LjunggrenAudio RYO VC Sequencer:
Compact 8-step Voltage Controlled Sequencer

No software or micro processors!

All low latency CMOS and Opamp circuitry!

Quickstart - what is the VC Sequencer and how do I get going?

The RYO VC Sequencer is a compact 8-step sequential voltage source in 10hp with classic forward/backward clocked operation and also any kind of pattern you like using control voltage levels scaled to each step of the sequencer, allowing the waveform you feed it with to determine the running pattern.

Examples of this would be a ramp to make it go forward, saw to go backward, triangle for pendulum, S&H'd noise for random etc. You could also use another sequencer's pattern to control the pattern of the VC Sequencer, the possibilities for exploration are endless.

RYO VC Sequencer

1. Step 1 CV Output Lvl Knob (-5V to +5V).
2. Step 2 CV Output Lvl Knob (-5V to +5V).
3. Step 3 CV Output Lvl Knob (-5V to +5V).
4. Step 4 CV Output Lvl Knob (-5V to +5V).
5. Step 5 CV Output Lvl Knob (-5V to +5V).
6. Step 6 CV Output Lvl Knob (-5V to +5V).
7. Step 7 CV Output Lvl Knob (-5V to +5V).
8. Step 8 CV Output Lvl Knob (-5V to +5V).
9. CV/Clock input (advances one step per pulse/+0.625V window crossed).
10. Reset input.
11. Output (stepped CV 10Vpp)
12. Mode switch (Voltage Controlled Mode/Reverse Clocked Mode/Forward Clocked Mode)

(Clocked Modes and CV Mode sync above audio rates

extending functionality into a 3bit waveshaper.)

Width: 10hp

Installation

To begin installation, please make sure that:

- you have a standard pinout eurorack bus board
- you have +12V and -12V power rails on that bus board [no +5V supply is required]
- the power rails are not overloaded

!!!Before installing this module disconnect the power from your system!!!

- Double check the polarity of the ribbon cable - The red stripe should be aligned with the -12V rail, on both the module and on the bus board

[we use shrouded headers but it's still possible a cable has been assembled with the stripe on the wrong side of the shroud so always double check!].

Also make sure when using busboards without shrouded headers that the pins aren't transposed a row vertically or horizontally – all pins should insert into holes on the cable.

*Although we use both PTC fuses and schottky diodes to provide reverse polarity and excess current protection, we do not take any responsibility for damages caused by wrong power supply connection**!***
After you have connected everything, double checked it and ensured your case is closed such that no power lines can be touched by your hand or any stray cables drop into holes, turn on your system and test the module

The VC Sequencer is a medium skill-level project, with a relatively minimal part count for it's feature set, although a multi-PCB build it only requires mid-level experience in PCB soldering and module assembly.

It can keep sync above audio rates: *Overall latency on version 1.3 is approx 5us (0.005ms) until the step changes and up to approx 10us (0.01ms) for voltage changes (bigger change = longer time).*

In version 1.3 the CV mode got an improvement allowing it to reach through the entire audio range; *Effectively extending the VC Sequencer's functionality into also being a 3 bit hands on waveshaper! (n.b. Both version 1.2 and 1.3 share the same PCB1.)*

In FWD/REV mode the CV/Clock input use a Schmitt trigger *this turns from low to high at approx 2.5V and from high to low at approx 2.3V (a window of 0.2V or 200mV), the same window applies to the Reset input.*

In CV mode the CV/Clock input uses a set of 7 Schmitt triggers with a window of approx 10-15 mV (0.01V - 0.015V). *(The first step doesn't need it's own Schmitt trigger). I.e. each step is separated by approx 0.625V.*

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Planned future expanders will offer chaining of 2 VC Sequencers for 16 step operation and unlimited extra parallel channels of CV or gate/trig. *For example, the first expander will have individual gate or trig outs for each step in 4hp. (Although it must be noted that the 16 step expander will add extra latency and lower the maximum clock frequency in 16-step mode.)*

(The 16 step expander will be released eventually but still has a number of development cycles to progress through.)

In Use:

When a knob is set fully to the left (CCW), that step will send -5V to the output when it is activated. *As the knobs are turned to the right from -5V toward the centre position, 0V (CW), the voltage sent to the output will become smaller when that step is activated.*

As 0V is passed and the knob continues to be turned to the right (cw),
the voltage sent to the output will increase until reaching max (+5V) when that step is activated.

The Schmitt trigger input in the FWD and REV clocked modes allow for not just standard 0V to +5V pulse wave input signals as clock sources but pretty much any periodic waveform that crosses the thresholds of the Schmitt trigger window, (*low to high at approx 2.5V and from high to low at approx 2.3V) and even weirder streams of signals such as outputs of a burst generator, weirder gate/trig generators and pretty much anything else you can imagine (bear in mind you may need to offset, attenuate, amplify or do other things to get the threshold response to behave as desired.)*

Likewise, in VC mode, as explained above, the sequencer can be made to run in standard forward stepping motion by feeding it a saw wave, to step in reverse using a ramp wave, and pendulum motion using a triangle wave; *but this is barely dipping a toe into the water compared to the depths that can be explored (see patch ideas for the excitements of sequential switch and logic based patches to expand and complicate things so much more!)*

As mentioned for the FWD and REV clocked modes, the reset input also uses a Schmitt trigger, with the same threshold window range, and so resetting of the sequencer in both clocked and VC mode can be done with a massive variety of input signals; *also when the sequencer is run at high rates even past audio frequency, the reset input will act as a sync input still accepting this wide range of input signals.*

Dimensions	
Height:	**3U** [128.5mm],
Width:	**10HP** (50.50mm)
Depth:	**42mm** (with power cable attached)
Weight:	125g (approx w/cable)

Current consumption	
+12V rail	**22mA** (version 1.2 **28mA**)
-12V rail	**11mA**
+5V rail	**no +5V** supply required

Basic specifications	
total frequency controllable range	DC to 100+kHz
max input signal	0V to +10V
max output signal/audio signal	10Vpp (-5V to +5V)
Max gain:	n/a

Nominal impedances	
Audio signal input:	100k ohm
Audio Signal **output**:	in loop compensated
CV input:	n/a

Patch ideas:

Although uses of sequencers in patch examples and ideas are found readily online and in some books, there are many other less obvious ways to use the VC Seq in patches in your modular rig:

below i've included some inspiring words to show the patches that can be tried; and, as ever, experiment – RYO modules are designed with all necessary protection and fail-safes so you can just start plugging in patch cables and see what happens!

Create Complex Waveforms I:
Clocking it at audio rate and turn knobs to define the shape of an 8 segment (3bit) waveform with max voltage swing of 10Vpp.

Create Complex Waveforms II:
Still clocking at audio rate, use a wave form from a VCO to clock the sequencer in VC mode, then modulate that VCO via its FM, Morph or whatever other VC waveshaping options are available.

Create Complex Waveform III:
Again Clocking at audio rate using VC mode, use a sequential switch also clocked at audio rate, synced to the sequencer via it's reset input to create periodic changes in the waveform clocking and therefore modulating the sequencer's output wave.

Create Complex Waveform IV:
Further fun clocking at audio rate using VC mode, still using a sequential switch clocked at audio rate and synced to the sequencer via reset in, as above; try using logic modules to choose which of the various sequential switch channels is routed where, whilst running the clock source as one of the logic inputs so keeping everything synced still!

Ratcheting:
Use VC SEQ to control an LFO's rate in time with your sequence to create variable ratcheting per step! OR the LFO with your sequence triggers controlling your sound generator modules' envelopes.

Clock division:
by setting the knobs to only max or minimum, you can create a divider, cutting the clock down to slower speeds - great for drums!

Bipolar self-patched sequencing:
By patching the output to the input to control direction and speed, you can sequence the sequencer to create complex generative rhythms.

Bipolar sequencing:
This in itself is a rarity among sequencers, most of which only operate in the positive unipolar range. Use this to hit occasional bass notes with your oscillators without strange patching, modulate bipolar parameters, or just use it as a full-swing audio-rate oscillator when clocked by a VCO!