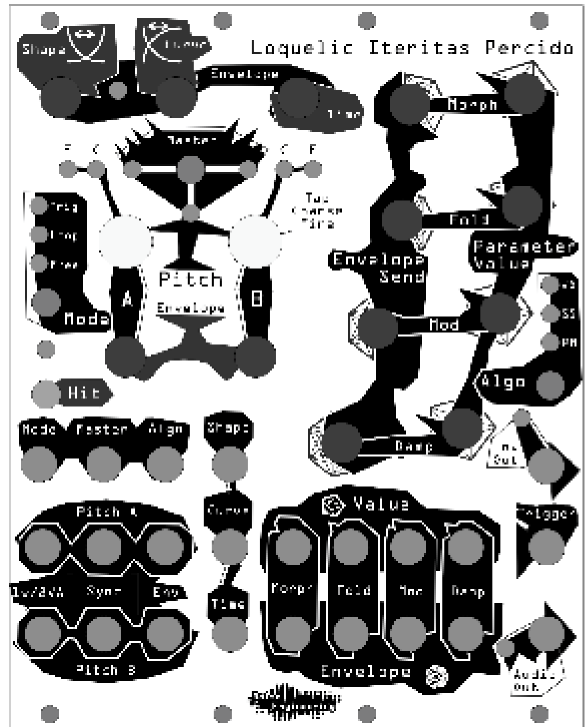
Noise Engineering

Loquelic Iteritas Percido

Complex Digital Voice

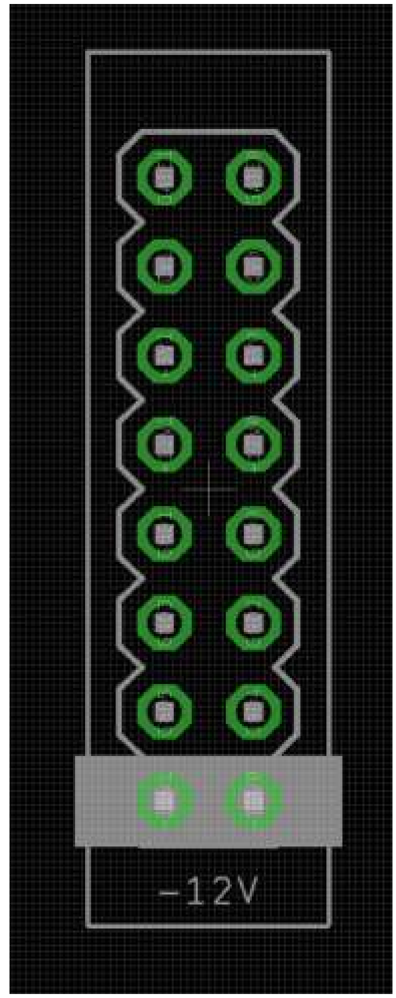
Overview

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.

Power



To power your Noise Engineering module, turn off your case. Plug one end of your ribbon cable into your power board so that the red stripe on the ribbon cable is aligned to the side that says -12v and each pin on the power header is plugged into the connector on the ribbon. Make sure no pins are overhanging the connector.

Line up the red stripe on the ribbon cable so that it matches the white stripe and/or -12v indication on the board and plug in the connector.

Screw your module into your case BEFORE powering on the module. You risk bumping the module's PCB against something metallic and damaging it if it's not properly secured when powered on.

You should be good to go if you followed these instructions. Now go make some noise!

A final note. Some modules have other headers -- they may have a different number of pins or may say NOT POWER. In general, unless a manual tells you otherwise, DO NOT CONNECT THOSE TO POWER.

Warranty

Noise Engineering backs all our products with a product warranty: we guarantee our products to be free from manufacturing defects (materials or workmanship) for one year from the date of the original retail purchase (receipt or invoice required). The cost of shipping to Noise Engineering is paid by the user. Modules requiring warranty repair will either be repaired or replaced at Noise Engineering's discretion. If you believe you have a product that has a defect that is out of warranty, please contact us.

This warranty does not cover damage due to improper handling, storage, use, or abuse, modifications, or improper power or other voltage application.

Noise Engineering

Loquelic Iteritas Percido

Complex Digital Voice

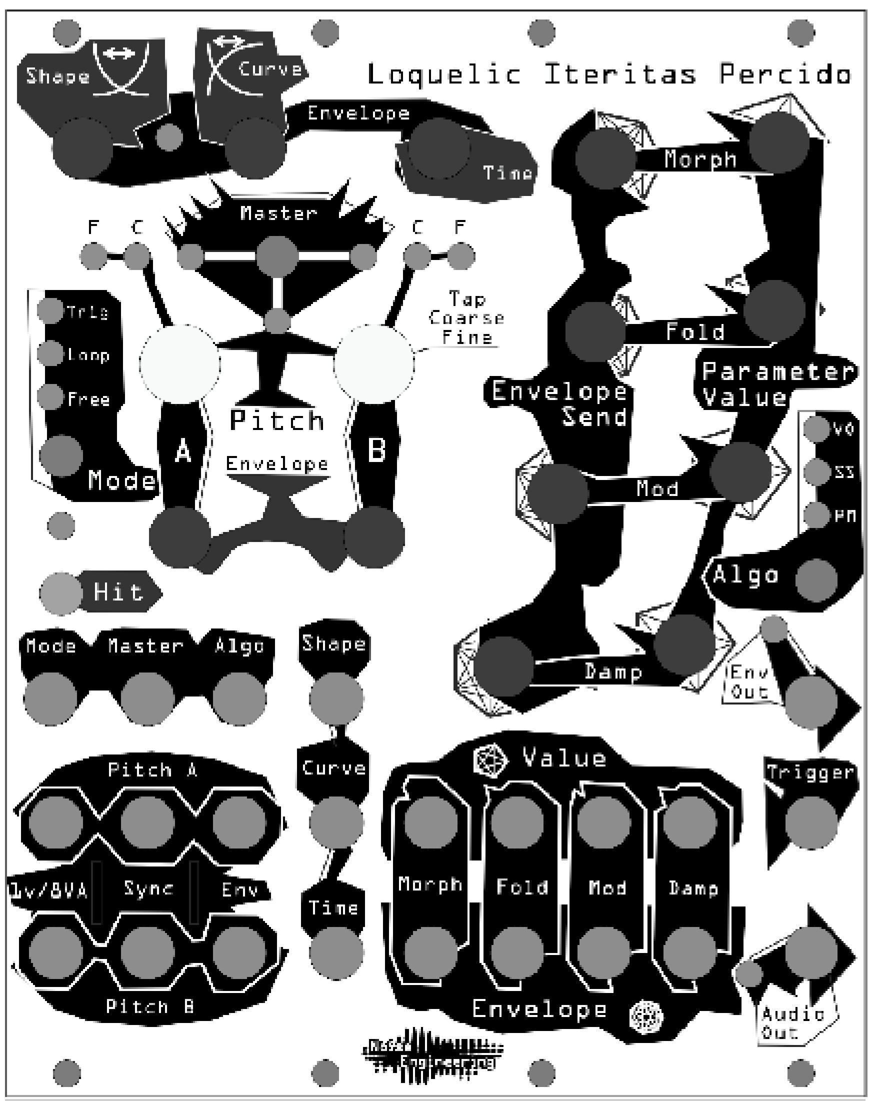
Interface: Tuning

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 inputs serve as offsets to the pitch set by the encoder. The 1v/8va inputs are cross normaled; normalization is broken when both inputs are patched.

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.
The Master switch features a 0-5v CV input that allows the setting to be switched with external voltage.



Basic Patching

The easiest way to get to know Loquelic Iteritas Percido is to set the Mode to Free, connect the output to your mixer, and play with the Morph, Fold, Mod, Damp, and Algo parameters.

A good next step is to hook any modulation source up to any of the four Value jacks. These are used for controlling the Morph, Fold, Mod and Damp parameters externally.

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 pitch sequencer to create musical intervals between the oscillators yields interesting results.

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

NB: To get the sound of the original LI, make sure all envelope sends are pointed to 12:00 and set Mode to Free.

Noise Engineering

Loquelic Iteritas Percido

Complex Digital Voice

Interface: Mode

The LIP envelope has 3 envelope settings, controlled by the Mode switch. The Mode switch features a 0-5v CV input that allows the setting to be switched with external voltage.

Trig

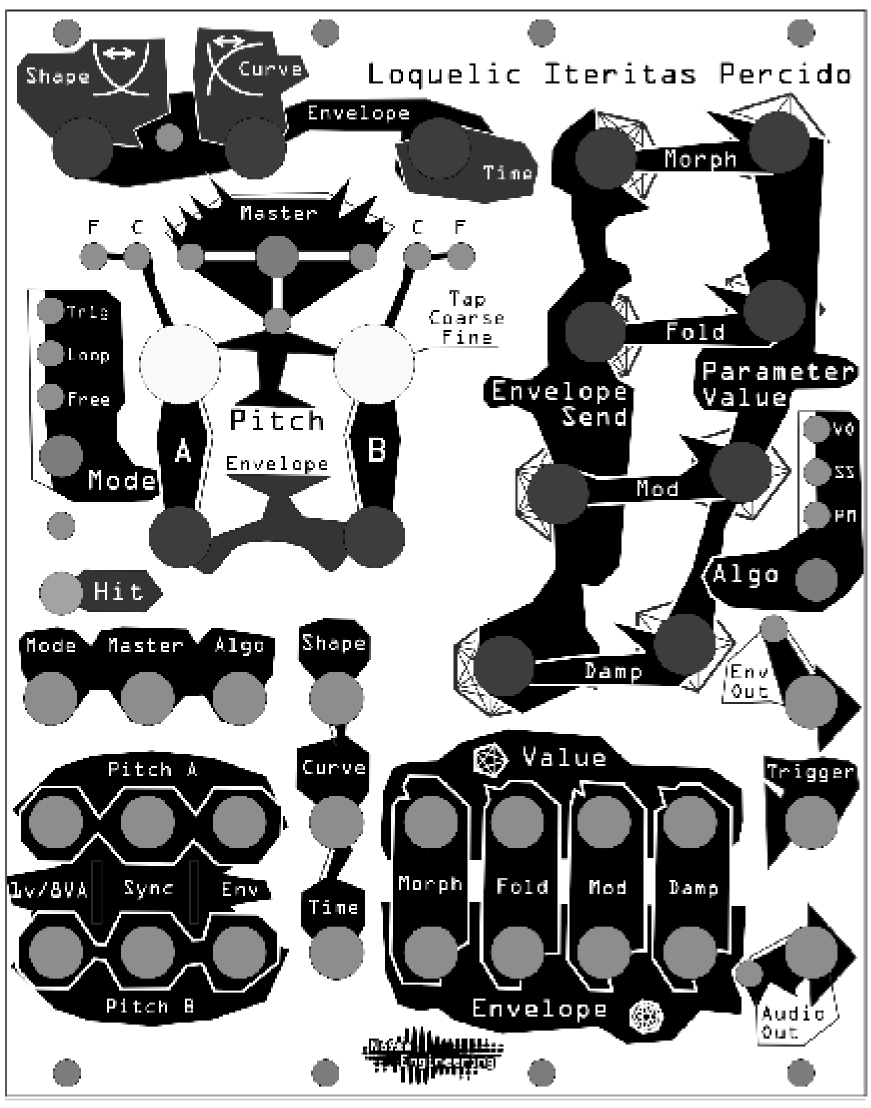
In Trigger mode, LIP acts like a traditional voice, with its envelope controlling a VCA on the output. LIP triggers on the rising edge and expects a voltage of about 3v.

Loop

In loop mode, the envelope will loop like an LFO. A trigger in will hard reset it.

Free

Free-running mode bypasses the VCA. A trigger in will activate the envelope, but will not affect the volume.



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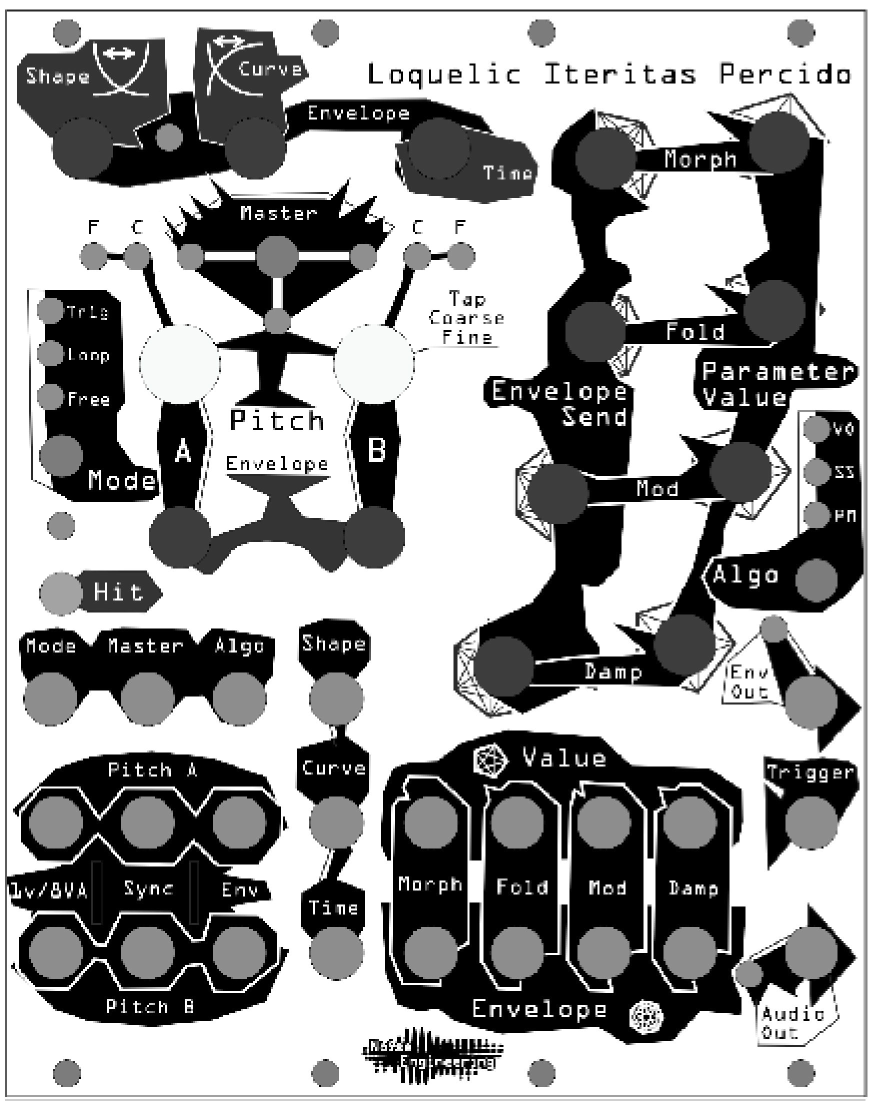
Loquelic Iteritas Percido
Complex Digital Voice

Interface: Envelope

Shape
Controls the ratio of attack vs. decay within the length of time set by the Time knob. For instance, fully left the envelope will be all decay. Fully right, the envelope will be all attack. In the center, the envelope will be 50% attack and 50% decay.

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 total length of the envelope.



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Loquelic Iteritas Percido

Complex Digital Voice

Interface: Envelope continued

Envelope Sends

LIP features six attenuverters that route the internal envelope to the two oscillator pitches and four tonal parameters. Positioned at 12:00, the envelope send is off and does not route to the parameter. Fully CCW results in an inverted envelope send. Fully CW yields full positive send. Note that the envelope send takes priority over the position of the parameter, so if a parameter is turned all the way up, turning the envelope send up will reduce the amount of the parameter in order to give the envelope its full range.
The envelope sends also feature CV inputs. The knobs act as offsets for the CV inputs.

Trigger

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

Envelope Out

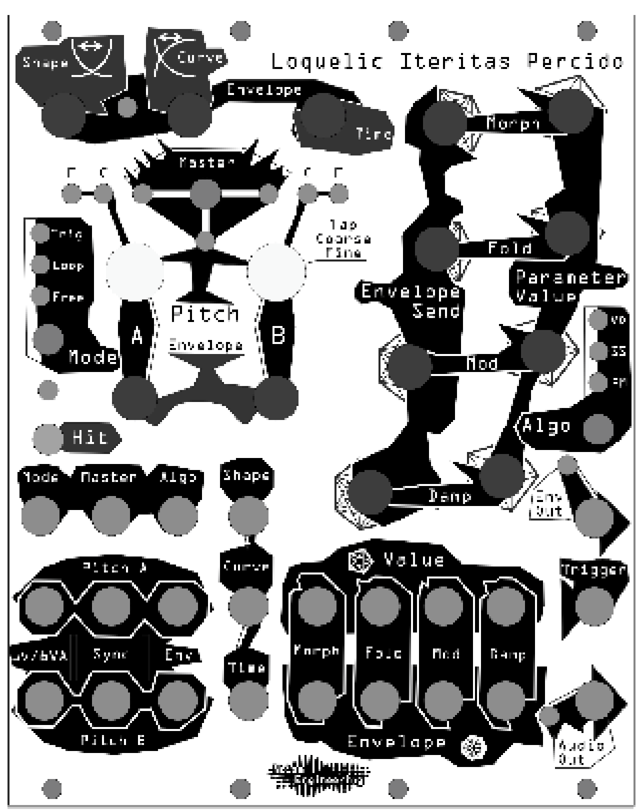
Output to patch the envelope to other modules.

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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Loquelic Iteritas Percido

Complex Digital Voice

Interface: Algo/VO algorithm

Algo:

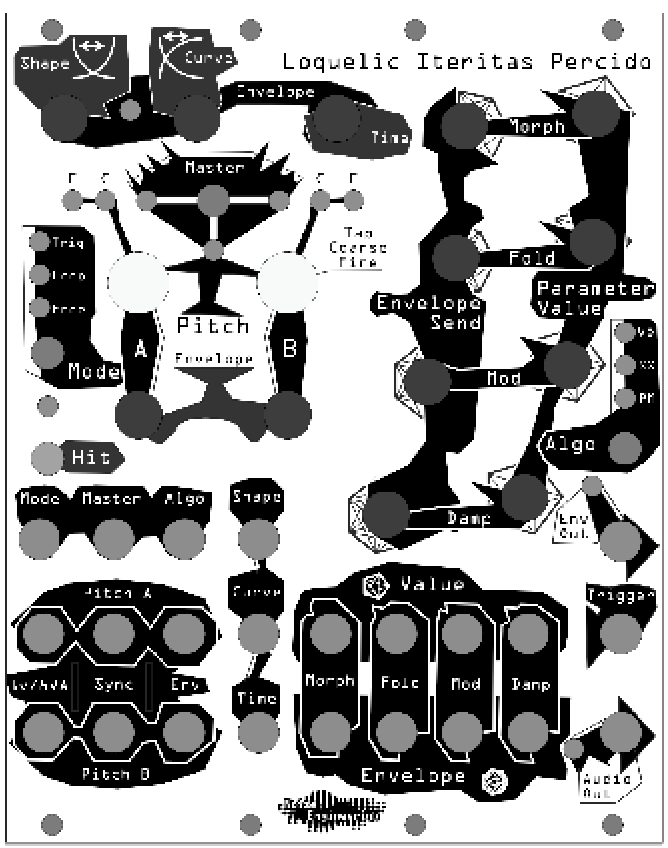
The LIP features three synthesis modes (described in the following sections), controlled by the Algo switch. The Mode switch features a 0-5v CV input that allows the setting to be switched with external voltage.

VO:

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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Loquelic Iteritas Percido

Complex Digital Voice

Interface: SS algorithm

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

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

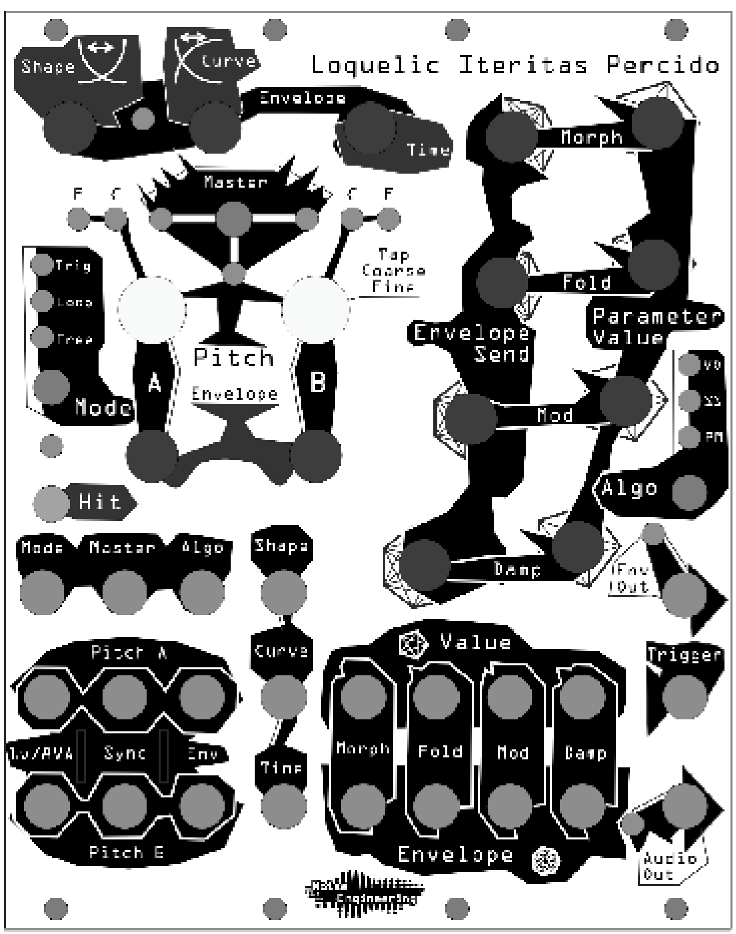
Controls

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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Loquelic Iteritas Percido

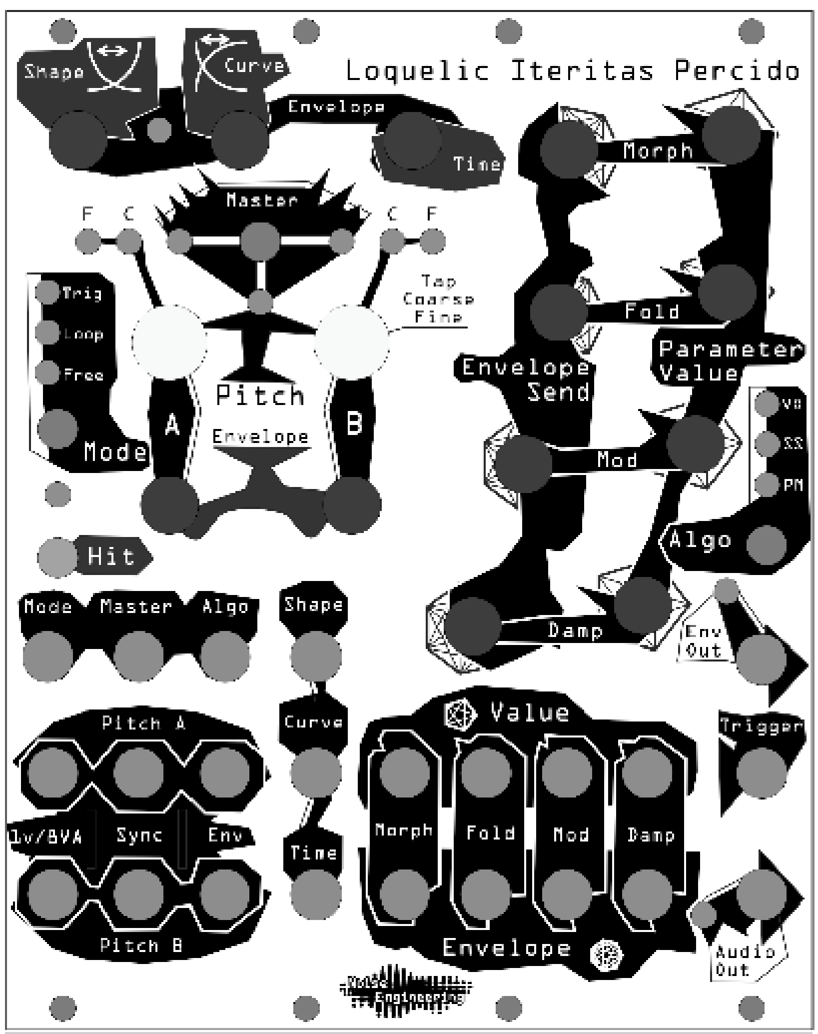
Complex Digital Voice

Interface: PM algorithm

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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Loquelic Iteritas Percido
Complex Digital Voice

CV and voltage

Loquelic Iteritas Percido has a wealth of CV inputs. Each input coresponds to a parameter on LIP. The CV inputs are offset by the knobs, so the sum of the knob position+the input CV gives each parameter its final value.
LIP's CV inputs respond to 0-5v, except the pitch inputs, which respond to 0-8v. Sync and Trigger respond to a rising edge of around 3v. The envelope output is around 0-6v.

Calibration

Loquelic Iteritas Percido is best calibrated by 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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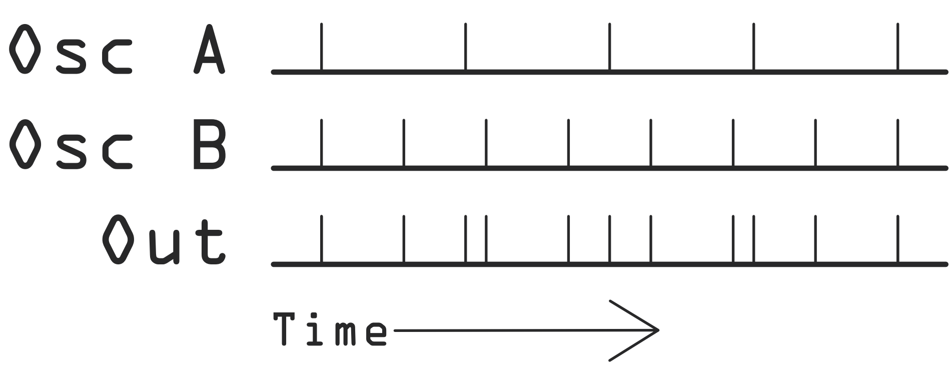
Sample Rate

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.

Noise Engineering
Loquelic Iteritas Percido

Complex Digital Voice

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.

Noise Engineering
Loquelic Iteritas Percido
Complex Digital Voice

Special Thanks

Shawn Jimmerson
Cyrus Makarechian & Black Line
William Mathewson
Mickey Bakas
Tyler Thompson
Alex Anderson
Derrick Baseck
Anthony Baldino

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