

Waves X-Noise

Software Audio Processor

Users Guide



In this manual –

<i>1. Introduction.....</i>	<i>2</i>
<i>2. Using X-Noise.....</i>	<i>4</i>
<i>3. Controls and Displays.....</i>	<i>6</i>
<i>4. Noise Profile.....</i>	<i>10</i>
<i>5. Important information and useful tips.....</i>	<i>12</i>

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1. Introduction

Waves X-Noise reduces noise with minimal signal degradation while preserving excellent audio quality. X-Noise is part of the Waves **Restoration** bundle, which removes clicks, crackles, and hum from vinyl records and damaged recordings. X-Noise and the other Restoration plug-ins have a friendly interface that is easy to learn and use.

This user guide describes:

- the problems X-Noise solves;
- how to use the software;
- the software user interface.

Click the ? on the toolbar for online help. Thanks for using X-Noise and enjoy!

WHAT PROBLEMS DOES X-NOISE FIX?

X-Noise is ideal for removing background noise caused by tape hiss and air-conditioner/ventilation systems. Loud, short-impulse noise and discrete signal disturbances should be treated first by **X-Click**, **X-Crackle**, or both.

X-Noise connects to an audio host application through its plug-in architecture. The algorithm is based on a single-ended, broadband, real-time, noise-reduction principle that uses frequency-domain analysis to detect and reduce unwanted noise from the source.

- *Single-ended* means that X-Noise does not rely on any complementary encode/decode processing applied during recording and playback (i.e., Dolby NR).
- *Broadband* refers to the wide frequency range from which noise is removed: high-frequency hiss and low-frequency rumble can both be targeted.
- *Real-time* operation allows you to adjust the parameters and hear the results immediately.

HOW DOES X-NOISE WORK?

X-Noise can *learn* the character of the disturbing noise from a segment of the original recording containing *only* the noise to be removed. This segment is typically obtained from the recording's beginning or end, or a gap in the audio. X-Noise uses this data to construct a *noise profile* that helps distinguish the noise from the audio data.

X-Noise employs the most recent psychoacoustic research and multilevel decision algorithms to remove noise while preserving the sonic clarity of the

source. It performs better than comparable DAW tools and as well or better than more expensive, dedicated-hardware solutions. X-Noise reduces noise while minimizing artifacts and other damage to the source recording.

X-Noise's controls are similar to a dynamics processor. Those familiar with a typical compressor/expander should get excellent results within a few minutes of experimentation.

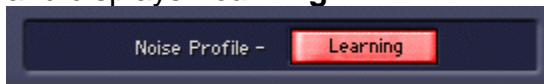
2. Using X-Noise

X-Noise uses two primary parameters, *Threshold* and *Reduction*, to control the noise-reduction process. Adjust these controls first to quickly configure X-Noise for a given input signal. *Resolution*, *Dynamics* and *High Shelf* parameters offer more detailed control.

For a complete user interface reference, see Controls and Displays. The following example will get you started using X-Noise.

STEP 1 – CREATE A NOISE PROFILE

Create a noise profile by selecting an audio section from the source recording (at least 100 ms) containing just the noise that you want to remove. Click the **Learn** button in the **Noise Profile** area below the X-Noise Analyzer. The button blinks and displays **Learning**.



Play this section through X-Noise. Click the **Learn** button again to stop the learning process and create the noise profile, which appears as a white line on the X-Noise Analyzer. The line represents the frequency content of the analyzed noise. At this point, save your X-Noise setup, which includes your noise profile.

If you cannot find a noise-only section, try the default white noise profile or one of the other available factory presets.

STEP 2 – NOISE REDUCTION

After creating the noise profile, cancel the selection of the noise-only segment to operate on the whole sound file. While playing the recording, adjust the **Threshold** and **Reduction** controls to the desired amount of noise reduction.

Threshold sets the level at which the noise profile is used to distinguish between the sound source and the noise. Setting the *Threshold* to 10 dB typically means that the noise level is below the noise profile and therefore subject to removal.

Use the *Reduction* control to set the amount of noise reduction applied.

Increasing the *Reduction* setting increases the amount of noise removed from below the noise profile. If time-aliasing artifacts (*singing* or *robot-like* sounds) appear, decrease the *Reduction* setting and increase the *Threshold* (about 30 dB above the background noise). Artifacts can be further minimized by adjusting the *Attack*, *Release*, *Resolution* and *High Shelf* parameters (see Controls for more details).

STEP 3 – MONITORING

One of X-Noise's great features is the ability to monitor either the normal *Audio* output or the *Difference* signal removed by X-Noise's current settings. Listen carefully to the *Difference* signal to determine whether your settings removed parts of the audio signal in addition to the noise. The goal is to maximize noise reduction while capturing and degrading as little of the audio as possible.

We recommend monitoring with headphones and monitoring between *Audio* and *Difference* several times until the right balance is found. Heavily damaged recordings may require a compromise between audio quality and noise reduction.

3. Controls and Displays

CONTROLS



THRESHOLD

Represents the level of the *noise profile*. The signal below the noise profile is removed, while the signal above the profile is not processed.

Settings: -20 to +50 dB; Default = 0 dB

REDUCTION

Determines the amount of noise reduction applied to the signal below the *Threshold*. 0% serves as a smooth setting that reduces a small amount of noise.

Settings: 0–100%; Default = 0 %

Dynamics



ATTACK

Sets the time from when noise is first detected to the noise reduction's peak level (set with the Reduction control). During the Attack time, noise reduction is smoothly increased to avoid pops and clicks from abrupt processing. The default setting (0.03 s) works well in most cases. Impulsive sounds may require a shorter time; sounds that evolve more slowly may require a longer time.

Settings: 0–1.000 s; Default = 0.030 s

RELEASE

Sets the time in which the noise reduction is smoothly decreased from the peak setting to 0. Like the Attack parameter, this gradual decrease avoids pops and clicks resulting from abrupt processing. The Release time begins after the Attack time has elapsed and the noise reduction has reached its peak. Longer times preserve more ambience. Shorter times are useful for reducing noise in speech for forensic applications.

Settings: 0–10.000 s; Default = 0.400 s

High Shelf



The **High Shelf** modifies how X-Noise operates on high frequencies; it is not an EQ filter in the signal path, but a Noise Profile modifier. Adding gain to high frequencies of the profile will call for more reduction of that spectrum and vice versa.

FREQ.

Controls the frequency above which the noise profile is modified.

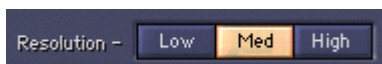
Settings: 700 Hz – 20 kHz; Default = 4006 Hz

GAIN

Controls the attenuation applied to high frequencies. Increasing the gain raises the threshold for frequencies above the shelf cutoff frequency and the algorithm reduces more noise in that spectrum. Decreasing the gain lowers the threshold for the frequencies above the cutoff frequency, resulting in less noise reduction in the high frequencies.

Settings: -30 to +30 dB; Default = 0 dB

RESOLUTION



Resolution controls how fine the analysis engine is, which affects the amount of CPU resources used by the X-Noise algorithm. The *High* setting consumes more resources to analyze and process the audio data and results in the best audio. Slower CPUs will operate better using the Med or Low settings. The highest

resolution is the finest one in the frequency domain, but not in the time domain. If you hear smearing of fast audio events, lower the resolution.

Settings: Low, Med, High; Default = Med

We recommend creating the noise profile and processing your sound source with the same resolution, although it is possible to change between them.

NOISE PROFILE



The *Noise Profile* is created by analyzing an audio segment containing a representative sample of the noise you wish to remove. Best results are obtained when the section selected for analysis consists *only* of the background noise you want to remove. Click the **Learn** button to begin the process; the button changes to *Learning* and blinks red/yellow until it is stopped when clicked again. It is important to emphasize that no noise reduction occurs while learning the noise profile. See Noise Profiles for more information.

OUTPUT MONITOR



The Output Monitor switches between **Audio** (the audio processed by X-Noise) and **Difference** (the noise currently removed with selected settings). **Audio** is the default setting in which the process outcome is monitored. Use the Difference setting to hear the noise being removed from the source signal. If audio is present in the Difference signal, modify your settings to achieve a better balance between noise reduction and signal loss/degradation.

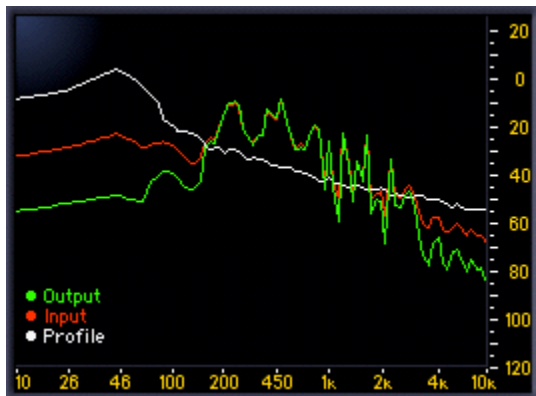
DISPLAYS

NR: NOISE REDUCTION METER



The **Noise Reduction Meter** shows the amplitude of noise removed. The meter level correlates to the sound level monitored with the Difference setting.

X-NOISE ANALYZER



The **X-Noise Analyzer** is the plug-in's main display. It shows three colored spectral envelopes:

- **Red** – the input signal before X-Noise processing
- **White** – the noise profile
- **Green** – the output signal after X-Noise processing

A healthy noise reduction process usually has the green output signal line mostly below the red input signal line but the peaks that cut through the profile can overlap red and green.

4. Noise Profile

WHAT IS A NOISE PROFILE?

A *noise profile* is a segment of data that represents a normalized portion of the noise targeted for removal. X-Noise uses this data to analyze the entire audio input for noise with the same characteristics.

CREATING A NOISE PROFILE

To create an effective noise profile, try to find a section (at least 100 ms) containing only pure noise in the source recording. These sections are typically found before the audio begins, after it ends, or during a pause in the speech or music.

Select and play this segment through X-Noise and click the **Learn** button (below the Analyzer). The button changes to Learning and blinks to indicate that X-Noise is creating the *noise profile*. Click again to stop the Learning process and return to normal processing mode. The spectrum of the noise is displayed in the X-Noise Analyzer as a white line.

At this point, we recommend saving your X-Noise setup, which includes the noise profile.

If the source material does not have a section containing the pure noise you want to remove, you cannot create a noise profile and must instead use one of the factory presets. This method generally compromises noise reduction efficiency because isolating the noise from the audio is less accurate which leads to more audible artifacts.

Important Note: The noise profile should be created from the source recording used as the input to X-Noise. Creating a noise profile from a different source will not help X-Noise recognize the noise in your source. However, if you cannot find a noise-only segment in your source but can find one from the *same recording session under the same conditions*, you can use it instead and obtain good results.

SAVING, LOADING, AND SHARING NOISE PROFILES

The WaveSystem includes a **Save** button that stores the noise profile in the setup file along with other parameter data. Each X-Noise setup file has two spaces available for noise profiles, allowing analysis and storage of two segments of noise which can be easily compared to see which works best.

After creating a noise profile, an asterisk indicates that the setup has been modified in the *Setup A/B* name bar. This noise profile can be saved into a new setup or over the current one. A noise profile can be loaded by itself from any previously saved setup. This can be useful if other sessions need to be processed from the same recording conditions.

5. Important information and Useful Tips

LATENCY

To properly perform its task, X-Noise must look ahead into the future. It manages this incredible feat by delaying the source signal by 5120 samples (about 116 ms in CD quality material). This is particularly significant when the noisy track runs along with other tracks. To maintain sync, other tracks should be delayed by the same amount. There is no way to avoid this in live recording situations, therefore X-Noise is not recommended when monitoring a live event. To use X-Noise in a sound file editor, it is important that the editor is able to compensate for the plug-in's delay. If this feature is not available in your host, add at least 5120 samples of silence at the end of the file and trim the start after the process is done.

STORING AND RECALLING THE NOISE PROFILE

Some audio host applications cannot store the noise profile data with the other plug-in settings. This means that saving a high level document such as a session, song, or work that includes X-Noise may not store the noise profile associated with that audio. We recommend saving setups within the WaveSystem to insure that the noise profile is saved.

SIDE EFFECTS

X-Noise creates minimal audible artifacts. Those produced are usually time-aliasing artifacts (referred to as *leftovers*, *gremlins*, *singing robots*, and *blips*) that sound like whistles or lingering oscillations. These can be treated by first lengthening the *Attack* and/or *Release* times. If the artifacts remain, choose more moderate *Threshold* and *Reduction* settings.