

# Vulpus Labs

# Segments

Introduction	2
Theory of Operation	3
Usage	4
Triggering	4
The Segment Start Value	4
The Segment End Value	4
The Segment Length Value	4
The Gate Output	5
The CV Output	5
The Mode Switch	5
Linking Segments	6
Credits and Acknowledgements	8

# Introduction

**S**egments is a CV signal generator. You set start and end CV levels, and the amount of time you want the output CV signal to take to get from the start level to the end level, then hit the trigger to start the segment playing.



**VULPUS LABS**  
KNOW MANY THINGS

Along with the CV signal **Segments** emits a gate signal for a controllable percentage of the time the segment is playing (so you can leave time at the end for an ADSR to release), and an end trigger when it comes to the end of the segment.

One of four selectable curves (linear, quarter sine, inverse quarter cosine and sinusoid) can be applied to the generated segment. The start and end levels can be modulated, either in "sample and hold" mode where the levels are fixed when the trigger fires and remain fixed until the segment has completed, or in "continuous" mode where the start and end levels, and hence the intermediate values, can change while the segment is running.

Instances of **Segments** can be chained to build up longer sequences, with each segment being triggered by the end trigger of the previous segment. CV signals can be passed through along a chain of segments, with each instance either emitting its signal if it is playing or passing through the input signal if it is not. A segment or chain of segments can be looped so that plays forever.

**Segments** is not intended as an audio-rate oscillator - because the length of each segment is set in a whole number of samples, it loses pitch accuracy at higher frequencies. (It can be quite fun to trigger it *with* an audio-rate oscillator, however). It is good as an envelope generator for long-running and non-standard envelope curves, a frequency CV source for electronic drums (kicks and blips), and a read-head position control for [Catkins](#) (the purpose for which it was originally developed).

# Theory of Operation

Mathematically, a segment is a portion of a line or curve bounded between two points. **Segments** interprets this notion as a CV signal changing over time, between a start point (the trigger which starts the segment "playing") and an end point (the trigger which fires when the segment has completed).

The user specifies the duration over which the segment will be played, the CV voltage that will be emitted at the start of the segment, the CV voltage that will be emitted at the end of the segment, and the type of line or curve that will connect them.

For example, given a "linear" shape, a segment lasting 5 seconds, starting at +4v and ending at -1v, will emit a CV value of +4v at the start, +3v after one second, +2v after two seconds, +1v after three seconds, 0v after four seconds and -1v after five seconds, at which point the segment will finish "playing" and the end trigger will fire.

When a segment is not playing, **Segments** will either emit a 0v CV signal, or pass through a CV signal fed to it through the "CV Link" jack.

For a portion of the time (from 0-100%) in which a segment is playing, a +5v gate signal is emitted. The ability to shorten the gate signal is useful if the CV output is being used to create an effect that we also want to apply an ADSR envelope to, since we will typically want to trigger the "[R]elease" phase of the envelope (which kicks in when the gate signal driving the envelope generator ends) before the segment itself has finished.

**Segments** has two operating modes, "Sample and Hold" mode and "Continuous" mode. In "Sample and Hold" mode, the start and end voltages of the segment are sampled when the start trigger fires, and held until the segment completes playing. In "Continuous" mode, they may change continuously during playback, moving the endpoints of the segment being played and hence also modulating the intermediate values being emitted as the segment progresses.

# Usage



**Segments** has six rows of controls, with a mode switch at the bottom.

## Triggering

The top row, "Trig", concerns triggering. A segment is triggered and starts running when a positive signal is received by the **Start** jack, or when the button in the middle is pressed. A 5v trigger signal is sent to the **End** jack when the segment has finished running.

## The Segment Start Value

The second row, "Start", concerns the start voltage of the segment. If the **In** jack is connected, the voltage is set by the CV signal sent to that jack; otherwise it is set by the knob in the middle. When a segment is playing, the start voltage of the segment is sent to the **Out** jack; otherwise, the current value of the knob, or of the CV signal if connected, is emitted.

## The Segment End Value

The third row, "End", concerns the end voltage of the segment, and works in the same way as the "Start" row.

## The Segment Length Value

The fourth row, "Len", concerns the length of the segment - the time it will take the output CV signal to move from the selected "start" value to the selected "end" value. Unlike the "start" and "end" values of the segment, which in "Continuous" mode can change at any time, the length value never varies during segment playback

A range switch sets the maximum length of the segment (the minimum is always 2 samples).

As with the "Start" and "End" rows, either the **In** jack (if connected) or the knob sets the length of the segment, which is passed through to the **Out** jack.

Note that the range selector has no effect on the value passed through to the **Out** jack, which receives just a CV signal between -5v for "minimum length" and +5v for "maximum length" (for whatever the selected range may be).

## The Gate Output

The fifth row, "Gate", concerns the gate signal that is sent to its **Out** jack for all or part of the time that a segment is playing. The knob controls the percentage of the segment length that the gate signal is sent for.

Unlike the previous rows, there is no CV input to control this: the **Link** jack receives a signal that is passed through to the **Out** jack when the segment is not playing. This can be useful when chaining instances of **Segments** (see more below on how chaining works).

## The CV Output

The final row, "CV", concerns the CV signal that is generated by a segment. The knob controls the shape of the segment that is sent to this row's **Out** jack: either "Linear" (a straight line), "Quarter Sine" (starts quickly, ends more slowly), "Inverse Quarter Cosine" (starts slowly, ends more quickly) or "Sinusoid" (starts and ends slowly, speeds up in the middle).

As with the "Gate" row, the signal received by the **Link** jack of the "CV" row is passed through to the **Out** jack when the segment is not playing. This can be used for chaining segments.

If nothing is connected, the CV signal sent to **Out** will revert to 0v when the segment has finished playing. If you want it to stay at the final value of the segment until the next trigger, you can connect the **Out** from the "End" row to the **Link** of the "CV" row.

## The Mode Switch

The mode switch at the bottom switches between "Sample and Hold" (S&H) and "Continuous" modes.

In Sample and Hold mode, whatever value was being sent to the "Start" and "End" **In** jacks when the segment was triggered is captured and held for the duration of the segment. This held value is what is sent to the corresponding **Out** jacks while the segment is playing, after which the signals sent to the **In** jacks are passed through directly.

In Continuous mode, values continue to be read from these jacks while the segment is playing, and intermediate values may be affected.

# Linking Segments

Multiple instances of **Segments** may be joined together to create more complex “shapes”. An example configuration is shown here:



The “Trigger” sections of the two instances of **Segments** are patched together to form a loop, so that the “end” trigger output of the first triggers the “start” of the second, and its “end” in turn retriggers the first. Once started, they will constantly trigger on a loop.

The “out” of each instance’s “End” section is patched to the “in” of each instance’s “Start” section, ensuring that each segment starts where the previous left off.

An LFO is patched into the **In** segment of the second instance’s “End” section, modulating it up and down.

The **Out** jack of the first instance’s “Len” section is patched into the **In** jack of the second instance’s “Len” section, ensuring that both sections are the same length.

The “Gate” and “CV” sections are patched circularly in the same way as the “Trigger” sections, so that each instance will pass through the other’s gate and CV signals when it is not active.

The second instance’s “CV out” signal is sent to the oscilloscope, which shows two constantly alternating segments: one tracing a line up from -5v to the sampled-and-held value of the LFO, and another tracing a line back down again to -5v. The “peaks” of the resulting signal move in line with the LFO’s sine wave curve.

# Credits and Acknowledgements

Segments was written by Dominic Fox in March 2023.

Thanks to Stephen Sauvé for beta-testing, and to the developers at Cherry Audio for their great products, especially Voltage Modular.