vxn-1c

Two-layer polyphonic synthesizer · CLAP plugin and web instrument



vxn-1c is a virtual-analogue polyphonic synthesizer with two layers. Each layer has two oscillators, a sub oscillator and noise, a high-pass filter and a four-pole ladder filter, two envelopes, two LFOs, a sixteen-route modulation matrix, and 32 voices that it can stack on one note. The layers play together, or split the keyboard. Their sum passes through dynamics, chorus, phaser, delay and reverb.

This manual describes every control. Its pictures of the faceplate are drawn by the plugin's own code, and its graphs are measured by running the plugin's engine. The example patches in the last chapters are factory presets: load them by name and play.

Contents

Overview 2
1 · Oscillators 4
2 · Mixer 5
3 · Cross modulation 5
4 · Filter 6
5 · Envelopes 8
6 · LFOs 9
7 · Voices and stacks 10
8 · The modulation matrix 13
9 · Layers, scope and meters 16
10 · Arpeggiator 17
11 · Effects 18
12 · Master 20
13 · Presets 22
14 · Patches 23
15 · Reference 36

Overview

What it is

vxn-1c is the successor to vxn-1b. It plays vxn-1b's sounds, with a new faceplate, Poly-Kritter's chorus, and a factory bank that adds this manual's patches.

The synthesizer is two complete instruments, **Layer 1** and **Layer 2**, which share one set of effects. Layer 1 always plays. Layer 2 plays only when switched on, and then either doubles Layer 1 on every note or takes the keys below a split point.

Signal path

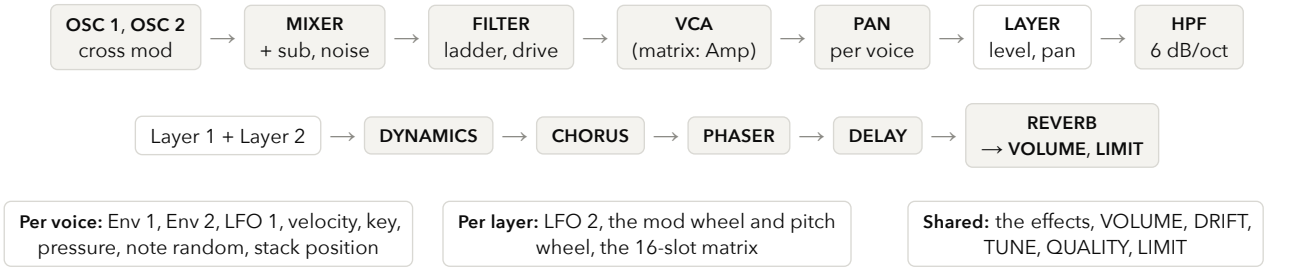


Figure 1. One layer's voice, then the shared chain. Everything up to the layer's level runs at the oversampled rate; the effects run at the host's rate, but for two at **HIGH** (Section 12).

There is no fixed connection from an envelope to the filter or the VCA. Both go through the modulation matrix (Section 8). The Init patch routes **Env 2** to **Amp**, so Env 2 shapes the level of every note, and leaves Env 1 unconnected.

The faceplate



Figure 2. Layer 1's page. Each number is the section of this manual that describes it.

1 **OSC 1, OSC 2**	the oscillators	2 **MIXER**	oscillator, sub and noise levels
3 **CROSS MOD**	sync, phase modulation, two rings	4 **FILTER**	high-pass and ladder filter
5 **ENV 1, ENV 2**	envelopes	6 **LFO 1, LFO 2**	low-frequency oscillators
7 **VOICE**	stacks, Poly and Solo, glide	8 **MOD MATRIX**	opens the layer's routing
9 **SCOPE, LAYER 2 ON**	layers, scope and meters	10 **ARPEGGIATOR**	plays held keys in turn
13 **Preset bar**	presets, copy and reset		

The header holds the preset bar, three page buttons and **LAYER 2 ON**. The page buttons show **LAYER 1**, **LAYER 2** or **FX / GLOBAL** below the header. The two layer pages are the same, each setting its own layer. FX / GLOBAL holds the layer mixer, the split, the effects and the master section (Sections 9, 11 and 12).

Faders read upwards. A push-button is on when lit. Hover over a control to see its value; drag it, or scroll over it, to change it. A control that has no effect in the current setting is dimmed, and still works.

Init

RESET LAYER and a new instance start from the Init patch. Its settings that matter most:

- **OSC 1** and **OSC 2** are saws, **OSC 2** an octave down, at levels 0.8 and 0.6.
- **FILTER** is a 24 dB low-pass at 1 kHz, **RESO** 0.2.
- **ENV 2** has a 5 ms attack and sustains at 0.8. It is routed to the VCA.
- **LFO 1** (a 5 Hz sine) is routed to pitch at ±0.05 semitones: a slight vibrato.
- **SPREAD** is routed to pan, but **SPREAD** is at 0.
- One voice per note (**WIDTH** 1), **Poly**, **QUALITY** Standard.
- The arpeggiator is off.

1 · Oscillators



1. **WAVE** sine, triangle, saw, pulse
2. **OCT** octave, −4 to +4
3. **SEMI** semitones, −7 to +7
4. **FINE** cents, −50 to +50
5. **PW** pulse width, 5% to 95%
6. **FREE** phase not reset by notes

OSC 1 and **OSC 2** are identical, except that OSC 2's **OCT** starts at −1. Their controls set each oscillator's pitch relative to the key: **OCT** in octaves, **SEMI** in semitones and **FINE** in cents. The pitch of each key also moves with **TUNE** (Section 12), the layer's **DETUNE** (Section 9), the pitch wheel and the matrix.

WAVE selects the waveform:

Position	Waveform
Sine	A sine shaped from the triangle, with a faint designed residue: the 3rd harmonic about 35 dB down, the 5th 45 dB, the 2nd 50 dB, a little different on every voice. The residue fades out before it reaches 20 kHz. Under **FM** the sine is pure.
Triangle	Odd harmonics, falling at 12 dB per octave. Its corners are band-limited, as the saw's and pulse's edges are, so it aliases least of the three.
Saw	Every harmonic, falling at 6 dB per octave. Band-limited by polyBLEP.
Pulse	Band-limited by polyBLEP. **PW** sets the width; at 50% it is a square, with odd harmonics only.

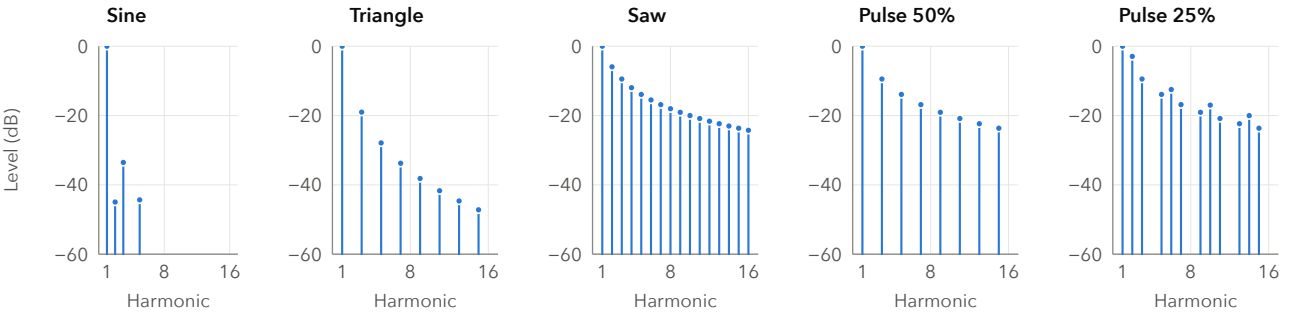


Figure 3. Harmonic levels against the fundamental, measured at the output: OSC 1 alone at C3 (130.8 Hz), at a low level so that the filter adds no harmonics of its own. A 25% pulse lacks every fourth harmonic.

PW sets the pulse's width, from 5% to 95%; it affects only the pulse. Each oscillator's width can also be moved by the matrix (Section 8), between the same limits. The pulse has its DC offset removed, so a narrow pulse sits off-centre: at 5% it swings from about +1.9 to −0.1 of the other waves' amplitude.

FREE lets the oscillator run continuously. Off, each new note restarts the oscillator's phase, so every note starts the same way. With **WIDTH** at 1, each voice has its own fixed start phase; in a stack the start phases follow **PHASE** (Section 7). On, notes start wherever the oscillator happens to be. Both are off at Init.

Output level

WAVE	Peak	RMS
Sine	0.48	0.38
Triangle	0.47	0.33
Saw	0.59	0.33
Pulse	0.62	0.47

One voice, OSC 1 alone at its Init level (0.8), C3, the filter open, **VOLUME** at full. Values are fractions of digital full scale. The ladder filter rounds off the peaks (Section 4), which is why the four peaks are so alike. **VOLUME** at its Init setting (0.7) takes 3 dB off these.

2 · Mixer



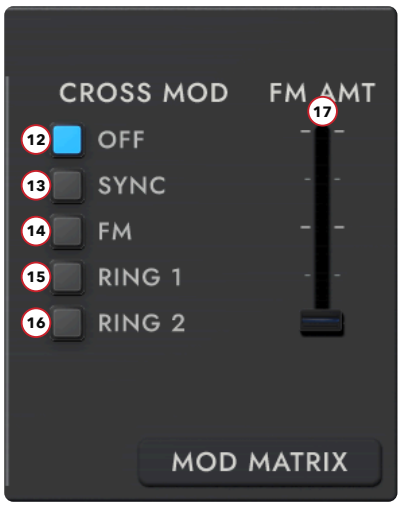
7	**OSC1**	OSC 1's level
8	**OSC2**	OSC 2's level
9	**SUB**	square an octave below
10	**NOISE**	noise level
11	**WHITE / PINK**	noise colour

The four levels are added and passed to the filter. Each runs from 0 to 1. There is no automatic gain: two oscillators at full level are twice as loud as one, and drive the filter twice as hard (Section 4).

SUB is a square wave one octave below OSC 1. With **CROSS MOD** at **SYNC** it follows OSC 2 instead, since OSC 2 then sets the pitch. It restarts at every note, whatever **FREE** is set to.

NOISE is white or pink: **WHITE** is flat, **PINK** falls at 3 dB per octave. Each voice has its own noise source, so stacked voices do not cancel or reinforce each other's noise.

3 · Cross modulation



12	**OFF**	the oscillators are independent
13	**SYNC**	OSC 1 restarts with OSC 2
14	**FM**	OSC 2 modulates OSC 1's phase
15	**RING 1**	OSC 1 through a diode ring with OSC 2
16	**RING 2**	OSC 1 switched by a clipped OSC 2
17	**FM AMT**	phase-modulation index, 0 to 4

CROSS MOD, in the VOICE panel, connects the two oscillators. OSC 2 is always the one that acts on OSC 1. It starts at **OFF**.

SYNC restarts OSC 1's cycle each time OSC 2 begins one. OSC 2 sets the pitch; OSC 1's tuning then sets the timbre, and moving it sweeps a band of harmonics. Both oscillators are still heard at their mixer levels, so for the classic sync sound set **OSC2** in the mixer to 0.

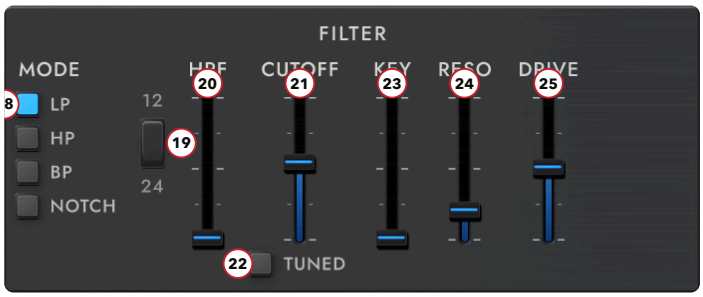
FM is phase modulation: OSC 2's output is added to OSC 1's phase, scaled by **FM AMT**. OSC 1 keeps its pitch, and OSC 2's frequency relative to OSC 1 decides which sidebands appear: a whole-number ratio gives a harmonic sound, any other ratio an inharmonic one. **FM AMT** is the index in cycles: at 1, OSC 2 at full swing moves OSC 1's phase by

a whole cycle either way. Most useful sounds lie below 0.5; higher settings are increasingly noisy. OSC 2 is still heard at its own level, so set **OSC2** to 0 to hear only the result. **FM AMT** has no effect in the other modes, and is dimmed.

RING 1 and **RING 2** each replace OSC 1, at OSC 1's level, with OSC 1 ring-modulated by OSC 2. Either way the output contains the sums and differences of the two oscillators' frequencies. **RING 1** is a model of a diode ring. **RING 2** clips OSC 2 to a near-square and uses it to switch OSC 1 between in phase and inverted, which adds odd harmonics of OSC 2 to every sideband: a harder, brighter sound than **RING 1**'s, at about the same level. OSC 2 is still heard at its own level.

The matrix destination **Cross Mod Sweep** (Section 8) moves the pitch of the oscillator that shapes the sound in each mode: OSC 1 at SYNC, OSC 2 at FM, and both at OFF and either RING. Routed from an envelope, it gives the swept sync lead of Section 14.

4 · Filter



18	**MODE**	LP, HP, BP, NOTCH	19	**12 / 24**	the ladder's slope
20	**HPF**	high-pass cutoff, 20 Hz to 18 kHz	21	**CUTOFF**	ladder cutoff, 16 Hz to 16 kHz
22	**TUNED**	show CUTOFF as notes	23	**KEY**	key tracking, 0 to 1
24	**RESO**	resonance, 0 to 1	25	**DRIVE**	level into the ladder, ×0.1 to ×4

Each voice has a four-pole ladder filter whose output is set by **MODE**. Each layer then has one gentle high-pass, **HPF**, on the sum of its voices.

The high-pass filter

HPF is a one-pole high-pass, 6 dB per octave, on the layer's whole sound: after its voices are summed and before the effects. It is always on. At its lowest setting, 20 Hz, it only clears DC and rumble. Raise it to keep a layer's low end out of a mix, or to leave the lows to the other layer. It is not a matrix destination; for a high-pass on each voice, use the ladder's HP mode.

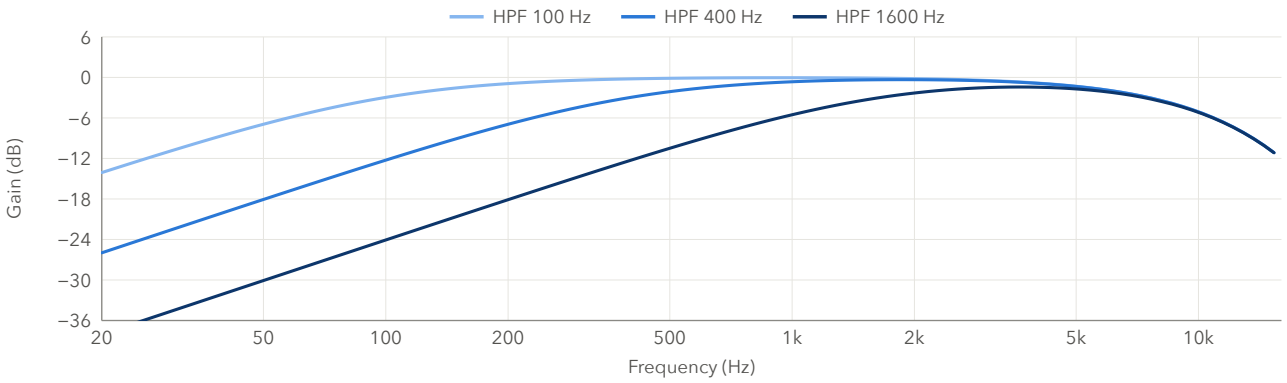


Figure 4. The high-pass filter at three settings, with the ladder open.

The ladder

CUTOFF sets the ladder's cutoff, from 16.35 Hz (C0) to 16 kHz. The fader is exponential: 800 Hz at its centre. It starts at 1 kHz.

The ladder is four one-pole stages in a loop, each with its own saturation. **MODE** takes the output from different points of the ladder:

MODE	Response
LP	Low-pass: 24 dB per octave, or 12 dB with the slope switch at 12.
HP	High-pass: 24 or 12 dB per octave.
BP	Band-pass, centred on the cutoff.
NOTCH	A notch at the cutoff. Always two-pole: the slope switch has no effect, and is dimmed.

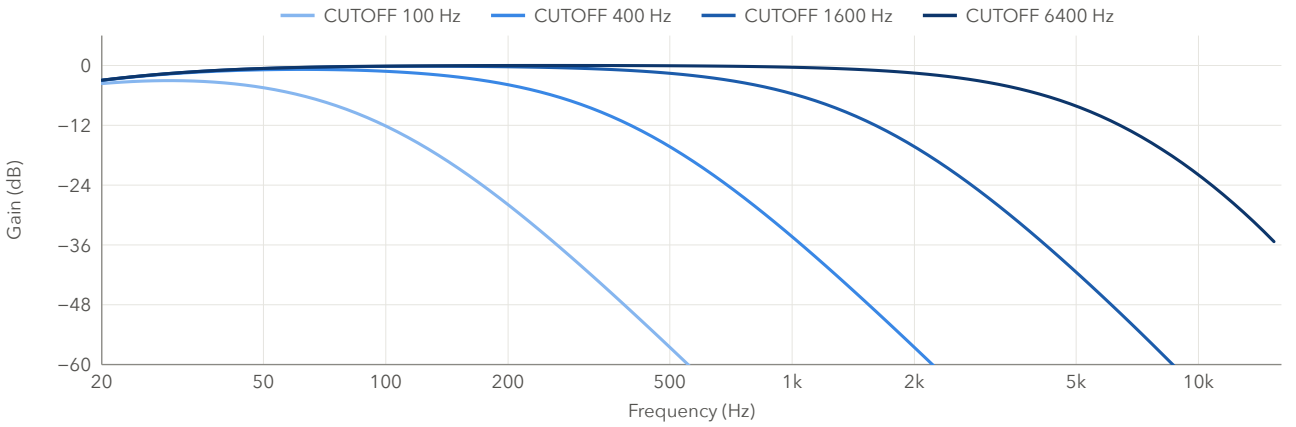


Figure 5. LP, 24 dB, at four CUTOFF settings, RESO 0. With no resonance the response is 12 dB down at the cutoff, and 24 dB per octave above it. All filter graphs are measured at a small level, at the output, against the open filter at 1 kHz.

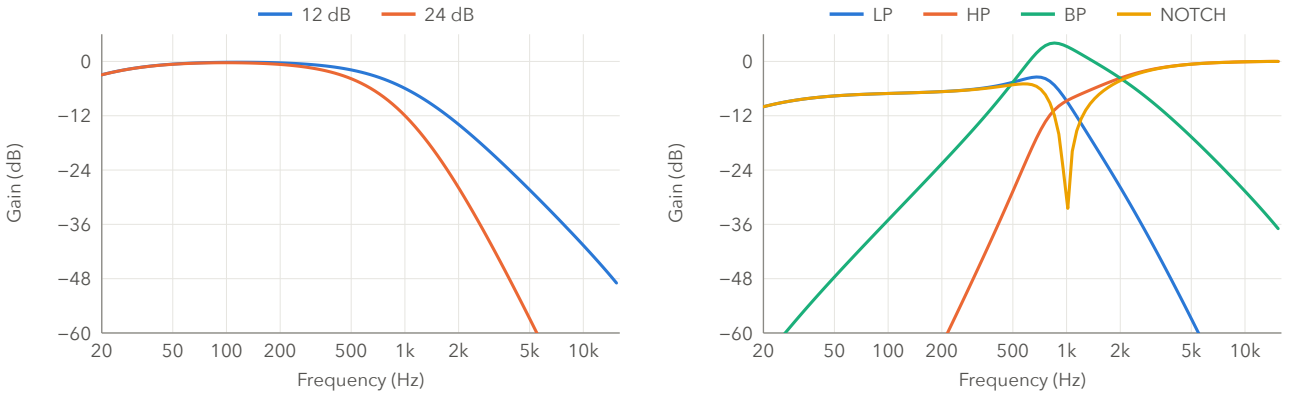


Figure 6. Left: LP at 1 kHz with the slope at 12 and 24. Right: the four modes at 1 kHz, 24 dB, RESO 0.3.

RESO feeds the ladder's output back to its input. As it rises the response peaks at the cutoff, and from about 0.95 the filter oscillates by itself, a sine at the cutoff frequency, at the same RESO whatever the cutoff or QUALITY setting. The feedback also lowers the level below the cutoff: at RESO 0.5 the low frequencies are 9.8 dB down, at 1 about 14 dB. That is the character of a ladder filter; nothing compensates for it, so raise the layer's level or **DRIVE** to make up. RESO starts at 0.2.

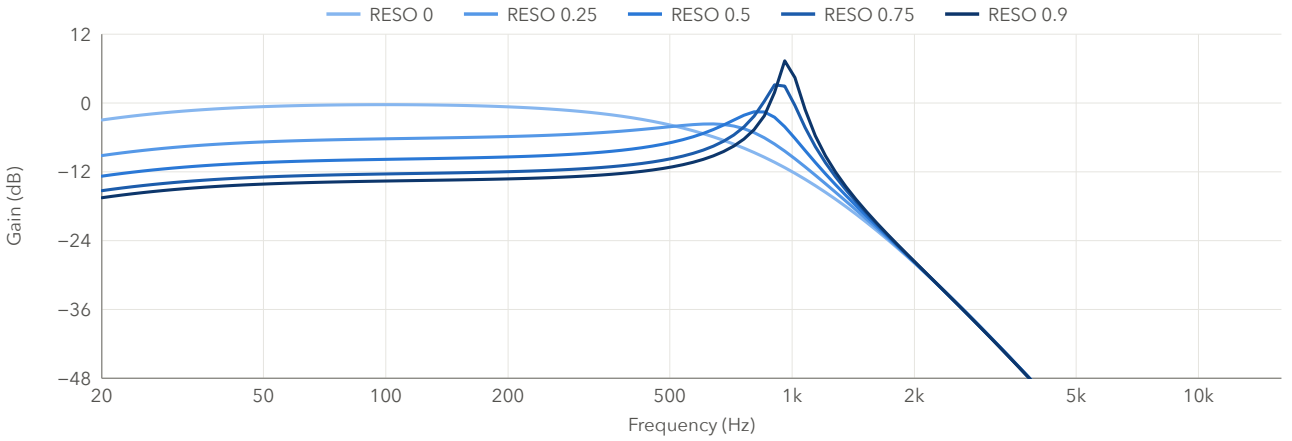


Figure 7. LP, 24 dB, CUTOFF 1 kHz, at five RESO settings.

KEY moves the cutoff with the key. At 1 the cutoff follows the keyboard exactly, an octave per octave, so a setting keeps its relation to every note; at 0.5 it moves half an octave per octave. The pivot is C0: at KEY 1 and CUTOFF at its lowest, 16.35 Hz, the cutoff is the played note's frequency. KEY follows the key played, not the pitch during a glide. It starts at 0.

TUNED changes only how **CUTOFF** is shown and set: its travel runs from C0 at the bottom to C4 at the top, and its readout and steps become whole notes, for setting a self-oscillating filter to a pitch. It does not change the sound.

DRIVE sets the level into the ladder, from ×0.1 to ×4, centre ×1. Each stage of the ladder saturates, so the more signal goes in, the more the filter compresses and adds harmonics. At Init levels the ladder is already working hard: a single sine oscillator at level 0.8 leaves it with its third harmonic only 17.6 dB down. Lower **DRIVE**, or the mixer levels, for a cleaner sound.

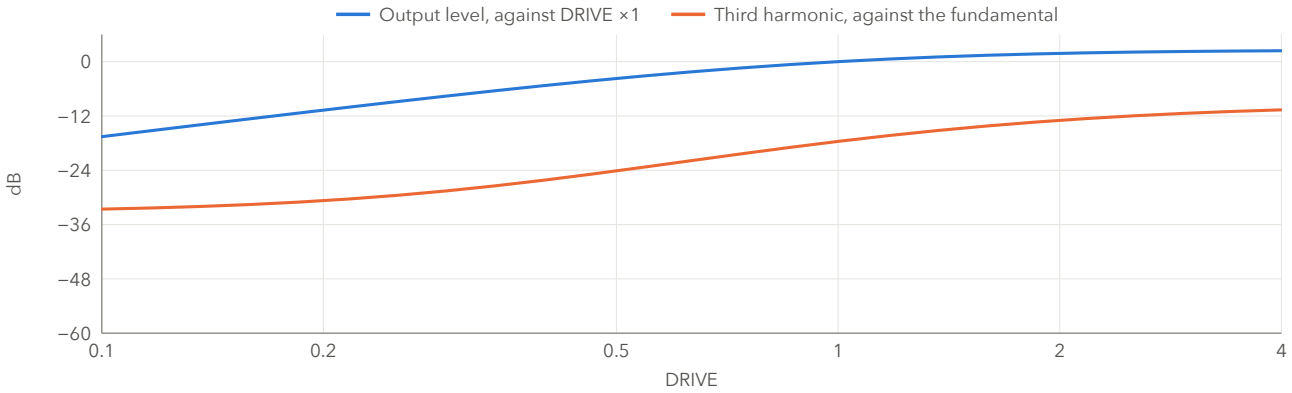
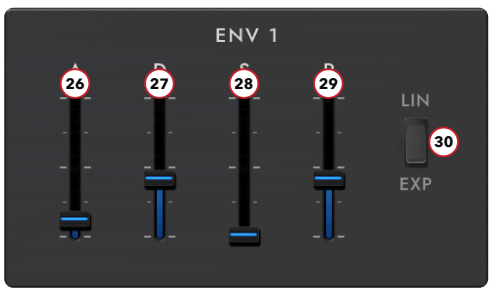


Figure 8. A 200 Hz sine at level 0.8 through the open filter, as DRIVE rises. Above ×1 the level hardly rises; the extra drive becomes distortion.

The matrix can move **CUTOFF** (in octaves: **Cutoff**, 48 semitones at depth 1) and **RESO**. It cannot move **DRIVE**.

5 · Envelopes



26	**A**	attack, 1 ms to 10 s
27	**D**	decay, 1 ms to 10 s
28	**S**	sustain level, 0 to 1
29	**R**	release, 1 ms to 10 s
30	**LIN / EXP**	the segments' shape

Each voice has two ADSR envelopes, **ENV 1** and **ENV 2**, with the same controls. Neither is connected to anything except through the matrix. At Init, Env 2 is routed to the VCA (**Amp**) and Env 1 to nothing. To sweep the filter with Env 1, add a route from Env 1 to **Cutoff**.

When a key goes down the envelope rises to 1 (attack), falls to the sustain level (decay), holds there while the key is held, and falls to 0 when it is released (release). A key released during the attack or decay goes straight to the release, from the level reached. A new note starts its attack from the envelope's current level, not from 0, so a fast repeated note does not click.

The time faders are exponential: 1 s at the centre. **S** is linear.

LIN / EXP sets the shape of the segments.

- **LIN**: straight lines. **A** is the time from 0 to 1, **D** the time from 1 to the sustain level, and **R** the time from the level at release to 0.
- **EXP**: curves, each approaching its target as a capacitor charges. **A** is the time from 0 to 1, as for LIN. The attack aims above 1 and stops when it reaches 1, so it is still rising steeply at the top, as an analogue envelope's does. **D** and **R** are the times to cover 99% of the distance.

Env 1 starts at LIN, Env 2 at EXP.

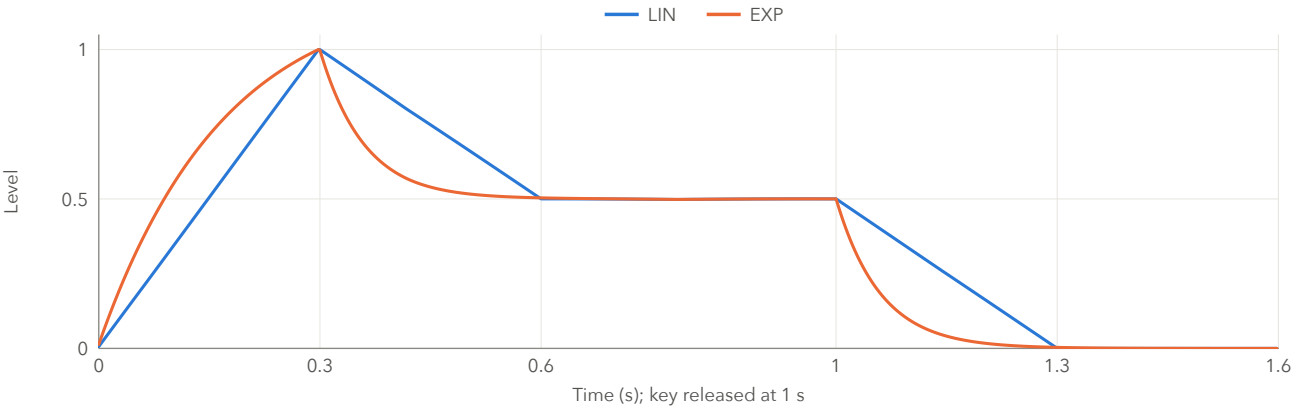
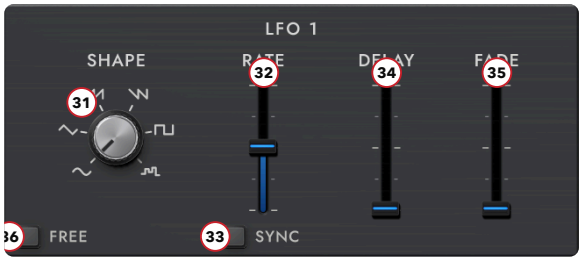


Figure 9. Env 2 on the VCA, read off the output: A 0.3 s, D 0.3 s, S 0.5, R 0.3 s.

The matrix can change an envelope's times and sustain for each note: **Env 1 Scale** and **Env 2 Scale** multiply all three times by up to 2 or by as little as ½, and **Env 1 Sustain** and **Env 2 Sustain** add to the sustain level. Both are read once, when the note starts. Routed from **Key**, for example, a scale shortens the envelopes of high notes, as on a piano.

6 · LFOs



31	**SHAPE**	six waveforms
32	**RATE**	0.01 to 40 Hz
33	**SYNC**	RATE as a note value
34	**DELAY**	silence after each note, 0 to 4 s
35	**FADE**	fade-in after the delay, 0 to 4 s
36	**FREE**	phase not reset by notes

LFO 1 runs once per voice. Each note restarts it (unless **FREE** is on), so the modulation always starts the same way on every note, and each voice of a chord moves on its own. **LFO 2** runs once per layer: every voice of the layer shares it, and notes do not restart it. LFO 2 has **SHAPE**, **RATE** and **SYNC** only; on Layer 2's page it also has **LINK** (Section 9).

Both LFOs swing between −1 and +1. **SHAPE** selects sine, triangle, rising saw, falling saw, square, or S&H (a new random value at the start of each cycle). A restarted LFO 1 starts at the point where its waveform crosses 0 rising, except the square and S&H, which start at the beginning of a cycle.

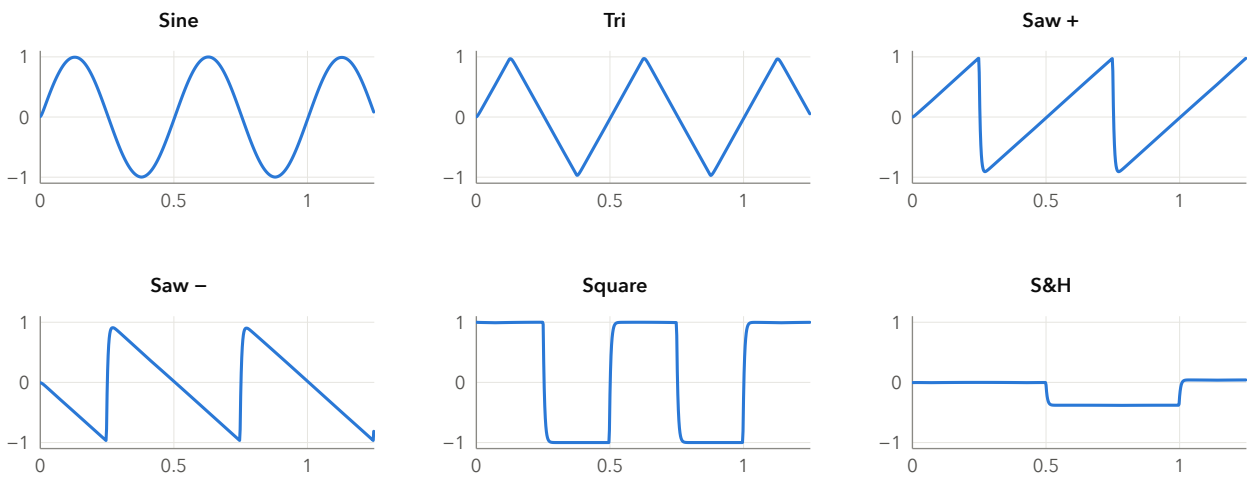


Figure 10. LFO 1 at 2 Hz from the start of a note, each shape read off the output through a route to **Amp**. Time in seconds.

RATE is exponential: 5 Hz at the centre. The LFOs are computed every 32 samples, so at fast rates their shapes become slightly stepped. With **SYNC** on, **RATE** selects a note value at the host's tempo instead, from a whole note (1/1) at the bottom to a thirty-second-note triplet at the top: 1/1, 1/1 dotted, 1/1 triplet, 1/2 … 1/32 triplet. Without a host tempo, 120 BPM is assumed. A synced LFO 2 restarts when the host's transport starts.

DELAY and **FADE** hold LFO 1 back after each note: its output is 0 for **DELAY**, then rises linearly to full over **FADE**. The LFO keeps running underneath, so the fade reveals it mid-cycle. Both start at 0.

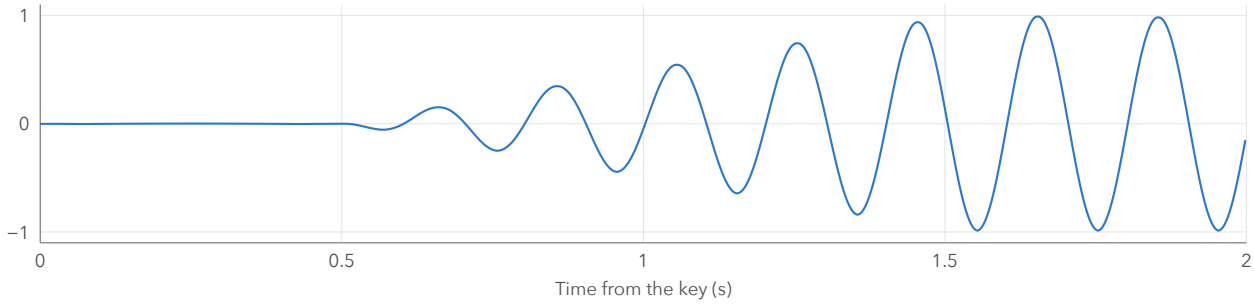
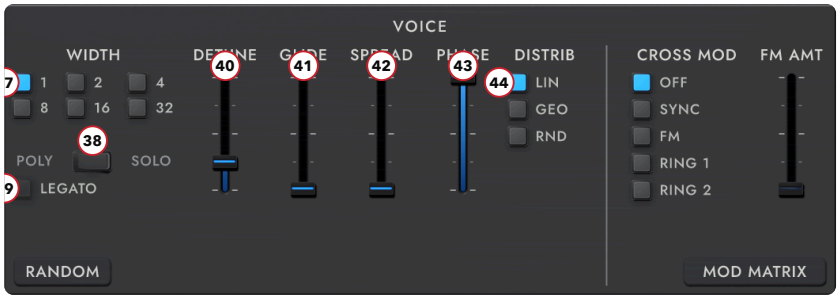


Figure 11. LFO 1, sine at 5 Hz, DELAY 0.5 s, FADE 1 s.

The matrix can change LFO 1's rate for each voice (**LFO 1 Rate**, two octaves either way at depth ±1).

7 · Voices and stacks



37	**WIDTH**	voices per note: 1 to 32	38	**POLY / SOLO**	chords, or one note at a time
39	**LEGATO**	Solo: no restart while a key is held	40	**DETUNE**	stack spread in pitch, 0 to 50 cents
41	**GLIDE**	glide time, 0 to 0.5 s	42	**SPREAD**	stack spread across the stereo image
43	**PHASE**	how random the stack's start phases are	44	**DISTRIB**	how the stack's voices are spaced

Each layer has 32 voices. **WIDTH** sets how many play each note: a **stack**. At 1 the layer plays up to 32 notes; at 8 it plays up to 4 notes of 8 voices each; at 32, one note.

WIDTH	1	2	4	8	16	32
Notes	32	16	8	4	2	1

When every voice is busy, a new note takes the stack of the oldest released note that is still sounding, or, if none, of the oldest held note. A stack's level is divided by the square root of its width, so a wide stack is about as loud as a single voice.

Detune, spread and distribution

The voices of a stack are laid out across a line from −1 to +1. **DETUNE** tunes each voice by its position times DETUNE, in cents, so the outermost voices are DETUNE above and below the note. **SPREAD** pans each voice by its position times SPREAD, through the Init patch's route from **Spread** to **Pan**. Both have no effect at **WIDTH** 1. DETUNE starts at 12 cents, SPREAD at 0.

DISTRIB sets the positions. **LIN** spaces the voices evenly. **GEO** draws the inner voices towards the centre, leaving the outer pair at the ends, for a stack with a strong centre and a thinner edge. **RND** places each voice at random, drawn again for every note.

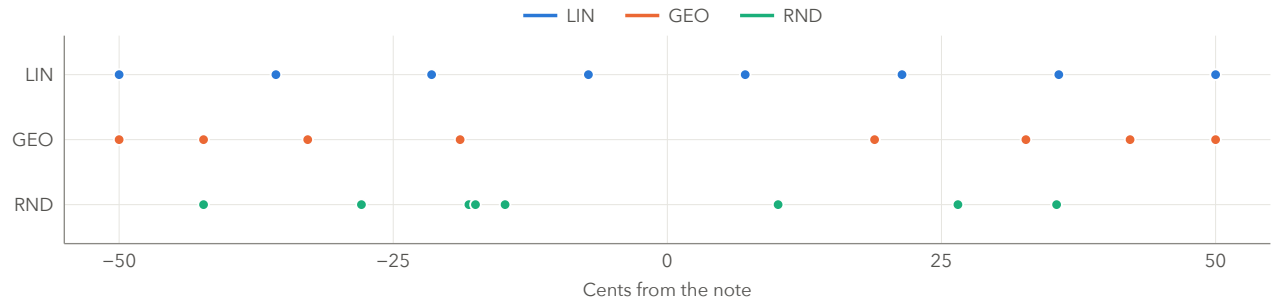


Figure 12. Where the eight voices of a stack sound, WIDTH 8 and DETUNE 50, measured as the peaks of the output's spectrum. RND is one note's draw.

PHASE sets how the voices of a stack start. At 0 every voice starts its cycle together, and a note begins with a strong, phase-aligned attack. At 1 (where it starts) each voice starts at a random point, and the stack sounds even from the first moment. With **FREE** on, an oscillator ignores PHASE.

Poly and Solo

POLY plays chords. **SOLO** plays one note (one stack) at a time. In Solo, held keys are remembered: release the newest and the note returns to the one held before it, the last one pressed.

LEGATO applies in Solo only. On, a key pressed while another is held changes the pitch without restarting the envelopes and LFO 1. The first key of a phrase always starts them. Off, every key restarts them.

GLIDE slides each voice's pitch to its new note. The glide slows as it nears the note: GLIDE is the time to cover about two thirds of the distance, and three times GLIDE covers 95% of it. The glide is even in pitch, so an octave up and an octave down take the same time. With **WIDTH** above 1, glides are much faster: the time is multiplied by 0.15, and GLIDE's readout shows the shortened time, marked "(stack)". Glide applies in Poly too, where each voice glides from the last note it played. It starts at 0 (off).

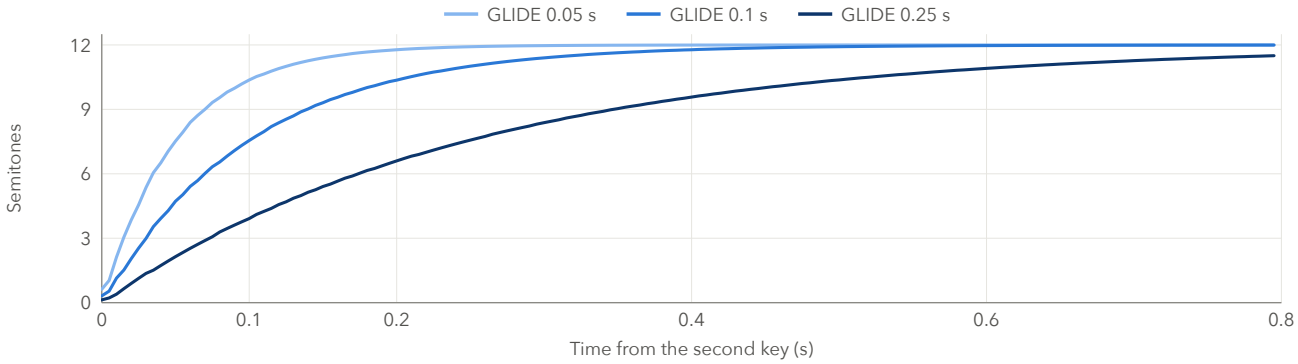


Figure 13. A legato octave in Solo, at three GLIDE settings, measured from the output's pitch.

8 · The modulation matrix

MOD MATRIX, at the foot of the VOICE panel, opens the layer's matrix over the page. Each layer has its own sixteen slots. A slot connects a **source** to a **destination**, at a **depth**. Click its ×, click outside it, or press Esc to close it.

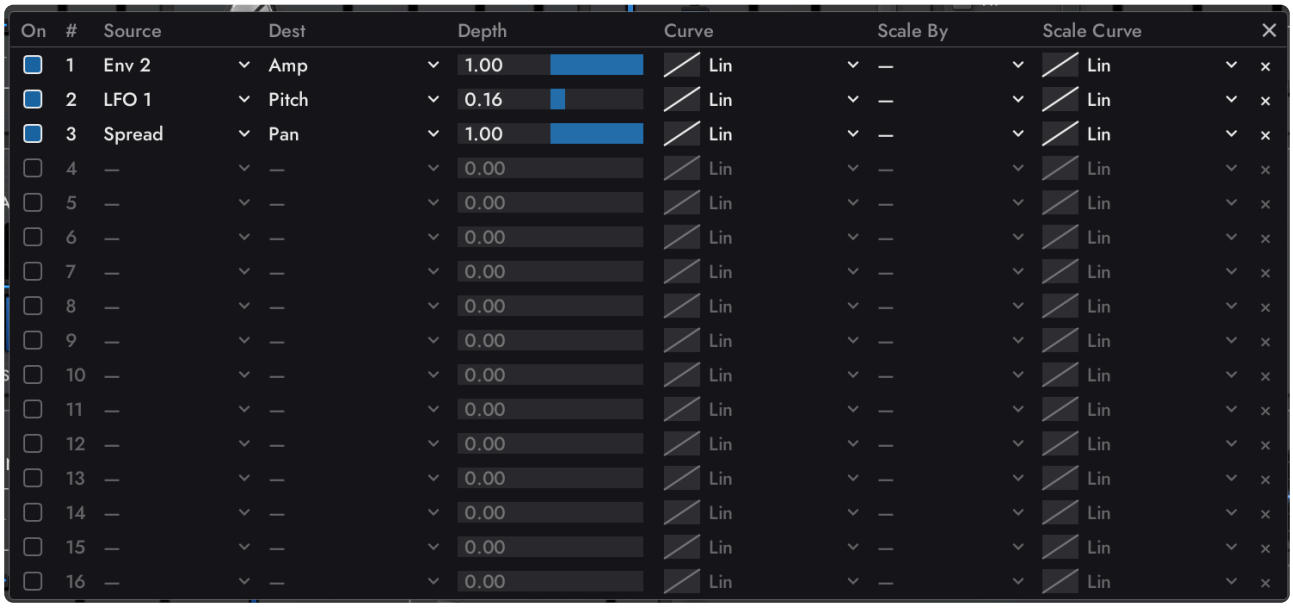


Figure 14. Layer 1's matrix at Init: Env 2 to Amp, LFO 1 to Pitch, Spread to Pan.

Column	What it sets
On	Whether the slot acts. A slot can be set up and switched off, to compare.
Source	What modulates.
Dest	What is modulated.
Depth	How much, from −1 to +1. Negative depths invert the source.
Curve	How the source's value is shaped before the depth.
Scale By	A second source that turns the route up and down.
Scale Curve	How the Scale By source is shaped.

The depths are the only part of the matrix a host can automate, as "Slot 1 Depth" to "Slot 16 Depth" for each layer. The rest is saved with the patch. Slots routed to the same destination add together.

Sources

Source	Range	What it is
Env 1	0 to 1	the envelope, 0 to 1
Env 2	0 to 1	the envelope, 0 to 1
LFO 1	−1 to +1	the voice's LFO, after DELAY and FADE
LFO 2	−1 to +1	the layer's LFO
Velocity	0 to 1	how hard the key was struck, 0 to 1
Key	0 to 1	the note, in octaves from C4 (C3 is −1, C5 is +1)
Mod Wheel	0 to 1	MIDI CC 1, 0 to 1
Pitch Wheel	−1 to +1	the pitch wheel, −1 to +1
Aftertouch	0 to 1	poly or channel pressure, 0 to 1; the latest message wins
Note Rnd	0 to 1	a random value for each voice, drawn at each note
Spread	−1 to +1	the voice's place in its stack, times SPREAD

Stack Pos	−1 to +1	the voice's place in its stack, −1 to +1

Every source is read for each voice. Key is the one source that goes outside its range: it counts octaves, so it reaches −5 at the bottom of the MIDI range.

Destinations

Destination	At depth 1	Unit	What it moves
Pitch	12	semitones	both oscillators; see the depth law below
Cross Mod Sweep	48	semitones	OSC 1 at SYNC, OSC 2 at FM, both otherwise (Section 3)
PWM (Both)	0.5	width	both pulse widths
Cutoff	48	semitones	the ladder's cutoff
Resonance	1	RESO	added to RESO, held within 0 to 1
Amp	1	level	the VCA; routes add, and the sum is held above 0
Cross Mod Amt	4	FM AMT	added to FM AMT; only at FM
Pan	1	pan	the voice's pan, held within hard left and right
Osc 1 PWM	0.5	width	OSC 1's pulse width
Osc 2 PWM	0.5	width	OSC 2's pulse width
Env 1 Scale	1	octaves of time	Env 1's times, ×½ to ×2, set at each note
Env 2 Scale	1	octaves of time	Env 2's times, ×½ to ×2, set at each note
LFO 1 Rate	2	octaves	LFO 1's rate, ×¼ to ×4
Env 1 Sustain	1	level	added to Env 1's S, set at each note
Env 2 Sustain	1	level	added to Env 2's S, set at each note

A source at its full value and a depth of 1 moves the destination by the amount in the second column; half the depth moves it half as far. The exception is **Pitch**, whose depth is cubed so that small depths give fine vibrato: depth 0.25 swings ±0.19 semitones, 0.5 ±1.5, and 1 a full octave.

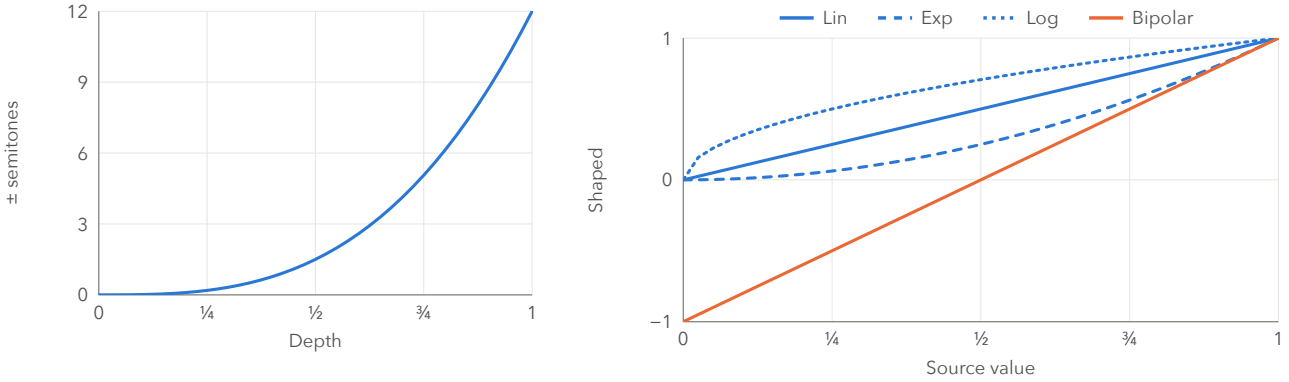


Figure 15. Left: a Pitch route's swing against its depth. Right: the curves applied to a source that runs from 0 to 1, from the engine's own shaping. Bipolar Exp and Log bend Bipolar as Exp and Log bend Lin. Abs leaves such a source as it is.

Curves

Curve shapes the source in two steps. First its range:

- **Lin** (no prefix) leaves it as it is.
- **Bipolar** turns a 0-to-1 source into −1 to +1: a mod wheel at its centre then does nothing, and moves the destination down below the centre and up above it.
- **Abs** folds a −1-to-+1 source into 0 to 1, so the route is strongest at both ends and does nothing in the middle. From **Spread** or **Stack Pos**, it reaches the outer voices of a stack and leaves the centre alone.

Then the response: **Exp** squares the value, so small values do less and the route comes in late; **Log** takes its square root, so small values do more. Both keep the sign.

Scale By

Scale By is a level control on the slot, worked by a second source. The route's output is multiplied by the Scale By source, brought into 0 to 1 and shaped by **Scale Curve**. A route from LFO 1 to Pitch scaled by the mod wheel gives vibrato that the wheel brings in; a route from Env 2 to Amp scaled by Velocity makes the level follow how hard each key is struck. With Scale By empty, the route is always at full.

Under Scale Curve, a −1-to-+1 source is moved into 0 to 1 by default (its centre becomes ½). **Bipolar** uses only the upper half of a source; **Abs** folds it, as for Curve. Exp and Log bend it as above.

Velocity and the VCA

The VCA's level is the sum of the routes to **Amp**. The Init patch routes Env 2 there and nothing else, so velocity does not change the level until a route uses it. The simplest is to set **Scale By** on slot 1 (Env 2 to Amp) to Velocity, as the Filter Envelope Bass patch does (Section 14).

A released voice keeps sounding until every envelope routed to Amp has finished its release. If nothing is routed to Amp, the voices are silent. The **Amp Gate** setting, available to a host but not on the faceplate, replaces the VCA with a plain on-off gate.

9 · Layers, scope and meters



45	**LAYER 1, LAYER 2**	each layer's level, 0 to 1
46	**PAN**	the layer's pan
47	**DETUNE**	the layer's tuning, ±50 cents
48	**MUTE**	silences the layer
49	**Split point**	the lowest note of Layer 1
50	**SPLIT**	divide the keyboard

LAYER 2 ON, in the header, switches Layer 2 on and off. Off, Layer 2 is not computed at all and Layer 1 plays every note. On, without **SPLIT**, both layers play every note: two sounds stacked. With **SPLIT** on, a note below the split point plays Layer 2, and a note at or above it plays Layer 1. The split point starts at C4 (MIDI 60). A layer whose arpeggiator is on arpeggiates the notes it is given (Section 10).

The pitch wheel, the mod wheel and aftertouch reach Layer 2 only while it is on.

MIXER, on the FX / GLOBAL page, has a strip for each layer, with a meter; the same level, pan and detune also appear on each layer's own page, beside its scope. **LEVEL** is linear. **PAN** keeps the total power constant: centred is unity, and a hard-panned layer is 3 dB louder in its channel. **DETUNE** tunes the whole layer, both oscillators and the sub, by up to 50 cents either way; its knob is exponential, with ±20 cents at the halfway points. **MUTE** silences the layer but keeps it running, so unmuting returns a held note mid-sound. Level, pan and mute changes fade over 10 ms.

LINK

On Layer 2's page, LFO 2 has a **LINK** button. With LINK on (and Layer 2 on), Layer 2's LFO 2 follows Layer 1's: the same rate and phase, so the two layers move together. Layer 2 keeps its own LFO 2 **SHAPE**. The Dual Layer Pad (Section 14) uses it to pan one layer with the other's filter sweep.

Copy and reset

COPY L1 TO L2 copies Layer 1's patch and matrix onto Layer 2, except Layer 2's mixer strip, sets Layer 2's **DETUNE** to 6 cents and switches Layer 2 on. **RESET LAYER** returns the layer being edited to Init, matrix and mixer strip included; the edited layer is the one whose page is shown, or on FX / GLOBAL the one last shown. Both ask for confirmation, and both can be undone.

Scope and meters

Each layer page has a **SCOPE** of that layer's output, before the effects: about 32 ms, starting at a rising zero crossing so that a held note stands still. Its lines mark 0 and −6 dB of full scale. Beside it is the layer's meter, and its **LEVEL**, **PAN** and **DETUNE**.

The meters show sample peaks from −60 to 0 dBFS, with a peak tick that holds for a second. The DYNAMICS panel's **GR** meter shows gain reduction, downwards, to 20 dB. Beside it, **IN** and **OUT** show the dynamics' input and output peaks, and MASTER's **OUT** meter shows what leaves vxn-1c, after **VOLUME** and **LIMIT**.

10 · Arpeggiator



51 **On**

52 **MODE** the order of the notes

53 **OCTAVES** how many octaves a pass climbs

54 **HOLD** keeps the notes after the keys lift

55 **RATE** a step, 1/4 to 1/32 of a note

56 **GATE** how much of a step a note sounds

57 **SWING** how late every second step is

Each layer has its own arpeggiator, under its scope. With it on, the keys the layer is given are not played directly: the arpeggiator holds them and plays them one at a time, a step at a time. It comes after the split, so with **SPLIT** on one layer can arpeggiate the keys below the split point while the other plays the keys above it; without SPLIT, each layer arpeggiates every key, or not, by its own setting.

The arpeggiator's notes reach the layer as keys would. **POLY** or **SOLO**, **WIDTH**, **GLIDE** and **LEGATO**, the envelopes and the matrix treat them as played notes, and each takes its key's velocity.

MODE sets the order:

- **UP**: lowest to highest, then again.
- **DOWN**: highest to lowest.
- **UP/DOWN**: up, then down, without repeating the top and bottom notes.
- **RANDOM**: any of the notes, never the same one twice running.
- **PLAYED**: the order the keys went down.

OCTAVES repeats the notes an octave higher for each octave above 1 before the pattern starts over: with C, E and G held at 2 octaves, UP plays C, E, G, then the same three an octave up. A note pushed above the top of MIDI's range is skipped.

RATE is the length of a step at the host's tempo: a quarter, eighth, eighth-triplet, sixteenth (at Init), sixteenth-triplet or thirty-second note. Without a host the tempo is 120 BPM. **GATE**, 5 to 100 %, is the share of each step a note sounds. At 100 % each note starts as the last one ends, so a **SOLO** layer with **LEGATO** slides from note to note. **SWING**, 0 to 50 %, delays every second step by that share of a step: 0 is straight, and about 33 % a triplet shuffle.

While the host plays, the steps fall on its beat grid: a key waits for the next step, and when the host loops or jumps, the arpeggiator moves with it. While the host is stopped, or without a host, the first key plays at once and the steps run on from it.

HOLD keeps the notes playing after the keys lift. A key pressed while none is held starts a new set of notes in their place. Turning HOLD off drops the notes whose keys are up.

Without HOLD, lifting every key stops the arpeggiator once its last note ends. Turning the arpeggiator off, or turning Layer 2 off, ends the note it is playing. Keys already down when the arpeggiator comes on keep sounding until they lift.

11 · Effects

The two layers' sum passes through **DYNAMICS**, **CHORUS**, **PHASER**, **DELAY** and **REVERB**, in that order, then **VOLUME** and **LIMIT**. Each effect has an on button in its panel's corner; all are off at Init. Switching one on or off fades over 30 ms. All the effects work in stereo, and run at the host's sample rate.

Dynamics



- 58 **On**
- 59 **THRESH** −60 to 0 dB
- 60 **RATIO** 1 to 20
- 61 **ATK** attack, 0.1 to 200 ms
- 62 **REL** release, 5 to 1000 ms
- 63 **MKUP** makeup gain, 0 to 24 dB
- 64 **DRIVE** saturation, 0 to 36 dB
- 65 **MIX** dry against processed

A compressor followed by a saturator. The compressor follows the louder of the two channels' peaks and turns both down together. Above **THRESH**, each **RATIO** dB of input gives 1 dB of output, with a soft knee 6 dB wide. **ATK** and **REL** are the times the gain takes to follow a rise and a fall. **MKUP** adds gain after compression.

DRIVE then saturates the signal. It keeps full scale at full scale and raises everything below it, so it both thickens the sound and makes it louder. At 0 dB it has no effect.

MIX blends the unprocessed signal with the processed one: below 1, quiet details stay while the peaks are held down (parallel compression). It starts at 1.

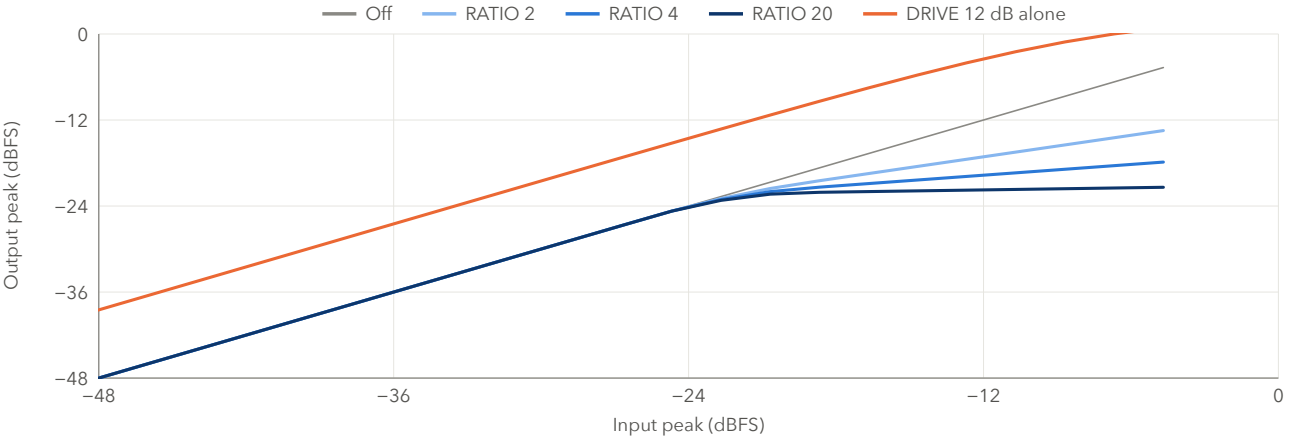
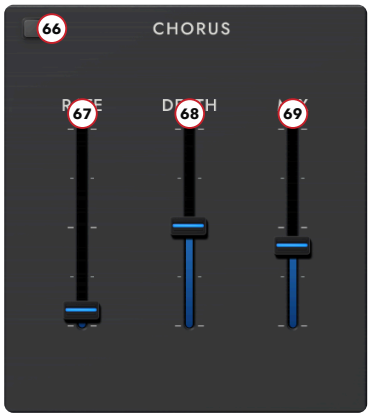


Figure 16. Steady-state levels of a 1 kHz sine, THRESH −24 dB, MKUP 0. The input was swept with Layer 1's level.

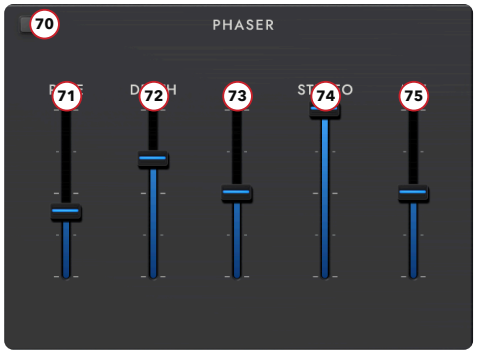
Chorus



- 66 **On**
- 67 **RATE** sweep rate, 0.05 to 8 Hz
- 68 **DEPTH** sweep width
- 69 **MIX** dry against wet

A model of a bucket-brigade chorus, as in Poly-Kritter. Each channel has its own delay line, swept by a triangle; the right channel's sweep is inverted, which widens the image. **DEPTH** sweeps the delay around 3.5 ms: at 1, from 1.7 to 5.3 ms. **MIX** trades the dry signal against the wet at constant power. The delay lines add a little saturation, high-frequency loss, slow random drift and a faint hiss, which is audible in silence while the chorus is on.

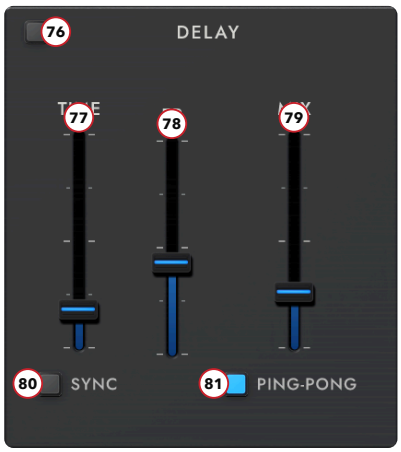
Phaser



- 70 **On**
- 71 **RATE** 0.05 to 10 Hz
- 72 **DEPTH** sweep width
- 73 **FB** feedback, −0.9 to 0.9
- 74 **STEREO** right channel's LFO offset, 0 to 180°
- 75 **MIX** dry against wet

Four all-pass stages per channel, which make two notches, swept by a triangle LFO around 600 Hz: two octaves either way at **DEPTH** 1. **FB** feeds the output back for sharper notches and peaks; negative values move them. **STEREO** offsets the right channel's sweep: at 180° (where it starts) the channels move in opposite directions, at 0° together. **RATE** is exponential, 1 Hz at the centre.

Delay

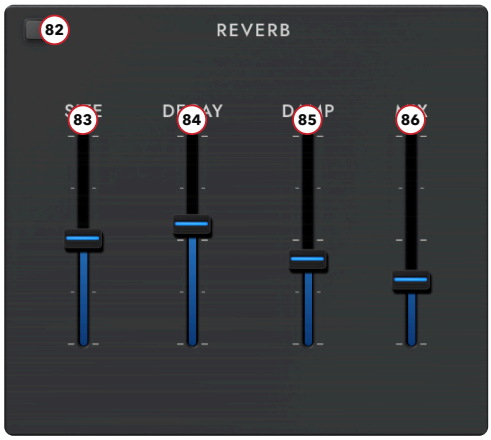


- 76 **On**
- 77 **TIME** 10 ms to 2 s
- 78 **FB** feedback, 0 to 0.95
- 79 **MIX** dry against wet
- 80 **SYNC** TIME as a note value
- 81 **PING-PONG** repeats cross between the channels

A stereo delay. **FB** sets how much of each repeat returns; every repeat after the first loses a little treble. Changing **TIME** while the delay sounds bends the pitch of the repeats as the time glides. With **SYNC** on, **TIME** selects a note

value at the host's tempo, from 1/1 to 1/32 triplet, as for the LFOs. **PING-PONG** (on at Init) crosses each channel's repeats to the other. A sound in the centre gives the same repeats in both channels, so to hear them alternate, pan the layer or use **SPREAD**. Switching the delay off and on clears its repeats.

Reverb



- 82 **On**
- 83 **SIZE** room size
- 84 **DECAY** reverberation time, 0.2 to 10 s
- 85 **DAMP** high-frequency loss
- 86 **MIX** dry against wet

A feedback-delay-network reverb of eight lines. **SIZE** scales the lines' lengths, from a small room to a large hall; changes glide over half a second. **DECAY** sets the time the reverberation takes to fall by 60 dB. **DAMP** makes the high frequencies die away sooner, from no loss at 0 to a dark tail at 1. There is no pre-delay.

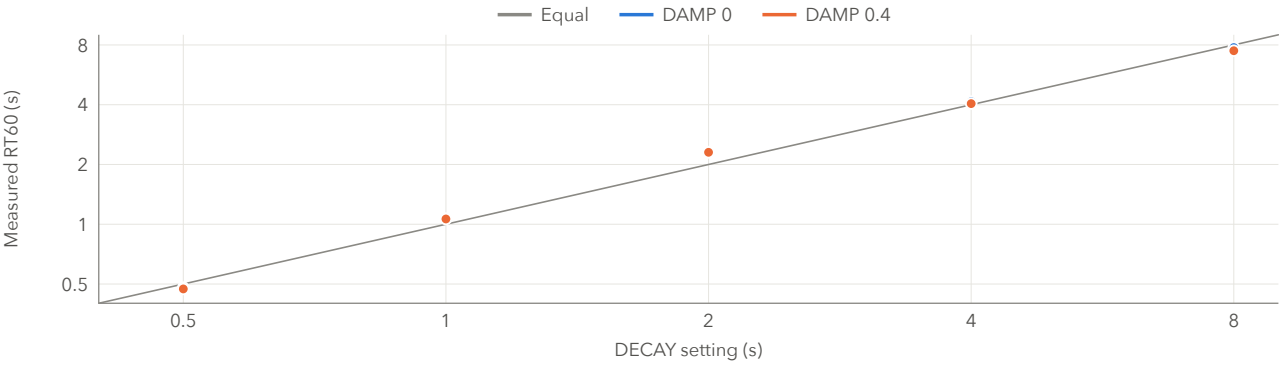
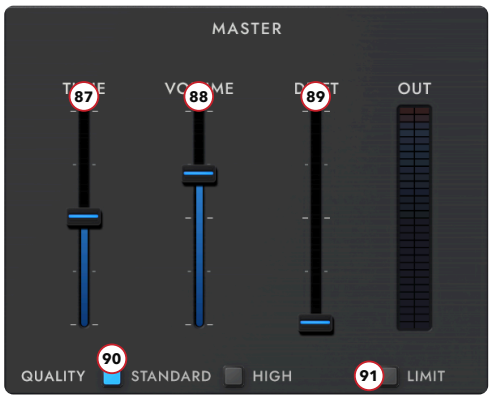


Figure 17. Reverberation time measured from the decay of a short note, against DECAY, SIZE 0.5.

12 · Master



- 87 **TUNE** ±12 semitones
- 88 **VOLUME** output level, 0 to 1
- 89 **DRIFT** analogue variation, 0 to 1
- 90 **STANDARD / HIGH** quality
- 91 **LIMIT** output limiter

TUNE transposes both layers, in semitones. **VOLUME** scales the output after the effects, linearly; it starts at 0.7.

DRIFT makes the voices differ as analogue voices do. Each oscillator of each voice wanders in pitch by up to 12.5 cents at DRIFT 1, slowly and at random, OSC 1 and OSC 2 separately. Each voice also gets fixed offsets: its cutoff by

up to 3 cents, its resonance by up to 7%, its envelope times by up to 12% and its sustain levels by up to 3%. All scale with DRIFT. At 0, where it starts, every voice is identical.

LIMIT stops the output exceeding full scale. It looks 2 ms ahead, holds peaks at about −0.6 dBFS and recovers over 100 ms. It delays the output by 2 ms while on. Without it, nothing stops the output going above full scale, where the host or the converter clips it. It starts off.

Quality

QUALITY sets the rate at which the voices run: the oscillators, mixer, filters and VCA, each voice several samples for each of the host's. A higher rate costs more processing and reduces aliasing: the inharmonic tones that appear when a sound's harmonics pass half the sample rate and fold back. They matter most on high notes, bright waveforms, sync, FM and a driven filter.

- **STANDARD** runs the voices at twice the host's rate, or a layer's voices at four times while that layer's **CROSS MOD** is **FM**, whatever its amount. FM's sidebands spread far above the note, and at twice the rate they fold back loudly. Each layer runs at its own rate, so FM on one layer doesn't cost the other.
- **HIGH** runs them at eight times the host's rate. In the web build it stops at four times.

At **HIGH** the **DYNAMICS**, while its **DRIVE** is above 0 dB, and the **PHASER** run at twice the host's rate too, which takes 13 to 68 dB off the aliasing their saturation makes. The other effects run at the host's rate either way. Each setting sounds the same apart from aliasing: on the factory presets, **STANDARD** is within 0.4 dB of **HIGH** in every third-octave band within 30 dB of the loudest. Changing the setting, or a layer's **CROSS MOD** to or from **FM**, crossfades over 5 ms, and the effects move between rates over 10 ms. It starts at **STANDARD**.

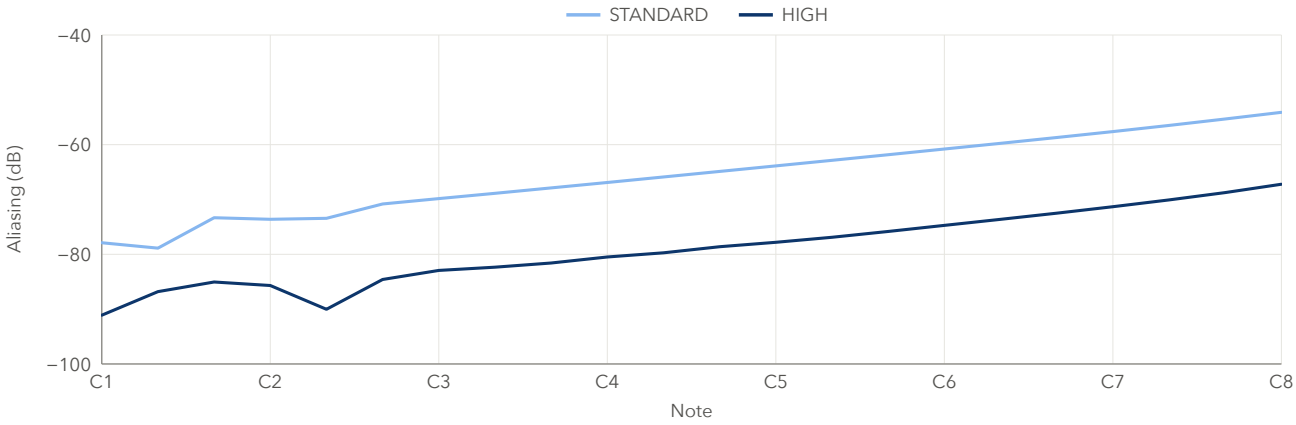


Figure 18. Alias energy below 20 kHz against the harmonics, for OSC 1's saw at its Init level with the filter open, at 48 kHz. HIGH takes 12 to 14 dB off STANDARD.

QUALITY	8 voices	64 voices	8 voices, web	64 voices, web
STANDARD	1.1%	7.4%	1.4%	9.0%
STANDARD, FM on LAYER 1	1.9%	10.6%	2.4%	12.9%
HIGH	3.7%	26.5%	2.4%	16.7%

The share of one processor core (Apple M3) at 48 kHz, eight notes held on the Init patch, the effects off. At **HIGH** the **DYNAMICS** and the **PHASER** together add about 1% more while sound passes through them; once their input has been silent long enough for any ringing to die away, they stop costing anything. The **CHORUS** keeps hissing in silence, as a bucket-brigade chorus does, so with it on the effects after it keep running. 64 voices is both layers at **WIDTH** 4; with **FM** on **LAYER 1**, **LAYER 2** stays at twice the host's rate. The web build was timed in V8, the WebAssembly engine of Chrome and Node, where **HIGH** runs at four times the host's rate.

MIDI and the host

vxn-1c responds to notes on every MIDI channel, the pitch wheel, the mod wheel (CC 1), and poly and channel aftertouch. It does not use MPE. The pitch wheel bends both layers by up to **Bend Range** semitones (2 at Init, up

to 12), a setting available to the host but not on the faceplate. Velocity, the wheels and aftertouch do nothing else unless the matrix uses them.

The host sees vxn-1c's 199 automatable parameters: 75 for each layer, 35 shared, and 7 for each layer's arpeggiator. The matrix's routing, the split and LINK are saved with the patch but cannot be automated.

The host's tempo sets the synced LFO rates, the synced delay time and the arpeggiators' rates, and its position puts the arpeggiators' steps on its beat grid (Section 10).

In the web build there is no host: the tempo is 120 BPM, the transport is stopped, and user presets are kept in the browser. Play it from the on-screen keyboard, the computer keys or a MIDI controller.

13 · Presets

The preset bar shows the current preset's name; ‹ and › step through the presets. **BROWSE** opens the browser of factory and user presets, by category. **SAVE** overwrites the current preset if it is a user preset, and otherwise acts as **SAVE AS**, which asks for a name and folder. A preset holds both layers, their matrices, the split, LINK and every global setting.

RANDOM, at the bottom left of the VOICE panel on each layer page, makes a new sound on that layer, one undo step. It picks one of eleven kinds — Bass, Pluck, Brass, Lead, Pad, Keys, Bell, Poly, FX, String or Arp — and builds the layer from Init in that kind's manner, matrix routes, cross mod and voicing included; an Arp switches on the layer's arpeggiator. The other layer, the split, LINK and every global setting, the effects among them, stay as they were; RANDOM on Layer 2 switches Layer 2 on. The sound gets a two-word name, and the name's tooltip gives its kind and a five-character seed, "Random Pad, seed 3F2AK": quote the seed to report a sound. **SAVE AS** then offers a user folder named after the kind.

14 · Patches

Each patch in this chapter is a factory preset, under the category given: load it by name. The pictures are the preset as vxn-1c draws it, and the numbered controls are the settings that differ from Init, with their values in the key below each picture. Build each from Init to learn how it works, or load it and change it.

Filter Envelope Bass

Factory preset: Bass / Filter Envelope Bass

A mono bass whose filter closes after each note. The patch adds three things to Init.

Env 1 sweeps **CUTOFF**: slot 4 routes it to **Cutoff** at depth 0.7, about 34 semitones, so each note starts nearly three octaves above the 180 Hz cutoff and falls back within half a second. **RESO** at 0.45 makes the sweep audible as a vowel-like peak, and the **SUB** adds weight an octave down.

Velocity opens the filter further (slot 5) and sets the level: slot 1, Env 2 to Amp, is scaled by Velocity, shaped by Log so that soft notes are not too quiet.

SOLO with a little **GLIDE** makes overlapping notes slide. Play staccato for separate notes, legato for slides.



Figure 19. Filter Envelope Bass: the Layer 1 page.

1 **Osc 2 Fine**	7.00 ct	2 **Sub Level**	0.500	3 **Cutoff**	180.00 Hz
4 **Resonance**	0.450	5 **Drive**	1.500	6 **Env 1 Attack**	1 ms
7 **Env 1 Decay**	0.35 s	8 **Env 1 Release**	0.15 s	9 **Env 1 Shape**	Exp
10 **Env 2 Attack**	1 ms	11 **Env 2 Decay**	0.30 s	12 **Env 2 Sustain**	0.850
13 **Env 2 Release**	0.12 s	14 **Voice**	Solo	15 **Glide Time**	30 ms



Figure 20. Filter Envelope Bass: the FX / GLOBAL page.

16 **Volume** 1.000

Layer	Slot	Source	Dest	Depth	Curve	Scale By
1	1	Env 2	Amp	1.00	Lin	Velocity (Log)
1	4	Env 1	Cutoff	0.70	Lin	—
1	5	Velocity	Cutoff	0.20	Lin	—

Sync Lead

Factory preset: Lead / Sync Lead

A sync lead whose timbre sweeps on each note. **CROSS MOD** is at **SYNC**, so OSC 1 restarts with OSC 2, and OSC 2's mixer level is 0, so only OSC 1 is heard. OSC 2 is raised to the same octave as OSC 1.

Slot 4 routes Env 1 to **Cross Mod Sweep**, which at SYNC raises OSC 1's pitch alone: each note starts 24 semitones up and falls to a fifth of that as Env 1 decays. The mod wheel (slot 5) adds up to another 14 semitones, for a held note that sweeps as the wheel moves.

SOLO and **LEGATO** with a short **GLIDE** make a monophonic lead. The delay is synced to a dotted eighth note.



Figure 21. Sync Lead: the Layer 1 page.

(1) **Osc 2 Octave**	0 oct	(2) **Osc 2 Level**	0.000	(3) **Cross Mod**	Sync
(4) **Cutoff**	6000.00 Hz	(5) **Env 1 Attack**	1 ms	(6) **Env 1 Decay**	0.60 s
(7) **Env 1 Sustain**	0.200	(8) **Env 1 Shape**	Exp	(9) **Voice**	Solo
(10) **Legato**	On	(11) **Glide Time**	50 ms		



Figure 22. Sync Lead: the FX / GLOBAL page.

(12) **Volume**	1.000	(13) **Delay**	On	(14) **Delay Time**	1/8.
(15) **Delay FB**	0.350	(16) **Delay Mix**	0.200	(17) **Delay Sync**	On

Layer	Slot	Source	Dest	Depth	Curve	Scale By
1	4	Env 1	Cross Mod Sweep	0.50	Lin	—
1	5	Mod Wheel	Cross Mod Sweep	0.30	Lin	—

Wide Unison Lead

Factory preset: Lead / Wide Unison Lead

A wide stack lead. **WIDTH** 8 plays eight voices per note, **DETUNE** spreads them 18 cents either way, and **SPREAD** 0.8 fans them across the stereo image. Both oscillators are saws in the same octave. Env 1 moves the cutoff a little (slot 4).

Vibrato comes from the Init patch's route from LFO 1 to Pitch (slot 2), deepened to 0.35 (about half a semitone) and scaled by the mod wheel, so it is silent until the wheel moves. **DELAY** and **FADE** hold it back for 0.4 s, then bring it in over 0.6 s, after each new note.

In **SOLO** with **LEGATO**, the stack slides between held notes. With WIDTH above 1 a glide takes 0.15 of the fader's time, which is what GLIDE's readout and the table below show.



Figure 23. Wide Unison Lead: the Layer 1 page.

① Osc 2 Octave	0 oct	② Cutoff	3000.00 Hz	③ Resonance	0.150
④ Env 1 Decay	0.50 s	⑤ Env 1 Sustain	0.300	⑥ LFO 1 Rate	5.50 Hz
⑦ LFO 1 Delay	0.40 s	⑧ LFO 1 Fade	0.60 s	⑨ Width	8
⑩ Voice	Solo	⑪ Legato	On	⑫ Detune	18.00 ct
⑬ Glide Time	6 ms (stack)	⑭ Spread	0.800		

Layer	Slot	Source	Dest	Depth	Curve	Scale By
1	2	LFO 1	Pitch	0.35	Lin	Mod Wheel (Lin)
1	4	Env 1	Cutoff	0.25	Lin	—

Phase Mod Bell

Factory preset: Keys / Phase Mod Bell

A struck bell from phase modulation. Both oscillators are sines, and **CROSS MOD** is at **FM**: OSC 2 modulates OSC 1's phase. OSC 2 is two octaves and two semitones up, a ratio of about 4.49, which gives inharmonic sidebands, and its mixer level is 0.

The index starts at **FM AMT** 0.1, and Env 1 (slot 4) adds up to 0.4 more at the strike, falling over about a second, so each note starts bright and mellows. Harder notes start brighter: Velocity adds up to 0.2 (slot 5). Small values of FM AMT go a long way: it counts whole cycles of phase, so 0.4 is already a strong modulation.

Env 2 has no sustain and a long decay and release, so notes ring after the key. The reverb is on.



Figure 24. Phase Mod Bell: the Layer 1 page.

1 **Osc 1 Wave**	Sine	2 **Osc 2 Wave**	Sine	3 **Osc 2 Coarse**	2 st
4 **Osc 2 Octave**	2 oct	5 **Osc 2 Level**	0.000	6 **Cross Mod**	FM
7 **Cross Mod Amt**	0.100	8 **Cutoff**	12000.00 Hz	9 **Resonance**	0.000
10 **Env 1 Attack**	1 ms	11 **Env 1 Decay**	1.20 s	12 **Env 1 Release**	0.80 s
13 **Env 1 Shape**	Exp	14 **Env 2 Attack**	1 ms	15 **Env 2 Decay**	3.00 s
16 **Env 2 Sustain**	0.000	17 **Env 2 Release**	2.50 s		



Figure 25. Phase Mod Bell: the FX / GLOBAL page.

(18) **Volume** 0.380 (19) **Reverb** On (20) **Reverb Size** 0.700

(21) **Reverb Decay** 3.00 s

Layer	Slot	Source	Dest	Depth	Curve	Scale By
1	4	Env 1	Cross Mod Amt	0.10	Lin	—
1	5	Velocity	Cross Mod Amt	0.05	Lin	—

PWM Strings

Factory preset: Pad / PWM Strings

A string ensemble from two pulse waves. OSC 1 and OSC 2 are pulses in the same octave, OSC 2 six cents sharp. Their widths are swept by different LFOs: LFO 2, a 0.35 Hz triangle shared by every voice, moves OSC 1's (slot 4), and LFO 1, per voice at 0.6 Hz and free-running, so that notes do not restart it, moves OSC 2's (slot 5).

WIDTH 2 with a little **DETUNE** and **SPREAD** widens each note. **HPF** at 150 Hz thins the low end, and **KEY** at 0.5 opens the filter on higher notes. A slow attack and release, chorus and reverb finish the sound.



Figure 26. PWM Strings: the Layer 1 page.

(1) **Osc 1 Wave**	Pulse	(2) **Osc 2 Wave**	Pulse	(3) **Osc 2 Fine**	6.00 ct
(4) **Osc 2 Octave**	0 oct	(5) **Cutoff**	2500.00 Hz	(6) **Resonance**	0.100
(7) **HPF Cutoff**	150.00 Hz	(8) **Key Track**	0.500	(9) **Env 2 Attack**	0.45 s
(10) **Env 2 Decay**	1.00 s	(11) **Env 2 Release**	1.20 s	(12) **LFO 1 Rate**	0.60 Hz
(13) **LFO 1 Free**	On	(14) **LFO 2 Shape**	Tri	(15) **LFO 2 Rate**	0.35 Hz
(16) **Width**	2	(17) **Detune**	6.00 ct	(18) **Spread**	0.600



Figure 27. PWM Strings: the FX / GLOBAL page.

(19) **Volume**	0.420	(20) **Chorus**	On	(21) **Chorus Rate**	0.50 Hz
(22) **Chorus Depth**	0.600	(23) **Chorus Mix**	0.500	(24) **Reverb**	On
(25) **Reverb Mix**	0.250				

Layer	Slot	Source	Dest	Depth	Curve	Scale By
1	4	LFO 2	Osc 1 PWM	0.70	Lin	—
1	5	LFO 1	Osc 2 PWM	0.60	Lin	—

Dual Layer Pad

Factory preset: Dual / Dual Layer Pad

Two layers on every note. **LAYER 2 ON** is lit and **SPLIT** is off.

Layer 1 is a pad of two saws a few cents apart, through a resonant low-pass. Its LFO 2, a slow sine, sweeps the cutoff (slot 4).

Layer 2 is a triangle an octave up, with a slower attack, at level 0.6 and 4 cents sharp of Layer 1. **LINK** is on, so Layer 2's LFO 2 moves with Layer 1's, and Layer 2 routes it to **Pan** (slot 4): the upper layer moves across the stereo image in time with the lower layer's filter sweep. The reverb, on FX / GLOBAL, is shared by both layers.



Figure 28. Dual Layer Pad: the Layer 1 page.

1	**Osc 2 Fine**	9.00 ct	2	**Osc 2 Octave**	0 oct
3	**Cutoff**	1800.00 Hz	4	**Resonance**	0.250
5	**Env 2 Attack**	0.60 s	6	**Env 2 Sustain**	0.900
7	**Env 2 Release**	1.50 s	8	**LFO 2 Rate**	0.20 Hz
9	**Layer 2**	On			



Figure 29. Dual Layer Pad: the Layer 2 page.

10	**Osc 1 Wave**	Triangle	11	**Osc 1 Octave**	1 oct
12	**Osc 2 Level**	0.000	13	**Env 2 Attack**	1.20 s
14	**Env 2 Sustain**	1.000	15	**Env 2 Release**	2.00 s
16	**Layer Level**	0.600	17	**Layer Detune**	4.00 ct
18	**LFO 2 Link**	On			



Figure 30. Dual Layer Pad: the FX / GLOBAL page.

(19) **Volume** 0.500 (20) **Reverb** On (21) **Reverb Size** 0.800

(22) **Reverb Mix** 0.350

Layer	Slot	Source	Dest	Depth	Curve	Scale By
1	4	LFO 2	Cutoff	0.10	Lin	—
2	4	LFO 2	Pan	0.60	Lin	—

Split Arp and Pad

Factory preset: Split / Split Arp and Pad

An arpeggio in the left hand and a pad in the right. **LAYER 2 ON** and **SPLIT** are lit, with the split point at C4, so the keys below C4 play Layer 2 and the rest play Layer 1.

Layer 2 is a plucked sound: a saw and a 0.3-wide pulse seven cents apart, through a resonant low-pass at 500 Hz that Env 1 opens at the start of each note (slot 4). Its arpeggiator is on, at **UP/DOWN** over 2 **OCTAVES**: hold a chord below C4 and it climbs two octaves from it and comes back down, a sixteenth note a step at the host's tempo. **GATE** 60 % leaves a short gap between notes, and **SWING** 15 % gives a light shuffle.

Layer 1 is Init made into a pad: a 0.6 s attack and 1.2 s release, the cutoff at 1.8 kHz, and two voices a note (**WIDTH** 2) detuned and spread, at level 0.6 so that it sits under the arpeggio. A dotted-eighth ping-pong delay and the reverb, on FX / GLOBAL, are shared by both layers.



Figure 31. Split Arp and Pad: the Layer 1 page.

1	**Cutoff**	1800.00 Hz	2	**Env 2 Attack**	0.60 s	3	**Env 2 Release**	1.20 s
4	**Layer Level**	0.600	5	**Width**	2	6	**Detune**	10.00 ct
7	**Spread**	0.500	8	**Layer 2**	On			



Figure 32. Split Arp and Pad: the Layer 2 page.

9 **Osc 2 Wave**	Pulse	10 **Osc 2 Fine**	7.00 ct	11 **Osc 2 Octave**	0 oct
12 **Osc 2 Level**	0.500	13 **Osc 2 PW**	0.300	14 **Cutoff**	500.00 Hz
15 **Resonance**	0.350	16 **Env 1 Attack**	1 ms	17 **Env 1 Decay**	0.18 s
18 **Env 1 Release**	0.15 s	19 **Env 2 Attack**	2 ms	20 **Env 2 Decay**	0.25 s
21 **Env 2 Sustain**	0.300	22 **Env 2 Release**	0.15 s	23 **Arp**	On
24 **Arp Mode**	Up/Down	25 **Arp Octaves**	2	26 **Arp Gate**	60 %
27 **Arp Swing**	15 %				



Figure 33. Split Arp and Pad: the FX / GLOBAL page.

(28) **Delay**	On	(29) **Delay Time**	1/8.	(30) **Delay FB**	0.350
(31) **Delay Mix**	0.200	(32) **Delay Sync**	On	(33) **Reverb**	On
(34) **Reverb Mix**	0.250	(35) **Split**	On		

Layer	Slot	Source	Dest	Depth	Curve	Scale By
2	4	Env 1	Cutoff	0.50	Lin	—

15 · Reference

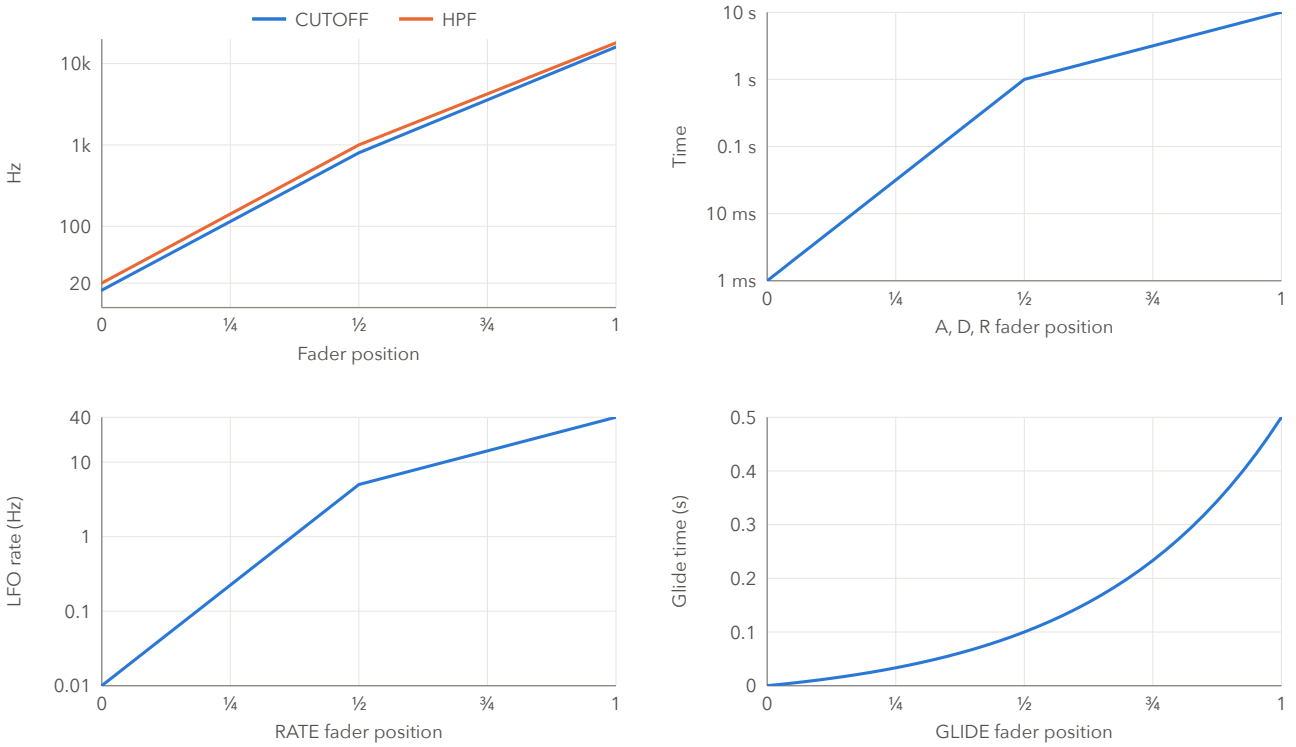


Figure 34. The fader laws, from the parameter table.

Quantity	Value	Notes
Voices	32 per layer	WIDTH 1 to 32 per note
Oscillator pitch	OCT ±4, SEMI ±7, FINE ±50 ct	plus TUNE ±12 st, layer DETUNE ±50 ct
Pulse width	5% to 95%	also under the matrix
FM AMT	0 to 4	phase-modulation index, in cycles
HPF	20 Hz to 18 kHz, 6 dB/oct	per layer, always on
Ladder cutoff	16.35 Hz to 16 kHz	800 Hz at the fader's centre
Ladder slope	12 or 24 dB/oct	NOTCH always two-pole
RESO	0 to 1	self-oscillates from 0.95
DRIVE	×0.1 to ×4	
KEY	0 to 1	1 = an octave per octave, pivot C0
Envelope times	1 ms to 10 s	LIN and EXP attacks both peak at A
LFO rate	0.01 to 40 Hz	or 18 note values with SYNC
LFO 1 DELAY, FADE	0 to 4 s each	
DETUNE (stack)	0 to 50 ct	outermost voices at ±DETUNE
GLIDE	0 to 0.5 s	time constant; ×0.15 for stacks
Matrix	16 slots per layer	depth ±1
DRIFT	±12.5 ct pitch wander at 1	plus fixed per-voice offsets
QUALITY	STANDARD 2× (4× with FM), HIGH 8×	the voices; at HIGH the dynamics and phaser at 2×; the web's HIGH 4×
Limiter	≈ −0.6 dBFS, 2 ms look-ahead	100 ms release
Tempo	the host's	120 BPM without one

The measurements in this manual are taken by running vxn-1c's engine at 48 kHz, through the same interface a host uses: parameters set, notes played, and the output analysed. The faceplate pictures are drawn by the same code that draws the plugin's window.

Troubleshooting

- **No sound:** nothing is routed to **Amp** in the matrix, or every route to Amp is switched off. RESET LAYER restores Init's route from Env 2.
- **Velocity makes no difference:** velocity acts only through the matrix (Section 8).
- **The filter envelope does nothing:** Env 1 is not connected at Init. Route it to **Cutoff**.
- **The sound gets quieter as RESO rises:** the ladder's feedback lowers the passband; raise the level or DRIVE.
- **Distortion at Init levels:** the ladder saturates. Lower DRIVE or the mixer levels.
- **DETUNE, SPREAD or PHASE do nothing:** WIDTH is 1.
- **FM AMT does nothing:** CROSS MOD is not at FM.
- **Only one or a few notes sound:** WIDTH is wide; at 32, the layer plays one note.
- **Layer 2 is silent:** LAYER 2 ON is off, its MUTE is on, or SPLIT is on and the notes are above the split point.
- **PING-PONG repeats don't alternate:** the sound is in the centre. Pan the layer, or use SPREAD.
- **A hiss with the chorus on:** the chorus models a bucket-brigade line, which hisses.
- **Keys play one note at a time, or a key sounds late:** the layer's arpeggiator is on. While the host plays, a key waits for the next step of its beat grid.
- **Notes keep playing after the keys lift:** the arpeggiator's HOLD is on.