

## QUICK-START – Cube-Tec RepairFilter for Pro Tools™

### Basic Overview

**RepairFilter** is used to remove steady state disturbances found in a wide range of recordings due to **hum** and **"buzz"** harmonics and anywhere there is reasonable frequency stability in an unwanted artifact. (Sinusoidal tones.) These problems can originate from grounding problems, lighting buzz, video scan frequency bleed, FM Heterodyning tones, etc.

**RepairFilter** has an analysis section (**sonogram**) and two filter processing sections: a **high-pass/low-pass** section and a bank of eight, multi-mode notch filters. The operating states of the notch filters can independently be set for either **Auto**, **Edit** and **Cursor** modes. These operating modes define how the disturbances are defined. Further parameters define how they operate.

In **"Auto"** mode, **RepairFilter** can automatically determine the center frequency and bandwidth required for a filter to remove a disturbance tone. This mode constantly tracks shifting frequencies automatically. A lot of common **hum** problems can be handled this way. Not all harmonics can be tracked used this mode, or perhaps you would like to over-ride the default filter parameters. In this case, you have two manual modes - **"Cursor"** and **"Edit"**.

**Cursor** mode employs the analysis section, where it is possible to view the sonogram and use the mouse to set filter frequencies and determine it's bandwidth. In **Edit**, mode you can manually enter these values or change the **Gain** and **Processing Threshold** functions - these are normally defaulted by the plug-in.

Audition modes allows you to adjust your settings and only listening to the part of the signal which removed by the notch filters. The removed components are also displayed in the **sonogram**.

### RepairFilter GUI

The interface can be broken into two main areas. The left side comprises of the **Spectrograph/Analysis** portion and the right-hand side the **Filter/Processing** Section. The **Filter** Section is further broken down into a **hi-pass/low-pass** section and the **8 multi-mode** filters. The **Audition** function is also in this area.

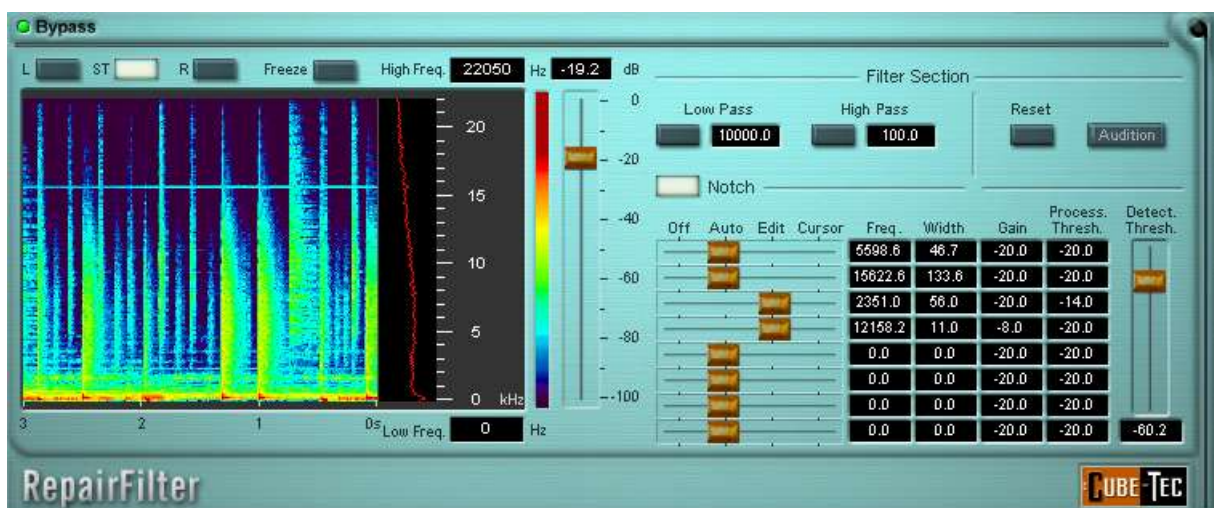


Figure 1: Tracking Video Horizontal Scan Frequency and Buzz Harmonics

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### Operational Approach

The **RepairFilter** combines an intuitive analytical tool with eight tracking notch filters and a **high-pass/low-pass** filter set. To achieve optimal results begin by setting all the notch filters in “**Auto**” mode. In doing this the **RepairFilter** will search for a steady-state tone and automatically set its center frequencies and bandwidth. Furthermore, **Auto** mode notch filters are adaptive to small variations in the steady-state disturbance - they will track frequency shifts dynamically, so that the filters will always be effective.

If this is not suitable for your particular audio program, you can switch the filter to **Edit** mode and adjust the desired frequency manually. Using the same procedure one can also manually set the **Width**, **Gain** and **Processing Threshold** for each filter. Additionally, one can switch the filter to **Cursor** mode and by left-clicking on the spectrogram’s frequency axis (directly above the steady state tone), set the filter’s center frequency to that disturbance. It’s a good idea to first zoom into that area to get the most accurate representation.

Use the **Processing Threshold** to set the signal threshold level above which the filter should have no effect and therefore to prevent filter ringing (this automatically activates the “**Edit**” mode for the selected notch filter).

The **Detection Threshold** on the other hand, is a global threshold that the disturbance must exceed to be detected (only applicable for filters set to **Auto** mode.)

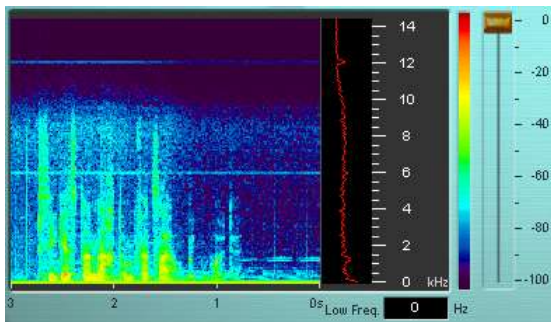


Figure 2: RepairFilter Spectrogram with disturbances at 6 and 12kHz.

Situated on the left-hand side of the **RepairFilter** window is the spectrogram. The purpose of the spectrogram is to highlight these steady tone disturbances and their frequencies. It’s possible to zoom into spectrogram to get better detail in lower frequencies. By left-click-dragging in the spectrum area you can adjust the frequency range that is displayed in the spectrogram. (A marquee is created around that section and when the mouse button is released, it will zoom-in.) In doing so, low frequency disturbances will become more visible and defined with greater accuracy. By right-clicking in the spectrogram, you can jump back to the previous zoom setting. Multiple zoom-in levels can be reversed

in this fashion. Right and left-clicking simultaneously on the mouse will result in a full zoom-out of the display (back to a frequency range between DC and half the sampling rate).

The spectrogram allows you the luxury of seeing the sound rather than hearing it. This point is reinforced by the vertical decibel slider which performs colour-amplitude coordination in the spectrogram. By dragging this slider down, one can analyze the louder parts of the signal more closely and therefore the loudness of the disturbances. It’s like a “contrast” control that lets you focus-in, on specific signal amplitudes. This is very useful tool for confirming how much **Width** must be applied (for the frequency) as well as **Gain**. The louder and broader the bandwidth, the more width and gain should be applied. Using the spectrogram in this way leads to more accurate usage of these parameters and therefore prevention of artifacts. For more information about the spectrogram, please consult the **SpectroGraph** manual.

Finally, use the “**Audition**” function to analyze the disturbances that will be removed by the notch filters using the current settings. In this way the settings can easily be adjusted.

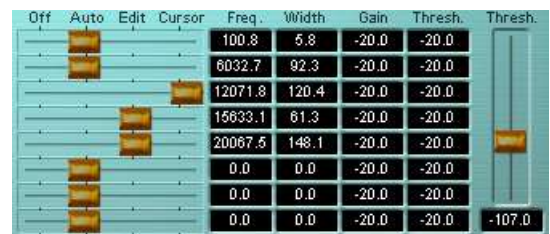


Figure 3: Notch Filter bank showing mode switches.

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This illustration demonstrates how the disturbance is displayed visually during “Audition”. When changing the sound material to which one wishes to apply the **RepairFilter**, it is wise to reset the **VPI** first. This way the **RepairFilter** forgets the previously learned notch filter data and starts anew. This of course is suitable for specific parts of one particular signal as well as separate sound sources.

### Summary of Parameters

#### General Parameters:

- **Low Pass** (Button) – switches low pass filter on/off.
- **Low Pass Edit** – lets you enter the roll-off frequency value.
- **High Pass** (Button) – switches high pass filter on/off.
- **High Pass Edit** – lets you enter the roll-off frequency value.
- **Reset** (Reset) – resets the whole **VPI**. Makes **RepairFilter** forget already learned data.
- **Audition** (Button) – shows the steady tone-disturbances **RepairFilter** removes. Does not include low- or high-pass filtered components.
- **Notch** (Button) – switches whole notch filter section on/off.

#### Notch Filter Modes:

- **Off** – Notch filter is turned off.
- **Auto** – Notch filter is in auto detection mode.
- **Edit** – all parameters (freq, width, gain, threshold) can be set manually.
- **Cursor** – frequency value of notch filter can be set by clicking into the spectrogram window. Only one filter can be set to cursor mode at a time.

#### Notch Filter Parameters:

- **Freq** – The frequency of the notch filter.
- **Width** – The bandwidth of the notch filter in Hz.
- **Gain** – determines how much of the tone disturbance is being removed.
- **Proc. Threshold** (Slider) – sets the signal threshold level above which the filter should have no effect.
- **Detect. Threshold** (Slider) – is a global threshold that the disturbance must exceed to be detected (only applicable in **Auto** mode).

#### Spectrogram Parameters:

- **High Freq** – the upper frequency of the spectrogram.
- **Low Freq** – the lower frequency of the spectrogram.
- **L** – left channel signal is being displayed in spectrogram.
- **R** – right channel signal is being displayed in spectrogram.
- **ST** – the spectral sum of left and right channels is being displayed in the spectrogram.
- **Freeze** (Button) - freezes the current spectrum display

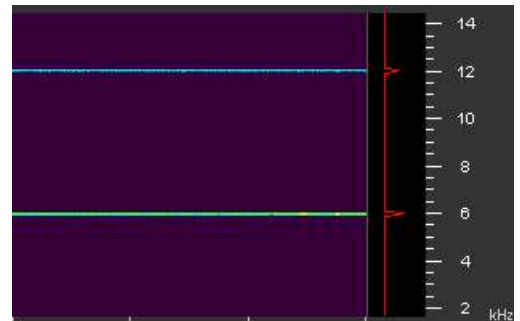


Figure 4: Spectrogram in Audition Mode. 6 and 12kHz tones removed.

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### Keyboard Shortcuts & Tips

- Using the CTRL-key when clicking a notch mode for one filter will automatically set that mode for all filters.
- When clicking on Gain or Threshold of the first Notch Filter and simultaneously pressing the CTRL-key one can change the values of these two particular parameters for all notch filters by dragging up or down.
- If the unprocessed audio material contains crackles, clicks or scratches, please use **VPIs** like **DeCrackler**, **DeClicker**, **DeScratcher** and so on first.
- If the unprocessed signal contains broadband noise then please use the **RepairFilter** firstly, followed by the **SpectralDeHiss** or the **DeNoiser**.
- If there is a serious amount of low-frequency hum, use **DeBuzz** first and then **RepairFilter** to remove the remaining upper harmonics.
- If the 8 given notch filters are not sufficient, then place two or more **RepairFilters** in series. For severe problems, it's possible to use a half-dozen **RepairFilters** in a row.
- By using the zoom functionality of the graph one can look for low frequency disturbances and use the high pass filter for low frequency noise, e.g. noise below 50 Hz. For high frequency noise it could be wise to use the low pass filter instead of several notch filters as the disturbances may exist outside the range of the wanted signal. However in doing so, be careful not to remove any parts of the desired signal.

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