

Rhino - a virtual synthesizer by Big Tick.

<http://www.bigtick-audio.com>

Overview

Acknowledgments

We would like to thank all our beta testers for their invaluable comments, especially Felix Petrescu, Rick McGowan, Jacky Ligon and Bruce Satinover for finding out so many bugs in the initial releases, and suggesting many innovative features.

Very special thanks go to [Daniel Maurer](#), for his incredible sound design work.

Installation

To start installation, run the executable installer file and follow the instructions. Once installed, you will be able to select Rhino in the list of available virtual instruments in your host software.

Windows notes:

You will be prompted for your VST plug-ins folder, where the Rhino2.dll plug-in will be copied.

Rhino is also available as a standalone program (Rhino2.exe).

The standalone program can be configured via a menu in the top left corner of the window.

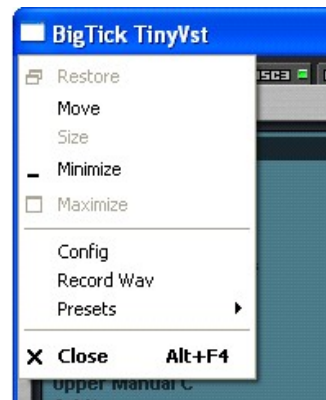
You can uninstall Rhino like any other Windows program, by using the Windows Control Panel.

Rhino can work as a portable application, i.e. without storing anything on your system drive. To enable this mode, you simply have to create a file with notepad, save it as ".Rhino2" at the root of the drive where Rhino is installed, and use it to define the path to the Rhino folder, as follows:

```
[BigTick] path=U:\Program Files\Rhino\
```

MAC notes:

Running the Rhino installer will install both the vst and audiounit versions in your /Library/Audio/Plug-Ins folder



The Rhino folder

The Rhino folder is where all support files are located.

- For Windows users, the folder you specified during installation
- For Mac users, ~/Library/Application Support/BigTick/Rhino

After installation, the Rhino folder contains the following subdirectories:

- Additive Settings: this is where Rhino stores presets for the **additive waveform editor**
- Effect Settings: this is where it stores **effects** presets
- Envelope Settings: this is where it stores predefined envelopes.
- Presets: this is where it stores preset banks (fxb)
- Skin: this is the location of the user interface parameters.
- Tunings: this is where alternate tuning scales are stored.
- Waves: this is where external waveforms are stored.

Registering Rhino

The demonstration version of Rhino is unable to save presets and automate changes, and drops notes randomly. To remove these limitations, you must purchase a registration key. You can register Rhino online from our web site, at <http://www.bigtick-audio.com>

To authorize Rhino, you simply need to put your key file in the Rhino folder.

UI

The user interface

Rhino interface is split into two parts. The top, dark grey part consists in a set of "tabs", which can be used to access different logical functions. The bottom part is fixed, and gives access to important global parameters.

The interface uses sliders that can be moved with the mouse left button. These sliders also have a numeric value displayed next to them. The following applies to all sliders in Rhino user interface:

- ❑ All sliders can also be controlled by the mouse wheel (if your VST host supports it).
- ❑ You can use the Shift key of the keyboard, to select values with more accuracy.
- ❑ You can drag the numeric values (with or without the Shift key) to set the value of Rhino parameters.



Changing the look of the interface

The look of the user interface can be customized using "skins". To install a new skin:

- ❑ Backup the contents of the skin subdirectory (in the Rhino install folder)
- ❑ Extract the contents of the new skin into this skin directory.

Global Controls



Global controls are located in the lower part of Rhino user interface, and are visible at all times. They provide a convenient access to the more commonly used parameters.

The eye in the Rhino icon will blink when receiving Midi data. Clicking on the eye acts as a "panic" button, and will turn all notes off and reset the synthesizer internal engine.

- ❑ The Current Program box displays the name of the current preset. Left-clicking on this box displays a menu for a quick access to all the presets of the current bank. Right-clicking displays the same menu than the one of the **bank area**.
- ❑ The Main Level slider controls the overall output of Rhino. If the output is too high, the Clip indicator will turn red. Click on it to reset it (and turn the main level down to avoid clipping).
- ❑ The Vib. Depth slider selects the amount of **vibrato**.



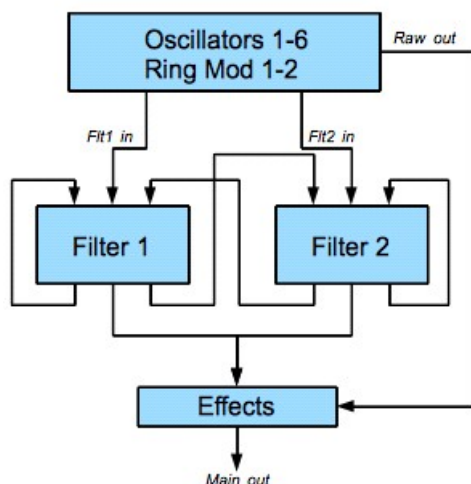
- ❑ The Voices parameter selects the global, maximum number of voices used internally by Rhino. The program features an advanced note stealing algorithm, making it possible to limit the CPU usage of the instrument, without noticeable artefacts.



When this parameter is set to 1, Rhino works in monophonic mode. This mode "remembers" the order of notes played, so that releasing a note will re-trigger the note previously played if it is still held. It is then possible to play extremely fast trills by repeatedly playing a note while holding another one.

- ❑ The Bend parameter controls the range of pitch bend, in semitones.

Rhino synthesis engine



The signal flow of Rhino is described in the figure to the left. Each note can have up to 6 oscillators. These can be routed through the filter section (which is made of 1 or 2 filters per note) or to the "RAW" output. The filter section output and the "RAW" output are then processed by the global effects section.

Each filter output can be fed back into itself, or into the other filter. It is thus possible to use the filter in parallel or serial mode, depending on the feedback settings. See the [Filters section reference](#) for more details.

The Routing Matrix

The Routing Matrix is used to define how the various components (oscillators, filters, ...) of the synthesizer interact to make a preset.

The top 6 rows of the matrix define the Frequency Modulation settings. These parameters are best explained using an example, in the picture to the right:

- ❑ Oscillator 1 is modulated by Oscillator 2 (with 74% amount)
- ❑ Oscillator 2 self-modulates (with 30% amount), but this modulation has been disabled using the right-click button.
- ❑ Oscillator 3 is modulated by Oscillator 1 (with 1% amount), Oscillator 2 (with 49% amount) and Oscillator 3 (with 77% amount). Note that Oscillator 3 is self-modulating.
- ❑ Oscillator 5 is modulated by Oscillator 6 (with 67% amount) and by the Ring Modulator 2 (AM2).

Lin	OSC1	OSC2	OSC3	OSC4	OSC5	OSC6	AMI	AM2
OSC1		001					x	
OSC2	074	030	049				x	
OSC3			077					x
OSC4							x	
OSC5					067			
OSC6						024		x
AMI								
AM2					040	050		
FLT1								
FLT2								100
RAW	100							

If you're familiar with FM theory, the columns are "carriers" and the rows are "modulators"; at a row/column intersection, the value determines the modulation index. This modulation index may also be affected by the FM/Vel and FM/Aft settings in the Vel/Aft window.

The bottom 3 rows define the Output Routing, determining how much of the column output goes to

various outputs. In our example:

- ❑ Oscillator 1 is going through the "RAW" output (e.g, straight into the effects section while bypassing the filters)
- ❑ Oscillator 3 is going (with 40% level) into Filter 1.
- ❑ Oscillator 5 is going (with 50% level) into Filter 1 too.

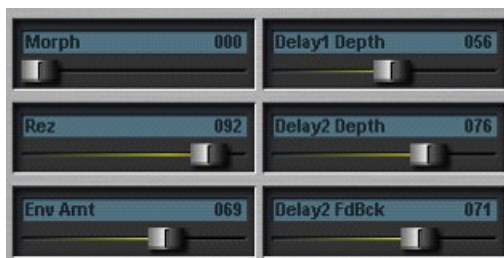
Finally, the 2 columns to the right define the Ring Modulators settings. Each ring modulator has up to 3 inputs. In our example:

- ❑ Oscillator 6 is FM-modulated (24%) by Ring Modulator 2 (AM2)
- ❑ Ring Modulator 1 (AM1) inputs are OSC1, OSC2 and OSC4.
- ❑ Ring Modulator 2 (AM2) inputs are OSC3 and AM1.
- ❑ Ring Modulator 2 is sent through Filter 2.

The LIN button at the top left of the matrix is used to select a linear FM scaling model. When disabled, the scaling of FM values is exponential, like in the classic Yamaha FM synthesizers.

You can temporarily disable a matrix routing by right-clicking it. This is very useful to quickly audition the effect of a given oscillator or modulation setting.

User sliders



The 6 User Sliders are located to the bottom right. These sliders control user-defined parameters of the synthesizer. This is very convenient to give quick access to useful parameters of a preset. In addition, since it is possible to assign up to 16 different parameters to the same slider, this feature can be used for crazy automation effects.

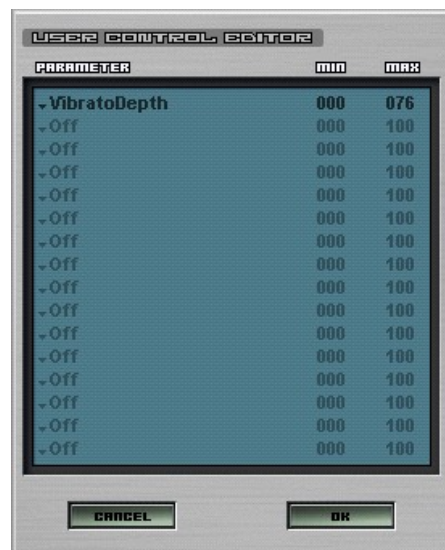
The description text associated to a user slider can be edited by right-clicking on it. The procedure to assign a parameter to a user slider is described below:

- ❑ Set a parameter to its desired start value.
- ❑ Click on the User Learn button to enable it.
- ❑ Move your selected parameter to its desired end value
- ❑ Move the desired user slider.
- ❑ Click on the User Learn button to disable it.

The user control will then control the selected parameter within the defined range. The range can be positive or negative.

You can clear a user slider assignment by using Ctrl- Left Click on the user control text while "user learn" mode is enabled.

Right-clicking on a user slider brings up an editor window, where the assignments for this slider can be fine-tuned.



Automation

Rhino can be automated using either standard VST automation, or MIDI automation. When the Midi Out button is enabled, moving a control on the Rhino interface will send the associated MIDI control change to the host (or, in standalone mode, to the selected MIDI output port).

The procedure to assign a midi controller to an item is described below:

- ❑ Click on the Midi Learn button.
- ❑ Move your selected item
- ❑ Send a midi control from your external controller.

The midi controller will then control the selected item.

You can clear a midi assignment by using Alt- Left Click on the item while "midi learn" mode is enabled.

Other global controls

The Glide button globally enables portamento. Each oscillator can have its own independent glide time, which is set on the [oscillator page](#).

Bank

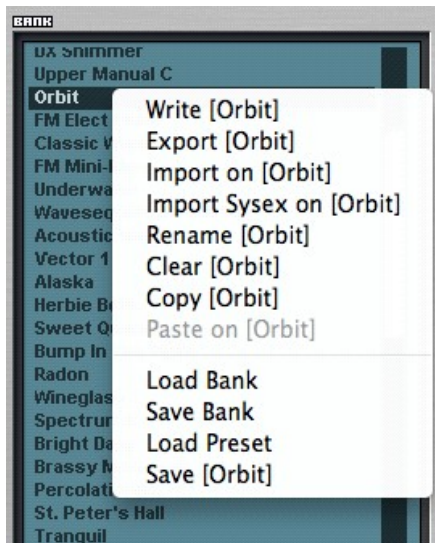
The first page of the synthesizer displays 2 lists of presets:

- the "bank area" to the left, with the 64 presets of the currently loaded bank.
- and the "library" to the right, which is a database of all your presets (it has no limitation on the number of presets it can store).

The bank area

To select a preset in the current bank, just left-click on it. Right-clicking on a preset brings up a menu, with the following options:

- Write: writes any changes done to the current preset back into the bank.
 - If you make changes to a preset, make sure you write the preset back into the bank, or your changes will be lost when you change presets. The registered version of Rhino auto-saves its settings upon exit. This auto-save file, named tmp.sav, is a standard FXP file stored into the Rhino installation folder.
- Export: export the current preset to a text file. This feature is enabled, even in the unregistered version of Rhino. Exported files can be imported in the registered version.
- Import: import a text preset file generated by the previous option.
- Import Sysex: import a DX7 or Tx81Z sysex file into Rhino. This powerful feature is not an attempt at a true Yamaha emulator. Nevertheless, it can be very useful for generating new sounds that can later be tweaked using Rhino features (most of which that were not present in the original synthesizers).
- Rename: change the clicked preset name.
- Clear: resets the preset to default settings. The default settings can be changed by replacing the default.fxp file, in the presets directory
- Copy: copy the preset into memory.
- Paste: paste a previously copied preset to the current location.
- Load Bank: load a new bank (FXB file).
- Save Bank: saves the current bank.
- Load Preset: load a new preset (FXP file).
- Save Preset: save the preset.

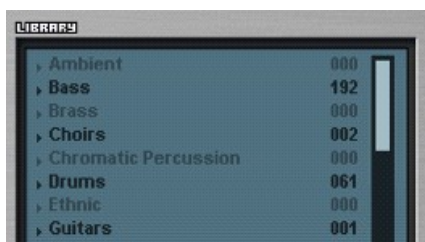


It is also possible, from any page of Rhino, to change the current preset by right-clicking on any one of the top interface tabs. The arrows keys can also be used to navigate through the presets list.

Rhino preset system is based on an internal bank of 64 presets. Additional banks are available for download on our web site, or from third-party sound designers. To load these files into Rhino, there are 3 options:

- Use the "Load Bank" menu option to load the new bank into the internal area. Your current internal data will be overwritten.
- Or place the new bank file into the presets directory in the Rhino install folder. The new bank will then be available via the drop-down "Bank Name" menu, in the upper right area of the bank page
- Or drag/drop the fxb file from Windows explorer into the bank area

The Library area



The library is a database of all your presets (it has no limitation on the number of presets it can store). You can use it to classify your sounds and easily navigate through presets. The number of presets in a category is displayed to the right, and empty categories are greyed out.

New categories can be created with the right-click menu. Presets can be auditioned directly from the library (just select a preset and it will be loaded automatically), or dragged and dropped from the bank area into the library area. In addition,

you can drop a fxp or fxb file from windows explorer (or from Finder on the MAC), directly into the library.

The library also features a "keyword mode", where all presets matching a given keyword are displayed. Toggling between "keyword" and "categories" mode is done with the right-click menu.

Other information on the bank page

Additional information is available to the right of the bank page:

- Bank Name: this is the name of the current bank. Right-click on this field to edit the name, or left-click to display a menu for quickly selecting any bank in the presets folder.
- Author: the name of the sound designer for the current preset. Right-click on this field to edit the name.
- Comments: comments provided by the sound designer on how to use the preset. Right-click on any line to edit it.
- Tuning: the tuning scale (in Scala .tun format) used by the current preset. Left-click to select a new scale. Rhino comes with several tuning files, including historically interesting tunings such as quarter-comma Meantone and Werckmeister III. The default is modern 12-tone equal temperament. Interested users can look at the [Scala Web site](#) for further information. When the "global" button (next to the tuning scale) is enabled, the displayed scale is global to all the presets of the bank.



Oscs

A Rhino preset can be made of up to 6 oscillators. The parameters for these oscillators are accessed through the oscillator pages, which are selected using the top window tabs. These parameters are described below.

It is possible to copy all the parameters of an oscillator into another one, using drag/drop on top level tabs.

Oscillator waveform

The waveform window, shown to the right, displays the shape of the selected oscillator waveform. Left-clicking in the oscillator name brings up a menu to select the current oscillator shape.

When the cursor is inside the waveform window, left and right arrows will appear at the bottom left of the window. Click on them to move to the next or previous waveform.



There are many, many different waveform shapes available in Rhino. All the available shapes have been carefully processed to minimize the amount of audible aliasing. They are sorted in logical groups, for instance:

- Attacks: short sampled attacks of various sounds, including vocals effects.
- Brass: trumpets, trombones, ...
- Effects: special effects.
- Loops: various animated patters and loops.
- Nature: samples from nature noises.
- Noise: various flavours of noise (white, pink, brown,)
- Percussions: metallic percussion sounds.
- Single-Cycle: computer-generated single-cycle waveforms.
- Synthesized: various sounds generated with other software synthesizers.
- User-Defined: User1 to User6 waveforms, defined using the built-in [additive editor](#)

Some third-party presets come with additional waveform packs. A waveform pack is a compressed file with a .vfs extension. To install a new waveform pack, simply place the associated .vfs file into the waves directory (in Rhino install folder).

The tab at the top of the oscillator page has a little green light, which is turned on whenever the oscillator is active. To turn off an oscillator, you can either:



- Set its waveform to OFF.
- or left-click in the waveform window to "mute" it.
- or left-click on the oscillator little green light (on the associated tab).

The more oscillators are used by a preset, the higher the CPU usage will be. It is thus recommended to turn off oscillators which are not used by a preset. You can (and should) safely turn off oscillators which are not used, either as an audio output, or as a FM input for another oscillator.

External waveforms

So far we've seen 2 different types of waveforms:

- Internal waveforms, which are multisamples stored in .vfs files.
- User-Defined waveforms, whose shape is defined using the **additive generator**.

There is a third type of waveform available in Rhino: external waveforms, which can be used to turn Rhino into a sampler ! Rhino can also import your own multisampled wav files, using either:

- Rhino own text file format
- or the industry-standard sfz format

Accepted wav files are Mono/Stereo, 8/16/24 bits files. In the case of stereo files, they will be converted to mono by averaging the left/right channels. This is because Rhino oscillators are monophonic.

To import your own waveforms, you will be putting files inside Rhino installation directory. Remember, For PC users, this directory is located in the folder you specified during Rhino installation. For MAC users, it is in ~/Library/Application Support/BigTick/Rhino Regardless of the format (sfz or txt), importing a multisample into Rhino requires three steps:

- Define a hierarchy of folders inside the waves/External folder (in your Rhino installation directory). This hierarchy defines how the multisample will be accessed in the Rhino waveform menus and submenus.
- Place the multisample definition (sfz or txt) file into this newly created folder.
- Place the associated wav files according to their definition in the multisample definition file. If the definition starts with a '/' or '\' character, this is assumed to be an absolute path. Otherwise Rhino will look for the wav file in a relative path, starting from the waves/Samples folder in the installation directory.

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Rhino multisamples file format

As an example to describe the file format, here's the contents of the "real strings" multisample, which is included in the Rhino 2 demo:

```
Acoustic\Real Strings 0-A5|RealString1C5.wav|C5|0|14350 A # 5-  
A6|RealString1C6.wav|C6|0|35511 A#6-127|RealString1C7.wav|C7|0|14551
```

The first line defines the name of the multisample. The remaining lines define, for each wav file:

- The note range for the sample
- The name of the wav file to use for the sample
- The base pitch of the sample (expressed either as a note number, or as an absolute frequency in Hertz; e.g 440.0)
- The amount of detuning (-50 to +50) for the sample
- The loop start point, expressed in samples. When playing a sample, Rhino will loop between this point, and the end of the sample. If this last value is omitted, Rhino will try to find the sample loop point from the 'SMPL' chunk stored into the wav file.

In our example above, 3 different wav files were mapped across the keyboard.

The .wav and .txt files can be packed into a redistributable .vfs file using a simple tool, which is available upon request to sound designers.

Oscillator Pitch

The Pitch. Coarse slider controls the detuning, in semitones, of the oscillator (default value is 0)

The Pitch. Fine slider controls fine tuning, in cents.

The Lfo button turns the oscillator into a low-frequency oscillator. This is a 3 state buttons, with the following meanings:

- Grey: normal mode (no LFO).
- Yellow: Oscillator frequency is divided by 100.
- Green: Oscillator frequency is divided by 10000.



Right-clicking in any of these sliders displays the pop-up window shown to the right. This window can be used to select the oscillator pitch mode:

- If x-Base is selected, the oscillator pitch is determined by a multiple of the default base frequency for the current note. This is very useful if you intend to use the oscillator as a FM modulation source.
- If Locked is selected, the oscillator pitch is "locked" to the displayed value (in Hertz). In this case the Lfo button described above is ignored.



The Pitch Modulation slider controls the range of the pitch envelope (see 6.4.5) for this oscillator.

The oscillator pitch can be slightly randomized with every note. The amount of randomness is controlled by the Pitch Random. slider.

The Phase Modulation slider sets the amount of modulation applied by the phase envelope for the oscillator. When set to its maximum value, the phase will be randomized with every note.

The Glide Time slider controls the time of the portamento effect for the current oscillator.

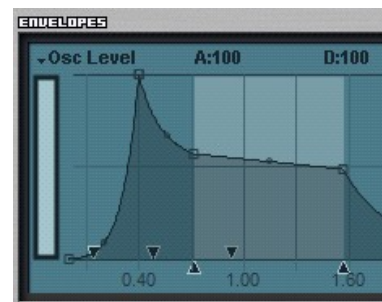
Oscillator Envelopes

Rhino envelopes are extremely powerful, and play a major role in Rhino preset design. They go way beyond the classical ADSR, and are capable of LFO effects or rhythmic patterns. Each oscillator has several envelopes, the one currently displayed is selected by left-clicking on the text at the top of the envelope curve.

Editing an envelope

The following applies to all envelopes:

- Right-click in the envelope background to bring up a menu allowing to add more envelope points, load and save envelopes, copy them across oscillators, stretch them, or fit them to the current display.
- If "autofit" is enabled (with the right-click menu) the display scale is continuously adjusted so that the entire envelope is visible in the window.
- If "lock points" is enabled (again, with the right-click menu), moving an envelope point will have no effects on its neighbors. If disabled, the neighbors are moved along.
- Use the left scrollbar to control the global envelope level.
- Left-click in the envelope background and drag horizontally to scroll.
- Left-click in the envelope background and drag vertically to zoom in and out.
- Drag square points to define the envelope shape, and circles to define the envelope segments curvature. Press the Shift key while dragging to fine tune the value.
- Control-Click on a square point to bring it to its default value (0 for level envelopes, 50 for pitch envelopes)
- Control-Click on a curvature control circle to set it to the default (50 = straight line) value.
- Right-click on a square point to delete it.
- The light area of the envelope is the sustain zone. The envelope will loop on this zone while the note is held. If the note off occurs before the sustain zone has been reached, then the envelope will jump to the segment immediately after the sustain zone. The sustain zone is edited by dragging the upward triangles at the bottom of the envelope. If both triangles are on the same point, the envelope has no sustain and will play till its end, regardless of the time at which the note off occurs. In the picture above, the sound will rise sharply to the maximum value, reach that point in 40ms, then decay sharply first, then linearly. At the end of the linear decay, it will keep steady at half the maximum value, until the note is released.



- Clicking on the top right Sync button enables Sync Mode. In this mode the envelope grid displays the current tempo bars, and the envelope is synchronized to the host tempo. When moving envelope points, these will “snap” to 1/32 beats, unless you maintain the “Shift” key pressed down.

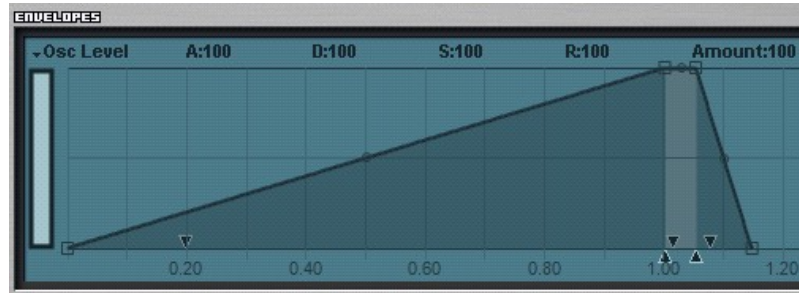
Quick ADSR control

Rhino features controls for Attack, Decay, Sustain and Release (A, D, S, R) of all envelopes. Each envelope has its own “amount” control, defining how much these global ADSR controls impact the envelope times. The A, D, S, R controls can be edited:

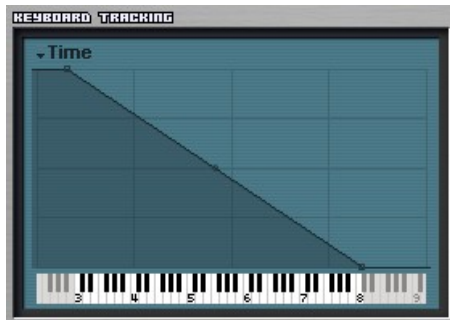
- Either directly, by dragging the displayed value at the top of the envelope window
- or by assigning them to any one of the user sliders, or to an external controller.

Envelope times modulation

The downwards triangles at the bottom of the envelope define how envelope segment durations will be affected by time modulations. For a given segment, the triangle marker indicates the shortest length this segment will have when modulation is applied. Here is an example, first define an envelope with 1 second attack, and set the modulation marker (the little downwards pointing triangle) to 20 ms.



Then, use the Keyboard Time Modulation curve to define how this modulation is mapped across the keyboard, as shown in the image to the left. With these settings, attack time will be 1 second for midi note C3, and 20ms for midi note C8. In between, it will move linearly from 1 second down to 20 ms.



Similarly, the Velocity Time Modulation curve can be used to control envelope times with velocity. And remember, each segment of the envelope has his own modulation marker !

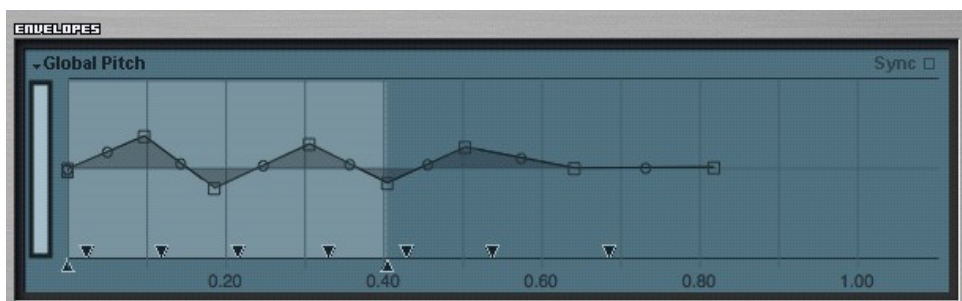
The oscillators envelopes

Each oscillator has 4 associated envelopes:

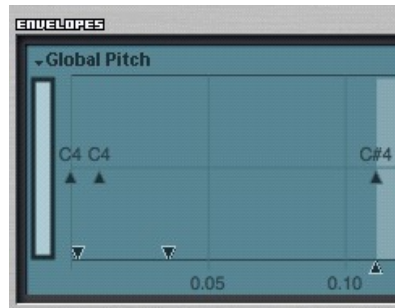
- A level envelope (Osc Level) controlling the oscillator level.
- A waveshaping envelope (WS Amount) controlling the amount of waveshaping applied to the oscillator (when a waveshaper is selected. See below for details about the waveshapers)
- A pitch envelope (Osc Pitch) controlling the oscillator pitch.
- A phase envelope (Osc Phase) controlling the oscillator phase. This envelope is used together with the “Phase Mod” slider, which defines the range of the phase modulation applied by this envelope.

The pitch envelopes

In addition, there’s a global pitch envelope (Global Pitch), shared by all oscillators, that can be used to define a global vibrato. Both Osc Pitch and Global Pitch envelopes have a default value of 50, which is the nominal pitch. Values higher than 50 raise the pitch, below 50 lower the pitch. The picture below shows how to use this envelope to create a vibrato effect.



Because it is hard to control pitch accurately with an envelope, the pitch envelopes have an additional editing mode, shown to the right. In this mode, all points are displayed on a flat, horizontal axis, but each point displays the name of the closest note. When moving a point up and down, the envelope value is adjusted so that it accurately reaches the desired pitch. To switch a pitch envelope view to this mode, use the "Edit Curve" option in the right-click menu.



Waveshaper

Each oscillator can have its own waveshaper. To enable the waveshaper, 3 steps are required:

1. Turn it on using the little green button above the waveshaper window.
2. Draw a waveshaping curve inside the waveshaper window, using the same actions (click and drag) than for editing an envelope.
3. Draw a waveshaping envelope for the oscillator, using the oscillator envelope window.

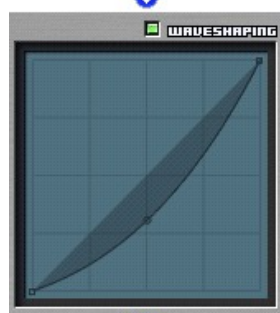
The waveshaper uses CPU, so make sure it's turned off (using the green button) for all oscillators that don't require it.

The waveshaper curve is the shape that a saw wave will be turned into. The picture to the right illustrates this, showing how a sine wave is turned into the bottom shape by applying a waveshaping curve.

A waveshaper curve with no effect is therefore a straight line from the lower left corner to the upper right corner (although it would be much more CPU-efficient to simply disable the waveshaper).

When the waveshaper is in use, the waveform display will reflect the effect of the waveshaper on the current waveform.

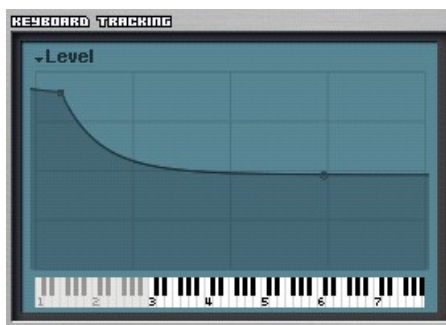
Extreme waveshaping settings can cause aliasing in the upper octaves. The keyboard tracking WS Amount curve, described in the next chapter, should be used to limit the amount of waveshaping for higher notes.



Oscillator Keyboard tracking

Each oscillator has 11 associated keyboard tracking curves, to define how the played note position controls various parameters of the oscillator. The keyboard tracking window is used to edit these curves, and works similarly to the envelope window. The available curves are:

- 1. Level: to control the oscillator level.
- 2. Time: to control the oscillator envelope times. This works in conjunction with the dark downwards triangles at the bottom of the envelope window.
- 3. Pitch: to control the oscillator pitch. Normally this is set to a straight line, but you can use this curve for special effects (like a "reversed keyboard"), or for limiting the pitch range of a given oscillator.
- 4. Fine Amount: to control the intensity of the "pitch fine" slider over the keyboard.
- 5. Detuning: to control the amount of a constant frequency offset which is added to the notes.
- 6. WS Amount: to control the amount of waveshaping for this oscillator.
- 7. WS Time: to control the waveshaping envelope times.
- 8. Pitch Env. Level: to control the range of the pitch envelope for this oscillator
- 9. Pitch Env. Time: to control the pitch envelope times
- 10. Phase: to control the oscillator initial phase.
- 11. FM Amount: to control the amount of Frequency Modulation.

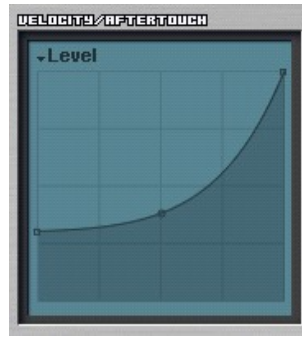


In addition, there's a global keyboard tracking curve (Global Pitch Amount), shared by all oscillators, that controls the range of the global vibrato envelope.

The keyboard tracking window can be scrolled by dragging the piano keyboard at the bottom of the window.

Oscillator Velocity and Aftertouch tracking

Each oscillator has 8 associated velocity tracking curves, and 2 aftertouch curves. These give more control over various parameters of the oscillator, for greater playability. Using these curves wisely is the key to designing great Rhino presets. Rhino responds to both mono and poly aftertouch messages. The available velocity curves, available in the Velocity/Aftertouch window, are:



- Level: to control the oscillator level.
- Time: to control the oscillator envelope times. This works in conjunction with the downwards triangles at the bottom of the envelope window.
- WS amount: to control the amount of waveshaping for this oscillator.
- WS time: to control the waveshaping envelope times.
- Pitch Env. Level: to control the range of the pitch envelope for this oscillator.
- Pitch Env. Time: to control the pitch envelope times.
- Phase: to control the oscillator initial phase.
- FM: to control the global amount of FM for this oscillator. This is like a global mixing control for all the FM inputs defined in the routing matrix.

The available aftertouch curves are:

- WS: to control the amount of waveshaping
- FM: to control the global amount of FM.

In addition, there are 2 global tracking curves (Global Pitch Amount), shared by all oscillators, to control the range of the global vibrato envelope with velocity or aftertouch

Filters

The filter pages, selected using the top window tabs, are used to edit all the parameters of the 2 filters.

It is possible to copy all the parameters of a filter into the other one, using drag/drop on top level tabs.

Filter types

There are 20 filter types available:

- ❑ Lowpass: the Cutoff slider controls the cutoff frequency of the filter, and the Rez slider controls the filter resonance. This filter comes with -12dB/-24dB/-36dB slopes.
- ❑ Highpass: Cutoff and Rez sliders behave like in the lowpass filter.
- ❑ Bandpass: the Cutoff slider controls the center frequency of the filter, and the Rez slider controls the filter bandpass width. Like the Highpass and Lowpass, this filter comes with -12dB/-24dB/-36dB slopes.
- ❑ Notch: the Cutoff slider controls the center frequency of the filter, and the Rez slider controls the depth of the notch.
- ❑ "Analog" Lowpass: this is a different model of a lowpass filter (again with -12dB/-24dB/-36dB variants), with a distinct analog flavor, a lot of warmth and very aggressive resonance.
- ❑ "Analog" Highpass: an highpass version of the previous filter.
- ❑ Comb filter: this filter mixes the signal with a delayed version of itself, bringing in lovely ringing tones, and is especially effective on drum loops. The delay time is controlled by the cutoff envelope.
- ❑ Allpass filter: this filter changes the phase of some frequencies in the input signal. These frequencies are controlled cutoff slider (the resonance control has no effect on the allpass filter). This filter can be used in 2 different ways:
 - ❑ If the output signal is mixed with the input, and the filter cutoff is modulated using an envelope, some frequencies are canceled out as the cutoff is swept by the envelope, leading in a slight phasing effect.
 - ❑ If the output signal is played raw, there is no audible difference between the input and the output. This is a convenient way to pan a raw oscillator output: send it through an allpass type filter, and use the filter output panning curves.

Regardless of the filter mode, the Cutoff Env. Mod slider is used to control the amount of cutoff modulation applied by the cutoff envelope. The Resonance Env. Mod slider works similarly, with the resonance envelope. With extreme resonance settings, the output of the filter can get rather hot, so you have the choice between:

- ❑ clipping the output at the filter level, by enabling the "clip" button next to the resonance slider
- ❑ or adjusting the main output level, in the global controls section, to avoid clipping.



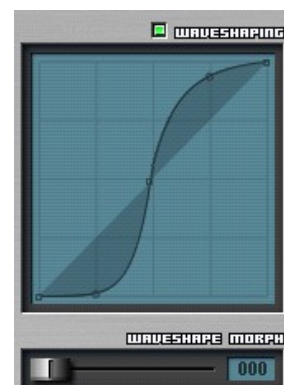
The Feedback1 slider controls the amount of Filter1 that is fed back into the current filter (so on the Filter1 page, it is self-feedback). The Feedback2 slider control the amount for Filter2.

Feedback can really increase the resonance output, so watch for clipping ! Make sure you enable clipping when playing around with filter feedback !

Filter "morphable" waveshaper

The filtered signal can be processed by variable waveshaper. It is similar to the one used in the oscillators stage, except that its shape can be morphed (hence the name) between two different curves.

When the "waveshape morph" slider is set to 0, the waveshaping window displays (and allows to edit) the first waveshaper curve. When the "waveshape morph" slider is set to 100, the second curve is selected. Anywhere in between, the waveshaper is morphing between the 2 curves.



Filter envelopes

The filter envelopes work just like the oscillators envelopes. There are 3 envelopes per filter, controlling the filter cutoff and resonance, as well as the amount of morphable waveshaping used to distort the filter output.

Filter keyboard tracking

This control works just like the similar control on the oscillator pages. There are 7 tracking curves

available:

- ✘ Cutoff level, to control the filter frequency cutoff.
- ✘ Cutoff time, to control the filter envelope segments times (in conjunction with the dark triangles at the bottom of the envelope window).
- ✘ Rez, to control the filter resonance value.
- ✘ Pan, to control the filter output pan. Since the filter outputs go into the effects section, but it is possible to make the played note position control the left/right stereo image of the audio going into the effects.
- ✘ Rez Time, to control the filter resonance envelope segment times.
- ✘ WS Time, to control the waveshaper envelope segment times.
- ✘ WS Amount, to control the amount of the morphable waveshaper effect.

It is possible to set a low-pass filter (-12dB/oct) with a cutoff of 100, which is basically "no-effect", and then use the Pan control to get an unfiltered sound that is panned from left to right. The allpass filter can also be used similarly (and with even less CPU usage).

Filter Velocity and Aftertouch tracking

Each filter has 10 associated velocity tracking curves, and 4 aftertouch curves. They work just like the similar control on the oscillator pages. The available velocity curves are:

- ✘ Cutoff Level, to control the filter cutoff.
- ✘ Cutoff Time, to control the filter envelope time (in conjunction with the downwards triangles at the bottom of the envelope window).
- ✘ Rez, to control the filter resonance.
- ✘ Pan, to control the filter output stereo image.
- ✘ Rez Time, to control the filter envelope resonance segment times
- ✘ WS Amount, to control the amount of the morphable waveshaper effect.
- ✘ WS Time, to control the waveshaper envelope time (in conjunction with the downwards triangles at the bottom of the envelope window)
- ✘ Feedback, to control the amount of feedback from both filters.
- ✘ Input Scale, to control the volume of the signal at the filter input. Because some of the filters have non-linear characteristics, scaling the input results in a slightly different tone. Controlling this with velocity can add expressivity to your presets.
- ✘ Output, to control the output of this filter that will be sent to the FX section.

When both filters are used, they are working in a parallel mode by default, with both filters output being sent to the effects section. However, it is possible to make a serial combination, where Filter1 is sent into Filter2, which is sent into the effects section:

- ✘ on the Filter1 page, set the velocity output curve to a flat zero, so that filter1 is not sent to the effects section.
- ✘ and on the Filter2 page, set the Feedback1 slider to a non-zero value

The available aftertouch curves are:

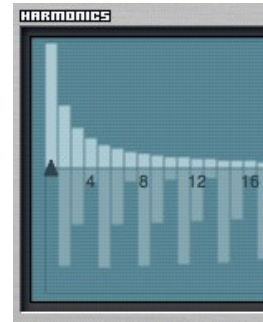
- ✘ AT cutoff, to control the filter cutoff.
- ✘ AT rez, to control the filter resonance.
- ✘ WS Amount, to control the amount of the morphable waveshaper effect.
- ✘ Feedback, to control the amount of feedback from both filters.

Additive

One of the most powerful features of Rhino is its built-in additive waveform generator. This tool is accessed through the "add" tab entry, and is used to define the shape of the "User-Defined" waveforms User1 to User 6, as explained above.

The "harmonics" window at the top is used to define the first 64 harmonics of your waveform:

- Left-drag on the top half of the window defines the level of an harmonic.
- Left-drag on the bottom half of the window defines the phase of an harmonic.



The resulting waveform is displayed in real-time in the waveform window. Rhino automatically normalizes the waveform on the fly.

The number of the selected harmonic is always displayed dynamically when you make some changes.

Additive presets can also be loaded and saved to disk, using the associated buttons.

Finally, the "import wav" button can be used to load a .wav file into the additive editor (you can also drop a .wav file directly from Explorer or Finder into the additive editor panels). Mono, stereo, 8/16/24 bits files are accepted (the sample rate does not matter). This feature is typically used to import single-cycle waves from analog synthesizers.

A number of functions can be used to modify the waveform or spectrum interactively:

- Right-clicking in the additive editor will bring up a menu with the various, self-explanatory options, to process the harmonic spectrum of the waveform. These functions can be applied to a reduced harmonic range, by using the triangle markers in the additive editor to define the desired range.
- Right-clicking in the additive waveform window displays another menu, that can be used to analyse any oscillator currently in use, and import it into the current additive slot.
- Left-click and drag in the additive waveform window to interactively modify the resulting waveform.
- Press the shift key and left-drag in the additive waveform window to generate a resync'ed version of the waveform (the waveform will be duplicated, starting from the click point).
- Press the ctrl key and left-drag in the additive waveform window to clip the waveform.

Whenever the waveform is modified, it will be re-analyzed to recompute its harmonics definition, and resynthesized using the additive engine.

Sequencer

Rhino features a step sequencer that can be used to trigger several notes in sequence. The “Water Falls” or “Micro-Algo1” presets are good examples on how to use it.

The note sliders define, for every step, the pitch of the played note. The displayed value is the pitch of the note at the step, for a played C4.



The velocity sliders define, for every step, the velocity of the played note.

The length sliders define, for every step, the length of the played note until it's released.

The step sequencer is enabled when one of the step buttons is selected. This button defines how many steps will be used in the sequence, and is defined using the small green buttons to the left of the note step sliders. In addition, the random button defines how the steps will be played: if it's enabled, a random step will be selected each time a note must be played, otherwise the sequencer will cycle through all steps.

Right-click in the note slider or display to bring up a menu for quickly selecting the desired note.

The sequencer speed depends on the host tempo. The speed slider gives additional control over the speed, for instance, if the host tempo is 120 bpm, the sequencer will play at:

- 30 bpm if the speed slider value is 0
- 60 bpm if the speed slider value is 50
- 120 bpm if the speed slider value is 75
- 240 bpm if the speed slider value is 100

Sequencer patterns can be loaded and saved using the associated, lower right button.

Effects

The effects section is composed of up to 2 effects. Use the menu under "Effect Type" to assign an effect.

Effects can work in serial or parallel mode, depending on the "Serial Mode" button.

❑ In Serial mode, the output from the filters and the "raw" output defined in the matrix is mixed, and sent to Filter1. The output of Filter1 is then processed by Filter2, and the output of Filter2 is the resulting Rhino output.

❑ In Parallel mode, the output from the filters and the "raw" output defined in the matrix is mixed, and sent to both Filter1 and Filter2. Both filters are then processed in parallel, and their output is finally mixed, resulting in the final Rhino output.



Parallel mode uses more CPU than serial mode, because it requires duplicating audio signals and additional mixing. Never set effects to Parallel mode if one of them is disabled.

Each effect has a Dry/Wet slider that can be used to select the mix between the raw and processed sound.

Effects can be synchronized to the current song tempo. The "sync 1" and "sync 2" buttons are used to enable effect synchronization. When it is enabled, depending on the selected effect, some parameters values will depend on the current tempo. The selected value is displayed using musical notation, the possible values are 1/32, 1/24, 1/16, 1/12, 1/8, 1/6, 1/5, 1/4, 1/3, 1/2, 2/3, 3/4, 1, 5/4, 4/3, 3/2, 5/3, 7/4, 2, 5/2, 3, 7/2, 4, 5, 6, 8

Effect settings can be loaded / saved to disk using the associated buttons on the effects page.

a DC filter is available to remove any DC offset that could have been introduced by the previous stages. You can toggle this filter off on the effect pages, although it is recommended to leave it on, because it doesn't use a lot of CPU, and doesn't add any coloration to the final sound.

Rhino features 23 different effect types. Their parameters are described below:

Stereo Delay

This effect consists in two (left/right) delay lines. Available parameters are:

- ❑ Left Time: the left delay time (up to 0.5 seconds)
- ❑ Right Time: the right delay time (up to 0.5 seconds)
- ❑ Feedback: the amount of feedback for both lines
- ❑ Filter Type: the type (Hipass or Lowpass) of filter used to attenuate successive delays
- ❑ Cutoff: the frequency of the attenuation filter.

Cross Delay

This effect is similar to the Stereo Delay effect, with feedback exchanged between the left and right lines.

Auto Pan

This effect moves the stereo image using a LFO. Available parameters are:

- ❑ Frequency: the frequency of the LFO driving the effect.
- ❑ Depth: the depth of the effect.
- ❑ LFO shape: the shape of the LFO, morphing between a sine and a square

This effect is usually very nice on electric piano sounds.

Rotary Speaker

This effect simulates a leslie with 2 rotating horns. Available parameters are:

- ❑ Speed: the horns rotation speed.
- ❑ Depth: the amount of Doppler effect caused by the horns rotation
- ❑ Cutoff: the frequency of the cutoff filter used to separate lows from treble.
- ❑ Separation: the width of the resulting stereo image.

Chorus 1

This effect is a simple stereo chorus made with 2 delay lines driven by a LFO. Available parameters are:

- ❑ Speed: the speed of the controlling LFO.
- ❑ Intensity: the maximum amount of detuning.

- Depth: the range of the LFO.
- Feedback: the amount of feedback for the delay lines.

Rich Chorus

This effect is a complex stereo chorus, made of 2 sets of 4 parallel delay lines with inter-modulation, each driven by its own LFO. A small stereo comb filter is also inserted before the delay lines, to change the effect "tone". Available parameters are:

- Speed: controls the frequency of all LFO's.
- Depth: the amount of detuning for the delay lines.
- Feedback: the amount of feedback.
- Color: controls the comb filters frequencies.

Crossover Chorus

This effect is another stereo chorus, where incoming signals are split between 2 frequency bands, and each band is chorused independently, using 2 chaotic low-frequency oscillators to provide distinct chorusing. Available parameters are:

- Speed: controls the frequency of the LFO's.
- Depth: the amount of detuning for the delay lines.
- Feedback: the amount of feedback.
- Frequency: controls the crossover frequency point.

Chaos Chorus

This effect uses chaotic oscillators to drive a classic, 4 voices chorus. Available parameters are:

- Speed: controls the frequency of the LFO's.
- Depth: the amount of detuning for the delay lines.
- Feedback: the amount of feedback.

Chorus+Delay

This effect combines a chorus and a delay effect in series. The delay uses a highpass filter for its attenuation. Available parameters are:

- Speed: controls the frequency of the LFO's.
- Intensity: the amount of detuning for the delay lines.
- Left and Right times: the times for the left and right delay lines.
- Feedback: the delays feedback.
- Cutoff: the frequency of the HP filter used for attenuation.

Stereo Granulator

This effect is too complex to describe. Experiment with it :)

CrazyComb

This effect combines two comb filters continuously swept by an LFO. The result is similar to a chorus, with more subtle overtones. Available parameters are:

- Min length: the minimum length of the comb filter.
- Mod depth: the range of the sweeping effect.
- Mod speed: the speed of the LFO.
- Feedback: the amount of feedback.

Flanger 1

This effect is similar to the Chorus1 effect above, but with much smaller delay amounts.

Stereo Ensemble

This effect uses 2 LFO to modulate the audio pitch and level. Available parameters are:

- Speed 1: the speed of the level-modulating LFO.
- Speed 2: the speed of the pitch-modulating LFO.
- Amount 1: the range of the level-modulating LFO.
- Amount 2: the range of the pitch-modulating LFO.
- Feedback: this parameter controls additional overtones.
- LFO shape: the shape of the LFO, morphing between a sine and a square.

Cross Ensemble

This effect is similar to the Stereo Ensemble effect above, but the feedback parameter is more a “cross-feedback”, which brings up different tones and spreads the stereo image.

Rich Ensemble

This effect uses 2 3-phase LFO’s to mix several detuned versions of the signal. Available parameters are:

- Speed 1: the speed of the first LFO.
- Speed 2: the speed of the second LFO.
- Amount: the range of the effect.
- Feedback: the amount of feedback used in the detuning delay lines. This parameter can bring additional overtones to the effect.

Quad Phaser

This is the famous CheezeMachine / EP-Phazer effect, implementing a 6-stage analog phaser, with the following controls:

- Speed: the speed of phasing.
- Depth: the effect range.
- Feedback: the amount of feedback, this can be used to make the effect more prominent.

Stereo Reverb

This is a simple reverb model, with the following parameters:

- Time: the decay time of the reverb.
- Length: the overall size of the room.
- Damp: the high-frequency damping caused by walls reflection.
- Diffusion: the amount of diffusion caused by the walls. This parameter changes the overall reverb “color”.

8-Taps reverb

This is a higher quality reverb, based on a two 8 taps delay lines. The following parameters are available:

- Pre-delay: the delay for the very first tap.
- Feedback: the amount of feedback in the 8 taps lines.
- Diffusion: the amount of diffusion caused by the walls.
- Room size: the perceived dimension of the room.
- Color: a comb filter controlling the coloration caused by the walls.
- Cutoff: a lowpass filter controlling the energy absorption caused by the walls.

Jezar’s reverb

This is a port of Jezar’s Freeverb – now integrated into Rhino ! It also features an additional predelay. The following parameters are available:

- Pre-delay: the amount of (small) delay before the reverberant sound kicks in.
- Room size: controls the amount of feedback on the comb filters stage.
- Damp: controls the attenuation on the comb filters stage.
- Width: the amount of “wet” output that goes into the final output

Stereo Oktaverb

This very strange effect is based on the “Stereo Reverb” model, but processes a version of the signal pitched up by one octave.

3-Bands EQ

This is a small 3-bands EQ section (or more accurately, a resonant state-variable filter). Available controls are:

- Cutoff: the base frequency of the EQ.
- Rez: the width of the Mid section.
- Low, Mid, High: the mix of the various filter bands.

Ring Modulator

Another goodie for experimental effects ! Play around with the parameters and enjoy :)

Overdrive

This overdrive unit can be used as an amp simulator. The audio signal is first processed by an highpass filter, then distorted, and processed through a lowpass filter. Available controls are:

- LP Cutoff: the frequency of the final lowpass filter.
- LP Q: the resonance of the final lowpass filter.
- HP Cutoff: the frequency of the first highpass filter.
- HP Q: the resonance of the first highpass filter.
- Gain: the amount of gain boost before the distortion unit.
- Drive: the amount of distortion.