

The Q167 LFO++ is a Low Frequency Oscillator and universal modulator with a wide range of interesting features. This functionally-dense module creates complex modulation with a variety of common and unusual waveforms. The built-in envelope generator produces spring-like decays for both frequency and amplitude - increasing or decreasing.

Direct patch points for both frequency and amplitude make it easy to control modulation with a wheel, expression block, keyboard pressure or a sequencer.

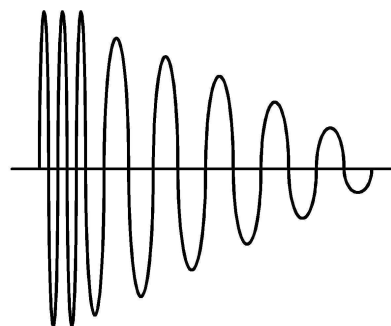
The envelope generator provides control over sustain time to produce delayed modulation, a partial section of a waveform, bursts of waves, and bursts of gates for use with sequencers.

The unique waveform control section starts with simple familiar waves and curves them into waves you haven't heard before.

The LFO++ can also act like an audio oscillator with 1V/Octave response, amplitude control, and harmonically rich waveforms.

Cross patch two Q167 modules together for mind-bending FM and AM sounds. A single LFO++ can be used as a simple synth voice to add layers to existing patches.

The Q167 makes patching modulation from controllers and within a system much easier. The same functionality would require 3 or 4 modules in a typical system - VCO, EG, VCA, Signal Processor, and multiple patch cables.



Q167 LFO++ Specifications

Panel Size: Single Width 2.125" w x 8.75"

Frequency CV Response: 1V/Octave

Amplitude CV Response: 0V=Off, 5V=Unity

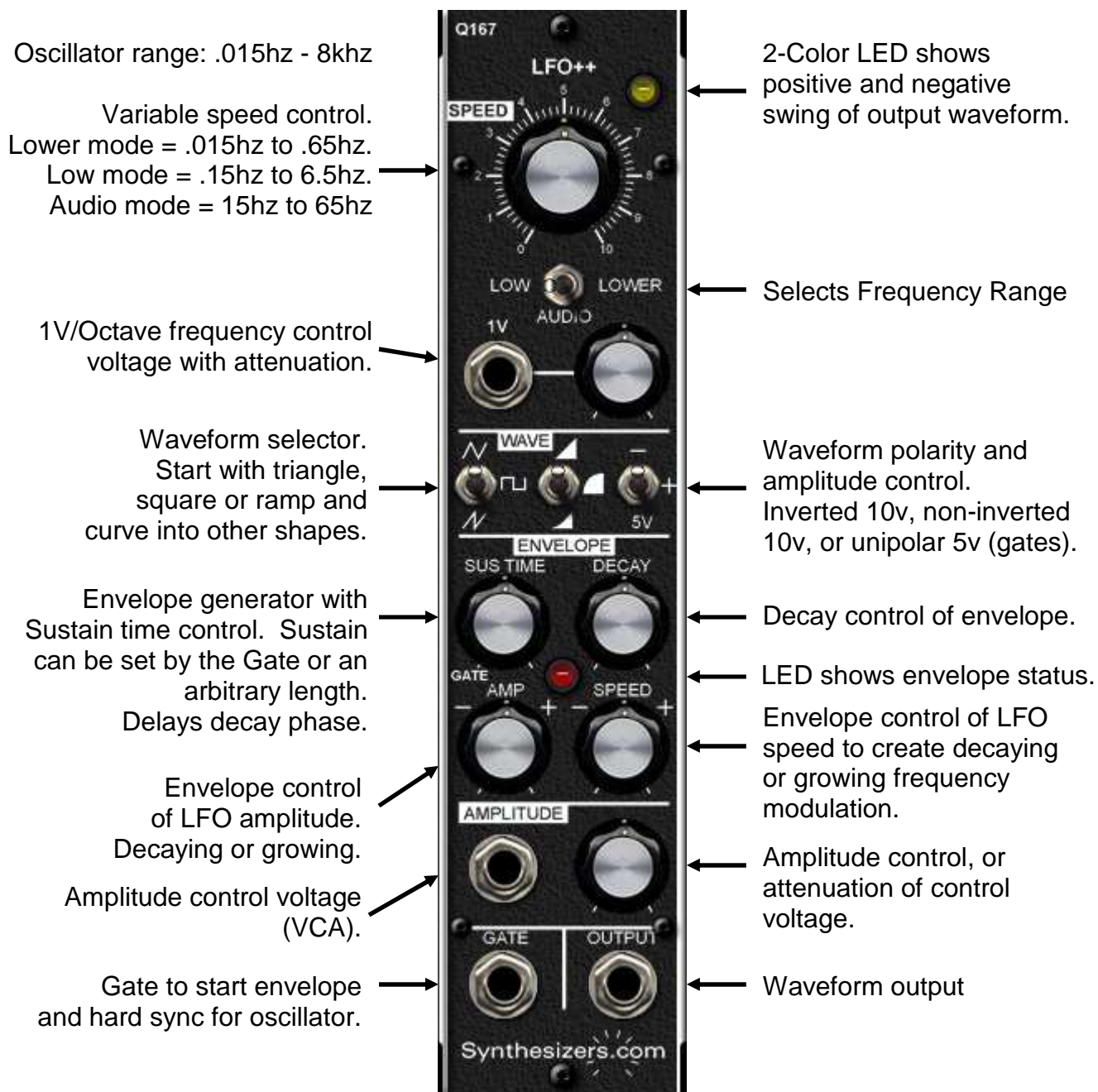
Frequency Range: .015hz to 8khz+

Waveforms: Triangle, Sine, Anti-Sine, Ramp, Saw, Smooth Ramp, Sharp Ramp, Square.

Waveform Levels: 10V Bipolar or 5V Unipolar

Gate/Sync Input: 5V typical. 1.6V threshold

Power Requirement: +15V@60ma, -15V@60ma, +5V@10ma



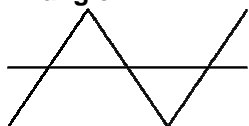
Waveforms

The LFO++ output waveform is built using 3 toggle switches. First, select the type of wave - triangle, square, ramp. Then select the curve type from the middle switch to curve the wave, or leave it the same by selecting the top position which is linear. Then select the polarity and amplitude.

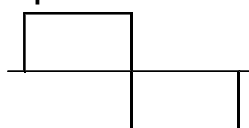
First, select the base waveform

These are the standard waveforms you've seen on most analog synthesizers

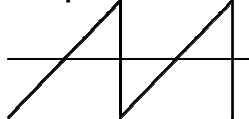
Triangle



Square

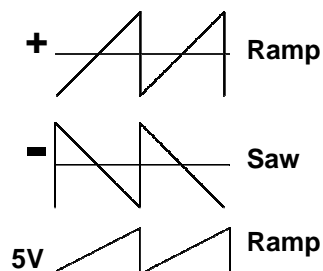


Ramp



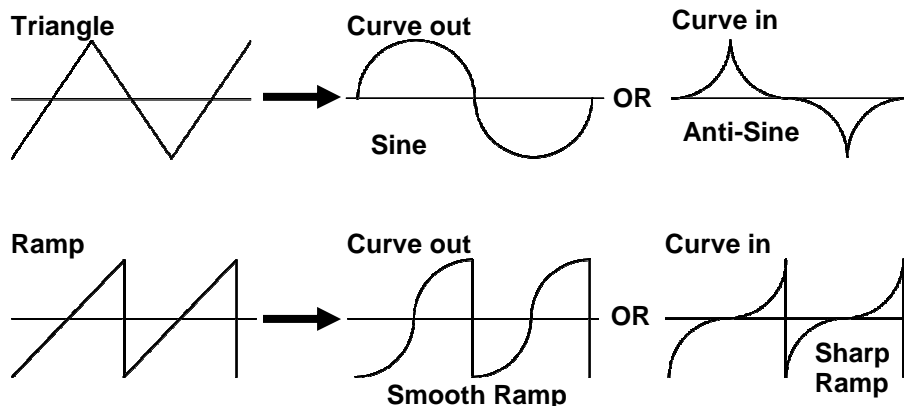
Finally, select polarity and amplitude

PLUS produces a bipolar wave with positive polarity and a 10v amplitude. MINUS produces an inverted 10v wave. Use these for audio and bipolar modulation. 5V produces a unipolar wave with a 5V amplitude. Use this for modulating VCAs or for creating gates.



Then, select the curve type

The triangle is linear, meaning the wave is not curved, the other 2 shapes curve the wave in or out. These waves have unusual harmonics and sound different when used as modulation.



The curve has no effect on a square wave.

Note: Square and Ramp waves are twice the speed of the Triangle wave.

Envelopes

LFO++ has a built-in envelope generator to control the speed and/or the amplitude of the output wave. You can create modulation that decays in both speed and amplitude over time, or grows over time, or delays before kicking in, or stays ON a certain length of time.

The Gate input starts the envelope, and it also resets the waveform just like a hard sync input. This ensures the waveform starts at the same place every time, in phase.

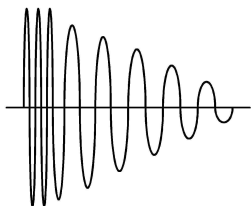
An interesting feature of the envelope generator is the Sustain Time control. Unlike a normal envelope with sustain LEVEL, this envelope gives you control over the sustain TIME. This provides a bunch of interesting options. For example, set the Sustain Time to get a certain number of pulses or wave cycles before decaying or turning off. Great for adding programmable beats to a sequence or a burst of notes. Remember, the output of the LFO++ can be gates too.

Sustain LEVEL is accomplished with the Amp and Speed pots. Sustain Time also gives you the ability to produce a delayed vibrato and/or tremolo effect - either growing or decaying over time.

Turn the Sustain Time control to the far left for no sustain and it will immediately proceed to the decay phase. Switch to the GATE position to allow the gate to control the Sustain time like a normal envelope. This configuration gives you many options not available on a typical LFO or envelope generator.

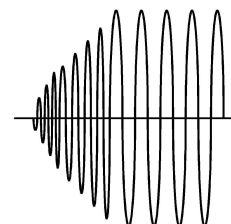
Sustain TIME

Sets the length of sustain phase. Creates delayed effects, or allows a burst of waves or gates. Set to 0 for immediate decay phase, or set to GATE to be controlled by the gate length.



Decay TIME

Sets how long the decay will be, from nothing to several seconds. Decay controls how the LFO's waveform speed and/or amplitude changes over time - either growing or decaying.



Amplitude

Determines how the envelope changes the waveform's amplitude. In the center no effect, to the left causes the amplitude to decrease over time, to the right cause the amplitude to increase.

Speed

Determines how the envelope changes the waveform's speed. In the center no effect, to the left causes the speed to decrease over time, to the right causes the speed to increase.

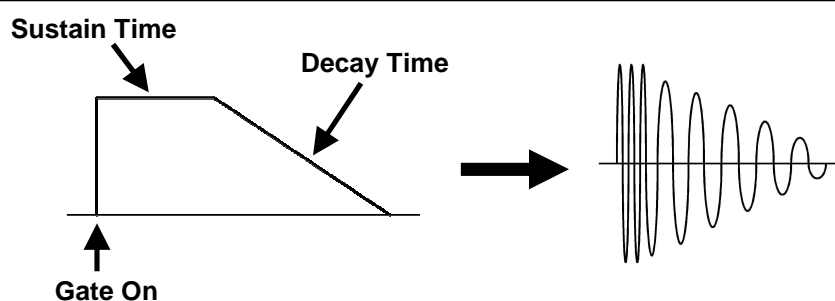
More about Envelopes

The envelope generator operation is optimized for use with the LFO. There are 2 controls - Sustain Time and Decay. These together with the Amp and Speed attenuators give you many interesting options. The attenuators are reversible and control the changes that the EG makes to the speed and the amplitude.

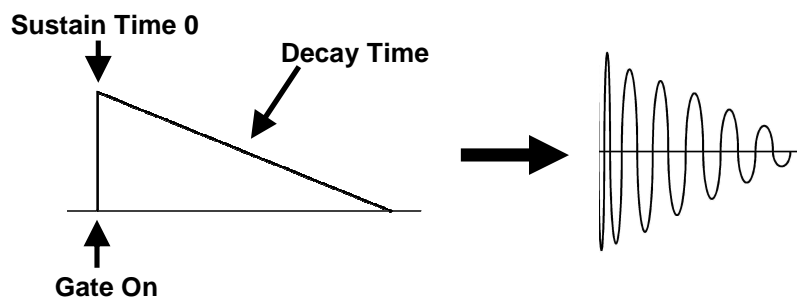
To start the envelope, patch in a Gate signal. Typically this is from a keyboard or a sequencer.

Since both the speed and the amplitude of the waveform can be affected by the envelope, both increasing and decreasing in varying amounts at the same time, and with the sustain and decay options, the total possibilities won't fit here, but here are some highlights:

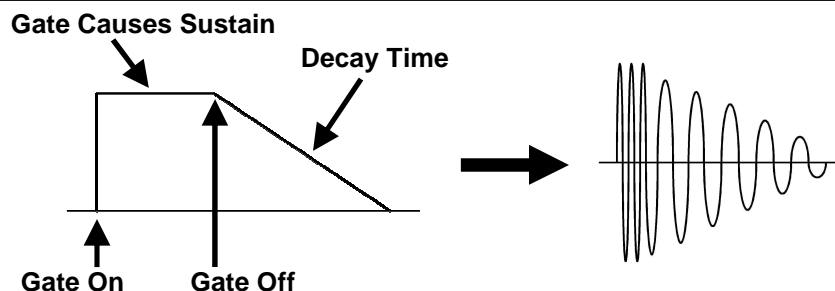
With the Sustain Time and Decay set, and the Amp and Speed attenuators set somewhere in the minus area, the LFO output will start loud and fast, then after the Sustain Time is finished will begin to decay, becoming slower and quieter.



With the Sustain Time set to zero which is right above the GATE setting, decay starts immediately. Decay can affect speed and/or amplitude, in a decreasing or increasing way.

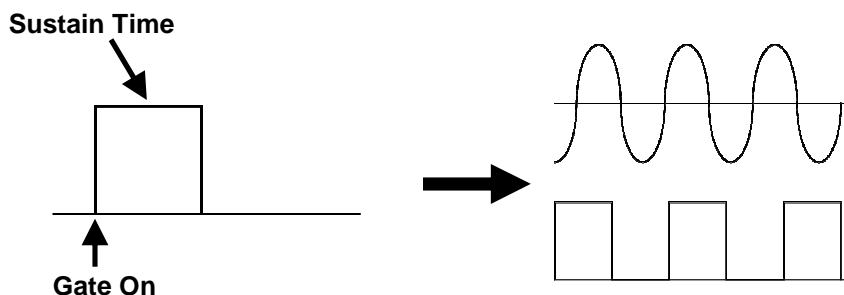


With the Sustain Time set to GATE, sustain is determined by the incoming gate signal, just like a traditional EG.

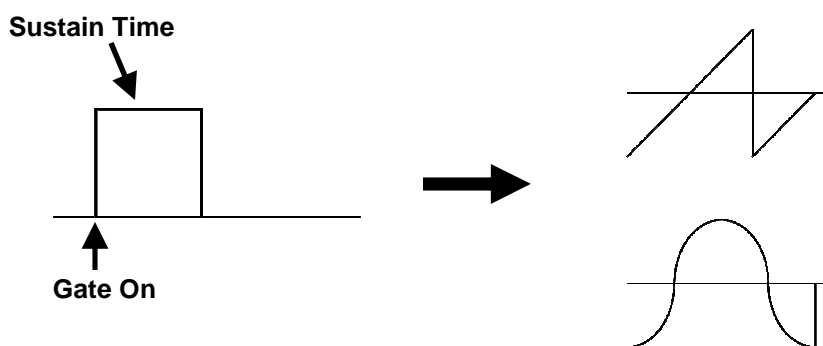


And more about Envelopes

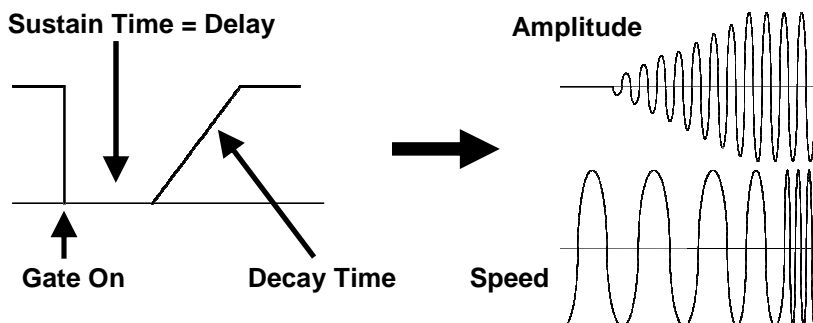
With the Decay set to zero, the EG can make an LFO waveform last for a certain amount of time set by the Sustain Time knob. This lets you create a specific number of waves or gates. Great for sequencing and short bursts of modulation or notes.



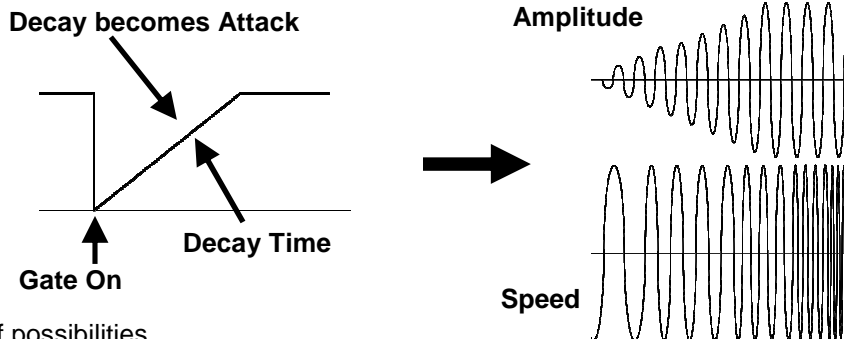
The Sustain time can also be a fraction of a single waveform allowing the LFO++ to create unusual curve envelopes on its own.



When the Amp or Speed attenuators are set in the plus area, this essentially turns the envelope upside down and Sustain becomes a delay before the effect begins. Delayed vibrato and tremolo are a staple of awesome synth leads.



With inverted Amp and/or Speed, Sustain time can be set to zero so the envelope becomes an attack where the amplitude or speed grows over time.



This only scratches the surface of possibilities.

Amplitude

The Amplitude section gives you manual and voltage control of the output's amplitude. Perfect for using a modulation wheel or keyboard pressure, or even another oscillator.

The knob goes from full OFF to full ON. When a control voltage is patched into the jack, the knob becomes an attenuator for the incoming voltage. These amplitude controls are added to the amplitude provided by the envelope generator. All together, this gives you complete control over the waveform's amplitude and how it varies over time. This lets you create decaying or growing waveforms to mimic natural sounds and instruments, and completely unnatural ones too.

Amplitude CV

Voltage control of the waveform's amplitude from an external source such as a modulation wheel or another oscillator.



Amplitude Knob

Manual control of the waveform's amplitude. This control is added to whatever the envelope generator produces. Becomes an attenuator when a CV plug is inserted.

Gate Input and Waveform Output

The Gate input is used to start the envelope generator and sync the LFO's waveform. It's a standard gate from a keyboard, sequencer or another oscillator. Typically 5v, but it can accept larger signals and even slow-moving signals with a trigger threshold of 1.6 volts. Without a gate, you still have complete manual control of the LFO waveform, amplitude and frequency.

The output jack provides the main output for the LFO++ module. The polarity and amplitude of the wave are set by the 3rd toggle switch in the WAVE section. This output can be audio, low-frequency modulation, or gate signals to drive sequencers or envelope generators.

Gate Input

Starts the built-in envelope generator and syncs the oscillator.

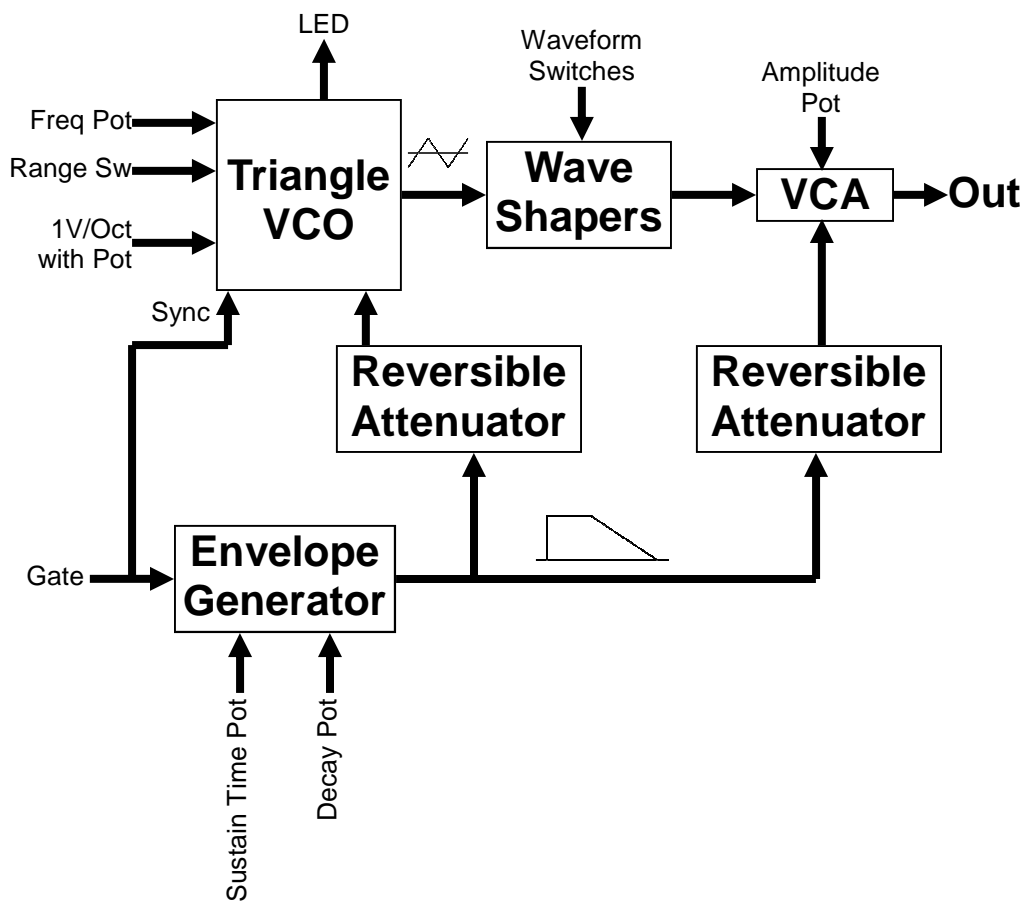


Output

This is the output for the LFO++. This output can be audio waveforms, low-frequency modulation waves, or Gates. The polarity and amplitude are set in the WAVE section.

Block Diagram

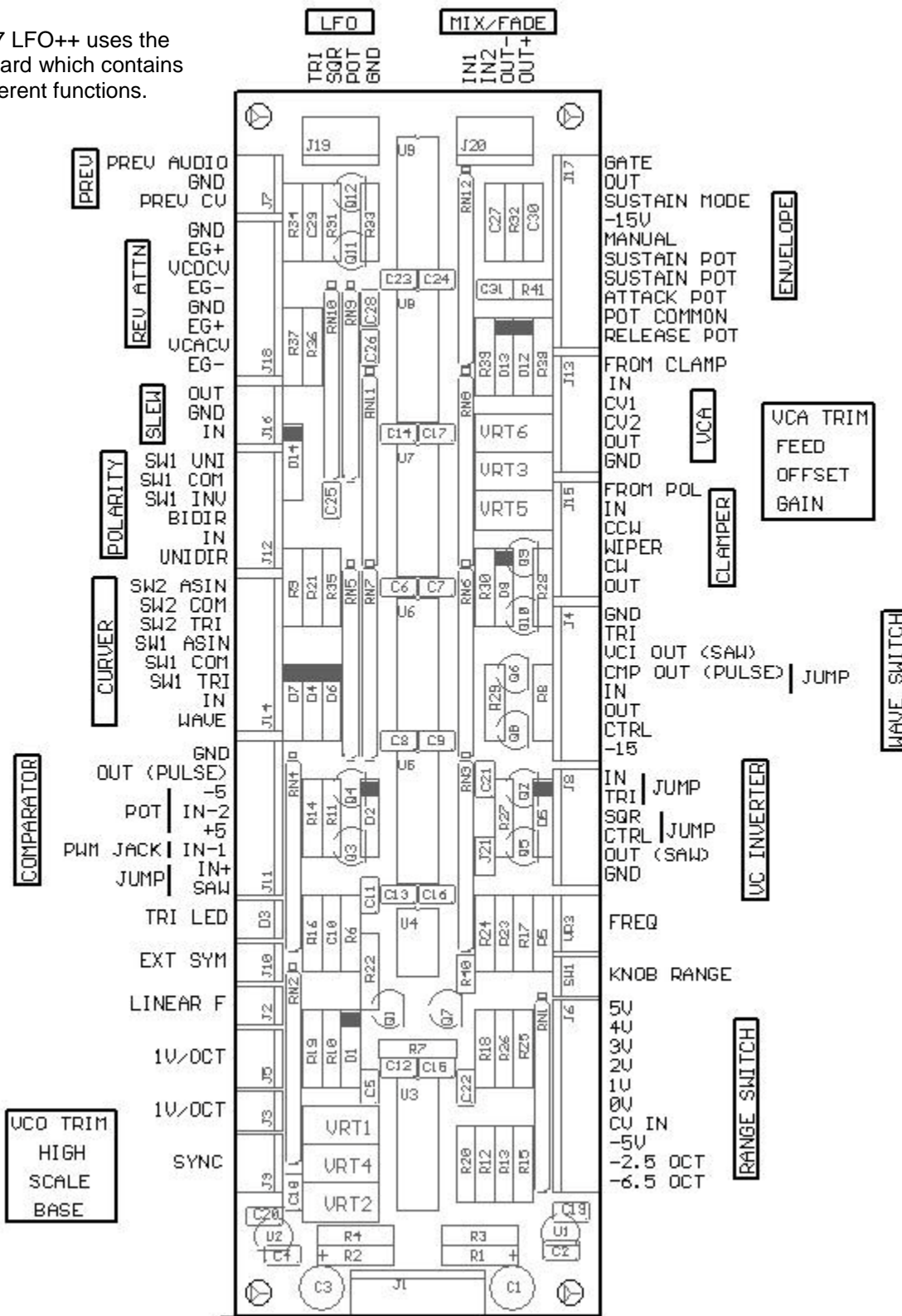
Here's a simplified block diagram showing the internal functions of the LFO++ module and how they are connected together. Think of it as a VCO, an envelope generator, VCA, and attenuator modules all pre-patched together. This creates the maximum possibilities with the least number of controls and the most intuitive operation.



Q167 LFO++

Nov 2015

The Q167 LFO++ uses the QFUN board which contains many different functions.



VCO Calibration

Calibration requires a frequency counter and an accurate voltage source such as a Q174 MIDI Interface or Q123 Standards Module.

Calibration is done using 3 trimpots.

Patch Voltage into 1V input and set attenuator to full Clockwise.

Set Speed pot to 5 and range to Audio.

Use triangle wave setting for the output.

Turn HIGH trimpot all the way clockwise until it clicks.

Set voltage source to 3V.

Adjust BASE trimpot to get 256.0hz.

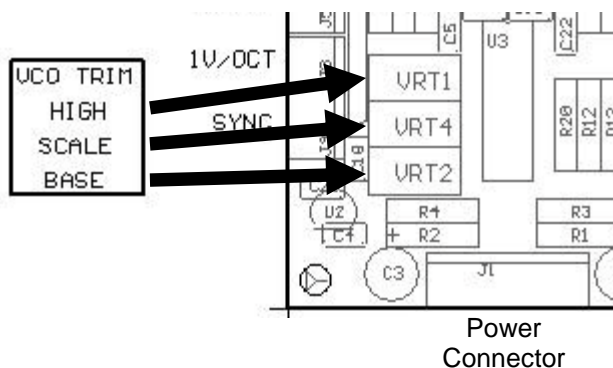
Set voltage source to 4V and look for 512.0hz.

Adjust SCALE trimpot while switching between 3V and 4V to get 256hz and 512hz.

Adjust BASE as needed.

If 4096hz is off, adjust HIGH trimpot.

Keep going to back to make sure 32.0hz is right.



VCA Calibration

Calibration requires an oscilloscope and/or or an AC voltmeter.

Calibration is done using 3 trimpots.

Set Amplitude pot to full clockwise and AMP EG attenuator to center.

Use Sine wave setting for the output.

Set range to Audio and Speed pot to 5.

View output on an oscilloscope or read with an AC voltmeter.

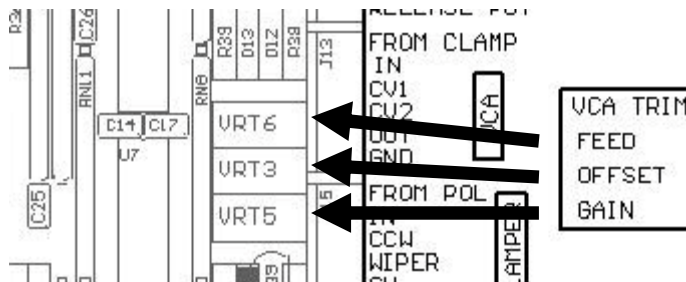
Set GAIN trimpot to get a 10v peak-peak waveform, or 3.5v AC on a voltmeter.

Adjust OFFSET trimpot to center the wave.

Adjust FEED trimpot to get the smallest wave.

Recheck GAIN.

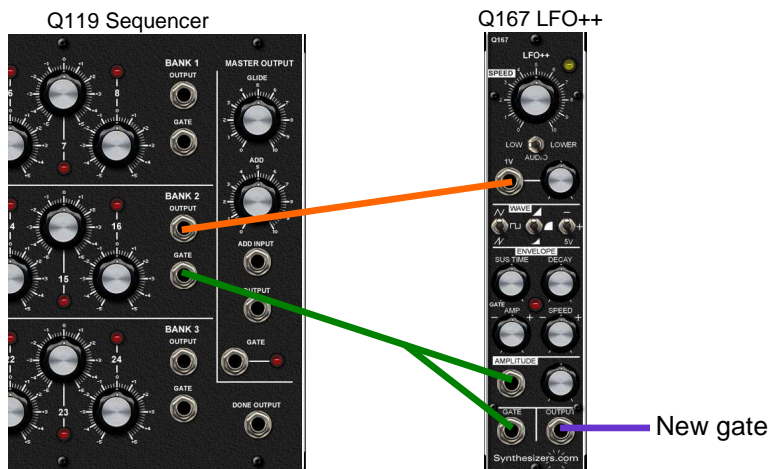
Recheck OFFSET and FEED.



Q167 LFO++

Nov 2015

This Q167 produces 1,2,3 or 4 beats for each step, under voltage control by row #2 of the sequencer.



Select square wave, and set the LFO speed so a sequencer knob can produce 1,2,3 or 4 gates per step.

Set polarity to 5V.

Set Sustain time to GATE. Decay to zero, Amp and Speed attenuators to center (off).

The sequencer's gate will sync the LFO output and will turn the burst of notes ON and OFF.

Two Q167 LFO++ modules are used in audio range to produce a complete FM synthesizer. No filtering needed, FM controls the harmonics. The audio output of the first Q167 is added to the pitch on the Q174 MIDI Interface.

