Noise Engineering
Cursus Iteritas Percido

Wavetable oscillator with envelope and
One Knob to Rule Them All

Overview

Type	Synth voice
Size	24HP Eurorack
Depth	1 Inch
Power	2x8 Eurorack
+12 mA	105/60 mA
-12 mA	60 mA
+5 mA	0/75

Cursus Iteritas Percido is the second module in the Percido line of powerful synth voices. Similar to its predecessor, the Loquelic Iteritas Percido, CIP takes the sounds of the original Cursus Iteritas and adds the musical envelope from LIP with attenuverter-controlled routing to each knob. With the addition of the performance-oriented Master Blaster and CV outputs, CIP is a powerhouse of incredibly versatile synthesis.

Etymology

Cursus-- from latin Cursus 'series'
Iteritas -- from Latin itero 'repeat' with suffix -tas 'state of being'.

“Repetitiousness”

Percido -- from Latin 'Danger'

“Dangerous Repetitiousness Series”

Input & output voltages

All CV inputs respond to 0-5v, except pitch, which responds to 0-8v. The Env and MB Out are 0-5v. Sync responds to a rising edge around 2v, and Trig responds to a rising edge around 3v.

Interface

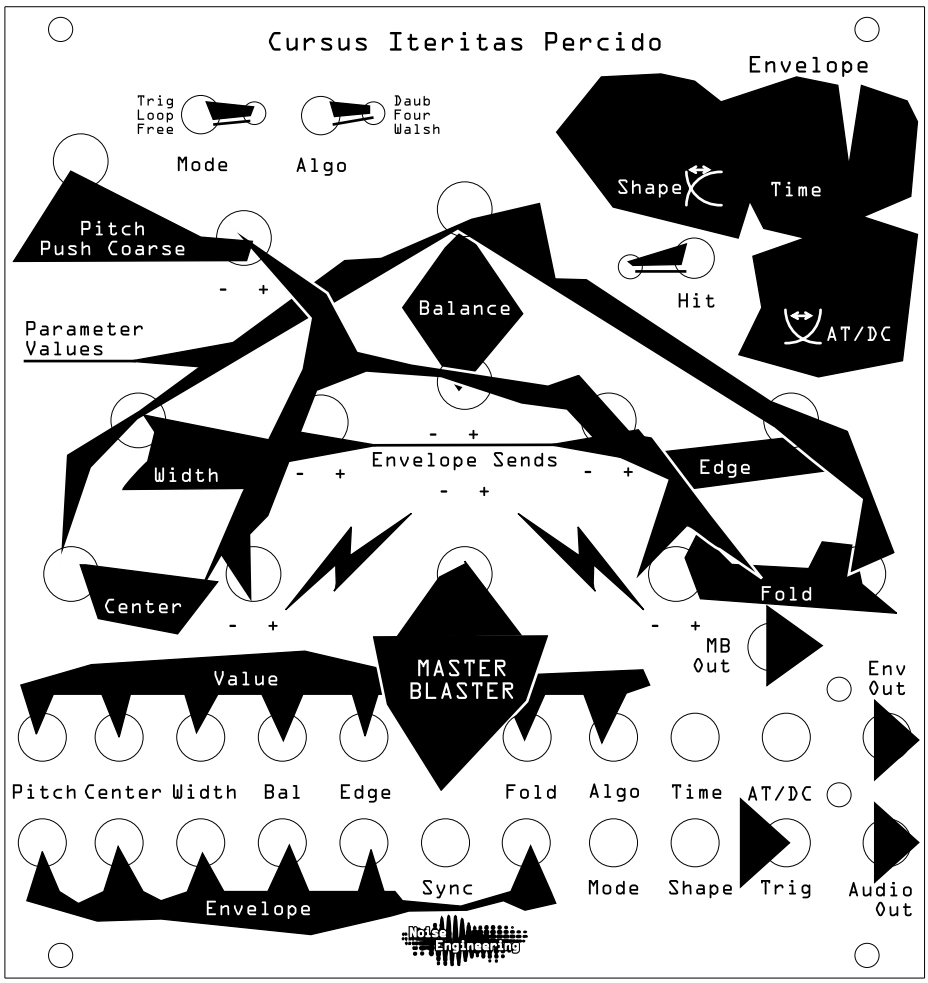
Pitch: Sets the pitch. Turn to adjust fine tuning, press and turn to adjust coarse tuning. Encoder sums with the pitch CV input.
Mode: Sets the behavior of the envelope.

- **Trig:** In Trigger mode, CIP expects a trigger input to start the envelope. CIP 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 CIP.
- **Free:** Free-running mode is the original Cursus Iteritas. The oscillator will continue to run. A trigger in will still reset the envelope on the trigger rising edge, but will not affect the volume.

Algo: Selects which orthogonal function set is used to produce the wavetable.

- Daub: Daubechies – uses wavelets
- Four: Fourier – uses sine waves
- Walsh: uses the Walsh Transforms

Hit: Momentary button to manually trigger CIP. When depressed, CIP behaves like it received a rising edge on a trigger.
Time: Controls the length of the envelope.
AT/DC: 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.
Shape: controls the shape of the curve: CCW gives an exponential curve, while CW gives a logarithmic curve. In the center, the shape is linear.

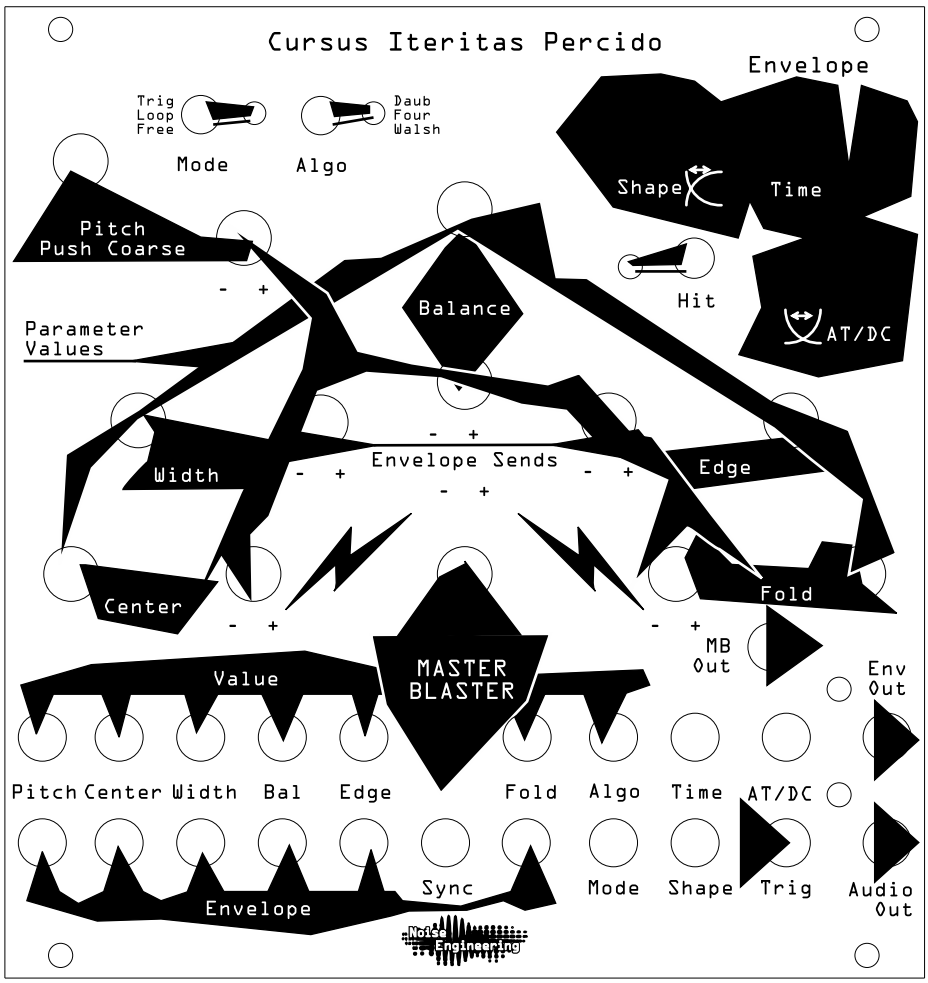


Interface

The pitch and five tone controls have envelope send attenuverters. 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.

Center: Selects the center harmonic used to build the wavetable
Width: Controls how many different harmonics are used to create the wavetable
Balance: Allows selection of harmonics included in the output.
Edge: Controls the oversampling filter of the wavetable. As this is turned to the right, it will add musical overtones.
Fold: Wavefolder. Awesome.

MASTER BLASTER: One knob to rule them all.
Master Blaster is a performance-oriented master attenuverter for all envelope sends. At center, all sends are off. Fully clockwise, all envelopes send the full amount set by their respective knobs. Fully counterclockwise, all envelopes send the inverted full amount set by their respective knobs.
MB Out: 0-5v output based on the position of the MASTER BLASTER knob to send to other modules.
Sync: Triggers edge-based oscillator reset.
Trig: Input to trigger CIP. The envelope also resets (in any mode) when CIP receives a trigger
Env out: Output to send envelope to other modules.
Audio Out: AC-coupled audio output.



Patch Tutorial

Patch 1: Set the envelope to Free, patch the Audio Out to your mixer, and play with the parameters to hear the sounds CIP can make. Set MASTER BLASTER fully clockwise and engage some of the envelope sends. Press the Hit button to hear modulation.

Patch 2: Send a trigger sequencer to the Trig input, and send some modulation like CV sequences from Mimetic Digitalis to some of the CV ins to hear CIP come alive.

Patch 3: Get things moving! Set some of the envelope sends to full clockwise. Use Master Blaster to attenuate and invert multiple sends at a time. Change Modes and Algos to explore different uses of CIP.

Tone Generation

Cursus Iteritas Percido generates a spectral description based on knob positions. Center, Width, Balance, and Edge determine amplitudes for each harmonic. This description is fed into the inverse transform for the current function set to produce the time-domain wavetable. The wavetable is normalized to reduce amplitude variations across spectral changes. Oversampling of the wavetable depends on pitch: lower octaves have higher oversampling since the sample rate only varies by a factor of two. The Edge control interpolates the oversampling from point sampling to a cubic-spline interpolation (NURBS). As the period of the full length of the wavetable always evenly divides the sample rate, the additional aliasing is largely harmonic in nature. Fold controls the signal wavefolding. In many places in the signal path, there are soft clipping stages to mimic analog-style clipping to give more warmth and complexity to the sounds generated.

Variable Sample Rate

Cursus Iteritas Percido uses a sample rate that is a multiple of the fundamental (lowest) oscillator frequency. This moves alias power that is a multiple of the fundamental to be mapped to a multiple of this tone, therefore making the aliasing align with the harmonics of the tone. This works well for settings with a strong harmonic structure (spread fully CW or fully CCW) and adds unique aliasing character for other tones.

Calibration of Tuning

CIP comes pre-calibrated but over time it may change and need a touch up.

Pitch calibration is controlled by a linear resistor-divider network. To calibrate the tuning, attach a voltmeter (preferably 4+ digit) to the test points CAL1 and GND on the rear panel and adjust the trim pot.

The voltage measured should be 5/16 (.3125) times the input voltage applied to the CV input. A reasonable way to tune the scale is to use an adjustable voltage source to generate 4 volts then adjust the tuning trim until the test points read 1.2500V. CIP can also be tuned using a reference supply capable of generating a 1 volt difference and using a stroboscope such as the Peterson 490 to tune an octave interval. This method is preferred to the meter-only method.

Voltage Supply

Cursus 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.

Design Notes

A while back, our friend Derrick (aka Baseck) called us up and said, “Come over, you have to see this!” We’ve known Derrick a while. If you’re into Eurorack, you’ve surely seen some of his completely insane demos. We learned a long time ago that when he says he has something that is worth a look, it IS.

Derrick had put together a patch with the Cursus Iteritas and a load of pitch envelopes routed in. We walked away from this afternoon with a blog post and ideas for a few modules. The first was the Roti Pola, a CV mixer that we were inspired to make entirely because of Derrick’s workflow, but the second was the Cursus Iteritas Percido. When we started designing it, Markus, the new addition to the NE team, suggested the inclusion of the Master Blaster knob to make live performance with the CIP even more badass. We mocked it up in software and knew it was a winner. Pretty quickly Markus suggested a Master Blaster output so a MB-controlled CV could be sent to other modules as well -- control multiple modules with a single knob! Simplicity.

Special Thanks

Derrick “Baseck”
A conversation with Scott Jaeger (The Harvestman) and Yasi Perera led to the development of the original Cursus Iteritas