Noise Engineering

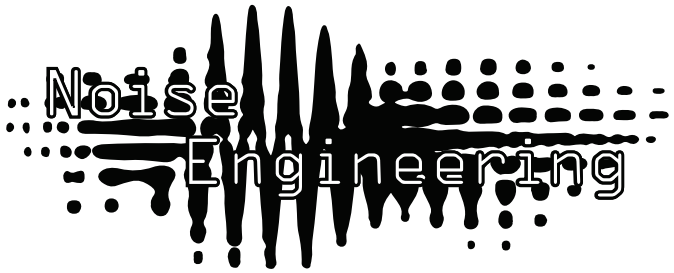
Loquelic Iteritas Percido

Complex Digital Voice

Overview

Type	VCO/ Voice
Size	20HP Eurorack
Depth	1 Inch
Power	2x8 Eurorack
+12 mA	150 / 80
-12 mA	5
+5 mA	0 / 90 (optional)

Loquelic Iteritas Percido is an extension of the original Loquelic Iteritas. Like Loquelic Iteritas, it is a digital VCO with interpretations of three classic synthesis algorithms involving dual pitch control parameterized by four tone controls. LIP adds an envelope that can be shaped and routed to pitches and tone controls, making it into a free-standing voice.



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Patch Tutorial

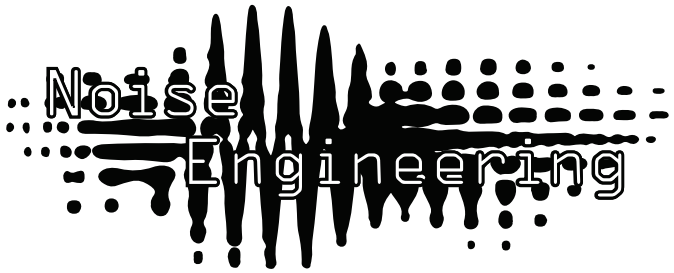
The easiest way to get to know Loquelic Iteritas Percido is to set the mode to Free, connect the output to your mixer, and start twiddling the knobs and listen.

A good next step is to hook any LFO up to any of the four tone control inputs (Morph, Fold, Modulate, Damp).

Other interesting effects can be created by controlling the pitches independently (by default the 1v/8va inputs are normaled to each other). For instance, using a Tonnetz Sequent to produce musical intervals produces interesting results.

Switch mode to Loop and experiment with the envelope controls and sends. LFOs and other CV sources can be hooked up to envelope controls to vary sounds even more.

To get the sound of the original LI, do not route the envelope to any pitch or tonal parameter (make sure all envelope sends are pointed to 12:00) and set LIP to FREE.



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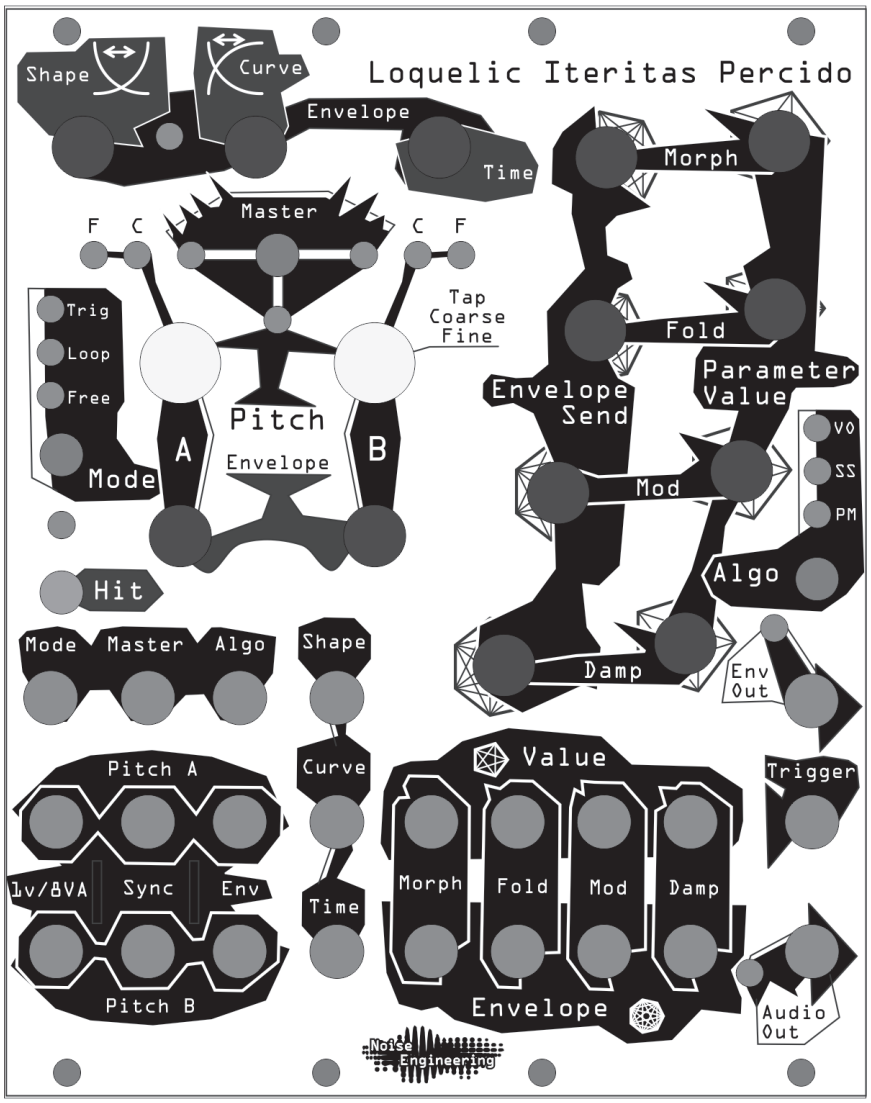
Interface

Pitch A/B

The pitch of each oscillator can be controlled by pitch encoders. Tap encoders to alternate between coarse and fine tuning. The 1v/8va input serves as an offset . The pitch inputs are cross normaled.

Master

controls the sync of the oscillators. When in the middle position both oscillators are free running. When A is selected, oscillator B will sync to oscillator A; when B is selected, A syncs to B.



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Interface: Mode

Trig

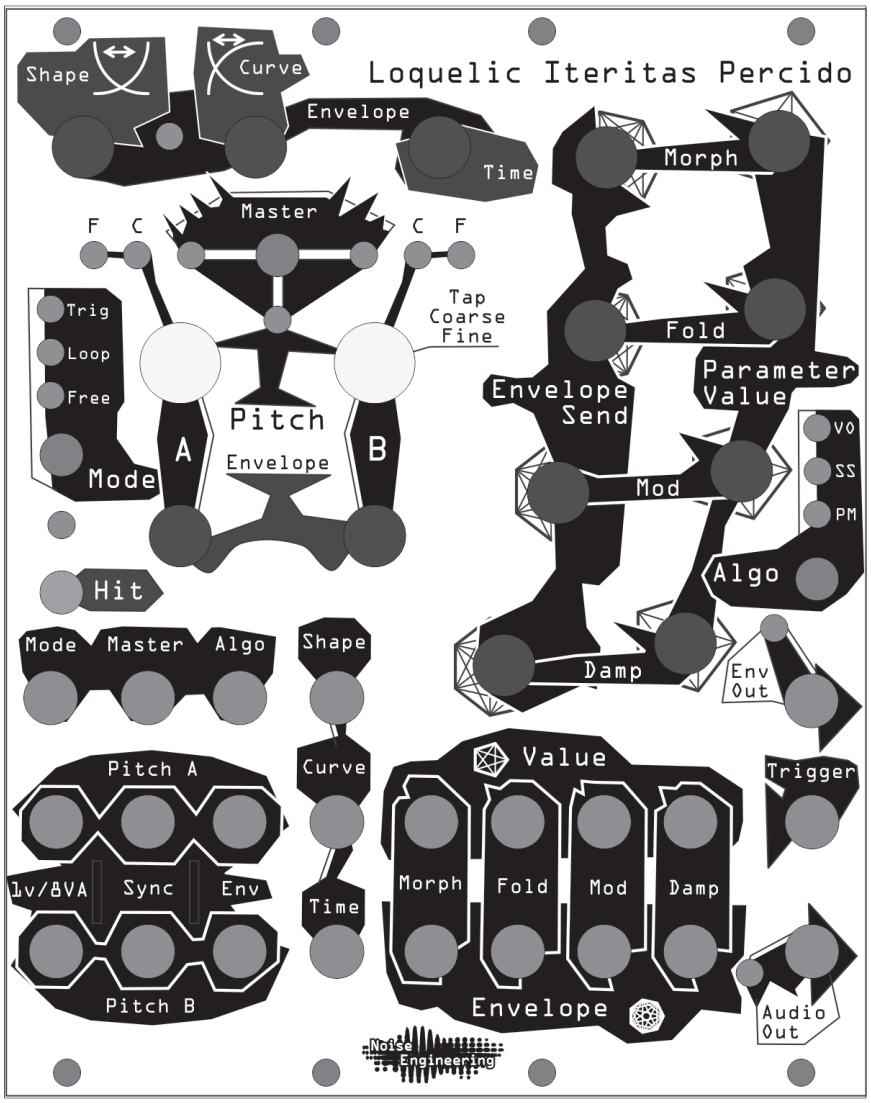
In Trigger mode, LIP expects a trigger input to start the envelope. LIP triggers on the rising edge and expects a voltage of about 3v.

Loop

In loop mode, the envelope will continually regenerate. A trigger in will hard reset it on the rising edge; without a trigger in, it will regenerate based on the parameters set on LIP.

Free

Free-running mode is the original Loquelic Iteritas. Oscillators will continue to run. A trigger in will still reset the envelope on the trigger rising edge, but will not affect the volume.



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Interface: Envelope

Shape

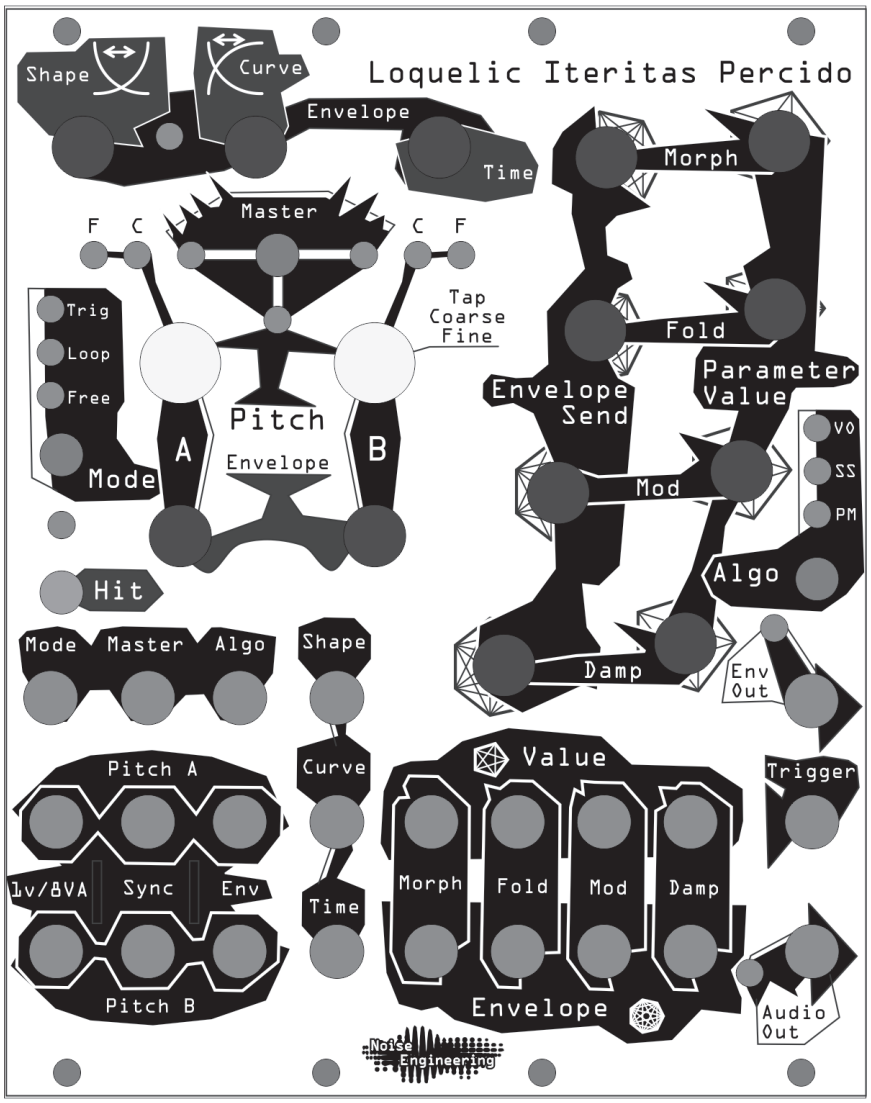
controls the attack and decay of the envelope. All the way CCW, the envelope is all decay; all the way CW, attack dominates. Turning the knob transitions between these two extremes gradually.

Curve

controls the shape of the curve: CCW gives an exponential curve, while CW gives a logarithmic curve. In the center, the shape is linear.

Time

controls the length of the envelope.



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Interface

Envelope Controls

six attenuverters that route envelope to pitches and parameters. Positioned at 12:00, the envelope is off and does not route to a parameter. Fully CCW results in an inverted envelope send. Fully CW yields full positive send.

Trigger

Input to trigger LIP. The envelope also resets (in any mode) when LIP receives a trigger.

Envelope Out

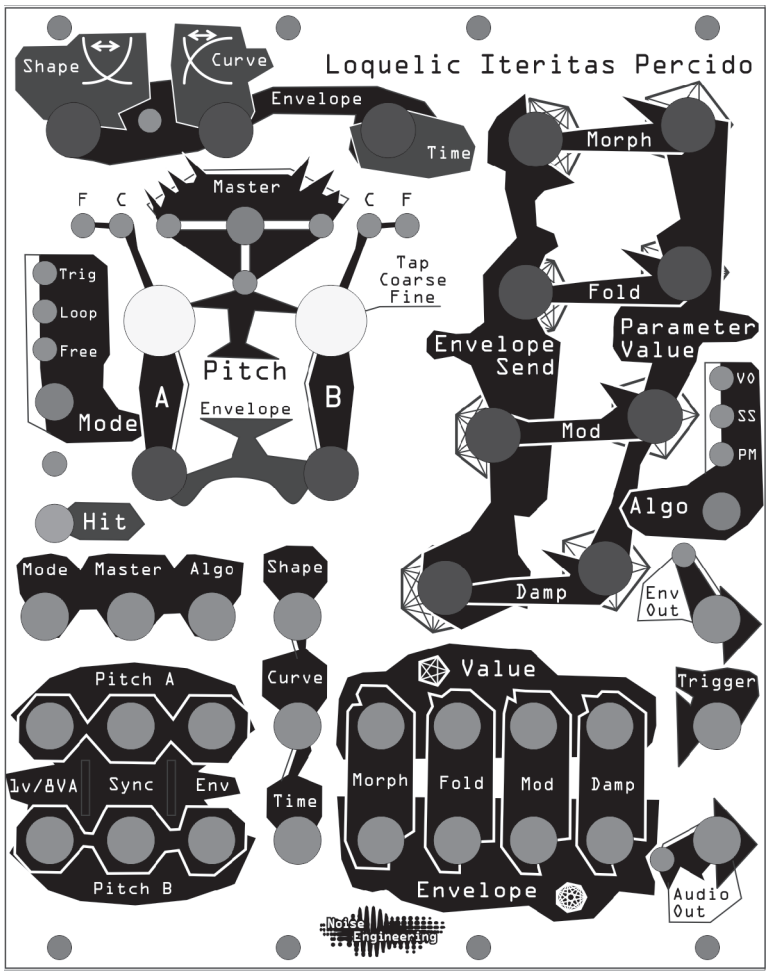
Output to send envelope to other modules.

HIT

Momentary button to manually trigger LIP. When depressed, LIP behaves like it received a rising edge on a trigger.

Audio Out

the AC-coupled audio output.



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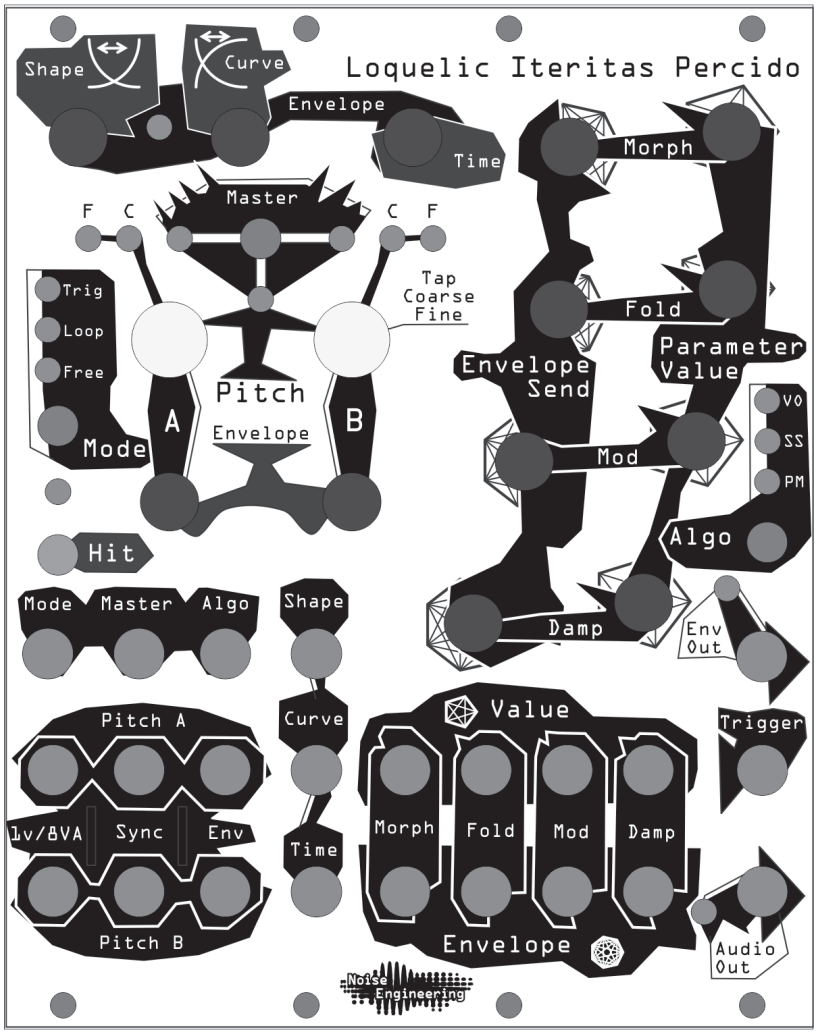
Interface: Algo V0

As in Loquelic Iteritas, the VO algorithm is roughly based off of the VOSIM algorithm discussed in Curtis Roads's epic *Microsounds*. This algorithm amplitude modulates a carrier by an exponential to create a complex harmonic structure. The simplest carrier is a sinusoid which produces a spectrum with a Gaussian distribution centered on the carrier. More complicated waveforms produce Gaussians around each harmonic, producing spectra similar to comb-filtered noise. Pitch A is the fundamental frequency of the carrier. Pitch B is the retrigger frequency of the exponential decay.

Controls

MORPH - changes the waveform of oscillator A
DAMP - sets the decay constant on oscillator B relative to its period
MOD - phase modulates oscillator A by oscillator B
FOLD - sets the wave fold threshold on the final wave folder



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Interface: Algo SS

Algorithm SS is a highly modified version of summation synthesis originally developed by James Moorer. The premise comes from a simple mathematical equality between an infinite harmonic series and a relatively easy-to-compute expression:

$$\frac{sin(\Theta) - a\ sin(\Theta - \beta)}{1 + a^2 - 2a\ cos(\beta)} = \sum_{x=0}^{\infty} a^x sin(\theta + x\beta)$$

This equation allows a wide variety of musical spectra to be produced by only two parameters. LIP generalizes the sinusoidal terms into multi-waveform oscillators: two of these track the two input pitches while the third tracks the difference of the two pitches and adds a wave folder for more harmonics. In the equation oscillator A is the left sinusoidal term in the numerator. Oscillator B is the sinusoidal term in the denominator. The equation becomes

$$\frac{sin(w_A t) - a\ sin(w_A t - w_B t)}{1 + a^2 - 2a\ cos(w_B t)} = \sum_{x=0}^{\infty} a^x sin(w_A t + x w_B t)$$

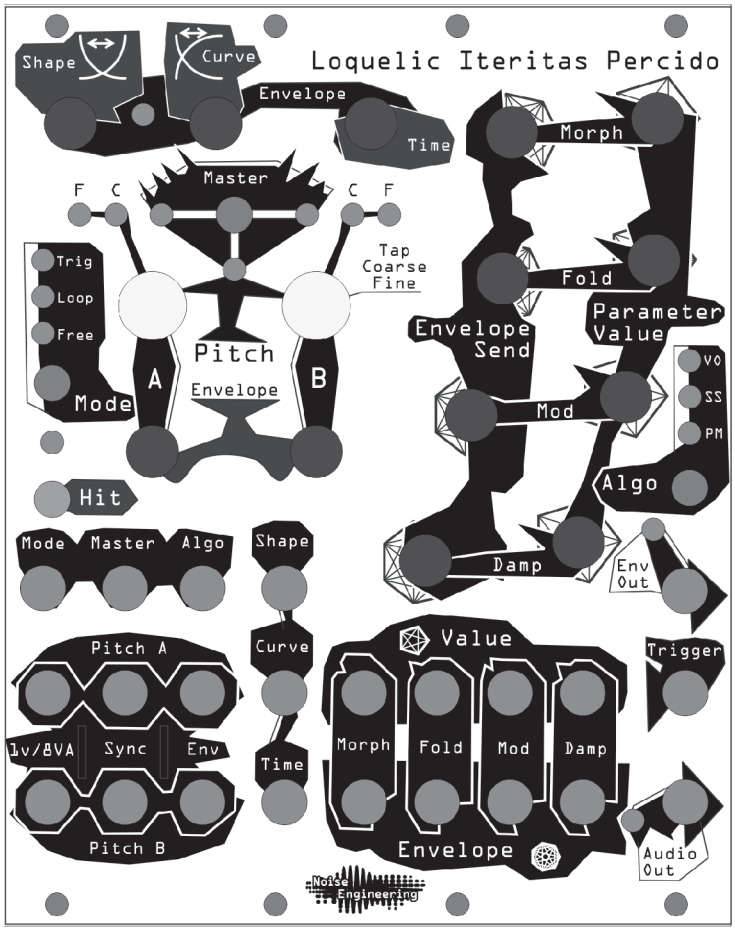
Controls

MORPH - changes the waveform of all oscillators

DAMP - sets the **a** parameter in the equality. This controls the generated spectra with higher values producing higher power harmonics.

MOD - phase modulates oscillator A by oscillator B

FOLD - sets the wave-fold threshold on the final wave folder



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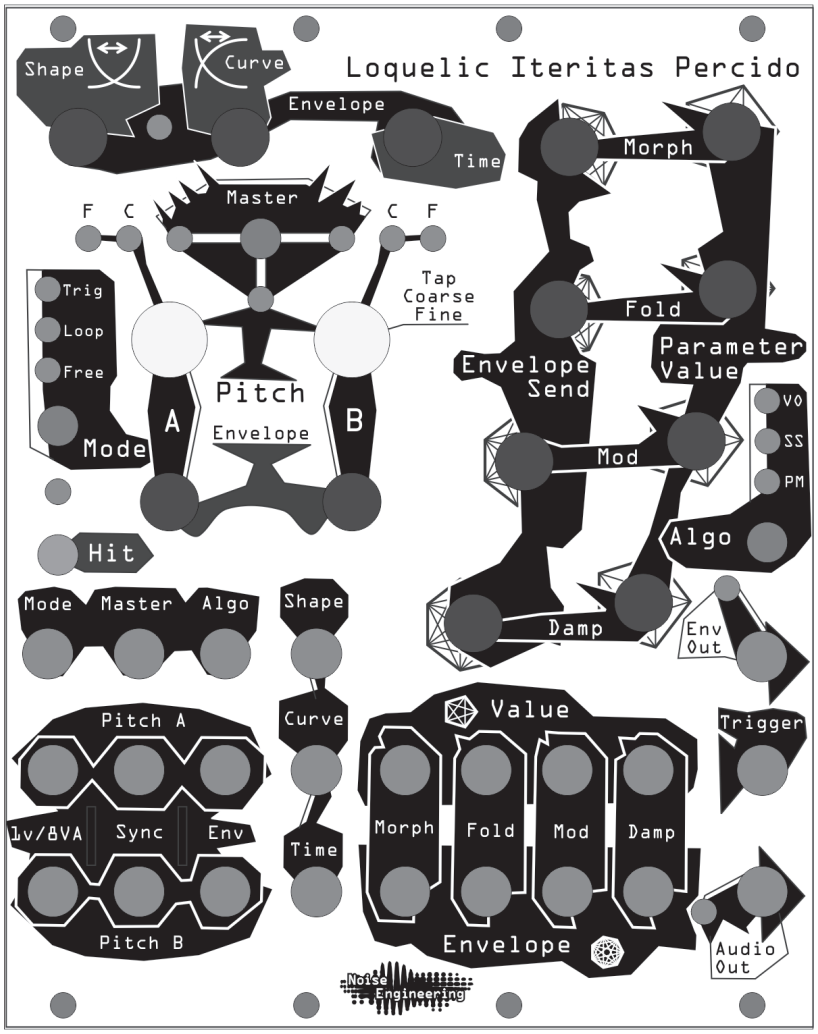
Interface: Algo PM

The PM algorithm is a naive time-domain two-oscillator phase-modulation implementation that combines both oscillators with amplitude modulation.

Controls

MORPH - changes the waveform of both oscillators
DAMP - blends between oscillator A and B through their product (AM)
MOD - phase modulates the oscillators by each other
FOLD - sets the wave-fold threshold on the final wave folder



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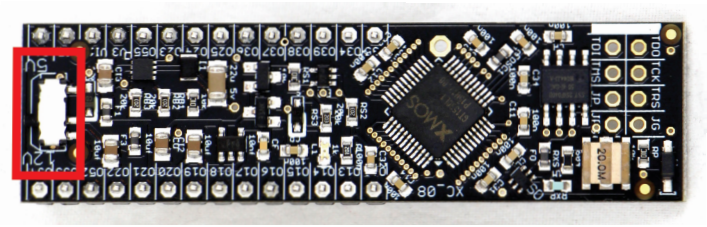
Calibration

Loquelic Iteritas Percido is best calibrated using a stroboscope and tuning octaves across the pitch range. Each pitch input has as separate calibration. The pitches can be isolated from each other by using the master switch to force the base pitch to be determined by only one input.

Voltage Supply

Loquelic Iteritas Percido can run its processor on the 5V eurorack power rail to reduce noise and load on the 12V bus. Gently push the switch tab in the direction of the desired rail to use.



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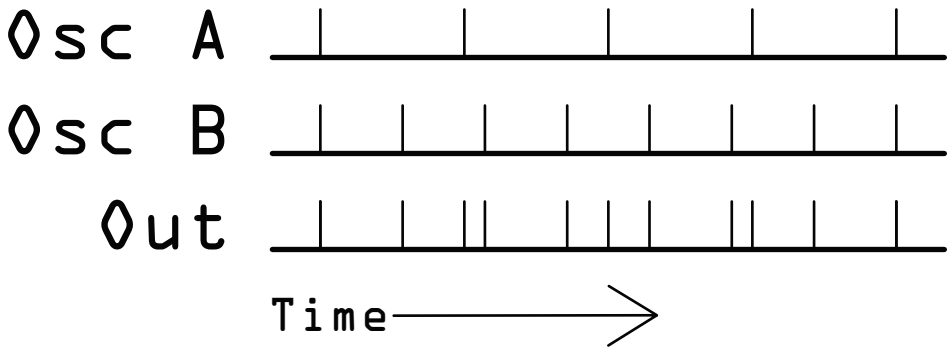
Sample Rate

Loquelic Iteritas/Loquelic Iteritas Percido use a unique multisampling technique to make aliasing more musical. By choosing a particular sample rate for a waveform that has a harmonic structure (all overtones are integer multiples of the fundamental) the alias power can be moved into frequencies that are also multiples of the fundamental and therefore more musical.

This gets complicated when synthesizing two oscillators at different pitches but using the same DAC. The compromise that LI/LIP make is to give up the notion of a fixed sample rate and compute a time delay between samples based on both oscillators. For the single oscillator case, this delay is based entirely on pitch. If this delay is computed based on each oscillator's pitch, both sample rates can be interleaved by checking which oscillator's delay will be up first. This oscillator is then updated to its next timestep and an output value is computed based on both oscillator's output state. This makes no guarantees about exactly where the aliasing goes. It is an attempt to make the aliasing related in some way to the fundamental pitch.



Two independent sample rates combine to form one irregular sample rate. Sample rate is not a constant.

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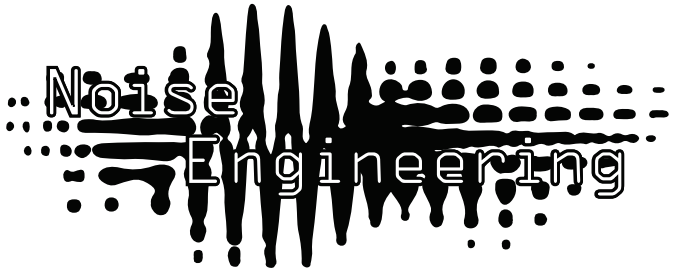
Design Notes

The original LI was just a simple implementation based on VOSIM but I soon realized I could pack a lot more punch in this form factor and found two additional algorithms. Loquelic Iteritas was designed to be a functional oscillator for sound designers as well as for musicians. I wanted to maximize the possible sound space given the input controls going from simple calm sounds to extreme, even broken, sounds. The priority of tonal variance led to some sacrifices on the musical side such as the total pitch range.

My wife, Kris, however, had other ideas: her first time playing with LI, she said, "This should be a drum." Pretty quickly, we realized that the module was hugely versatile, and people used it in many ways, but Kris was far from alone in recognizing the utility of an envelope and a trigger for Loquelic Iteritas. And we got to work.

There have, as always, been multiple revisions from the functional to the mundane (people at Superbooth in 2017 were treated to a version with one LED so bright it hurt to look at until we covered it with Noise Engineering stickers!), but from the start, we were pretty excited about the expansion of LI. It's the largest module we've made so far, but we think it packs a hell of a punch. We hope you agree, and we hope you have as much fun playing with this one as we've had making it.



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