fullbucket scrooo Software Synthesizer PlugIn User Guide

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Introduction

The scrooo is a polyphonic software synthesizer plug-in for Microsoft Windows (VST2/VST3/CLAP) and Apple macOS (VST2/VST3/CLAP/AU) based on a spectral formant synthesis architecture and written in native C++ code for high performance. The main features are:

- Up to 64 voices polyphony including Unison mode 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
- MIDI Learn – all parameters can be controlled by MIDI CC
- MTS-ESP (**https://oddsound.com/**) dynamic micro-tuning support
- Plug-in supports Windows and macOS (32 bit and 64 bit)

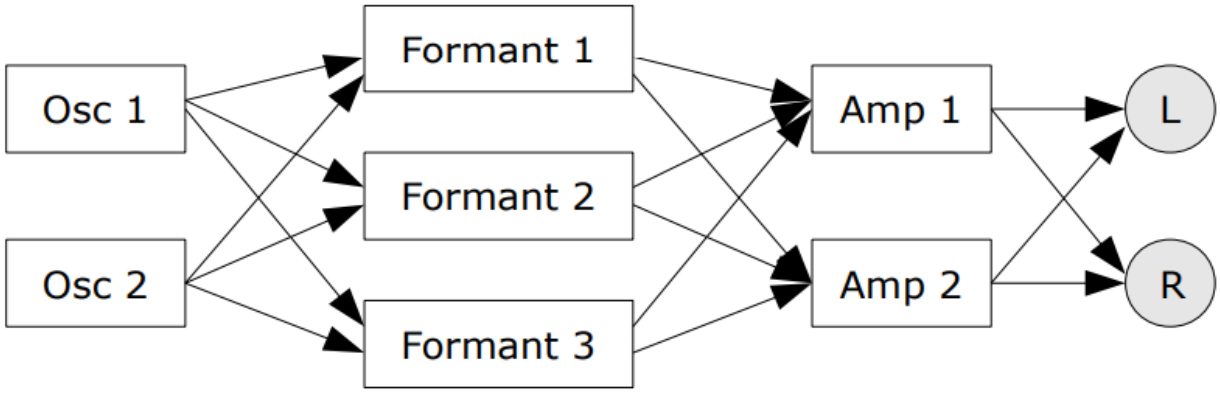
The scrooo is based on the new iPlug2 framework maintained by Oli Larkin and the iPlug2 team. Big thanks, guys!!! Without your work it would not have been possible to create a resizable scrooo user interface.
To resize the plug-in you just grab the yellow triangle at the bottom right of the window and drag it. You can save the current window size using the menu entry
“Save Window Size” in the Options Menu. If you have trouble with the standard version of the scrooo, please grab the (sound-wise identical) “N” version of the plug-in which is based on the original iPlug framework.

What’s New With Version 2.0?
Version 2.0 of the scrooo is fully compatible with the previous version 1.x; it should be safe to replace the old plug-in with the new one.
The scrooo now supports MTS-ESP (**https://oddsound.com/**) dynamic micro-tuning.

Besides the new user interface I added two new features to the scrooo: Unison mode and optional Single trigger mode of the envelopes. I also did a lot of refactoring to the original code but I guess you will not notice much of it.

Architecture

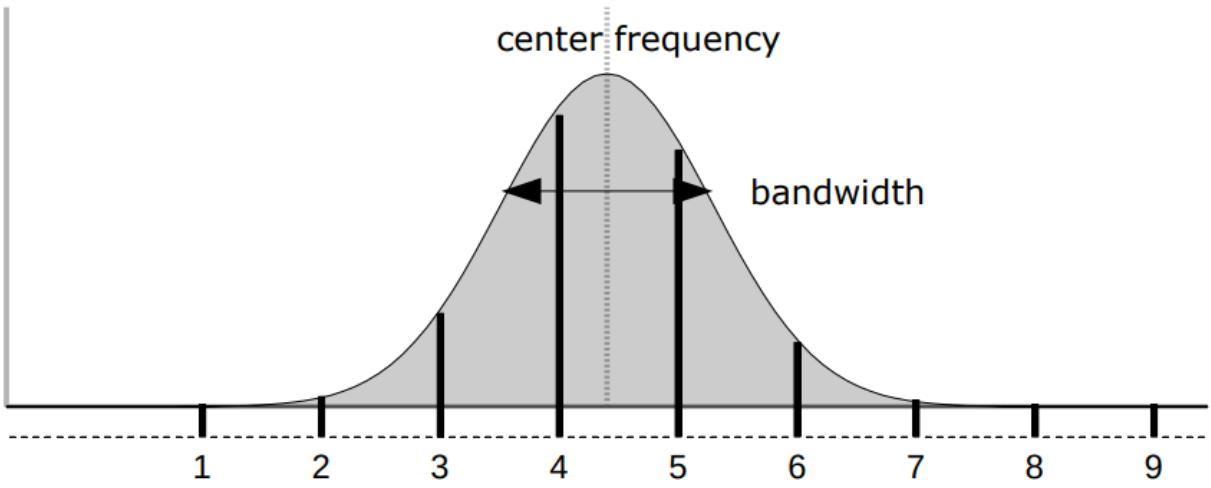
Each voice of the scrooo features two oscillators feeding three separate formant generators. The outputs of the formant generators are routed to two individual amplifiers with panorama control which are connected to the main stereo output bus.



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.
Version 2 of the scrooo now generously provides an "oscilloscope screen" for each formant displaying rough sketches of the resulting wave form (Partial mode), wave shape (Ring mode) or frequency spectrum (Fixed mode).

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 Level 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
Off	unipolar	constant value 0
On	unipolar	constant value 1
LFO1+	unipolar	output of LFO1 ranging from 0 to 1
LFO2+	unipolar	output of LFO2 ranging from 0 to 1
LFO3+	unipolar	output of LFO3 ranging from 0 to 1
Env1	unipolar	output of envelope 1 ranging from 0 to 1
Env2	unipolar	output of envelope 2 ranging from 0 to 1
Env3	unipolar	output of envelope 3 ranging from 0 to 1
Velo	unipolar	MIDI note velocity
Note+	unipolar	MIDI note value
Rnd+	unipolar	constant random value (for current note)
PBnd+	unipolar	MIDI pitch bend wheel (value at center is 0.5)
Wheel	unipolar	MIDI modulation wheel
LFO1	bipolar	output of LFO1 ranging from -1 to 1
LFO2	bipolar	output of LFO2 ranging from -1 to 1
LFO3	bipolar	output of LFO3 ranging from -1 to 1
Note	bipolar	MIDI note (value at C3 is 0)
Rnd	bipolar	constant random value (for current note)
PBend	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. It is possible to switch from Multiple to Single trigger mode using the designated Trig switch.

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 Down (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.

Control Section
Besides selecting programs, setting the Free parameter (see section Oscillators) and the Voice Mode as well as Pitch Bend intensity and Portamento time, this section of the scrooo provides some handy utility functions.

Options Menu
When clicking on the MENU button, a context menu opens with the following options:

Copy Program	Copy current program to internal clipboard
Paste Program	Paste internal clipboard to current program
Init Program	Initialize the current program
Load Program	Load a program file containing a patch to the *scrooo's* current program
Save Program	Save the *scrooo's* current program to a program file
Load Bank	Load a bank file containing 64 patches into the *scrooo*
Save Bank	Save the *scrooo's* 64 patches to a bank file
Select Startup Bank	Select the bank file that should always be loaded when the *scrooo* is started
Load Startup Bank	Load the Startup bank file; can also be used to check what the current Startup bank is
Unselect Startup Bank	Unselect the current Startup bank
Default Path for Program Files	Sets the default path for program and bank files
MIDI Thru	Set globally if MIDI data sent to the *scrooo* should be sent through to its MIDI output
Ignore Program Change	Set globally if MIDI Program Change data sent to the *scrooo* should be ignored
Reload Configuration	Reload the *scrooo's* configuration file (see section ***The scrooo.ini Configuration File***)
Save Configuration	Save the *scrooo's* configuration file (see section ***The scrooo.ini Configuration File***)
Check Online for Update	When connected to the Internet, this function will check if a newer version of the *scrooo* is available at fullbucket.de
Window Size…	Change the window size of the *scrooo*
Save Window Size	Stores the current window size to the configuration file so that it will be restored next time you load the *scrooo*
Visit fullbucket.de	Open fullbucket.de in your standard browser

Voice Mode
The number of voices in standard Poly mode ranges from 1 to 64. The new Unison mode allows up to 8 slightly detuned voices stacked on top of each other for various polyphonic modes. Clicking on the digital display opens a menu where you can select the desired Unison/Poly mode.

MIDI Learn
Every parameter of the scrooo can be controlled by one MIDI controller. If you want to change the assignment of MIDI controller (CC; MIDI Control Change) to scrooo parameter the MIDI Learn function comes in quite handy:

Just click the Learn button on the scrooo's control panel (caption turns red) and wiggle both the MIDI controller and the parameter you want to assign (you can abort Learn by clicking the red button again). To save the controller assignments use "Save Configuration" in the Options menu (see previous section).
If you want to unlearn the assignment, right-click the Learn button (the label now reads "Unlearn") and activate it. Now wiggle the MIDI controller or the parameter that you want to unlearn.

The scrooo.ini Configuration File
The scrooo is able to read some settings from a configuration file (scrooo.ini). The exact location of this file depends on your operating system and will be displayed when you click on "Reload" or "Save Configuration".

Parameters

Global

parameter	**description**
Voices	number of polyphonic voices (up to 32)
Unison	Switches from *Poly* to *Unison* mode
PBend	maximum pitch bend amount (± 24 semitones) of the oscillators
Porta	portamento time (0 to 5 seconds)
Volume	the overall volume
Free	controls whether the oscillators are restarted or are "running free" (like classic analog oscill ators) if a new note event occurs
Clip	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 *Clip* to create a distortion effect while attenu ating the overall output using the *Volume* control.

Oscillators

parameter	**description**
Pitch	the relative pitch (± 24 semitones)
Tune	fine tuning of the oscillator (± 1 semitone)
FM1 / FM2	amount of frequency modulation
FM1 / FM2 Source	the source of the frequency modulation; this can be any modulation source (see *Modulatio n Sources* above)

Formants

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

Amplifiers

parameter	description
Pan	stereo position (panorama)
Pan Mod.	amount of panorama modulation
Pan Source	the source of the panorama modulation; this can be any modulation source (see *Modulation Sources* above)
AM1 / AM2	amount of amplitude modulation
AM1 / AM2 Source	the source of the amplitude modulation; this can be any unipolar modulation source (see *Modulation Sources* above)
Level	output level

Envelopes

parameter	description
Single	switches from *Multiple* to *Single* trigger mode
Delay	initial delay time in seconds (Envelopes 2 and 3 only)
Attack	attack time
Decay	decay time
Sustain	sustain level
Release	release time

LFOs

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

Frequently Asked Questions

How do I install the scrooo (Windows VST2 32 bit version)?
Just copy the files scrooo.dll from the ZIP archive you have downloaded to your system’s or favorite DAW’s VST2 plug-in folder. Your DAW should automatically register the scrooo VST2 plug-in the next time you start it.

How do I install the scrooo (Windows VST2 64 bit version)?
Just copy the file scrooo64.dll from the ZIP archive you have downloaded to your system’s or favorite DAW’s VST2 plug-in folder. Your DAW should automatically register the scrooo VST2 plug-in the next time you start it.

Note: You may have to remove any existing (32 bit) scrooo.dll from your VST2 plug-in folder or else your DAW may screw the versions up…
How do I install the scrooo (Windows VST3 64 bit version)?
Just copy the files scrooo.vst3 from the ZIP archive you have downloaded to your system’s or favorite DAW’s VST3 plug-in folder. Your DAW should automatically register the scrooo VST3 plug-in the next time you start it.

How do I install the scrooo (Mac VST2/VST3/AU 64 bit)?
Locate the downloaded PKG package file scrooo_2_0_0_mac.pkg in Finder (!) and do a right- or control-click on it. In the context menu, click on “Open”. You will be asked if you really want to install the package because it comes from an “unidentified developer” (me J). Click “OK” and follow the installation instructions.

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) waveforms1. 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.
1 Apart from that, many other paradigms such as Frequency or Phase Modulation etc. exist.

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…

What is the plug-in ID of the scrooo?
The ID is 3315.

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.

How can I prevent output clipping?
Decrease the formants' and/or the amplifiers' Level 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 knob…?
Press the Shift key while moving a knob to increase it's resolution.
Hint: If you double click on a knob, the corresponding parameter will be reset to it's default value.

Documents / Resources

	fullbucket scrooo Software Synthesizer PlugIn [pdf] User Guide scrooo Software Synthesizer PlugIn, scrooo, Software Synthesizer PlugIn, Synthesizer PlugIn, PlugIn

References

- Full Bucket
- full bucket music
- Pure Data — Pd Community Site
- ODDSOUND