



## Cube-Tec Audio Restoration Plug-Ins For Pro Tools

by [Barry Rudolph](#)

FIELD TEST

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Germany-based Cube-Tec International has released Pro Tools versions of four of its 16 high-end audio restoration plug-ins, or Virtual Precision Instruments (VPIs). These new plug-ins use the same algorithms as the original VPIs that ran exclusively on Cube-Tec's AudioCube 5 system and cost up to \$5,000 each. AudioCube 5 systems is a 64-bit floating-point/384kHz integrated audio workstation for analysis, restoration, editing, archival, CD/DSD/SACD mastering and DVD-A authoring.

The Library of Congress, the Smithsonian, the National Archives, NPR, and many top-notch mastering houses and audio forensic companies use AudioCube 5 systems running these VPIs. Check my Mix magazine review of the [AudioCube 5](#) in the Dec 2002 issue.

Designed to tackle numerous problems encountered with old vinyl, wax cylinder, acetate and tape recordings, as well as many forensic applications, these automatable RTAS plugs run on PowerPCs and Universal Binary Macs hosting Pro Tools Version 7.2 (or higher) on HD systems, as well as LE and M-Powered rigs. They are iLok-authorized, work at up to 192kHz sample rates and use 32/64-bit, floating-point precision.

### THE PROBLEM-SOLVERS



DeBuZZ removes hums and buzzes that are related to a fundamental frequency such as AC line problems, rumble and optical soundtrack hum. DeBuZZ does a FFT (Fast Fourier Transform) analysis to determine the dominant frequency and will track changes in the noise's fundamental frequency and harmonics to an hundredth of a cycle. You can manually set this plug-in or, in Learn mode, it will build a set of up to 150 notch filters that will remove noise in the subsequent harmonic series predicated by their individual level and not necessarily their sequential order.



The DeScratcher and DeCrackler removal/interpolation tools are often used together in multiple processing steps to peel away layers of different noise disturbances, starting with the loudest and most intrusive. To fill the gap left in a file where the noise was removed, an interpolation tool synthesizes or reconstructs audio based on the original program's content just before and after the region of removed audio.

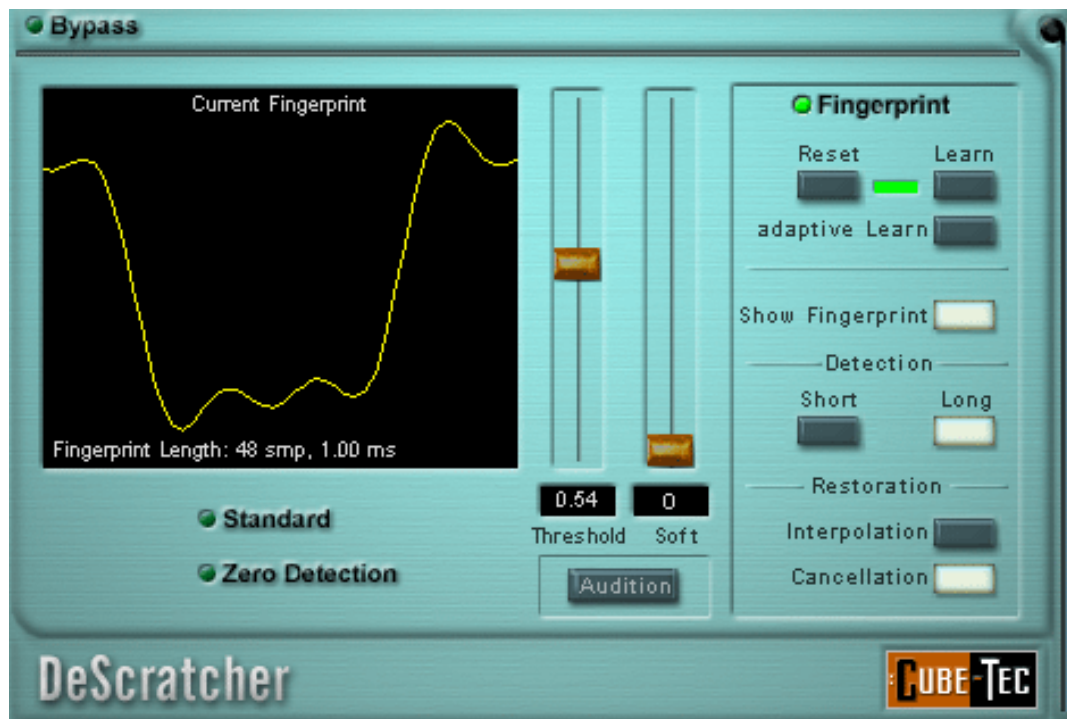
DeScratcher is for egregious scratches and noises. Noises up to 3,000 samples in duration are removed with the subsequent gaps automatically interpolated. DeCrackler removes clicks and crackles occurring at up to 8,000 per second. Because decrackling is one of the most difficult restoration problems, there are six different modes optimized for particular noise profiles that affect specific program types. After applying DeScratcher to a file, a restoration engineer would finish with DeCrackler to remove the shorter and more frequently occurring crackles.

SpectralDeHiss Expert removes broadband noise without pre-sampling the noise in isolation. It uses 1,000-plus variable-width notch filters that track the noise floor shape, which allows you to easily remove air-conditioning sounds, film camera noise and outdoor ambience. The many adjustable parameters provide a nice balance between max noise reduction and minimal artifacts, such as filter swishing and quacking.

## RESTORATION VS. DSP

The "art" in restoration lies in the details. You must use determined pursuit, trial and error, and know (by the experiential knowledge) the proper sequence of the right tools to use. Like restoring medieval art masterpieces, good audio restoration is an aesthetical balance between scrubbing away the detritus with minimal or no change to the underlying, original work.

Restoration is usually done as a "single-ended" process--fix the problem(s) and import the restored audio into your session prior to the final mix. Using an intelligent approach to standard processing, these plug-ins cleverly exploit Cube-Tec's time-tested signal processing and psycho-acoustics knowledge-base from the past ten years and employ masking thresholds to determine the optimized attenuation of disturbances. This advanced operation does come at a cost: host DSP resources.



Within an AudioCube 5 system with its vast DSP reserves, many VPIs can be simultaneously operated but for some Pro Tools systems, instantiating more than two or three of the RTAS-versions (on top of whatever other plug-ins are running) may break the DSP bank. In general, all these plug-ins use considerable host DSP resources and DeScratcher reports over 15,000 samples of latency--way beyond Pro Tools' ADC capability.

With my MAC Quadcore system and PT ver 7.3.1 and 4.5GB of RAM, I had no problem running all four plug-ins (mono instantiations) at the same time. For single core systems you might change the H/W Buffer Size to the max value of 2048, set the RTAS engine to "ignore errors during playback," and allow maximum CPU usage for RTAS processing (85%).

Certainly, running them virtually in real time allows you to tweak each plug for maximum total efficacy, but I found the

best restoration method was to use them as AudioSuite processors--fixing problems in one or more steps. I renamed each successive processed file in the playlist so that if I had to revisit a step later, I could simply step through the restoration process history.

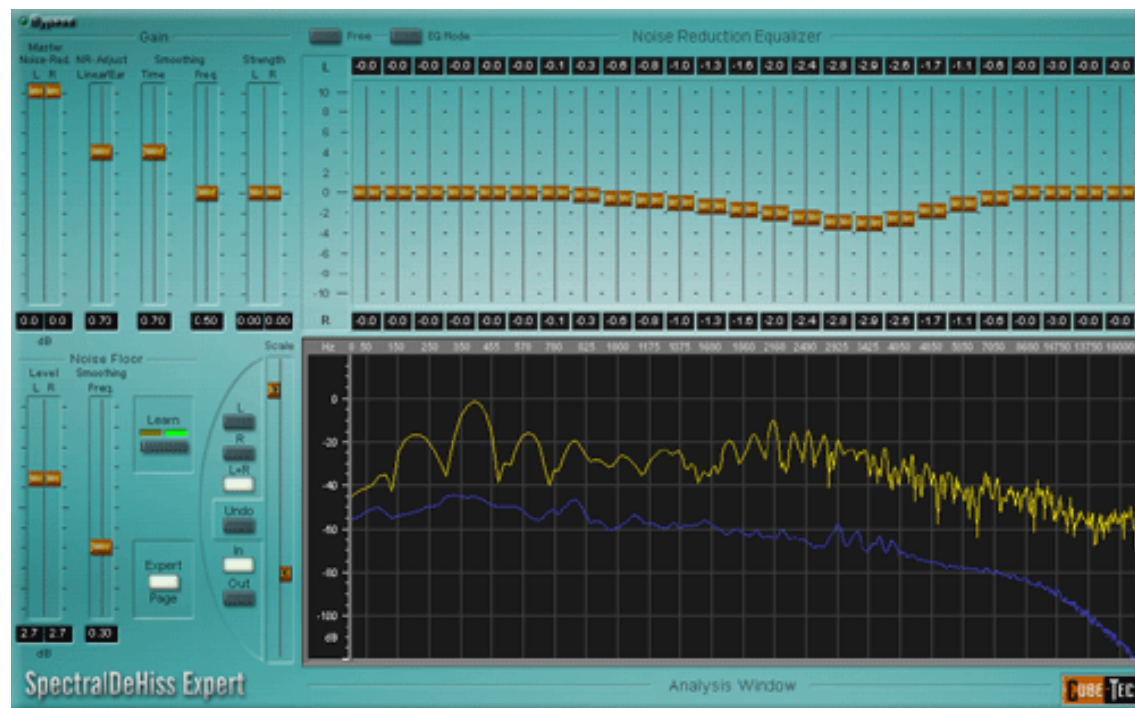
## LET THE HEALING BEGIN

For this test, I chose a very rough forensic file--a worst-case scenario where the conversation on a [tape recording of a 9-1-1 emergency phone call](#) was recovered to resolve an insurance claim. Unlike restoring a priceless, old vinyl record, this procedure differs mainly because any collateral damage to the audio due to digital processor artifacts is of secondary importance to the quest for high voice intelligibility--good enough to distinguish the exact wording and identity of the voices on the phone.

After looping the 44.1kHz mono WAV file to allow time for the plug-in's Learn function (which takes no more than about 10 seconds), I found the audio to have a considerable hum-and-buzz component and a very loud static square wave superimposed on it. Caused by a nearby digital cellular phone, this square wave was the predominant problem I removed first with DeScratcher.

With DeScratcher inserted in a Pro Tools session, on the Edit page I selected one period of the square wave noise waveform and played it while in DeScratcher's Fingerprint mode. The Fingerprint mode programs the software to correct audio from recurring noises such as repeating thumps or pops that do not have a sharp transient attack. Both Fingerprint and Zero Detection modes are for correcting disturbances that don't fall into the standard click or scratch profile. Noises do not have to be similar in nature or have periodicity to be removed using these DeScratcher modes. When the noise is removed, the gap left is automatically filled. [The result was miraculous.](#) I could now tell there were people talking on the phone.

To remove the LF hum noise, I used DeBUZZ, which quickly learned the fundamental frequency of the noise shown on a 20 to 130Hz graph. As shown by the Complexity slider, 60 notch filters were automatically created. Adjusting the Threshold lever upward increases noise reduction by setting the psychoacoustic masking level; lifting the Complexity slider adds more notch filters to increase the number of harmonics removed. With the hum and buzz removed, the 9-1-1 call was clearer yet --I could tell both people had English accents and were under duress. But there were still a lot of extra pops, clicks and a huge hiss noise floor.



### NO MORE SNAP, CRACKLE OR POP

Next up, I used DeCrackler to smooth out the background and diminish some of the pops. I arrived at a threshold setting of 0.13 and the reduction at 0.10 using the Audition button. I used the default Smooth mode for the least amount of artifacts. My sample was still submerged in broadband high-frequency noise, but the 9-1-1 call was clear enough to make out all the words from both the operator and the caller.

With its dynamic tracking filters that operate in both the time and frequency domains, I used Spectral DeHiss Expert last. This plug-in is the most sophisticated and complex of the four, with many parameters to adjust --experience and a lot of trial and error are required. The onscreen GUI has a frequency spectrum graph with 25 bands based on the Bark scale that's optimized for the psychoacoustics of human hearing measured in phons. Dropping specific frequency-band faders lessens noise reduction; raising them increases reduction. Also provided is a useful noise floor editor for selecting specific frequency bands for further attention.

The remaining noise in the sample was a combination of room tone and telephone system grunge (microphone, CODEC transmission and recording medium, probably a low-speed analog logging system). After the plug-in learned the noise floor's contour, I used the Audition

button to fine-tune the threshold to [remove most of the high-frequency whistling and hiss](#). There are many smoothing function parameters that alter the filter set created to be less intrusive; the equalizer can also be used as a post-restoration enhancement tool.

## IMPRESSIVE POWER

Using the power of the Cube-Tec Restoration plug-ins reminds me of one Hollywood's fictitious spy movies with its over-the-top special effects. I'm thinking of the scene where a government technician (supposedly) "washes" a noisy and completely garbled audio track to perfect clarity. Of course, this process doesn't happen as quickly in the real world, but the results are *that* good.

I tried it on lots of typical noise problems and they were soon ancient history. This is a must-own restoration/noise-reduction collection. Prices: DeBuzz, \$1,950; DeCrackler, \$1,850; DeScratcher, \$1,850; and Spectral DeHiss Expert, \$1,950; quantity discounts are available.

Cube-Tec, dist. by Sascom, 905/469-8080, [www.sascom.com](http://www.sascom.com).

Check Out A Loop Of The Original, Unrestored Forensic Sound File At: [OriginalNoise.wav](#)

Then Follow My Four Successive Restoration Steps I Performed Using The Four Cube-Tec Pro Tools Plug-Ins Reviewed Here For The First Time.

Step One: [NoiseDeScratchedStep1.wav](#)

Step Two: [NoiseDeBuZZedStep2.wav](#)

Step Three: [NoiseDeCrackledStep3.wav](#)

Step Four: [NoiseDeSpectralHissedStep4.wav](#)

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