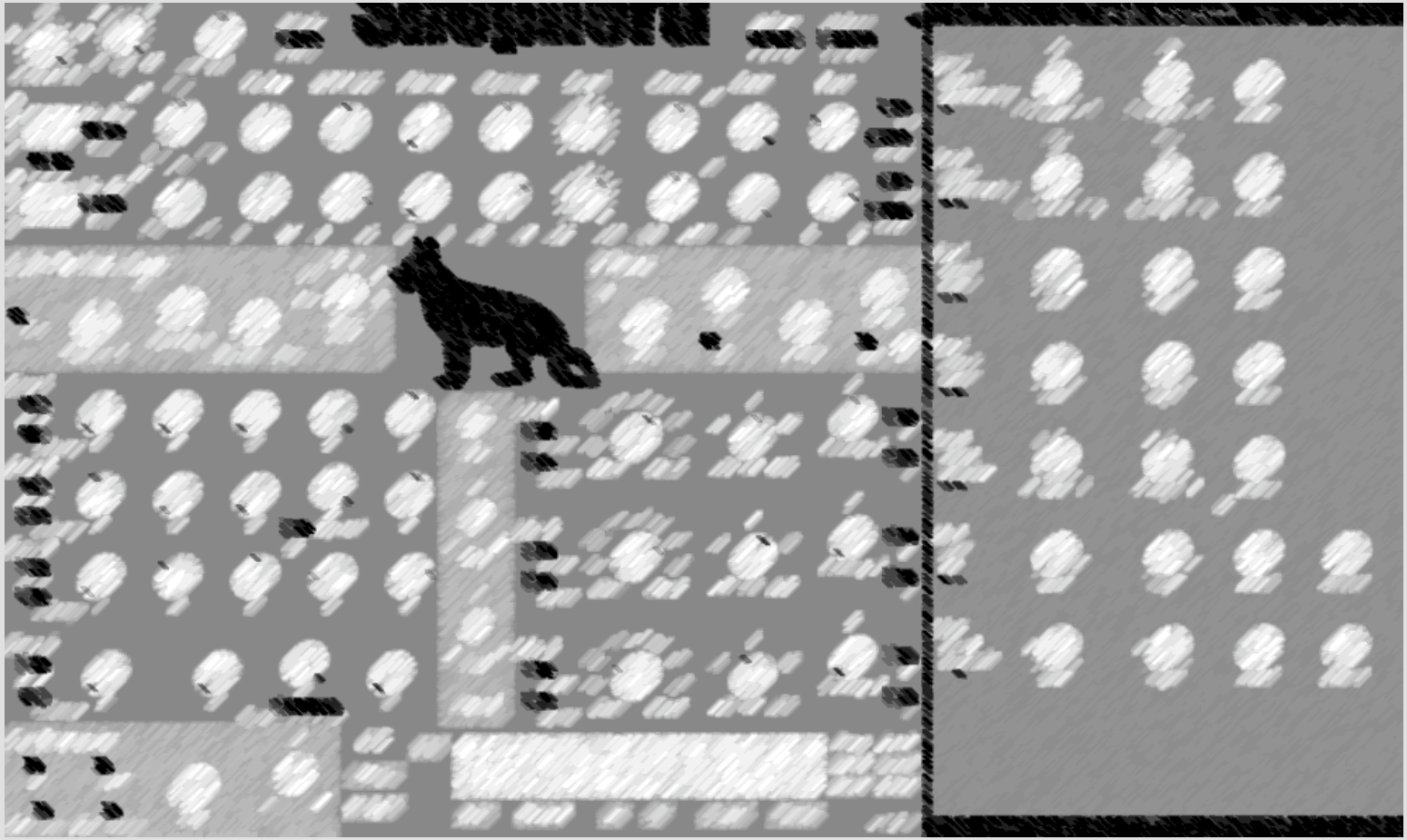
Shepherd



Audio Units

VST

User Guide

version 1.0

bdd

Blind Dog Designs

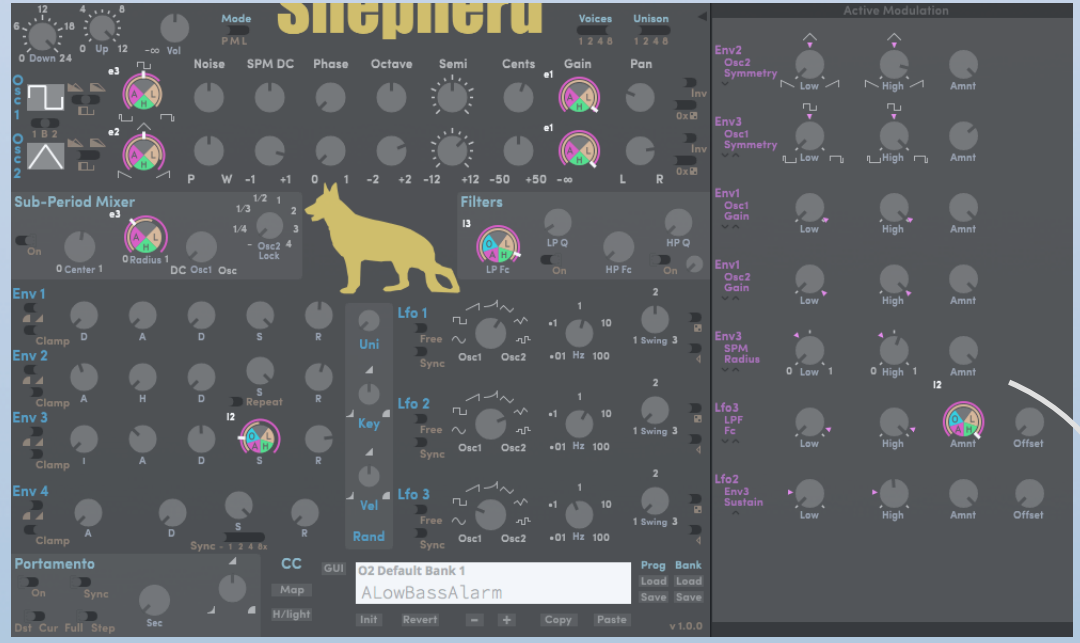
www.blinddogdesigns.com

Thank you for your interest in **Shepherd**!

We've tried hard to keep this manual short. Writing a manual is even less fun and more work than reading one, so anything that we've actually included here seemed important.

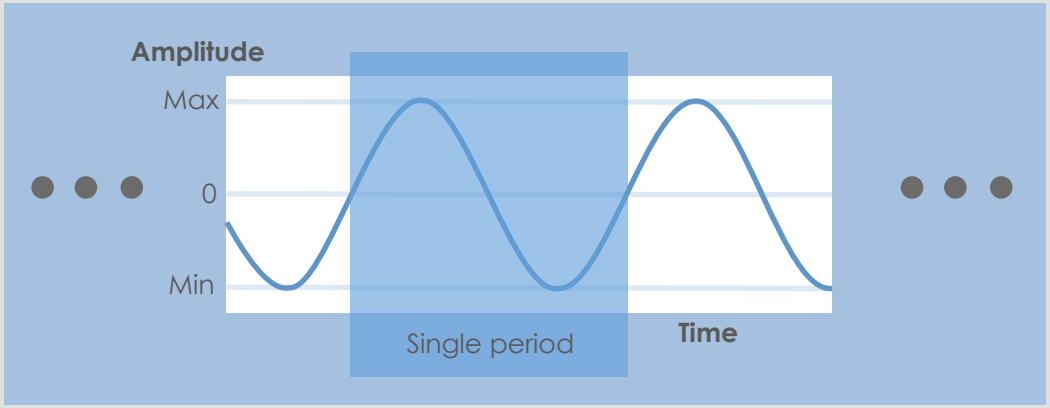
In a nutshell,

Single-level GUI – no menu diving/searching
Easy, intuitive, and powerful modulation assignment
Novel synthesis approach


Shepherd
Mode
PML
Voices
Unison
Noise
SPM DC
Phase
Octave
Semi
Cents
Gain
Pan
Sub-Period Mixer
Filters
Env 1
Env 2
Env 3
Env 4
Lfo 1
Lfo 2
Lfo 3
Uni
Key
Vel
Rand
Portamento
CC
Map
H/light
GUI
O2 Default Bank 1
ALowBassAlarm
Prog
Bank
Load
Save
Init
Revert
Copy
Paste
v 1.0.0
Active Modulation
Env2
Osc2 Symmetry
Env3
Osc1 Symmetry
Env1
Osc1 Gain
Osc2 Gain
Env3 SPM Radius
Lfo3 LPF Fc
Lfo2 Env3 Sustain
Low
High
Amnt
Offset

Sound-Design Approach

An oscillator generates a repeating signal* where, for each iteration (period), the amplitude starts at a particular value, ascends to a maximum value, descends to a minimum value, and then re-ascends to its starting value, ready to start another cycle. A sine wave is a good example of this pattern.



Output of a sine-wave-generating oscillator

When an oscillator cycles quickly (but not too quickly), the result can be perceived as sound. Cycling at the same rate, different shapes of repeating signal generate sound having the same pitch but different timbre.

Many synthesizer oscillators use fixed patterns (waveforms) to define the shapes of their cyclic signals (sine waves, square waves, triangle waves, etc.). Such implementations bring with them an amount of inflexibility, and those waveforms most often used represent only a very small fraction of the many waveform shapes that are possible.

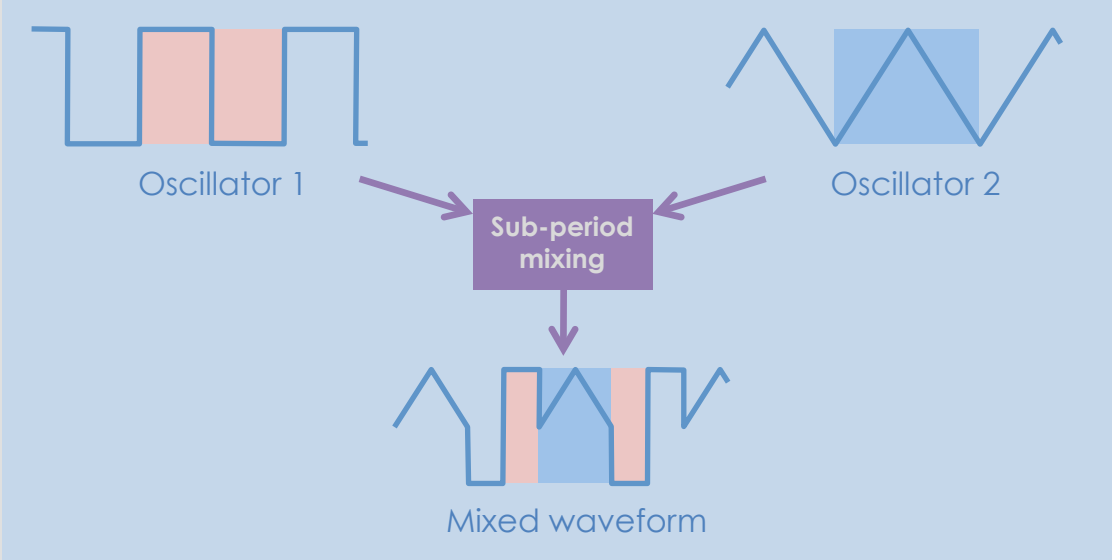
** This is a simplified description to provide a context for the synthesis approaches used in Shepherd.*

One common exception to static-waveform generation is pulse-width modulation (PWM). In a pulse wave, the repeating signal spends the first part of its cycle at a maximum value and the remaining time at a minimum value. PWM dynamically changes the fraction of time spent at the maximum value, and this can generate varied and interesting sounds compared to those of unchanging waveforms. **Shepherd** incorporates the idea of PWM, but applies it to a variety of different waveforms, allowing smooth transitions between sawtooth and triangle waveforms, for example.

Additional sound complexity is often derived from the use of multiple oscillators. Simultaneous use of more than one oscillator can produce fatter and more interesting sounds. Some synthesizers temporally shift between different waveform patterns within the same oscillator or shift between the signals of different oscillators. Such temporal shifts and the duration of such shifts, however, generally take place over amounts of time that are much larger than the period of the oscillators being used.

To increase sound-design flexibility, **Shepherd** allows the output of different oscillators to be alternated over sub-period timeframes. For example, one cycle of oscillation may be made up of the first quarter of the waveform of one oscillator followed by the central half of the waveform of a second oscillator, finally returning to the waveform of the first oscillator for the remainder of the period.

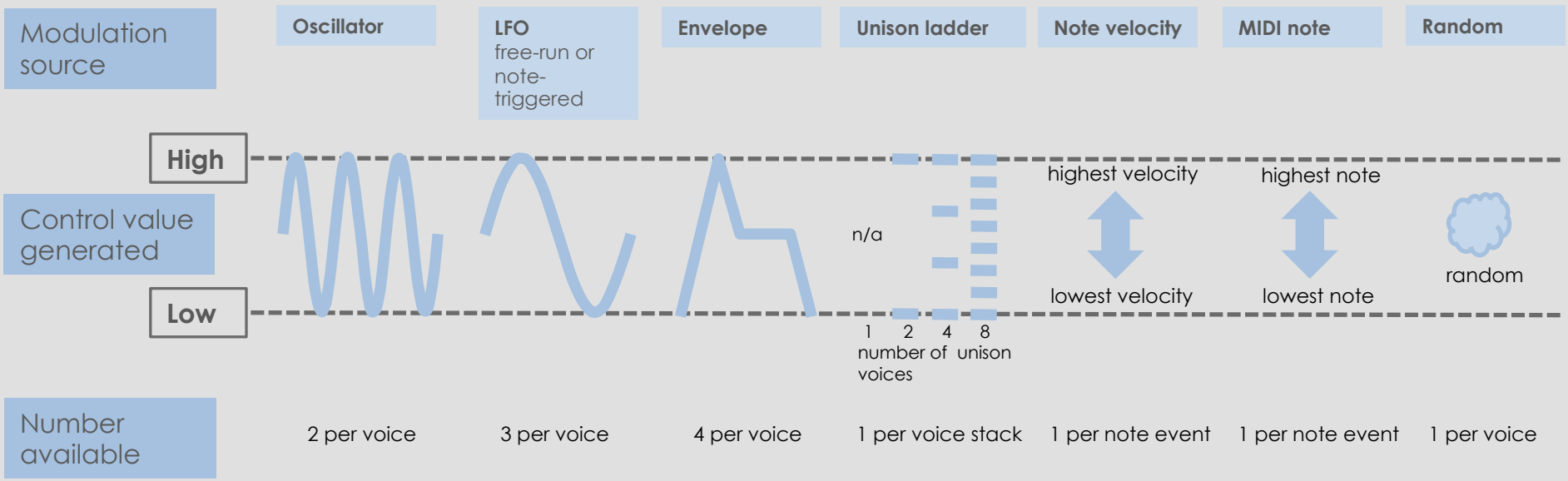
Waveform variation by sub-period mixing of multiple oscillators



Modulation Overview

Shepherd allows almost all of its synthesis parameters to be dynamically controlled, permitting interesting and evolving sounds. Even the parameters that represent and dictate each modulation interaction can themselves be modulated.

Most parameters can be modulated by up to six sources at the same time. And each modulation source can act upon up to twelve different targets simultaneously, with each source-target combination having its own **Low**, **High**, **Amount**, and (sometimes) **Offset** settings. These settings will be explained next.



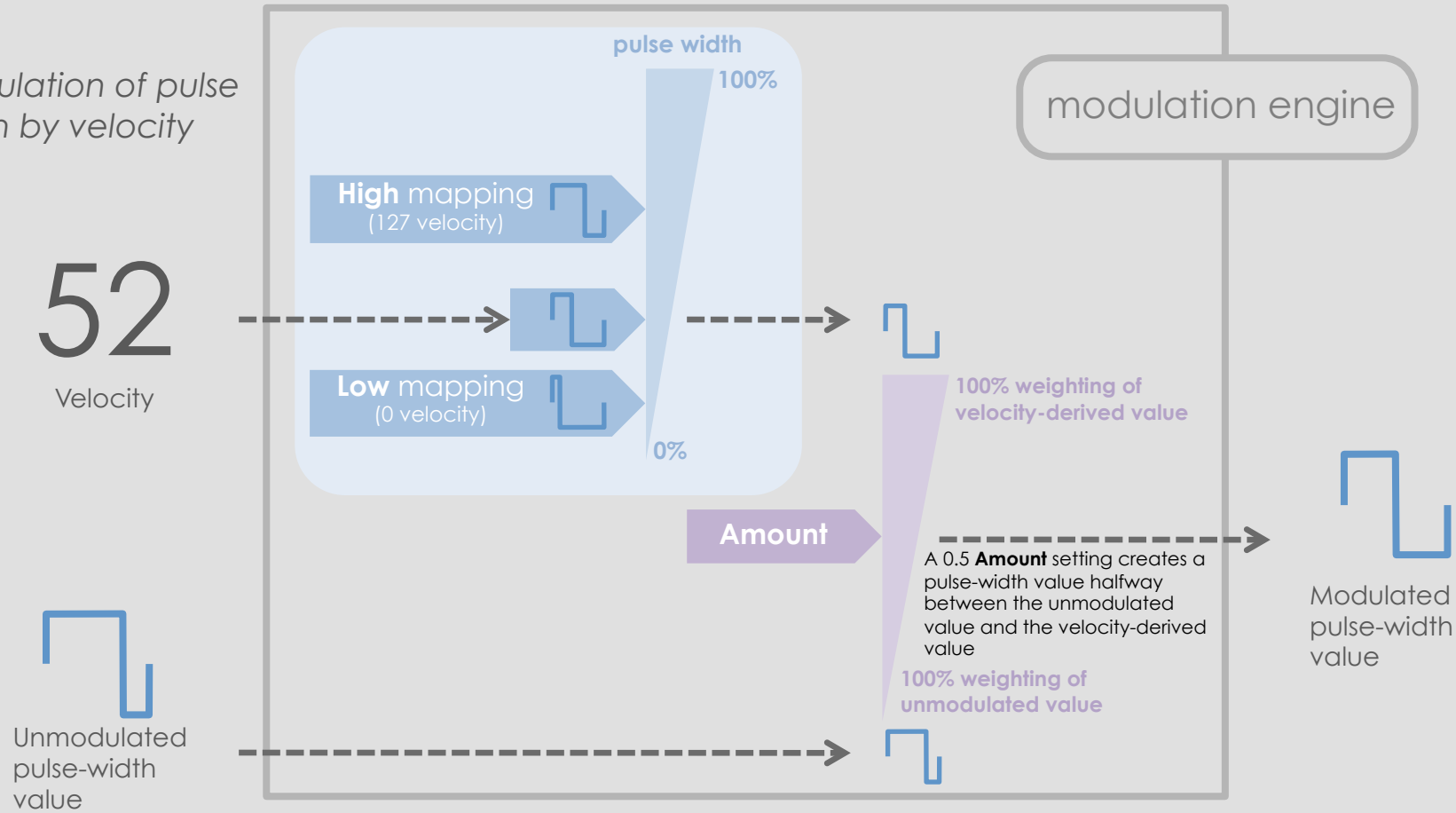
Available modulation sources

Imagine that you want velocity (how fast you strike a note) to alter the pulse width (PW) of an oscillator. In **Shepherd**, the exact modulation behavior is determined by three user-set parameters (in addition to the actual note velocity):

Low: the PW value that should correspond to the lowest possible velocity (0)
High: the PW value that should correspond to the highest possible velocity (127)
Amount: the degree to which a velocity-derived PW value should supplant the original PW

A velocity-derived PW value gets calculated by interpolation of the note's actual velocity relative to the **Low** and **High** parameter settings, and then the original PW is mixed with the velocity-derived value according to the **Amount** parameter, producing a final modulated value.

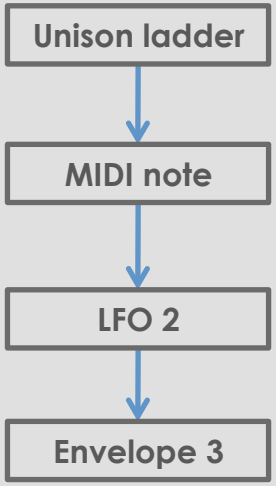
Modulation of pulse width by velocity



Of course, the **Low** parameter does not have to be set to a smaller pulse-width value than the **High** parameter; any two values are fine. If **High** is set to a smaller pulse-width value than **Low**, you will simply get a smaller pulse-width the faster you strike a note.

LFO modulators offer an additional **Offset** parameter, which imposes a phase offset for the modulation relative to the phase of the LFO waveform.

When multiple modulators are assigned to the same parameter (for example, both velocity and an envelope can simultaneously modulate pulse width), the modulators act in a user-assigned order, with the output from one handed in turn to the next.



Example of a possible order for modulator processing

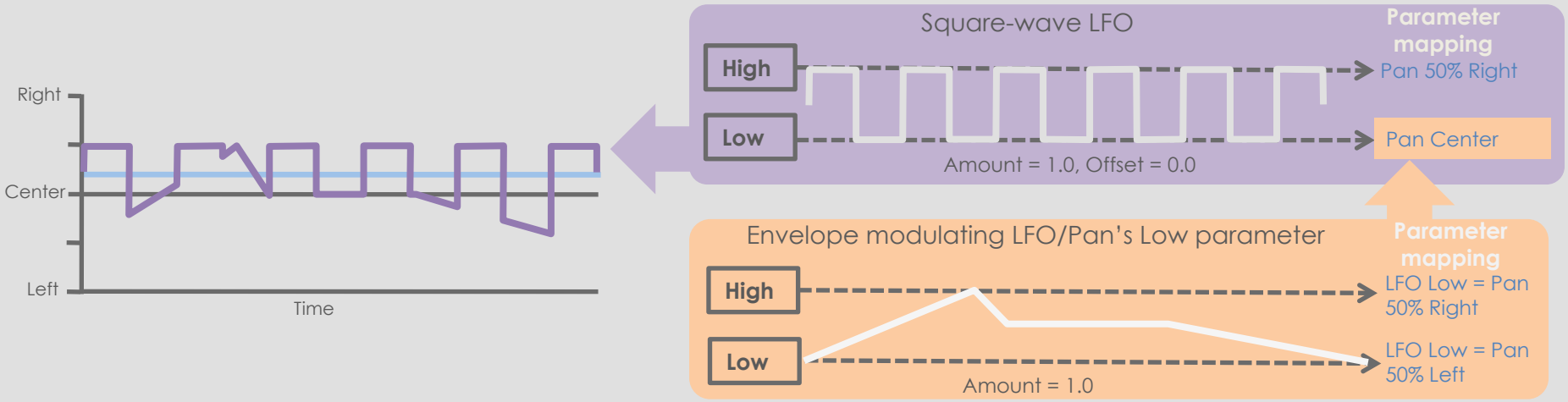
Because many modulators can be chained together, their setting values are all treated as continuous, regardless of the underlying **Shepherd** parameter being discrete or not (for example, when modulating octave tunings, an LFO's **Low** setting can be +1.3, not just +1 or +2). Final modulation results get made discrete where appropriate, with two exceptions: octave and semi-tone tunings (those modulations are left continuous for smooth pitch-bend effects).

The **Low**, **High**, **Amount**, and **Offset** parameters for a modulation assignment can themselves be modulation targets.

Case 1. Pan setting with no modulation

Case 2. Pan setting modulated by an LFO

Case 3. Pan setting modulated by an LFO with the modulation's Low parameter itself modulated by an envelope



Envelopes, in Particular

Envelopes in **Shepherd** can operate in two different modes. The first mode follows the scenario just described, where the envelope creates a modulation control value. The second (and perhaps, more standard) mode has the envelope selectively dampen the value which it is modulating. For example, a gain envelope doesn't usually add gain above and beyond the value it is modulating; it clamps the signal to evolve over time from silence up to the unmodulated level and then back down to silence.

In this second mode:

Low: the fraction of input signal to pass when the envelope is at its minimum

High: the fraction of input signal to pass when the envelope is at its maximum

Amount: the degree to which the envelope-clamped value should supplant the original input signal

GUI Elements

Knobs

To change any knob's value, grab (i.e. left-click and hold) its body and move the mouse vertically. After you grab, the larger the horizontal distance between the mouse pointer and the center of the knob, the finer the setting adjustment that is made. Holding shift down while moving the mouse allows for even finer adjustments. Some knobs are continuous, while others snap to discrete values. If a knob has a sensible default value, then double clicking the knob will reset the knob's value.

Near each knob are the abbreviations of any modulators assigned to the parameter controlled by that knob (for the moment, don't worry about how to do the actual assignment). The abbreviations can appear to the left of the knob or above it. Single clicking on a particular modulator abbreviation will select it (or deselect it, if it was already selected). When selected, the abbreviation will turn white and colored wedges for each of the parameters for that specific modulation appear inside the knob. Each of these wedges can be grabbed and moved to change the parameter settings. An uncolored wedge will also let you change the unmodulated value. Modulator parameters' values are displayed as arcs around the knob. The **Low** and **High** parameters are used to define the end points of a single arc (if **Low** is set to a lower value than **High**, then the arc will appear yellow, but if **Low** is higher than **High**, the arc will appear green). **Amount** and **Offset** are given their own arcs.

Assigned-modulator abbreviations (LFO1 selected)

Offset value arc

Amount value arc

Low/High value arc

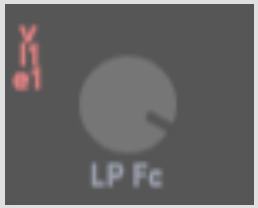
Unmodulated-value indicator turns white while any abbreviation is selected

Modulator-parameter controls for an LFO modulating LPF Fc

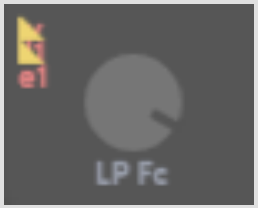
GUI Elements

Knobs (cont'd)

Double clicking on a modulator abbreviation will bypass/un-bypass that modulator. A yellow triangle over the abbreviation indicates that it is bypass'd. Any bypass'd modulator will simply be ignored; however, it will save CPU to remove it altogether rather than just bypass it.



No modulators are bypass'd



Velocity and LFO1 modulators are bypass'd

The order of the modulator abbreviations indicates the order in which they operate (top-to-bottom, left-to-right). Any new modulator will be added to the end of the chain. A modulator's position in the chain can be changed by simply dragging the abbreviation to a new position. The addition and removal of modulators will be covered shortly.

Reordering of a modulation chain

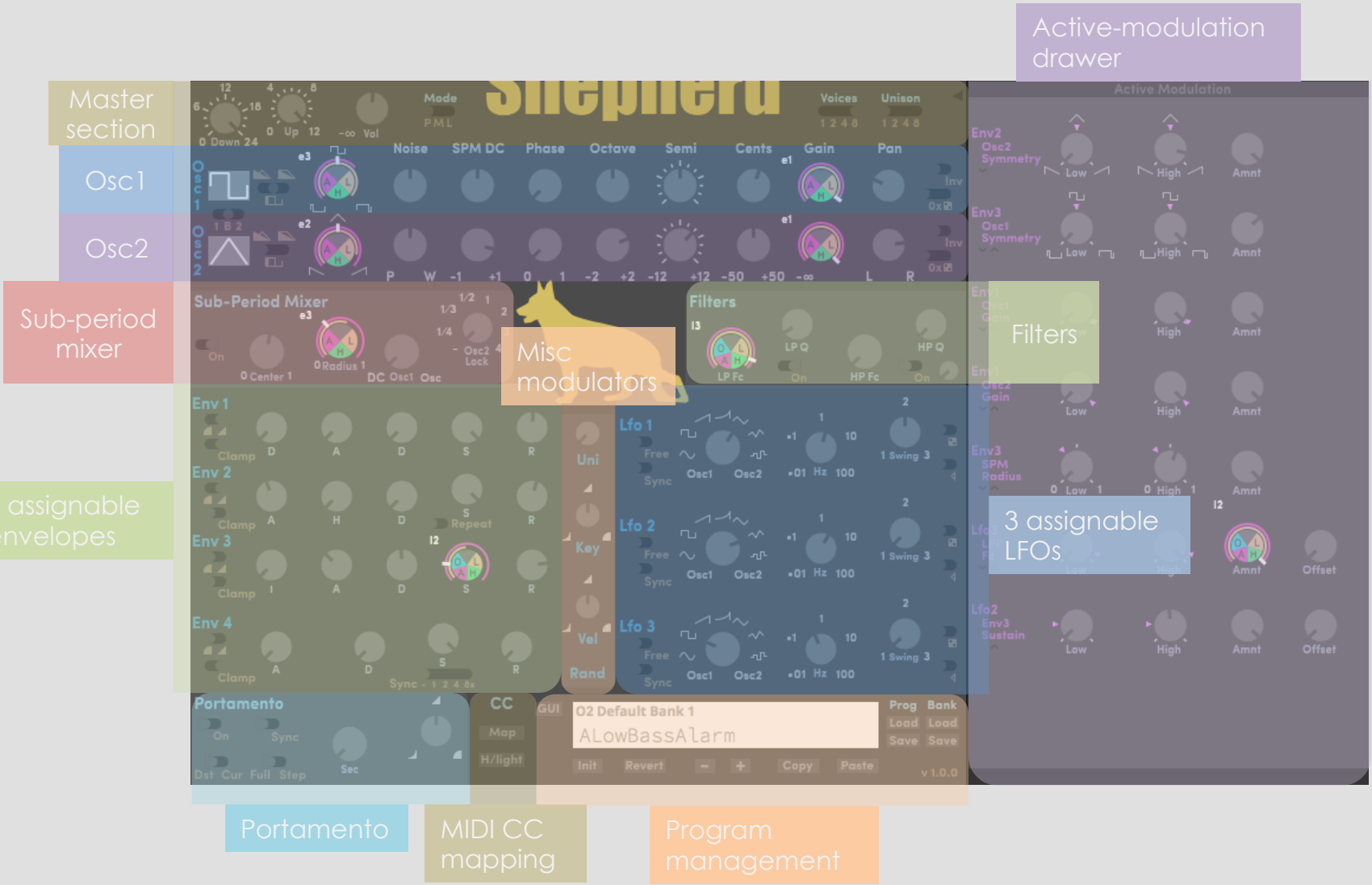
GUI Elements

Toggle switches

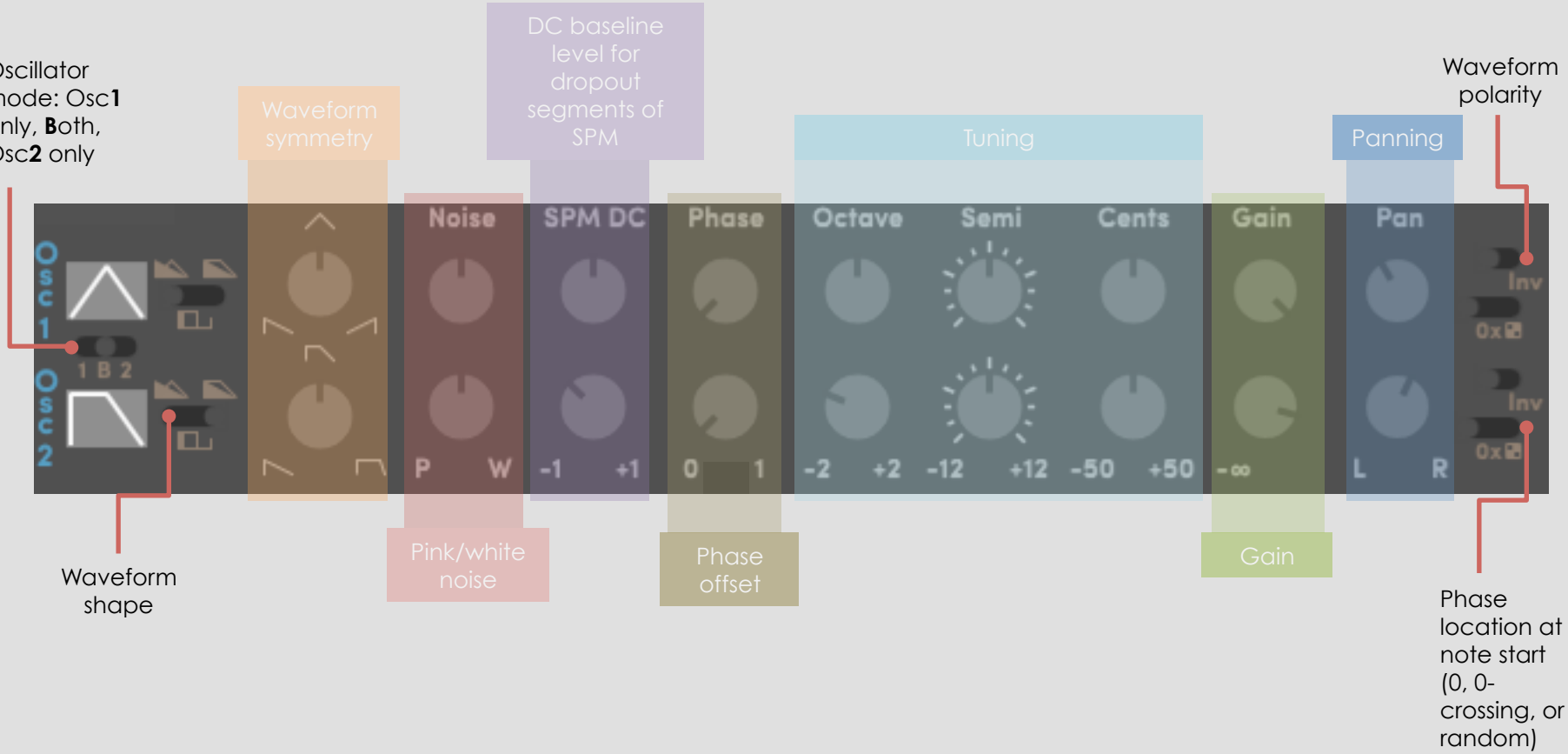
To change the setting of a toggle, click on the toggle's dark track at the spot where you would like the toggle to be positioned (or grab and drag the toggle, if you want to do more work).

Currently, no parameter controlled by a toggle can be modulated, so there will be no modulation-source abbreviations nearby.

Interface Overview



Oscillator Overview



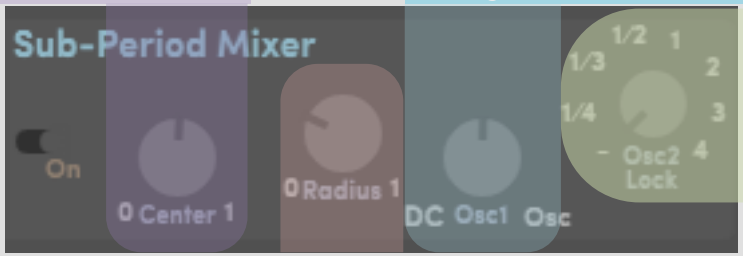
Oscillator mode determines which Osc's will be routed to audio output.

Sub-Period Mixer

When the SPM is on, the generated waveform is the same as Osc1 except across a user-defined region of Osc1's period, where Osc1 and Osc2 are mixed.

Osc1 phase location of the center of the region over which to mix Osc1 and Osc2.

Balance of Osc1 and Osc1's SPM DC value to render across the mix region. If Oscillator mode is "2", then no amount of Osc1 is mixed, regardless of this knob's setting.



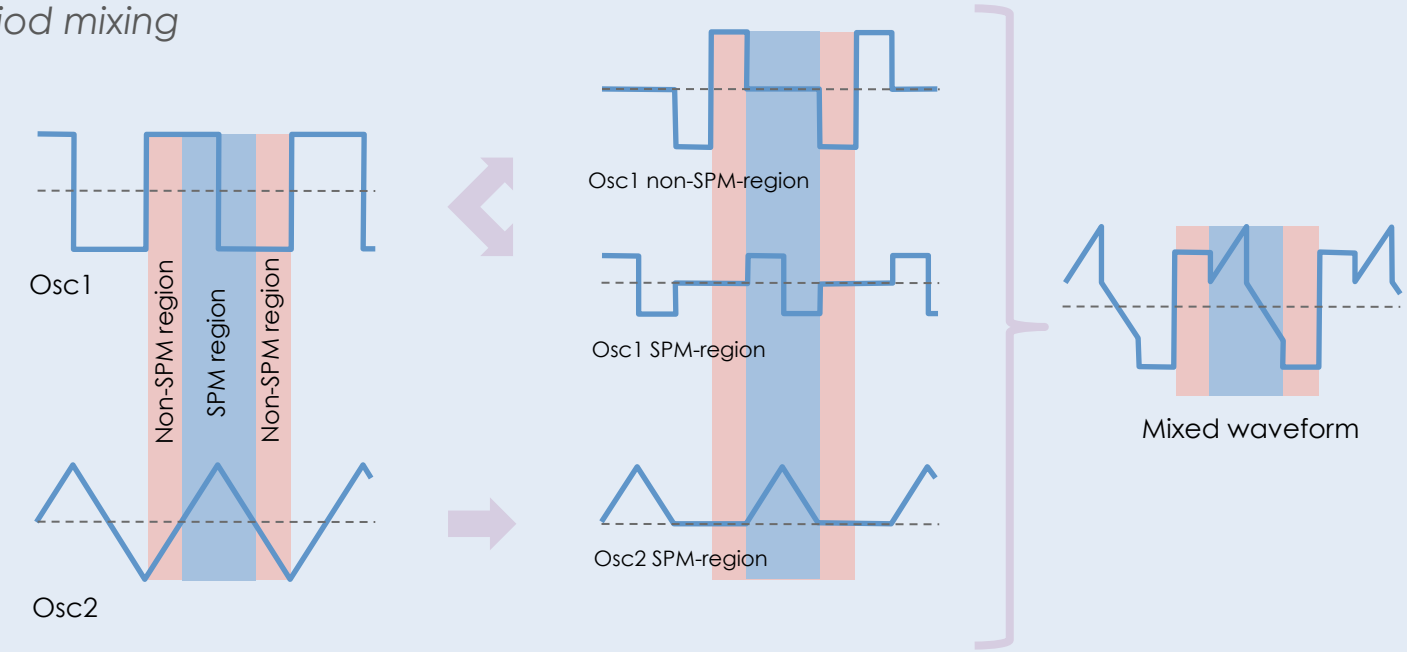
Frequency-ratio lock to impose on Osc2, relative to Osc1. In the first position, there is no lock.

Osc1 phase range to each side of the center location over which to mix Osc1 and Osc2.

Example of sub-period mixing

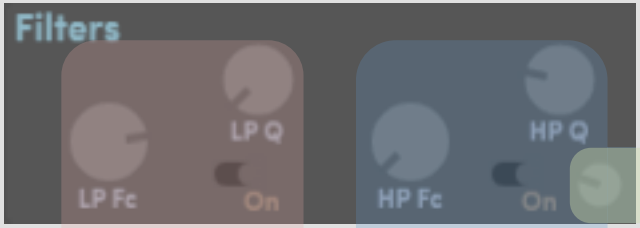
Oscillator mode = "B"
Osc1 SPM DC = 0
Osc2 SPM DC = 0
SPM CENTER = 0.5
SPM RADIUS = 0.25
SPM Osc1 mix = 50:50

Based on the above settings, across each cycle of Osc1, from period-fraction .25 to .75, the final waveform is Osc2 mixed with a 50:50 mix of Osc1 and its SPM DC value. Elsewhere, the waveform is Osc1.



Filters

Filters are processed serially: low pass first, then high pass.



Filter smoothness

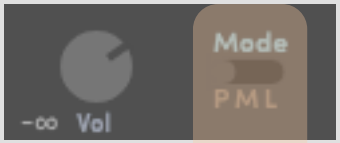
Low-pass filter cutoff and resonance

High-pass filter cutoff and resonance

N.B. Be careful with extreme clockwise settings of LPQ and HPQ, as they can produce loud amplifications of particular frequencies.

Master Section

Number of stacked voices per note

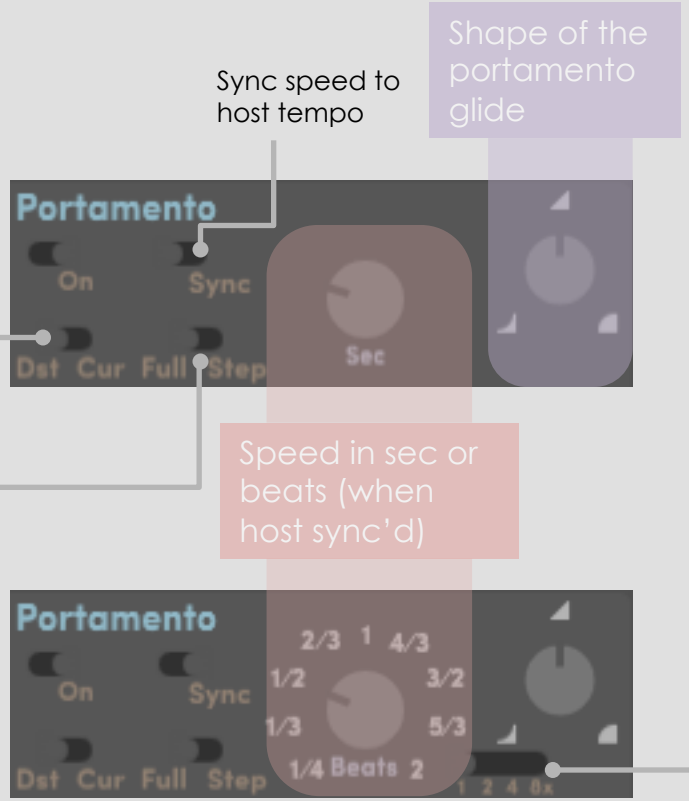


Maximum polyphony

Note mode: **P**oly, **M**ono, **L**egato

Pitch-bend ranges in half steps

Portamento



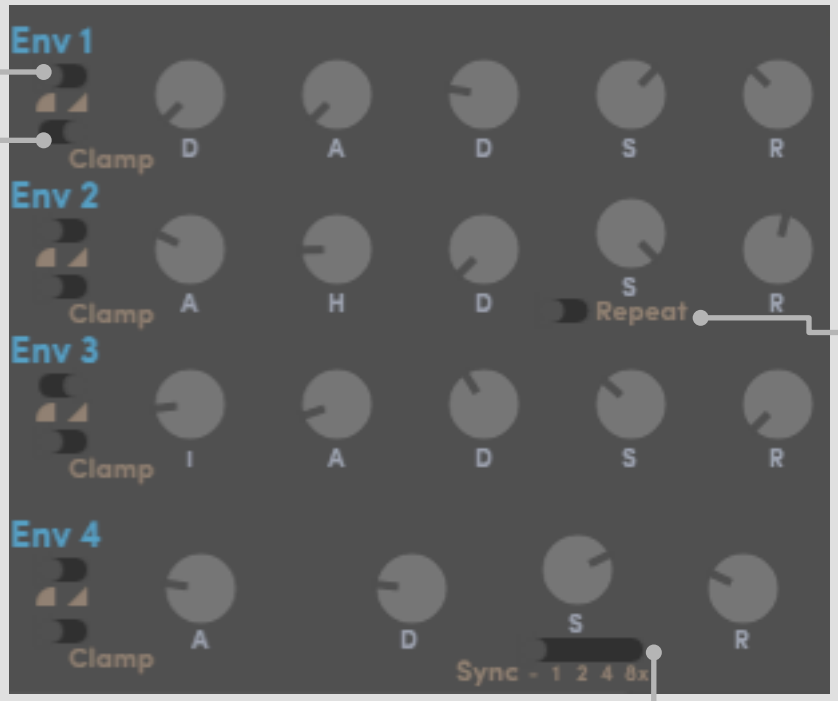
Portamento is only active in Mono and Legato modes.

Modulators

Envelopes

Envelope shape: exponential or linear

Envelope mode: control value or clamp



(Delay)ADSR

A(Hold)DSR

Keep repeating AHD segments

(Initial)ADSR

Sync-able ADSR

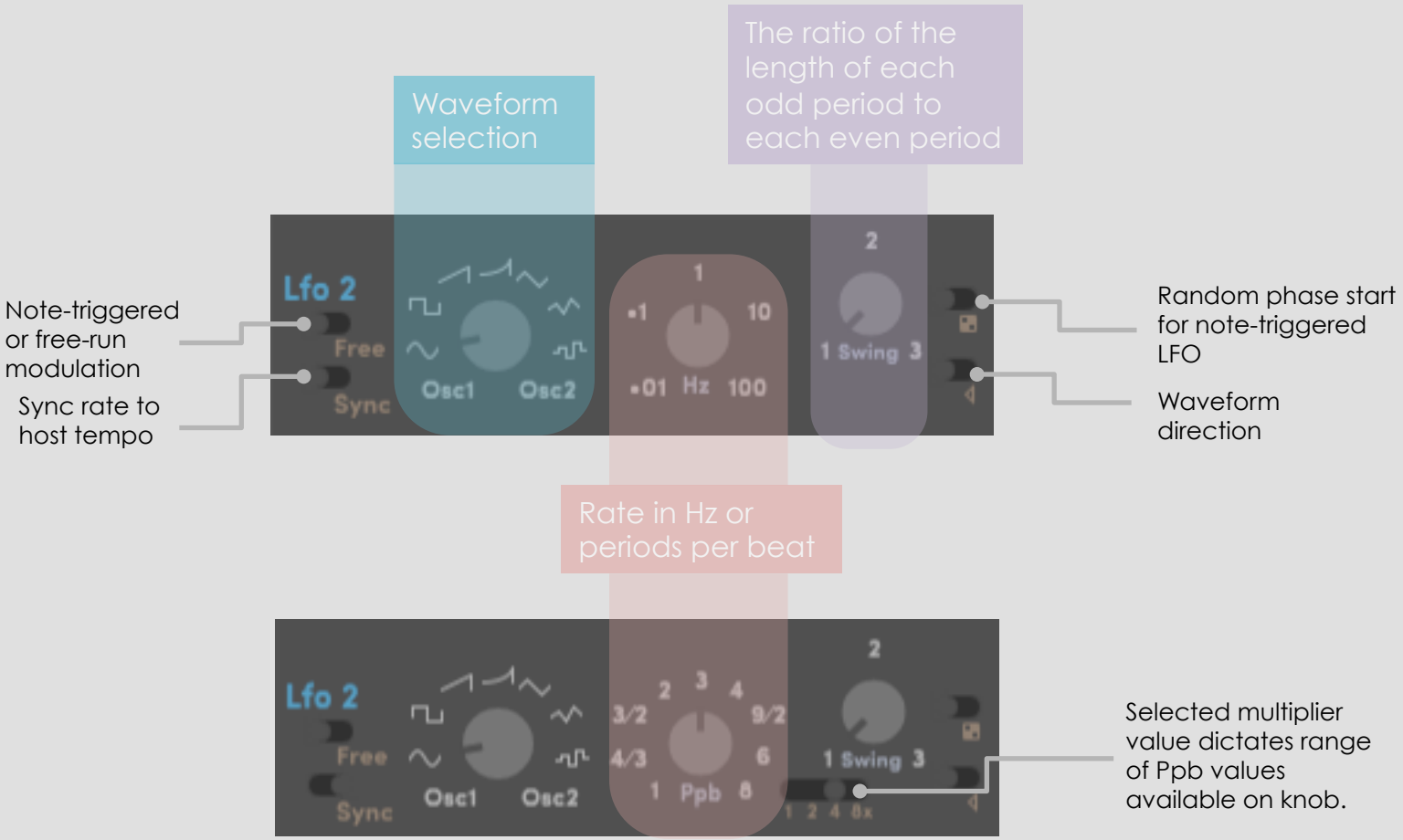
In Shepherd, think of non-sustain envelope-segment values as rates of change (instead of amounts of time). This allows a more intuitive interpretation of Env4 modulating the Attack segment of Env1, for example.

Also, note that at very high values, non-sustain envelope segments will simply hold their values until the rate is increased.

Sync segment rates to host tempo. Selected value dictates range of beat durations available on knobs.

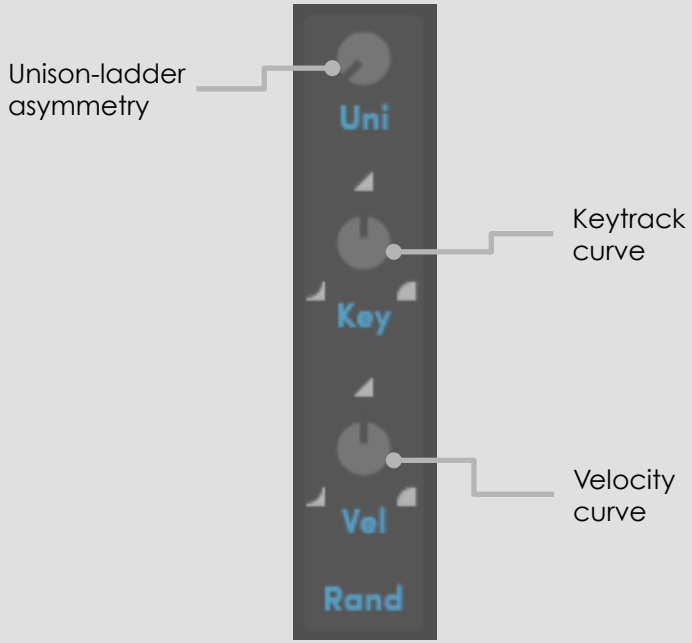
Modulators

LFOs



Modulators

Unison, MIDI note, MIDI velocity, and Random

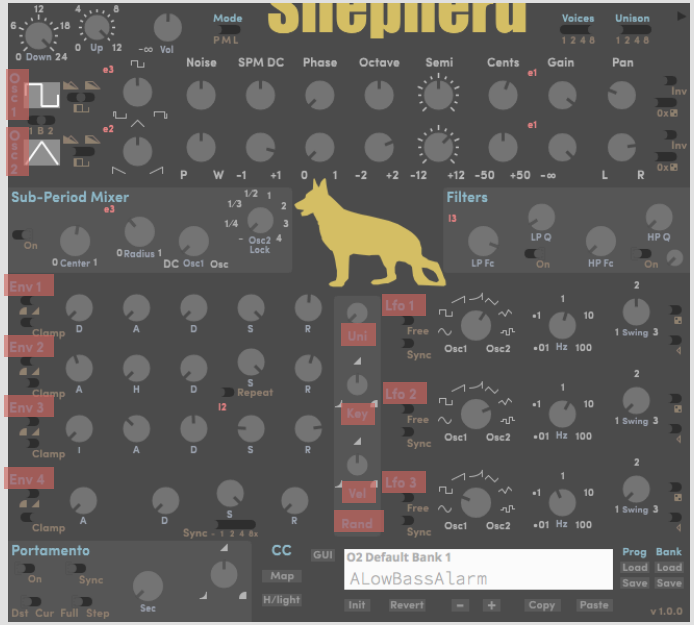


Modulation Assignment

To assign a modulator, drag the name of the desired modulation source (any of those shown in boxes to the right) and drop the name onto the knob of the desired target.

Applying an LFO to the non-sustain segments of an envelope will create a sample/hold effect. These modulations will only have **Amount** and **Offset** parameters.

The rate of a free-run LFO cannot be modulated by any note-wise modulator. This can restrict toggle behavior and modulation assignment.



Assignment of Note Velocity to LPF Q

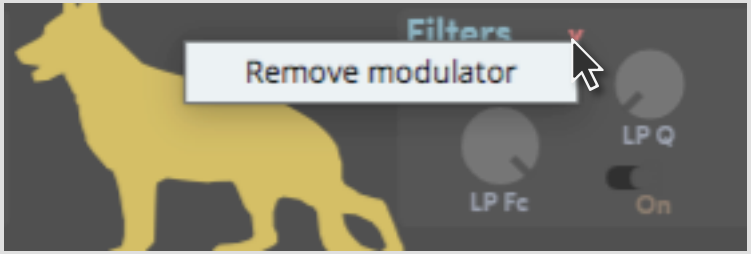
A floating copy of the modulation-source name appears when it has been grabbed.

The modulation-target's knob will be highlighted if the source being dragged can be assigned to it.

A modulation-source label near the target indicates successful assignment of the modulation source.

Modulation Removal

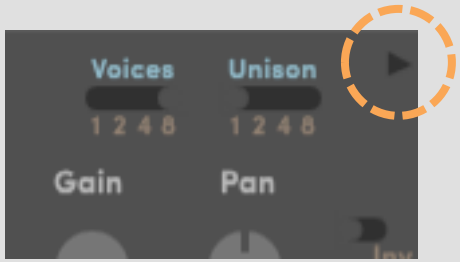
A modulator can be removed by right-clicking on the relevant modulation-source abbreviation near the target knob and selecting “remove modulator.”



For modulators in the main GUI panel, this will also remove the mirrored parameter-control knobs from the modulation drawer, as well as any modulators impacting those drawer knobs (this will make more sense after the next two pages).

Modulation Drawer

Clicking on the dark triangle in the upper right corner of the main GUI-panel will open (or close) the modulation drawer.



Whenever a modulator is assigned to a knob in the main GUI-panel, a new row of knobs appears in the drawer. These new knobs are mirrors of the **Low**, **High**, **Amount**, and **Offset** control wedges which appear on the main-panel knob when the appropriate modulator abbreviation is selected. Changes to parameter settings, *via* either the main-panel control wedges or *via* the dedicated drawer knobs, will be seen in both places. This keeps everything nicely in sync.

To provide a useful frame of reference, where appropriate, the **Low** and **High** drawer knobs show a colored triangle marking the unmodulated value of the parameter being modulated.

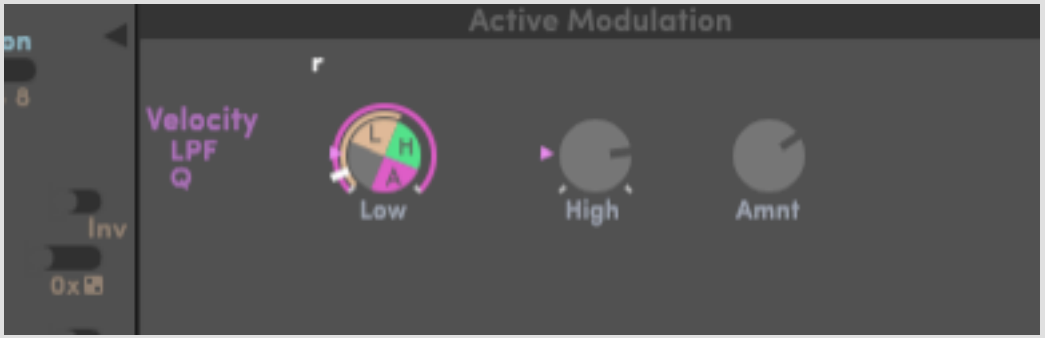
Main-panel knob, showing Velocity modulating LPF Q.

Corresponding row of modulation-drawer knobs, mirroring Velocity's control parameters for the modulation of LPF Q. The colored triangle indicates the non-modulated setting of the main-panel knob.

When there is more than one row of modulation knobs in the modulation drawer, each row will display dark up/down arrows. These can be used to shift the order of the rows in the drawer.

Since the mirror knobs in the drawer are themselves full and distinct knobs, they can have modulators assigned to them in just the same way as knobs in the main GUI-panel. So you can assign a modulator to control a parameter of another active modulation. For example, here's Random modulating the **Low** parameter of Velocity's modulation of LPF Q:

Main-panel knob, showing Velocity modulating LPF Q.



Corresponding row of modulation-drawer knobs, mirroring Velocity's control parameters for the modulation of LPF Q. Here, the **Low** parameter is being modulated by the Random modulator.

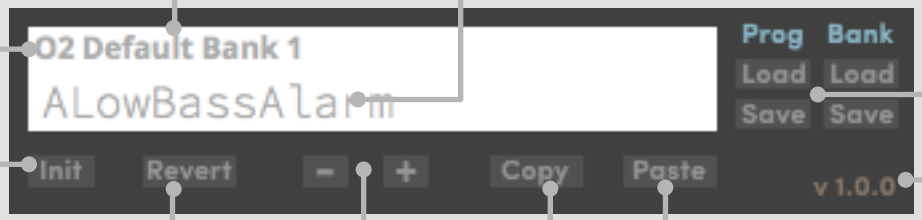
Program Management

At any one time, Shepherd holds three banks of 75 programs each.

Current-program name – double click to edit (press return/enter to accept changes or click-out/Esc to abandon changes). Only letters, numbers, spaces and the following characters (_ - . +) are allowed, and only up to 24 characters.

Name of the current bank.

Program number (01->75)



Load/save individual programs and banks. Bank operations will apply to the bank of the currently selected program.

Initialize program

Revert the program settings back to those of the loaded bank file for the current program. CC mappings are not reverted, though any mappings made obsolete by the reversion are removed.

Increment/decrement program number. Holding either button for ~500 ms will open a panel from which any program/bank can be selected.

Copy program name, program parameters, and CC mappings into memory for easy pasting into another program slot.

Paste a previously copied program into the current program slot.

Click on version number to open "About" window

CC Mapping

The **Map** button opens a panel for changing CC mappings. Different tabs group assignable parameters according to their functionality (the Modulations tab gets dynamically populated according to active modulation assignments in the current program). A particular CC channel can be assigned to a parameter by clicking on the channel indicator for that parameter and then selecting a channel, or by putting that parameter into learn mode by selecting the checkbox. Be aware that learning only lasts as long as the assignment panel is open.

CC mappings are program-specific (since all the modulation mappings are program specific), but CC mappings can easily be copied between programs using the Copy and Paste buttons on the panel (which will ignore the program-specific Modulation tab).

If the **Highlight** button is held down, mapped CC channels will be shown superimposed on the relevant knobs/toggles.

CC mappings which apply to modulator-control parameters (**Low**, **High**, **Amount**, **Offset**) will be displayed on the appropriate modulation-drawer knobs; however, CC channels mapped to modulator-control parameters of modulators that are acting on other modulator-control parameters (for example, the CC channel of the **Low** parameter of LFO1 modulating the **Amount** parameter of Velocity modulating LPF Q) will not be displayed, since those parameters do not have their own distinct knobs.

Credits

Pink noise generation is by the method of Larry Trammell (home.earthlink.net/~ltrammell/tech/newpink.htm).

Program-name font is Source Code Pro from Adobe Systems Incorporated (www.adobe.com) under SIL Open Font License, Version 1.1.

General auxiliary-window/dialog font is Noto Sans from Google (www.google.com) under Apache License Version 2.0.

VST PlugIn Technology by Steinberg. VST is a trademark of Steinberg Media Technologies GmbH.

Audio Units by Apple, Inc. The Audio Units logo is a trademark of Apple, Inc.