

# *the scrooo*

**VST™ Software Synthesizer**

Version 1.0

© 2011 by Björn Arlt @ Full Bucket Music  
<http://www.fullbucket.de/music>



VST is a trademark of Steinberg Media Technologies GmbH

## Table of Contents

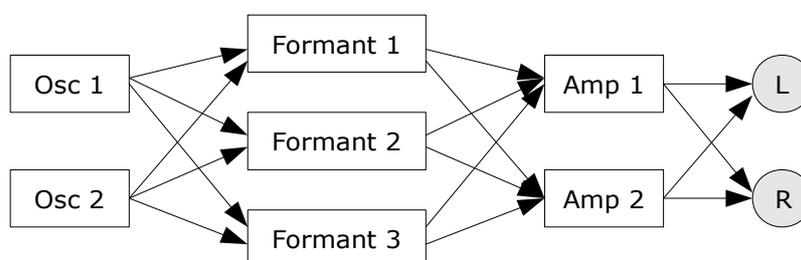
Introduction.....	2
Architecture.....	2
Oscillators.....	3
Formant Generators.....	3
Amplifiers.....	4
Modulation Sources.....	4
Envelopes.....	5
LFOs.....	5
Parameters.....	5
Global.....	5
Oscillators.....	5
Formants.....	6
Amplifiers.....	6
Envelopes.....	7
LFOs.....	7
Frequently Asked Questions.....	8

## Introduction

The *scrooo* is a VST™2.4 polyphonic software synthesizer plug-in based on a spectral formant synthesis architecture and written in native C++ code for high performance. The main features are:

- Up to 32 voices polyphony including portamento
- Two band-limited carrier oscillators
- Three fully independent formant generator sections
- Three formant generation modes
- Two amplifiers with volume and panorama control
- Three envelopes (ADSR) with exponential slopes
- Three low frequency oscillators (LFOs) with tempo synchronization

## Architecture



Each voice of the *scrooo* features two oscillators feeding three separate formant generators. The outputs of the formant generators are routed to two individual amplifiers with panorama control which are connected to the main stereo output bus.

Aside from the audio modules, the *scrooo* has three envelopes and three LFOs for modulation purposes.

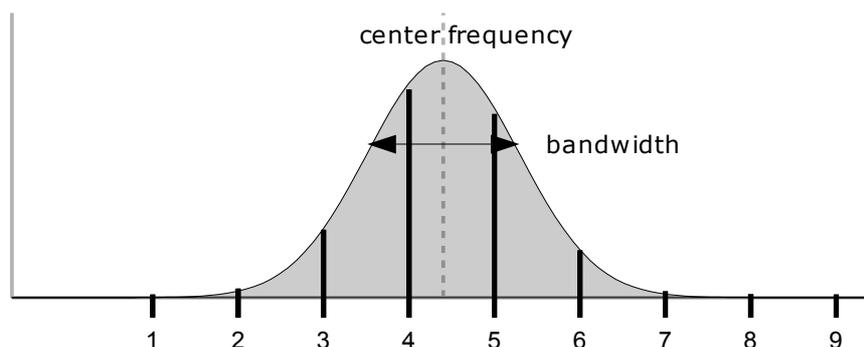
## Oscillators

Each oscillator of the *scrooo* produces a sinusoid waveform feeding the three formant generators to create more complex signal spectra. The frequencies of both oscillators can be modulated independently by two different modulation sources (unipolar or bipolar).

On a new note event, digital oscillators typically start at the same initial phase angle of the waveform (e.g. the zero-crossing of a sine's rising slope) while classic analog oscillators do not; they are "running free" (which means they are still oscillating even if no note is played). The *scrooo* will emulate this behavior if the *Free* parameter in the Global section is turned on.

## Formant Generators

The *scrooo* features three formant generators with individual center frequencies and bandwidths. Furthermore, the center frequency and amplitude of each formant can be modulated by various modulation sources.



Partial amplitudes for a given center frequency and bandwidth.  
The bell-shaped area shows the formant spectrum's "hull".

There are three modes of formant generation:

- **Fixed**  
The center frequency of the formant is independent of the oscillator's base frequency; the generated spectrum will contain only integer multiples of the base frequency (i.e. harmonics).
- **Partial**  
The center frequency of the formant is a fractional multiple of the oscillator's base frequency; the generated spectrum will contain only integer multiples of the base frequency (i.e. harmonics).
- **Ring**  
The center frequency of the formant is a fractional multiple of the oscillator frequency; the generated spectrum typically will contain inharmonic frequencies.

Thus, *Fixed* and *Partial* modes result in the generation of a pure harmonic formant spectrum while *Ring* mode allows the creation of inharmonic spectra (similar to the output of a Ring modulator; hence the name). On the other hand, *Partial* and *Ring* modes generate formant spectra that are "shifted" along the frequency scale with

respect to the base frequency while they are “fixed” in *Fixed* mode (which is a typical characteristic of “acoustic” instruments).

Each formant generator can be applied to only one or both of the oscillators; the resulting output can be sent individually to the two amplifiers.

## Amplifiers

Both amplifier sections offer a stereo panorama control which can be modulated by any unipolar or bipolar source. The output volume is controlled by the *Volume* parameter, the output signal of Envelope 1, and two optional unipolar modulation sources. Note that Envelope 1 is hard-wired to both amplifiers.

## Modulation Sources

The *scrooo*'s oscillator and formant center frequencies, amplitudes etc. can be modulated by various modulation sources. Sources that produce a control signal of positive values only (including zero) are called *unipolar* while sources producing either positive or negative values are called *bipolar*. The following table lists the available modulation sources and their polarity.

source	polarity	description
<i>Off</i>	unipolar	constant value 0
<i>On</i>	unipolar	constant value 1
<i>LFO1+</i>	unipolar	output of LFO1 ranging from 0 to 1
<i>LFO2+</i>	unipolar	output of LFO2 ranging from 0 to 1
<i>LFO3+</i>	unipolar	output of LFO3 ranging from 0 to 1
<i>Env1</i>	unipolar	output of envelope 1 ranging from 0 to 1
<i>Env2</i>	unipolar	output of envelope 2 ranging from 0 to 1
<i>Env3</i>	unipolar	output of envelope 3 ranging from 0 to 1
<i>Velo</i>	unipolar	MIDI note velocity
<i>Note+</i>	unipolar	MIDI note value
<i>Rnd+</i>	unipolar	constant random value (for current note)
<i>PBnd+</i>	unipolar	MIDI pitch bend wheel (value at center is 0.5)
<i>Wheel</i>	unipolar	MIDI modulation wheel
<i>LFO1</i>	bipolar	output of LFO1 ranging from -1 to 1
<i>LFO2</i>	bipolar	output of LFO2 ranging from -1 to 1
<i>LFO3</i>	bipolar	output of LFO3 ranging from -1 to 1
<i>Note</i>	bipolar	MIDI note (value at C3 is 0)
<i>Rnd</i>	bipolar	constant random value (for current note)
<i>PBend</i>	bipolar	MIDI pitch bend wheel (value at center is 0)

## Envelopes

The three envelopes of the *scrooo* are standard ADSR generators with exponential slopes as featured in classic analog synthesizers. Envelopes 2 and 3 also feature an initial delay parameter. Envelope 1 is hard-wired to the amplifiers and directly controls the overall amplitude contour.

## LFOs

The three low frequency oscillators (LFOs) generate a periodic control signal from 0 to 100 Hz and/or can be tempo-synchronized to the host. Seven waveforms are available: *Sine*, *Triangle*, *Square*, *Saw Up* (rising sawtooth), *Saw Dn* (falling sawtooth), *S/H* (Sample and Hold, i.e. random values), and *3-Step* ("stair"-shaped waveform with three steps). The *Retrig* parameter controls whether the LFO is restarted for each new note or is "running free" (similar to the Free Run mode of the oscillators).

It is possible to modulate the magnitude of the LFO's output by any unipolar modulation source (even by the LFO itself). This can be used to control the LFO via the modulation wheel or to create complex modulation signals, "magic vibrato" effects, etc.

## Parameters

### Global

parameter	description
<i>Voices</i>	number of polyphonic voices (up to 32)
<i>PBend</i>	maximum pitch bend amount ( $\pm 24$ semitones) of the oscillators
<i>Porta</i>	portamento time (0 to 5 seconds)
<i>Volume</i>	the overall volume
<i>Free</i>	controls whether the oscillators are restarted or are "running free" (like classic analog oscillators) if a new note event occurs
<i>Clip</i>	controls if the overall output is unlimited or clipped to unity Note: The clipping LED will light as soon as the signal clips; thus, you can use <i>Clip</i> to create a distortion effect while attenuating the overall output using the <i>Volume</i> control.

### Oscillators

parameter	description
<i>Pitch</i>	the relative pitch ( $\pm 24$ semitones)
<i>Tune</i>	fine tuning of the oscillator ( $\pm 1$ semitone)
<i>FM1 / FM2</i>	amount of frequency modulation
<i>FM1 / FM2 Source</i>	the source of the frequency modulation; this can be any modulation source (see <i>Modulation Sources</i> above)

## Formants

parameter	description
<i>Mode</i>	<p><i>Fixed:</i> the center frequency is fixed i.e. independent of the base frequency; only harmonics of the base frequency are generated</p> <p><i>Partial:</i> the center frequency is a fractional multiple of the base frequency; only harmonics of the base frequency are generated</p> <p><i>Ring:</i> the center frequency is a fractional multiple of the base frequency; typically, inharmonics of the base frequency are generated</p>
<i>Range</i>	center frequency of the formant
<i>Spread</i>	bandwidth of the formant
<i>FM1 / FM2</i>	amount of center frequency modulation
<i>FM1 / FM2 Source</i>	the source of the center frequency modulation; this can be any modulation source (see <i>Modulation Sources</i> above)
<i>Volume</i>	initial amplitude of the formant
<i>Osc 1 / Osc 2</i>	enable / disable formant generation for Oscillator 1 and 2
<i>Osc 1 / Osc 2 Send</i>	balance of formant output sent to Amplifiers 1 and 2
<i>AM</i>	amount of amplitude modulation
<i>AM Source</i>	the source of the amplitude modulation; this can be any unipolar modulation source (see <i>Modulation Sources</i> above)

## Amplifiers

parameter	description
<i>Pan</i>	stereo position (panorama)
<i>Pan Mod.</i>	amount of panorama modulation
<i>Pan Source</i>	the source of the panorama modulation; this can be any modulation source (see <i>Modulation Sources</i> above)
<i>AM1 / AM2</i>	amount of amplitude modulation
<i>AM1 / AM2 Source</i>	the source of the amplitude modulation; this can be any unipolar modulation source (see <i>Modulation Sources</i> above)
<i>Volume</i>	output volume

## Envelopes

parameter	description
<i>Delay</i>	initial delay time in seconds (Envelopes 2 and 3 only)
<i>Attack</i>	attack time
<i>Decay</i>	decay time
<i>Sustain</i>	sustain level
<i>Release</i>	release time

## LFOs

parameter	description
<i>Waveform</i>	seven types are available: <i>Sine</i> , <i>Triangle</i> , <i>Square</i> , <i>Saw Up</i> (rising sawtooth), <i>Saw Dn</i> (falling sawtooth), <i>S/H</i> (Sample and Hold, i.e. random values), and <i>3-Step</i> ("stair"-shaped waveform with three steps)
<i>Retrig</i>	when a new note event occurs, <i>Retrig</i> controls whether the LFO starts at the beginning of the wave form or is "running free" (similar to the <i>Free</i> control for the audio oscillators)
<i>Rate</i>	rate or speed of the LFO (in Hertz or note lengths)
<i>Sync</i>	controls whether the LFO is synchronized to the host tempo
<i>AM</i>	amount of amplitude (output level) modulation
<i>AM Source</i>	the source of the amplitude modulation; this can be any unipolar modulation source (see <i>Modulation Sources</i> below)

## Frequently Asked Questions

### **What is this "Formant Synthesis" thing?**

There are two major approaches to waveform generation: *Subtractive Synthesis*, where a complex waveform is *reduced* to a less complex one using filters, and *Additive Synthesis*, where a complex waveform is *constructed* using a large number of simple (sinusoid) waveforms<sup>1</sup>. *Formant Synthesis* (as implemented in the *scrooo*) is more on the latter side but works slightly different: A "carrier" waveform is created from a sinusoid using a non-linear transform (*Wave Shaping*) and "tuned" to a specific frequency (the center frequency of the formant). Thus, the spectrum of the formant is generated by shifting the (more or less controllable) spectrum of the carrier waveform to the formant's frequency domain. Since the *scrooo* supports the addition of up to three formants (or even up to six if the oscillators and formants are adjusted in a twisted way) the overall spectrum can get quite complex.

If you want to learn more I highly recommend a visit at <http://www.puredata.org/> . Here you can download the *Pure Data* application, a great audio (and graphics) processing tool including many examples and background information.

### **Hey, no filters in the scrooo?**

Yes, that's true, there is no filter inside the *scrooo*... well, to be honest there is a DC blocker right before the overall output but that doesn't count, right?

### **No filters? Then it's just a piece of crap!**

If you do think so, I strongly recommend not to install the *scrooo*. If not, you may ask yourself...

### **How do I install the scrooo?**

Just copy the file `scrooo.dll` from the ZIP archive you have downloaded to your system's or favorite DAW's VST plug-in folder. Your DAW should automatically register the *scrooo* VST plug-in the next time you start it.

### **What is the VST plug-in ID of the scrooo?**

The ID is 3 3 1 5 .

### **How can I decrease the scrooo's CPU load?**

Always try this:

- If you don't need a formant to be generated for one or both oscillators, switch off the respective *Osc 1* or *Osc 2* button of the formant.

Whenever it does not degrade the *sound* you need, try this:

- Reduce polyphony, i.e. the number of voices.
- Turn of Free Run mode of the oscillators.
- Turn of tempo-synchronization of the LFOs.

---

<sup>1</sup> Apart from that, many other paradigms such as *Frequency* or *Phase Modulation* etc. exist.

***How can I prevent output clipping?***

Decrease the formants' and/or the amplifiers' *Volume* parameters. Alternatively, switch on the *Clip* parameter in the Global section but that might lead to distortion effects. Hey, maybe that's exactly what you need? ;-)

***How can I fine-tune the Parameters in the scrooo editor?  
Especially the Range slider...?***

Press the *Shift* key while moving a slider to increase it's resolution. Additionally, use the Plus/Minus buttons attached to each slider.

*Hint:* If you press the *Ctrl* key while clicking on a slider, the corresponding parameter is reset to it's default value.