Little LFO

User Manual

Little LFO

by Little IO Co.

Re Rack Extension

Contents

Overview

Little LFO is a multi-use semi-modular Rack Extension. It can be used as a sound and/or modulation source for Reason. As a sound source, there is a huge variety of possibilities. It comes with 125 Combinator patches made by 9 patch designers, with instruments such as synths, basses, drum kits and sound effects. As a modulation source, the combination of various internal modulation and waveforms gives a wide range of modulation possibilities.

Common Uses

- Oscillator section for a synthesizer
- Modulation section for synthesizer or effects
- Weird noise maker for sound effects or fun

Cool Features

- Separate portamento for each oscillator
- Pulse width can be used on any waveform
- All active oscillators are hooked into a modulation cycle (See **Internal Modulation Cycle** section)
- Adjustable phase correction for tempo synced oscillators (See **Phase Correction** in the Tempo Frequency Control section)

More Standard Features

- 4 Oscillators
- 15 waveforms
- Frequency can be controlled by keyboard, tempo, or freely set
- Optional anti aliasing
- Amplitude, frequency, phase, and pulse width controls for each oscillator
- Keyboard synchronization for each oscillator
- Amplitude, frequency and phase modulation between oscillators
- Oscillator synchronization
- ADSR envelope is automatically hooked up to amplitude, but also has 2 CV outputs
- CV inputs for oscillator amplitude, frequency, phase, and pulse width
- Audio outputs with and without envelope
- Bipolar and unipolar CV outputs, each with and without envelope
- Gate and note CV input and output/throughput

Oscillator Status

Switch

This switch turns the oscillator on and off. When the oscillator is off, it is removed from the modulation cycle.

Status Light

When the oscillator is at the top of the waveform, the light is all the way on. When the oscillator is at the bottom of the waveform, the light is all the way off. This is a useful visualization when the oscillator's frequency is below 10Hz.

Oscillator Label

The oscillators are labeled 1, 2, 3, and 4.

Volume and Envelope

Volume

The Volume slider controls the output to all audio sources.

Minimum: -∞ dBFS (All audio signals silent)
Maximum: 0 dBFS (Unaltered audio signals)

Envelope

There is a single ADSR envelope (Attack -> Decay -> Sustain -> Release) in Little LFO. It internally controls the amplitude of all signals sent to the enveloped Audio and CV outputs (See **Oscillator CV Outputs** and **Audio Outputs**).

Attack (ATT)	0 - 64 seconds
Decay (DEC)	0 - 64 seconds
Sustain (SUS)	0 - 1 scaling of amplitude
Release (REL)	0 - 64 seconds

The envelope will affect the amplitude of all enveloped output ports.

When legato is off, hitting any MIDI note will always jump to the attack part of the envelope. When legato is on, only *trigger* notes will jump to the attack part of the envelope.

Legato

Legato changes a few controls throughout Little LFO. When legato is off, each MIDI note is considered a distinct *trigger*. When legato is on, only MIDI notes that are preceded by no active notes are considered a *trigger*. Trigger notes re-trigger the envelope to immediately restart from the attack. Notes that overlap or occur continuously are considered *tied*. In legato mode, tied notes do not restart the envelope. This can be useful for tying notes together into phrases.

Oscillator Shape Section

The wave shape section of each oscillator lets you choose from 15 different waveforms set their amplitude, phase, pulse width and keyboard synchronization.

Wave Selector

Choose from 15 different waveforms by scrolling through them with up/down buttons:

	sine		down curve		3 pyramid
	triangle		up curve		5 pyramid
	square		3 step		9 pyramid
	down saw		4 step		noise
	up saw		8 step		smooth noise

If you want anti aliased versions of these waveforms, there is a toggle on the back that you must enable.

Amplitude (AMP)

This controls the amplitude of the audio and CV outputs and affects the amount of internal modulation given to the next active oscillator in the modulation cycle.

Minimum: 0%
Maximum: 100%

Phase (PHS)

This controls the point in the waveform at which it will begin playing.

Minimum: -180° (1 half waveform backward)

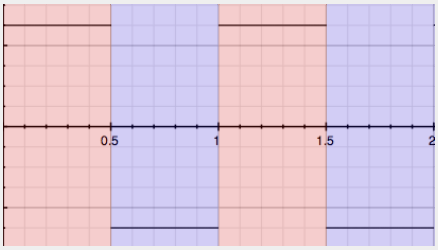
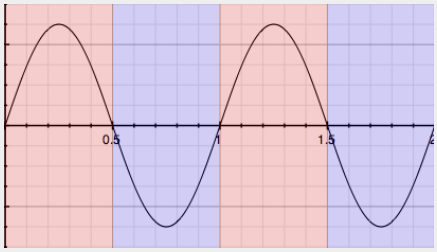
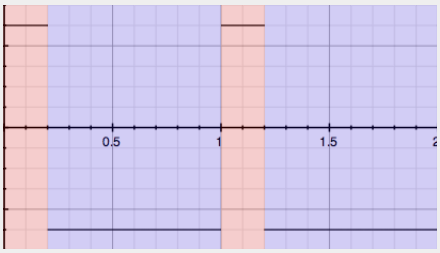
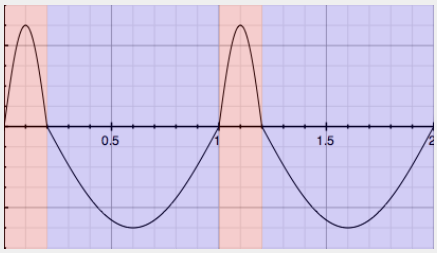
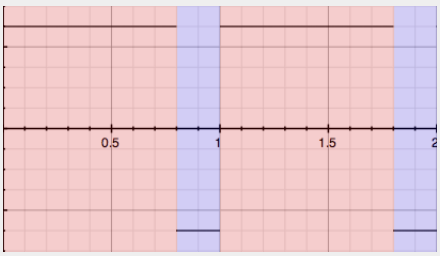
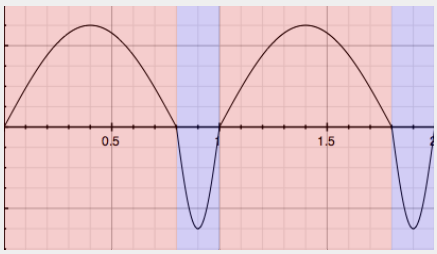
Maximum: +180° (1 half waveform forward)

Pulse Width (PW)

Pulse width changes the length of the first and second halves of the wave linearly, while keeping the overall wavelength the same. Any waveform will be affected by the pulse width control of its waveform section.

Minimum: 0%
Maximum: 100%

As an example, here is how pulse width affects square and sine waves.

Pulse Width Amount	Square Wave	Sine Wave
PW: 50% Unchanged Waveform		
PW: 20%		
PW: 80%		

Keyboard Sync (SNC)

This will reset the oscillator to the beginning of its waveform when there is a new MIDI key hit or there is new gate input. This control does *not* change the frequency of the oscillator. Keyboard Sync is affected by the legato control on the top right of the device (see **Legato** in **Volume and Envelope**). If legato is off, all key hits make the oscillator restart from the beginning of its waveform. If legato is on, only *trigger* notes make the oscillator restart.

Note: Currently, oscillators faster than 64Hz are not keyboard synced if the envelope is engaged. This may change in a future release.

Oscillator Frequency Section

The frequency section lets you control the frequency by selecting a controlling source and modifying it with two knobs.

Setting Frequency Control Source

You can control the frequency of each oscillator in three different ways: through the keyboard, through the tempo-synced frequencies, or by freely setting the exact frequency. To set the frequency control source, click on the button next to the desired frequency control source: Keyboard, Tempo or Free. The Major (larger) and Minor (smaller) knobs change functionality depending on which frequency control source is selected.

Keyboard Frequency Control

In this setting, the frequency is controlled by MIDI notes and notes triggered through the note and gate CV input.

Note: Before any note is ever sent to Little LFO, keyboard frequency controlled oscillators will default to MIDI note 0, which is about 8.18Hz.

Major Control (SEMI): Semitone offset

For every note sent to Little LFO, the oscillator's frequency will be set to the specified number of semitones away from that note's frequency. For example, setting this knob to +7 will cause this oscillator's frequency to be a musical fifth above the note sent to Little LFO. This is useful for harmonizing oscillators and adding sub oscillators.

Minimum: -32 semitones
Maximum: +32 semitones

Minor Control (PORT): Portamento

Portamento is a “glide” between notes. Playing one note and then another will cause the frequency glide from the first note to the second continuously. The portamento knob sets the time it takes to make the full glide from the lowest MIDI note possible to the highest MIDI note possible. Smaller note changes will take less time.

Minimum: 0 seconds
Maximum: 10 seconds

If legato is on, there will only be a glide between *tied* notes (see **Legato** in **Volume and Envelope**).

Tempo Frequency Control

In this setting, the frequency is controlled relative to the overall tempo (BPM).

Major (TEMPO): Tempo

This knob sets the frequency to a fraction of the tempo. For example, 4/4 means once every 4 beats. So, the period is 4 beats, and the frequency is set accordingly. As another example, 1/4 means once every beat, so the period is 1 beat. As another example, 4/4T means 3 times for every 2 times that the 4/4 would play. In other words, 4/4T is 1.5 times the frequency of 4/4. The 24 possible tempo synced values are 32/4, 16/4, 12/4, 8/4, 7/4, 6/4, 8/4T, 5/4, 4/4, 3/4, 4/4T, 2/4, 3/8, 2/4T, 1/4, 3/16, 1/4T, 1/8, 1/8T, 1/16, 1/16T, 1/32, 1/32T, and 1/64.

Note that the oscillator keeps playing; it does not start or stop on particular beats. The beats are just used to determine the period of the waveform, which equivalently sets the frequency. So, in the 4/4 example, the oscillator’s frequency is set so that the beginning of the waveform occurs at the beginning of the first beat of four beats.

Minor (CORR): Phase Correction

The oscillator’s base frequency is set by frequency section on the oscillator itself, whether by keyboard frequency control, tempo frequency control, or free frequency control. The oscillator’s frequency can be modulated by another oscillator or CV frequency input. Thus, collectively, the influences that affect the oscillator’s frequency are the frequency control knob on the oscillator itself, frequency modulation from another oscillator, or frequency modulation from CV input.

A tempo synced oscillator is in phase with the tempo when the beginning of the oscillator’s waveform occurs at the points in time specified by the TEMPO knob. For example, if the TEMPO knob is set to 4/4 and the oscillator is in phase with the tempo, then the beginning of the waveform will occur once every four beats, at the beginning of the first beat.

If the tempo synced oscillator's frequency is being changed by the influences mentioned above, it is possible for it to get out of phase with the tempo. This may or may not be desirable. Phase *correction* pulls the oscillator back in phase with the tempo.

The CORR knob sets how long it takes to *correct* the phase of the oscillator.

Minimum: 0 seconds (immediate correction)
Maximum: ∞ (no correction)

When the CORR knob is set to 0, correction happens immediately. When it's set to ∞, the correction takes forever, or, in other words, there is no correction.

With immediate correction, then the oscillator will immediately be set in phase with the tempo. In this case, frequency modulation from another oscillator or from CV input have no effect. Changing the TEMPO knob of the oscillator itself results in clicking because the phase is immediately changed.

With no correction, the oscillator's frequency will be the normal result of all influences on the frequency--a combination of the TEMPO knob's base frequency, the frequency modulation from another oscillator, and the frequency modulation from the CV input. This allows the oscillator to get out of phase with the tempo.

With some correction, e.g. if the CORR knob is set to 1 second, then the oscillator's phase will be pulled back in phase with the tempo over a time span of 1 second. So, if the TEMPO knob is changed to a new position, then within 1 second the oscillator's phase will smoothly shift to be in phase with the tempo. This will not cause clicking. If the oscillator's frequency keeps changing more than once a second, either due to frequency modulation or multiple changes to the TEMPO knob, then the phase will never catch up. This can be an interesting effect.

Try This: Set the oscillator to a low frequency, modulate its frequency, and change the CORR knob to create different types of repeating waveforms.

Free Frequency Control

In this setting, the frequency is specified in Hz.

Major (FRQ): Frequency

Minimum: 0 Hz

Maximum: 4096 Hz

Minor (FINE): Fine Control

This knob also sets the frequency in Hz, giving finger grained control within a smaller range. Its value is added to the value of the FRQ knob to determine the frequency.

Minimum: -12 semitones (1 octave)

Maximum: +12 semitones (1 octave)

Note: By setting both the FRQ and FINE knobs to their maximum values, it is possible to set the oscillator frequency to a maximum of 8192 Hz.

Modulation Section

The modulation section controls frequency, amplitude, and phase modulation as well as synchronization. The internal modulation cycle determines which oscillator is modulating which (see **Internal Modulation Cycle**). When describing modulation, it is important to distinguish between the *modulation* and *carrier* frequencies. For example, if Oscillator 2 is modulating Oscillator 1, then Oscillator 2 is the *modulator* and Oscillator 1 is the *carrier*. In this example, the modulation section highlighted below determines how Oscillator 2 modulates Oscillator 1.

In general, a modulation section has a *modulator* and a *carrier*. The modulator is always the oscillator immediately to the right of the modulation section. The carrier is determined by the internal modulation cycle.

Note: In the knob controls for amplitude, frequency, and phase modulation, negative percentages act as if the modulator signal was inverted.

Synchronization (SNC)

Turning SNC on make it so that, whenever the modulator arrives back at the beginning of its waveform, it forces the carrier wave to jump to the beginning of its waveform. This causes the carrier wave to have the same base frequency of the modulator wave.

Amplitude Modulation (AMP)

The carrier amplitude is modulated by, at a maximum, the percentage of its frequency specified set by the AMP knob. When the modulator is at its trough, it will reduce the amplitude of the carrier by the AMP knob. When the modulator is at its peak, it will not reduce the amplitude of the carrier at all.

Minimum:	-100%
Maximum:	100%

Note that the maximum amplitude of the carrier is set by the AMP knob in the Wave Shape section of the carrier oscillator. Together, these two controls set the minimum and maximum amplitude of the carrier frequency. For example, with the amplitude modulation at 50% and the carrier amplitude at 60%, the carrier amplitude ranges from 60% when the modulator is at its

peak to 30% when the modulator is at its trough.

Frequency Modulation (FRQ)

The carrier frequency is modulated by, at a maximum, the percentage of its frequency set by the FRQ knob.

Minimum: -100%
Maximum: 100%

For example, if the carrier base frequency is 400 Hz and the frequency modulation knob is set to 100%, then the carrier modulates between 800 Hz when the modulator is at its peak to 0 Hz when the modulator is at its trough. With the modulation knob at 50%, the carrier would modulate between 600 Hz and 200 Hz.

Phase Modulation (PHS)

The carrier phase is modulated by, at a maximum, the percentage of half a period (180°) set by the PHS modulation knob. The carrier phase can be shifted forward 180° and backward 180°, enabling full 360° modulation.

Minimum: +100% (180° ahead)
Maximum: -100% (180° behind)

If the PHS knob is set to a positive value, then, when the modulator is at its peak, the carrier is ahead of its base phase by that value, and, when the modulator is at its trough, the carrier is behind its base phase by that value. If the PHS knob is set to a negative value, the reverse is true.

Note: In the modulation cycle, if all oscillators are phase modulating each other, you may create phase modulation feedback which sounds like very noisy static (similar to white noise).

Internal Modulation Cycle

All active oscillators are automatically hooked into a modulation cycle. The modulation goes right to left and wraps around end to end.

For example, if all oscillators are turned on, then Oscillator 4 will modulate Oscillator 3, which will modulate Oscillator 2, which will modulate Oscillator 1, which will modulate Oscillator 4.

Any inactive oscillator is left out of the cycle.

As another example, if only Oscillators 1 and 3 are turned on, then Oscillator 3 will modulate Oscillator 1, and Oscillator 1 will modulate Oscillator 3.

By default, the modulation controls are all set to 0, so no modulation will occur until these are changed. For specifics on modulation controls, see **Modulation Section**.

Audio Outputs

Audio outputs provide the audio data in different formats.

Note: Triangles on both sides of an output mean that it is enveloped.

+ALL KEYS+

The +ALL KEYS+ output is a sum of all oscillators in keyboard frequency control mode. This audio output is enveloped, as indicated by the envelope triangles. +ALL KEYS+ is convenient for using Little LFO as a synth.

Oscillator Audio Outputs

Oscillator audio data is available enveloped or unenveloped. The enveloped audio output is on the right; unenveloped is on the left.

Anti Aliasing

By default, anti aliasing is off. Turning it on removes a particular kind of dissonance from the audio outputs when playing higher notes.

Note: Even if anti aliasing is turned on, aliasing may still occur with oscillator syncing, pulse width modification, and aggressive modulation. This may change in a later release.

Performance CV Ports (As in “Performance” Arts)

Gate CV Input and Output

There is a Gate CV input port to control the envelope on Little LFO. This can be paired with Note CV input like in many other devices to create monophonic keyboard input.

There is also a Gate CV output port that can act as a throughput of the Gate CV input. Gate CV input and the gate information of MIDI notes sent directly to Little LFO also comes out through this port. Gate CV output data can be sent to other CV input ports to create velocity tracking.

Try This: Create a velocity tracked oscillator by connecting the gate CV output to an oscillato AMP CV input. The faster you hit a note, the louder that oscillator will be. Maybe turn down th base amplitude of that oscillator on the front of the device.

Note CV Input and Output

There is a Note CV input port to control the frequency of keyboard controlled oscillators. This can be paired with Gate CV input like in many other devices to create monophonic keyboard input.

There is also a Note CV output port that acts as a throughput of the Note CV input. Note CV input and the note information of MIDI notes sent directly to Little LFO come out through this port. Note CV output data can be sent to other CV input ports to create keyboard tracking.

Try This: Create a keyboard tracked vibrato or tremolo by connecting the note CV output to a tempo-synced oscillator’s FREQ CV input. The higher the note, the higher the oscillator’s frequency. Use the trim knob of the FREQ CV input to limit the effect to within the desired range.

Envelope CV Outputs

Little LFO has a single ADSR envelope which controls the amplitude of the enveloped CV outputs. The Envelope CV outputs provides just the envelope information itself. The value ranges between 0 and 1 as specified by the attack, decay, sustain, and release values. With the

Envelope CV out, this data can also be sent to other input ports to control things such as frequency, pulse width, etc.

Oscillator CV Inputs

In addition to the internal modulation on the front of the device, the oscillators can be modulated using the CV inputs on the back of the device. The amplitude, frequency, phase, and pulse width of each oscillator can be modulated via these CV inputs.

Trim Knobs

Each oscillator CV input has a trim knob that reduces the range of the effect.

Minimum: 0 (0%)

Maximum: 127 (100%)

By default, the trim knobs are set to 127 and thus allow the maximum range of the effect. If the trim knob is set to, for example, 63, then the range of the effect is reduced by about half.

Amplitude CV Input (AMP)

The AMP CV input adds or subtracts from the oscillator's base amplitude set on the front of the device. The maximum range of the effect is ±100% of the oscillator's base amplitude. For example, with the trim knob set to 127 and the oscillator's base amplitude at 50%, then the maximum AMP CV input will raise the oscillator's amplitude to 150% and the minimum AMP CV input will reduce the oscillator's amplitude to -50%.

Note: Percentages over 100% are hard clipped. Negative percentages invert the waveform.

Frequency CV Input (FREQ)

The FREQ CV input adds or subtracts from the oscillator's base frequency set on the front of the device. This port has *note resolution*, so the maximum range of the effect is ±127 semitones from the oscillator's base frequency. If the trim knob is set to *N* semitones, then the range of the effect is ±*N* semitones.

Note: Since the FREQ CV input port has note resolution, plugging in note CV output from the Matrix Pattern Sequencer, RPG8, or other devices will cause the oscillator to shift its base frequency by that many semitones.

Try This: Plug in two frequency control sources to two different oscillators to create non-standard polyphony.

Try This: Turn on Oscillators 1 and 2 and set them to keyboard frequency control mode. For each oscillator, turn on a Matrix Sequencer and hook its note CV output into the oscillator's FREQ CV input and its gate CV output into the oscillator's AMP CV input. Then create some modulation between the oscillators. When both Matrixes are playing notes at the same time, the oscillators are modulating, but when only one Matrix is playing a note there is no modulation. Distributor or Ochen K's poly splitter can be used as well.

Phase CV Input (PHS)

The PHS CV input shifts the phase of the oscillator from the oscillator's base phase set on the front of the device. The maximum range of the effect is ±180°.

Pulse Width CV Input (PW)

The PW CV input adds or subtracts to from the oscillator's base pulse width set on the front of the device. The maximum range of the effect is ±50%. For example, with the trim knob set to 127 and the oscillator's base pulse width at 50%, then the maximum PW CV input will increase the oscillator's pulse width to 100% and the minimum PW CV input will decrease the oscillator's pulse width to 0%. Pulse width is capped between 0% and 100%.

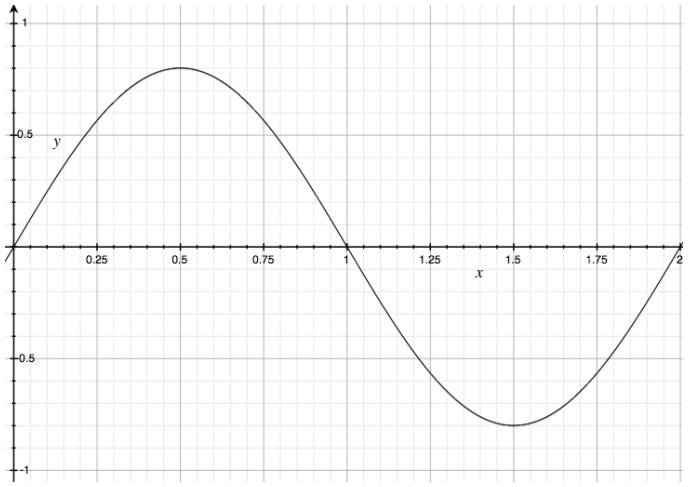
Oscillator CV Outputs

Oscillator CV output is available in four forms. The audio data can be adjusted by the envelope or not, and it can be *bipolar* or *unipolar*. The six oscillator audio output ports are highlighted above. They form two rows and three columns which correspond to the table below.

	Not Enveloped	Not Enveloped	Enveloped
Bipolar	Not enveloped, bipolar CV output	Not enveloped, bipolar CV output	Enveloped, bipolar CV output
Unipolar	Not enveloped, unipolar CV output	Not enveloped, unipolar CV output	Enveloped, unipolar CV output

Bipolar

Bipolar CV output values can range from -1 to 1. The center of the waveform corresponds to the value 0. For example, if the oscillator amplitude is 80%, then its bipolar CV output ranges from -0.8 to 0.8.



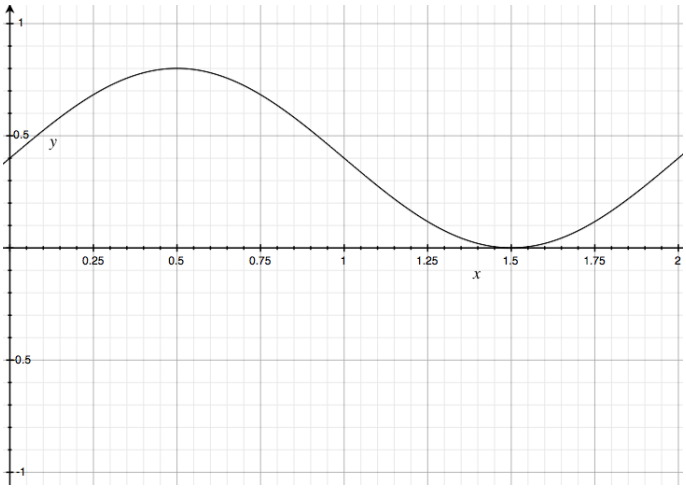
Example bipolar CV output for a waveform with amplitude 80%

One possible way to use this is to plug the CV output of one oscillator, call it Oscillator A, into the

frequency CV input of another oscillator, call it Oscillator B. Then Oscillator B will have a higher frequency when Oscillator A's CV output is positive and lower frequencies with Oscillator A's CV output is negative.

Unipolar

Unipolar CV output values can range from 0 to 1. The waveform is bottom aligned at 0 and vertically scaled down by half to fit within the 0 to 1 range. For example, if the waveform's amplitude is 80%, then then its unipolar CV output ranges from 0 to 0.8.



Example unipolar CV output for a waveform with amplitude 80%

Enveloped

Enveloped CV output values are amplitude adjusted by the envelope.

Try This: Plug an enveloped CV output from one oscillator into the frequency CV input of another oscillator. This will cause a vibrato effect in the second oscillator which slowly comes in with the attack of the envelope.