audio* 's features. The song segment you will be restoring is titled “My Sin“ (matrix # N-869G) which was performed by the California Ramblers for the Edison Company on 4-25-29. It can be heard in its complete and restored form on a Diamond Cut Productions release entitled “The California Ramblers - - Edison laterals 2“ (DIAMOND CUT P-301D).

It is important to note that the steps are order dependent.

1. Open the Wavefile:

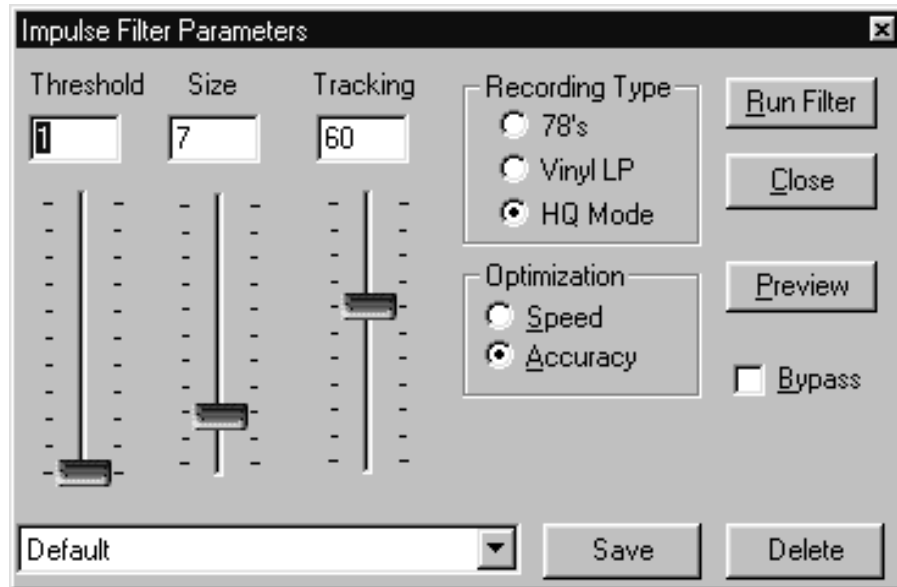
- 1.1 Open the *Diamond Cut Millennium/LIVE* demo wave file by using the File, Open Source menu, and select the file called demo1.wav.



2. Remove the Ticks and Pops:

The Impulse Noise Filter will be used to remove the ticks, clicks and pops from the Demo Wavefile.

2.1 Click on the Impulse Noise Filter that can be found under the Filter Menu.



2.2 Set the Impulse Filter Parameters to the following values:

- A. Threshold = 9900
- B. Size = 6
- C. Tracking = 1
- D. Vinyl LP mode is not checked (in other words, this feature is not enabled)
- E. Preview Mode is not checked

2.3 Click on "Run Filter" using the left mouse button. The computer will start processing the file, and depending on the speed of your computer, will have completed the file after somewhere between 5 to 60 seconds. At the end of this process, you should note that the statistics dialog box will have indicated that roughly 350 clicks have been removed from the Source File. This step will have completed the De-Clicking process. The results of this process will be the file found in the Destination Workspace.

2.4 To hear the results of this process, press the play button on the toolbar (the arrow pointing toward the left). Note: this step is optional.

2.5 Shut down the Impulse Filter by clicking the Close button on the dialog box, using the left mouse button.

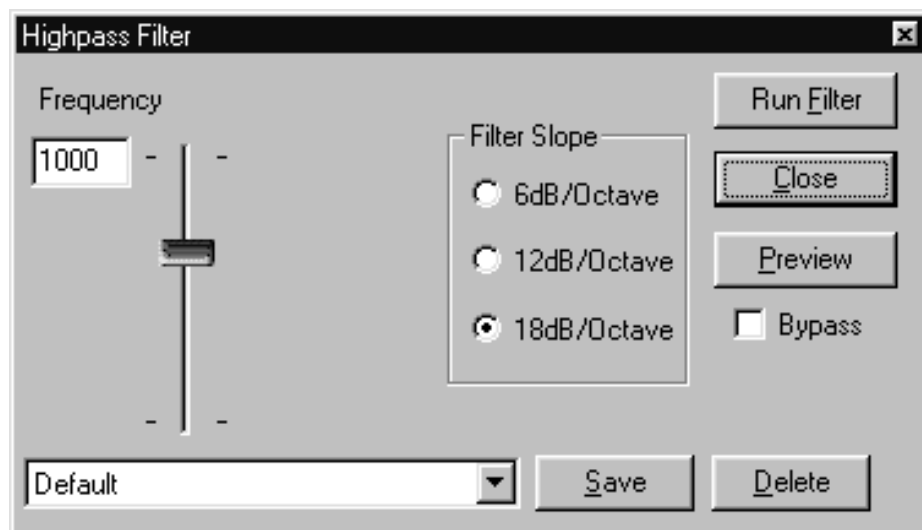
3. Remove Low Frequency Rumble:

The next procedure is intended to remove low frequency “rumble“ from the Demo Wavefile. You will be using the *Diamond Cut Millennium/LIVE* High Pass filter.

3.1 Click on the “Make Destination the Source“ function which will be found under the “File Menu.“

3.2 Next, click “OK“ in the “Save As“ dialog box. *Diamond Cut Millennium/LIVE* will automatically assign a Temporary File name to this new Source file. It can be viewed in the newly opened “Source Workspace.“

3.3 Click on the High Pass filter that will be found under the Filter Menu.



3.4 Set the following Parameters:

Frequency = 55 Hz

Slope = 18 dB / Octave

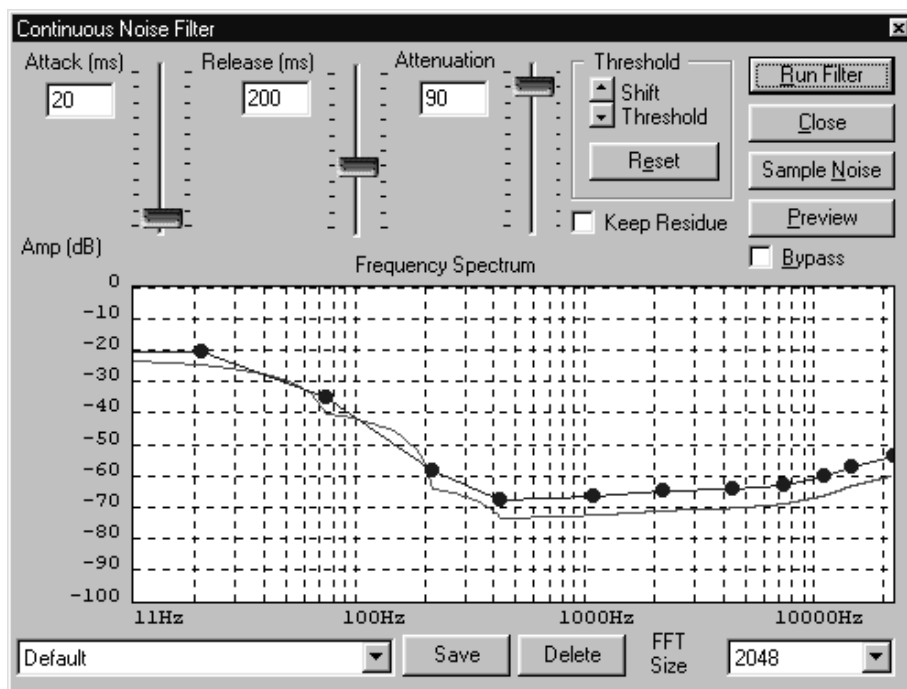
3.5 Click on “Run Filter.“ After the filter has completed its operation, the results will be found in the Destination Workspace.

- 3.6 To hear the results of this process, once again, click on the play button. You should hear that the rumble on the original recording is now gone. Your speakers must have good low frequency response to hear the difference.

4. Remove the Hiss and surface noise:

This procedure uses the continuous noise filter. The term "Continuous Noise" refers to the constant background hiss and crackle that appears on most old recordings.

- 4.1 Once again, click on the "Make Destination the Source" feature found under the File Menu.
- 4.2 Click on "OK" in the "Save As" dialog box. The file, which had just been in the Destination Workspace, will now be found in the newly opened "Source Workspace."
- 4.3 The purpose of the next process is to remove continuous noise from the recording. This includes such noises as hiss and other random noises. You will be using the "Continuous Noise Filter."
- 4.4 First, you must give the filter a sample of noise to use as a template. To do this, highlight the first ½ second of the Demo Wavefile. To do this, use the left mouse button and drag it until approximately the first 0.5 seconds of the source wavefile is selected. The highlighted sector will be indicated in yellow. Use the play button to be sure that you have highlighted only lead-in groove noise, and no impulses from stylus drop or music.
- 4.5 Click on the Continuous Noise Filter, which will be found under the Filter Menu.
- 4.6 Click on the "Sample Noise" button found in the filter dialog box. You will see a blue threshold line appear above the red signal spectrum line. It is only necessary to understand what is going on here if you are an advanced user. Otherwise just follow the directions. If you are an advanced user, you will find more information on the use of this filter in other sections of the Help file discussing the Continuous Noise Filter.
- 4.7 Set the following parameters for the Continuous Noise Filter:
 - A. Attack Time = 40 msec.
 - B. Release Time = 80 msec.
 - C. Attenuation = 100dB



- 4.8 Highlight the entire source workspace by double clicking with the left mouse button anywhere within the source waveform display area. It may be necessary to move the Continuous Noise filter dialog box out of the way before selecting the source waveform.
- 4.9 Click on the "Run Filter" button. The results of the Continuous Noise Filter processing step will be found in the Destination Workspace, after your computer has completed running the algorithm. To hear the results, click on the play button on the toolbar.

This concludes our example of a "basic" sound restoration job. The next advancement would be to adjust the filter parameters more to your own personal taste. Furthermore, you may choose to run the graphic equalizer, low pass filter, or some other filter after the continuous noise filter has been completed. The variations in the results that you can obtain are tremendous when you consider all of the various permutations of filters and parameters available for you to choose from. Proficiency in the use of *Diamond Cut Millennium/LIVE* will develop over time as you experience the various results that can be obtained from the program.

Also you may want to consider to upgrade this program to either *Diamond Cut Millennium* or *Diamond Cut LIVE* if you need more sophisticated filters or effects. Furthermore the provided manual with these version explains on more than 300 pages in greater detail the audio restoration process. It also contains a in depth tutorials on every filter and effect, a 70 pages appendix with explanations on almost every aspect of restoring audio. Informations on upgrading to *Diamond Cut Millennium* or *Diamond Cut LIVE* can be found on page 37 of this manual.

By using the „Save Settings“ feature you can save the ranges of parametric values that have worked well for you for certain filters as a function of the type of materials you have restored.

Common Questions (FAQ)

This section lists some common questions new users have about *Diamond Cut Millennium/LIVE*.

Q Why does the waveform display only show part of my file?

A By default, *Diamond Cut Millennium/LIVE* only reads the first few megabytes of a wavefile for the initial display. This adversely affects none of the wavefile processing operations. Portions not shown on the display can still be played, filtered and operated on just as if they were displayed. To set the size of the waveform that will be displayed, use the Preferences dialog box (under the edit menu) and increase the "Display Length Limit" to the size of the file you wish to be displayed. Keep in mind that the larger the display size, the longer it will take to initially open a wavefile.

Q How do I control the recording level of the audio signal?

A In Windows 95/98/ME, there is a speaker Icon in the lower right hand corner of the Taskbar. Double-click on this Icon to bring up the control panel for your sound card. There are level controls for the Mic or Line inputs of the sound card. Also be sure that the correct input is selected (Mic, Line, or Aux) for your particular recording setup. For Windows 3.11 systems you should either use the mixer application that is supplied with your sound card or use the Windows control panel to access the sound card driver utilities.

Q Why does preview mode sound like it is stuttering?

A All of the filters in *Diamond Cut Millennium/LIVE* require a fair amount of processing power. If your computer cannot complete the processing fast enough to keep up with the audio stream, then the preview mode will stop and start in short bursts that sound like stuttering. This effect can be reduced or eliminated by increasing the number of "Preview Buffers" in the *Preferences* dialog box. Each „Preview Buffer“ adds about 10ms of pre-processing before

preview playback starts. So increasing the Preview buffers to 50 will give approximately 5 seconds of clean (non-stuttering) audio.

Q Will increasing the amount of RAM in my computer make *Diamond Cut Millennium/LIVE* run faster?

A *Diamond Cut Millennium/LIVE* does not require huge amounts of RAM. If your computer system has 12 to 16 Mbytes of RAM, then further increases will not appreciably speed up the program. The software uses disk based processing so hard drive speed and raw processor speed will generally have a greater effect than increased RAM beyond a certain minimum.

Q Will a Pentium Processor with MMX speed up the program?

A No. While a faster clock speed is better regardless of the processor, the MMX feature of all new Pentiums is designed to speed up Fixed-point operations. *Diamond Cut Millennium/LIVE* performs all of its processing using floating point calculations that are not affected by MMX.

Q I want to purchase a system optimized for use with the software. What sort of system will provide me with the fastest performance of all of the various *Diamond Cut Millennium/LIVE* filters, effects, and editing features?

A Purchase a computer with the fastest clock speed possible. Check benchmark performance of the CPU chips math co-processor performance, and specify the one that produces the best results. Keep *Diamond Cut Millennium/LIVE* on a different hard drive from your wavefiles. And use SCSI hard drives as opposed IDE drives. Look for drives with fast access times. Purchase a high performance sound card. Lastly, turn off all superfluous programs that may be running in background.

Q I am unable to record a wavefile using the *Diamond Cut Millennium/LIVE* program. What can I do?

A If you press the record button and the recording level meters do not move, check the following items:

1. Make sure that your music source (CD, tape player, DAT, etc) is connected to the correct input on your sound card. This should most likely be the LINE or AUX input.
2. Go to the control panel, and click on the Multimedia Icon. Make sure that the correct audio card is selected as the recording device and that the recording level is not set to zero.
3. Most sound cards place a volume control on the task bar. Click on the volume control icon to bring up the level control screen. Select the recording controls (usually a menu item.) Make sure that the input is enabled. Sometimes the LINE or AUX inputs are disabled by default.

Q How do I avoid producing dropouts during recording or playback?

A Make sure that you have reviewed all of the following:

1. Make sure that you are using the latest drivers for your sound card. They can usually be obtained from the card manufacturers or Microsoft's web site.
2. Make sure that the screen saver and all power management functions will not kick-in during recording or playback. By default, the screen saver has a 1-minute timeout, so after 1 minute of no keyboard or mouse activity, the screen saver will kick-in. This flurry of disc activity will put a glitch on the recording or playback of wavefiles.
3. Turn off all power saving features, or set their timers to a value of time greater than the longest musical selection that you want to record or play.
4. Make sure that there is nothing in the Start-Up group. Look in the Windows **Start->Programs->Startup** group and remove any programs that may run during your recording session. A notorious culprit is Microsoft's Fast-Find feature. It periodically searches the hard disk. It is installed with all Microsoft Office products.
5. If you are getting desperate, try disabling virtual memory in the Windows control panel. Novice users should not attempt this because it can seriously effect your PC's performance.

Q I have a vinyl LP that is very noisy, and still has too many clicks after processing. What can I do?

A Try running the impulse filter twice or more. First run it with the Tracking control set to zero, and adjust the threshold control to remove just the largest clicks. When done, make the destination the source, and re-run the filter with the Threshold set back to 1, and adjust the tracking control to get the smaller clicks.

Another thing to try is to use the file reverse feature, and then process the vinyl recording through the impulse noise filter. When done, re-reverse the file.

Q I have a record with one major scratch on it running from the center to the outside is a spiral pattern. How do I eliminate the loud „click“ which I hear which occurs once per revolution of the record?

A You should use the impulse noise filter in the following way. Set the tracking control to its minimum value. Set the threshold to its maximum value. Set the „samples“ to about five. While in Preview mode, slowly decrease the Threshold control until you see the click counter increment once for each click, which is occurring. Do not increase the Threshold control any further than necessary. Next, increase the „Samples“ control until the click is not longer audible. This technique is also useful for getting rid of the clicks produced by cracked 78-RPM shellac records. It is even possible to take a broken 78, glue it together, and then after transferring it, remove the clicks, which occur at the breakage points.

Q How do I generate a simulated stereo wavefile from a monophonic wavefile?

A Start with a monophonic file that has been de-noised, and convert it to stereo using the File Conversion Filters. Some stereo effect may be added here by applying a little „Time Offset“ during this process. Next, make the destination the source, to get a new source file. Run the Reverb effect with a Small or Medium hall, setting the decay to a low number and the early reflections level nearly to zero.

Q Does the order in which I process noise out of a wavefile matter?

A Yes. Always remove clicks and pops with the impulse noise filter before de-hissing a recording using either the continuous noise filter or the dynamic noise filter. And never reduce the bandwidth of an audio signal before applying the impulse noise filter (and this applies both in the analog side of your signal path as well as the digital side.)

Q My system is stuttering in preview mode. What can I do?

A If you have a Pentium 166 MHz or faster computer, almost all of the software's filters should run in real time. (The stereo continuous noise filter is the slowest determinate algorithm, and the impulse filter can stutter if set to aggressively on any machine.) If you are still getting stuttering, try setting the number of Preview Buffers higher. The Preview Buffers setting is located in the Edit->Preferences menu. Also, make sure that you are not running any other programs at the same time that you are running *Diamond Cut Millennium/LIVE* . Other programs can use CPU cycles, even if they are seemingly idle.

Q I have an analog tape recording with clipping distortion due to over-modulation during the recording process. Is it possible to „soften“ the clipping sound in order to reduce the harshness produced during the overloads?

A Clipping distortion can sometimes be reduced by utilizing the Impulse noise filter. If the clipping distortion is at the peaks of the waveform, set the tracking control set to its minimum value, and the threshold set to maximum. Highlight a segment of the recording which contains distorted and non-distorted material. In preview mode and with accuracy optimization checked, adjust the Threshold control until the clipping distortion is reduced. In some cases, it may become necessary to run the Reverse NAB curve before following the above procedure. After the distortion has been reduced with the impulse filter, it will be necessary to run the NAB curve to re-correct the recordings equalization. These two curves can be found in the factory preset listing under the Paragraphic Equalizer filter. The reason for the above two steps is that the saturation overload occurs at the tape to tape head interface. The resultant overload is then phase shifted during playback by the NAB equalization circuit in the tape recorder. Utilizing the Reverse NAB curve places the clipping distortion closer to the peak of the waveform, where it actually occurred.

Troubleshooting

Listed below are some common causes of problems using *Diamond Cut Millennium/LIVE*:

- Exit other programs, especially during recording. While *Diamond Cut* does not put any restrictions on the types of programs that may be run while *Diamond Cut Millennium/LIVE* is running, closing other programs will increase the chances of a glitchless recording.
- Do not use a compressed drive to record digital audio. If you are using a compression utility such as DriveSpace, DoubleSpace, or Stacker, do not use the compressed drive for audio recording. The overhead of compression will slow down the recording process and cause dropouts in the recording.
- Disable any screen saver or background process during recording. When a screen saver becomes active, it can cause a momentary flurry of disk activity that may cause dropouts in the audio recording. Some programs install a background task in the „Startup“ group of Windows when they are installed. Make sure any program that is run, will not suddenly cause disk activity. (One such example is Microsoft's Fast Find application installed with their Office Suite products)
- Make sure your computer will not enter an energy saving mode while recording. Windows 95/98/ME has a feature that allows the hard drives to be powered off after a certain period. Use the control panel's „Power“ application to check the timeout period.
- Ensure that you have a Windows 95/98/ME version of your sound card driver. Many systems that have been upgraded from Windows 3.1 to Windows 95 are still using the Windows 3.1 sound card drivers. Check the version of your sound card driver or ask the manufacturer to verify that the driver was written for Windows 95/98/ME.
- Update your sound and video drivers. You should be using the latest drivers that are available for your sound and video cards. Many problems can be resolved by updating the drivers. Drivers are usually available from the manufacturer via a Bulletin Board Service (BBS), CompuServe, America On-Line, or the World Wide Web. Contact the manufacturer for details.

Purchasing the full version:

Digital Broadcast Systems GmbH
Feldbergstr. 19
D-61440 Oberursel
Germany
Phone 0049-6171-582010
Fax 0049-6171-582012
Email: info@diamondcut.de
Webadresse: www.diamondcut.de

Technical support for registered users:
Email: support@diamondcut.de
Web Page: www.diamondcut.de
Phone 0049-6171-582010
Fax 0049-6171-582012

Enjoyment!

Some people will buy this program just for the heck of it and then wonder what to do with it. Have some fun! It can be really rewarding to take a junky old recording that has been long forgotten and try to turn it into a "Lerner and Lowe Musical." If you can take an old amateur recording, and make it seem almost professional in terms of the recording quality, it will get the attention of the folks who were involved with the original production many years prior. Send everyone free copies of your "restoration" and watch the reaction! Most people will be thrilled to hear their past presented in such realistic (although sometimes embarrassing) detail.

Or - - -

Have you ever noticed that you can always tell which records you loved to listen to 20 or 30 years ago just by looking at them? The ones which are in perfect shape today are the ones you hated, and the ones which make you cringe to listen to today (because of all of the noise and distortion on them) are the ones you loved back then (sort of ironic, right). Record collectors will find *Diamond Cut Millennium/LIVE* to be a valuable tool for the restoration of some of those old recordings that have not been re-released on CD yet. Some of the fun is in the process of restoration itself. It is very rewarding to be able to dust away the cobwebs which time has entangled on your rare record recordings. They often can be made to sound almost as good as new. And if you purchase a CD-ROM writer (which is compatible with the .WAV file format), then you can enjoy them as you did years ago, but without the fear of wearing them out.

System Requirements

1. 166 MHz Pentium or better.
2. 16 bit Stereophonic Sound Card with line level inputs, or a "Digital Only" Card.
3. 16 Mbytes of RAM*.
4. Windows 95/98/ME, Windows NT 4.0/2000 or higher.
5. An Audio Source.
6. An Audio Reproduction System.
7. A Hard Drive with enough space to accommodate your Wavefiles. A formula is provided to calculate the space requirement under Recording Audio Signals onto your Hard Drive. (The program requires 2 Mbytes by itself).
8. Mouse, Keyboard, and Color Monitor.

* If your computer has 16 Mbytes of RAM, further increases in the quantity of RAM will not appreciably speed up the *Diamond Cut Millennium/LIVE* algorithms.