The Educational DIY Synth Thing

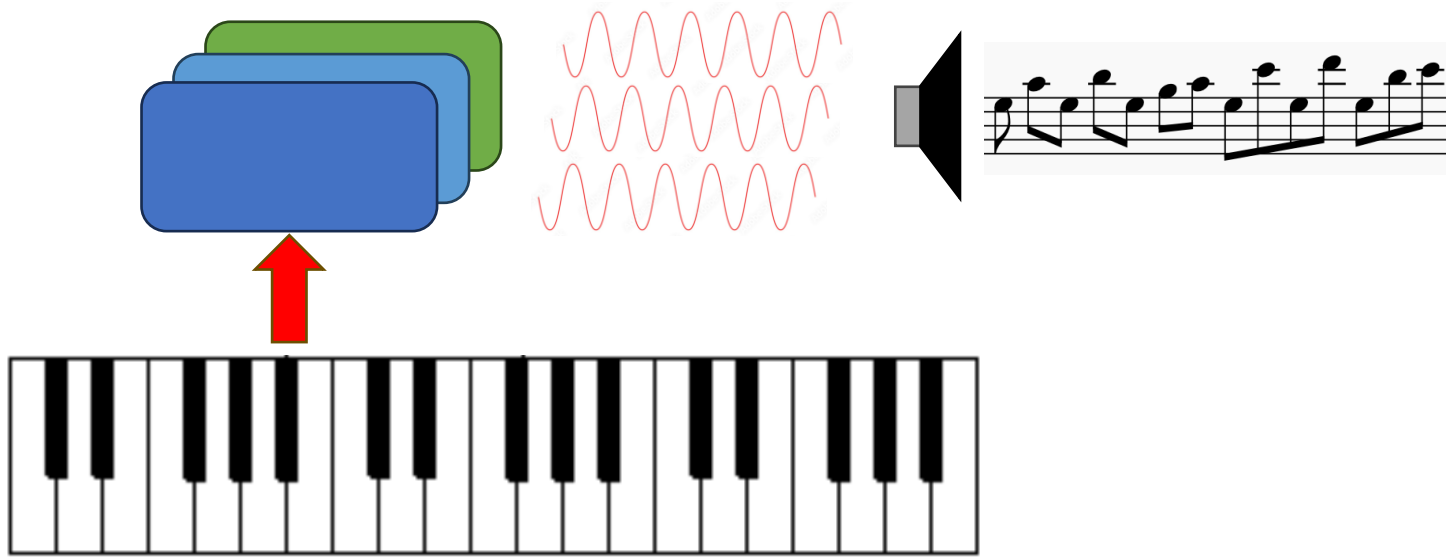
Projects – v0.1 – Nov 2024

https://diyelectromusic.com/2024/05/07/educational-diy-synth-thing/

Introduction

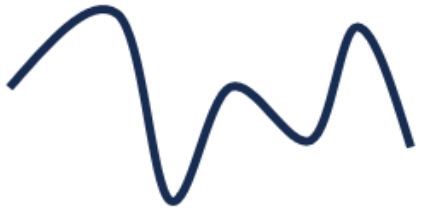
Introduction to Analog Synthesis

- Key Principles:
  - Audio Signals
  - Voltage Control
  - Gate and Trigger Signals
- Other Principles:
  - Envelopes
  - Modules
  - Monophonic
  - Polyphonic

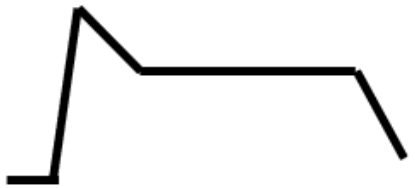


Key Principles

- Audio Signals
  - Produce the sounds.

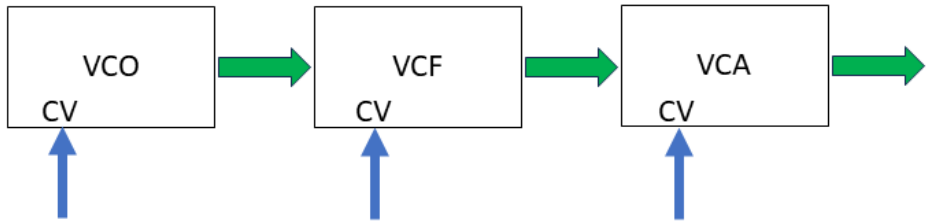


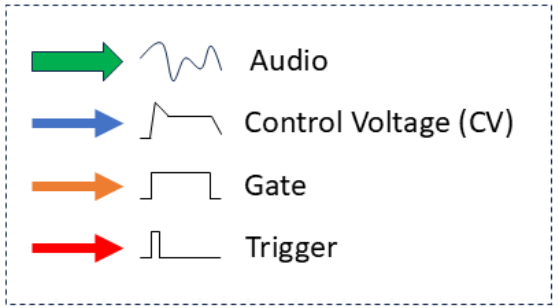
- Control Voltages
  - Everything is controlled by voltage levels.
  - Can be constant or changing.
  - Can be continuous or with a start and end.



- Gates and Triggers
  - Start and stop sounds.

Basic Structure of an Analog Synthesizer





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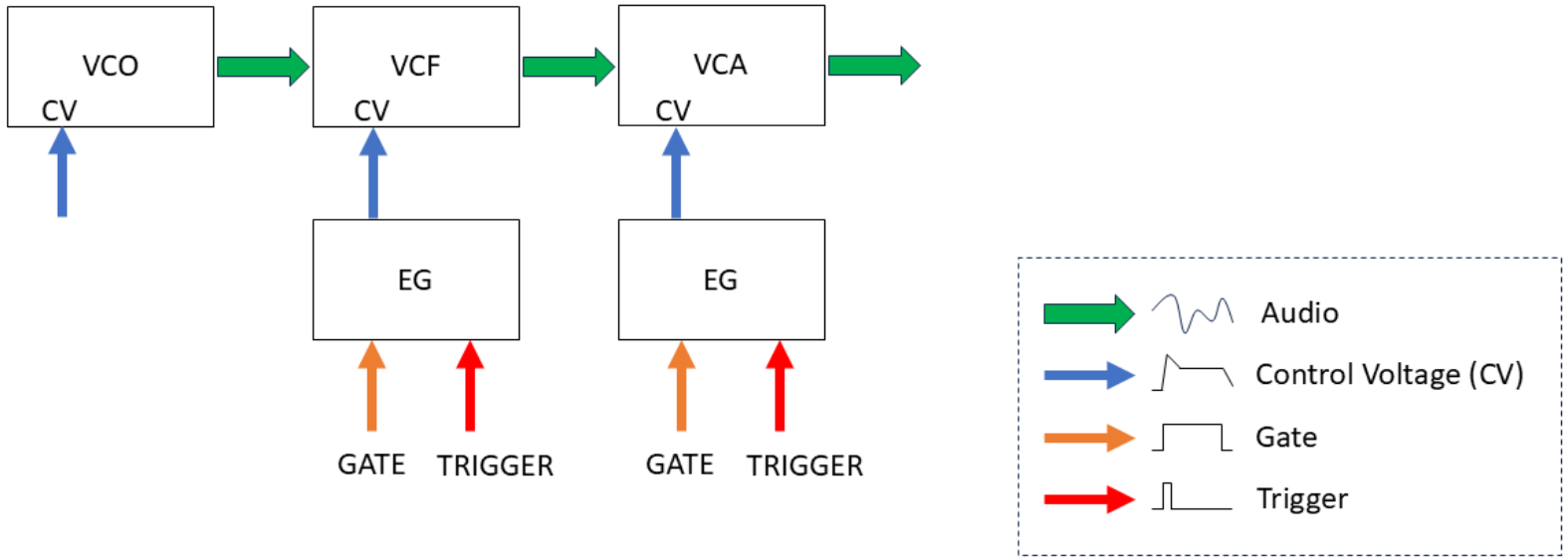
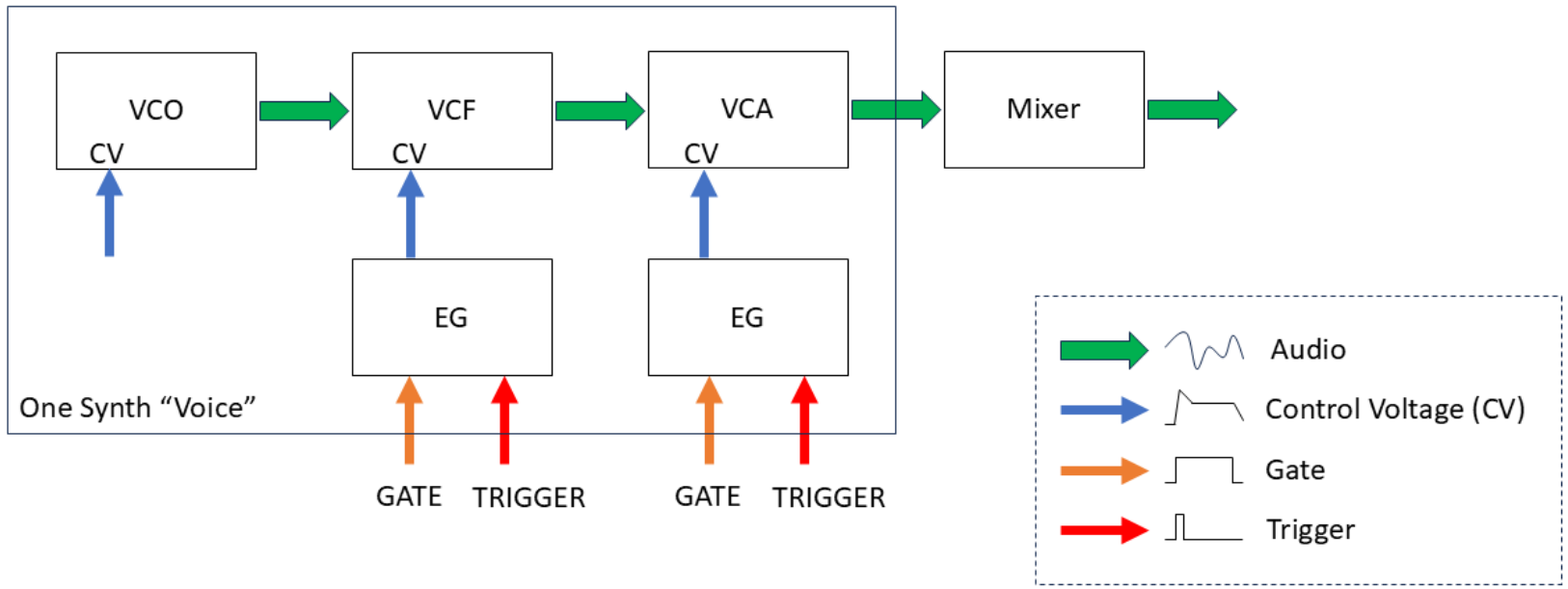


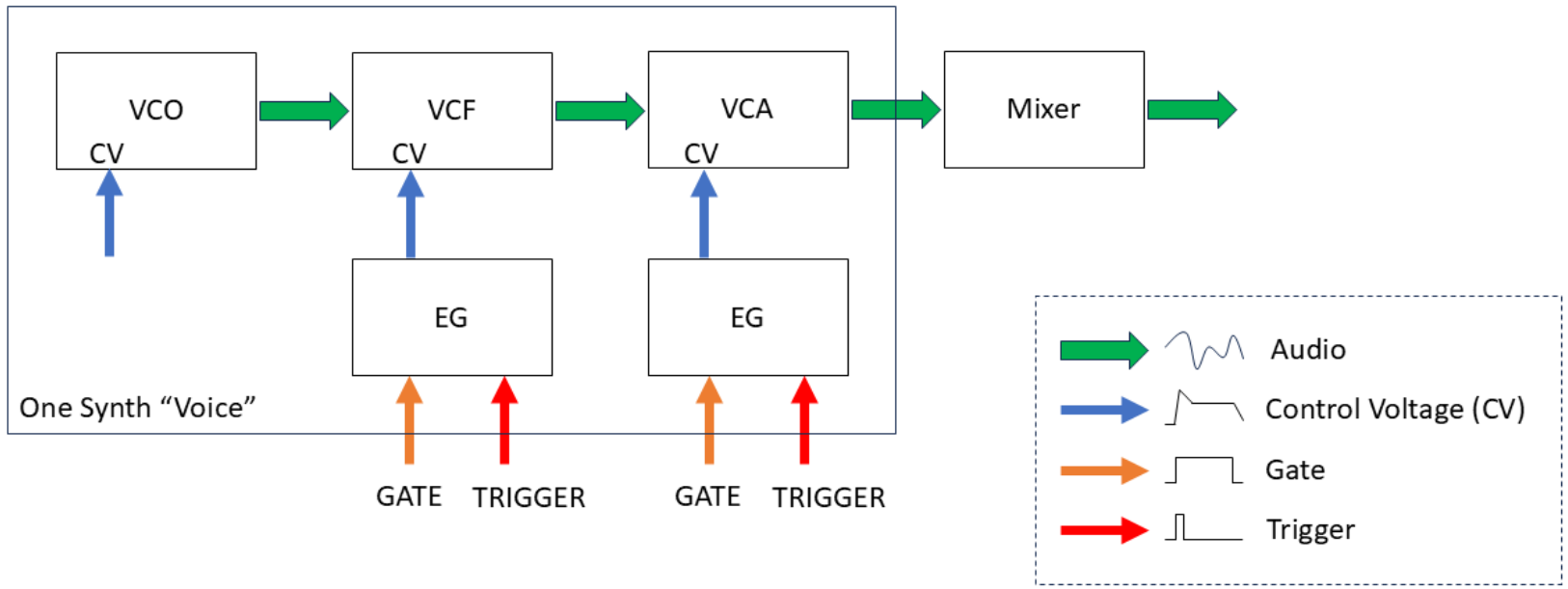
One Voice = Monophonic

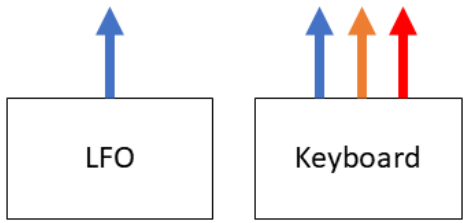
Basic Structure of an Analog Synthesizer



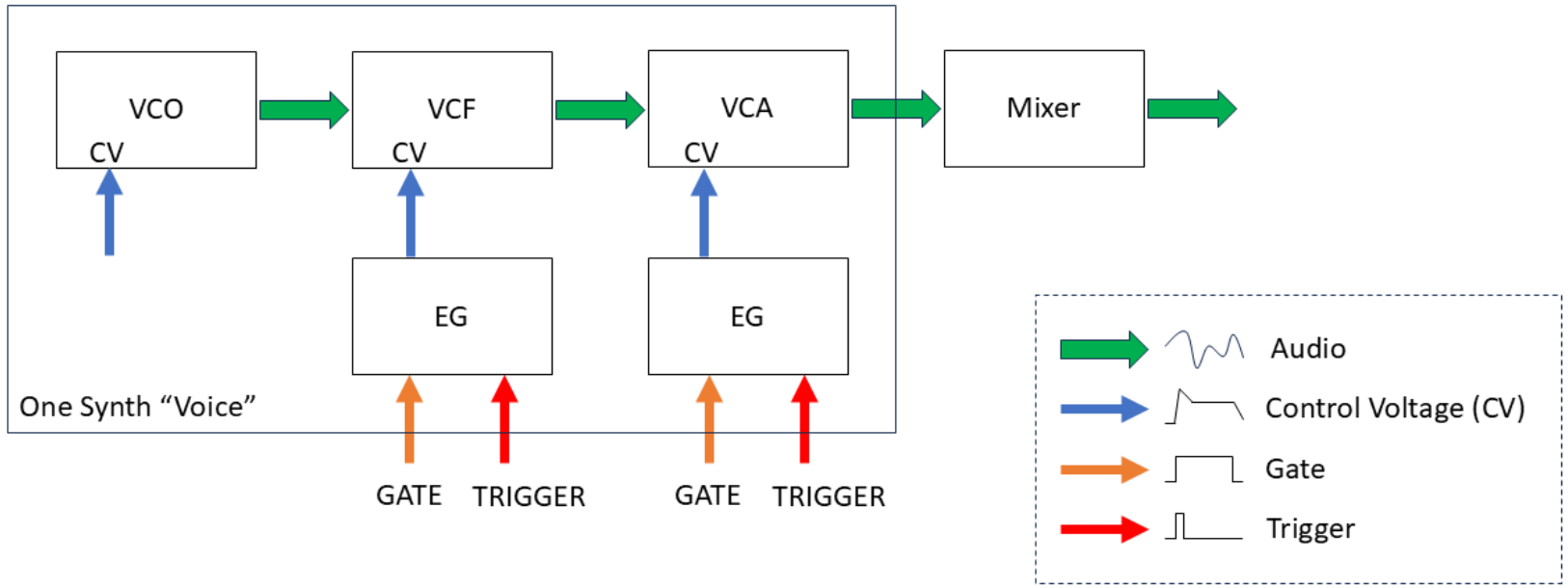
Many Voices = Polyphonic

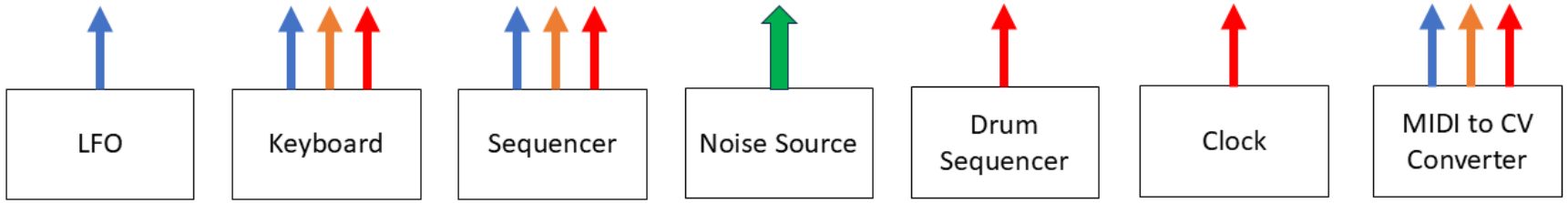
Basic Structure of an Analog Synthesizer



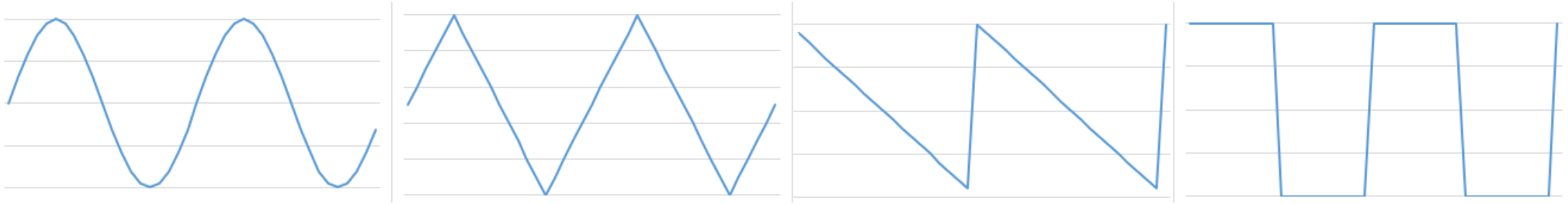


Basic Structure of an Analog Synthesizer



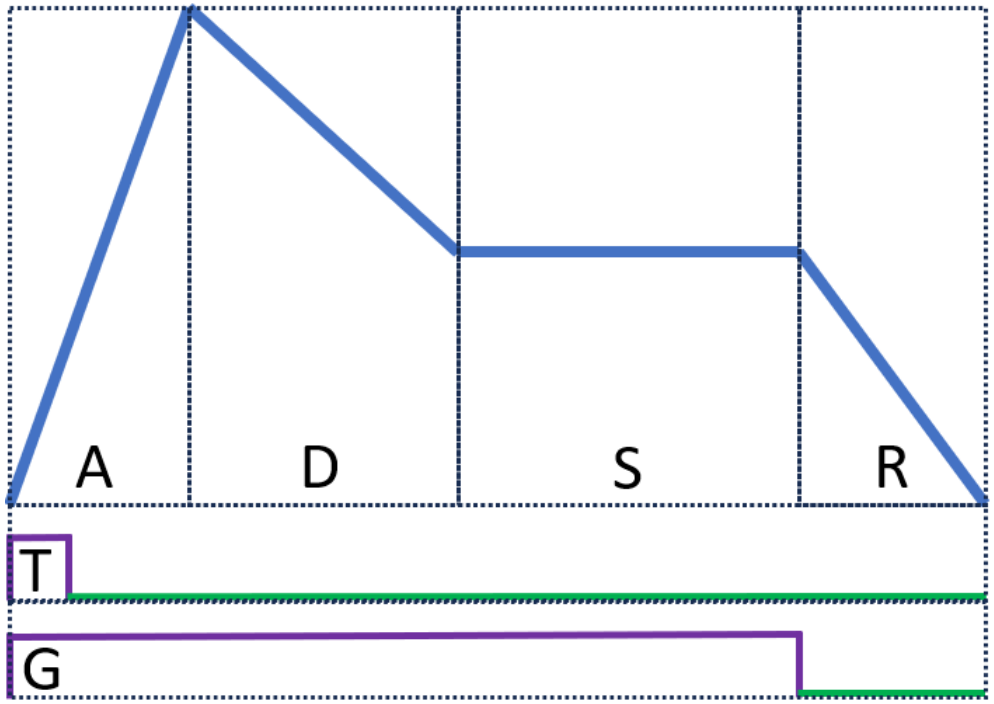


Waveforms



Sine Triangle Saw Square

Envelopes



- Attack (A)
- Decay (D)
- Sustain (S)
- Release (R)

< Trigger

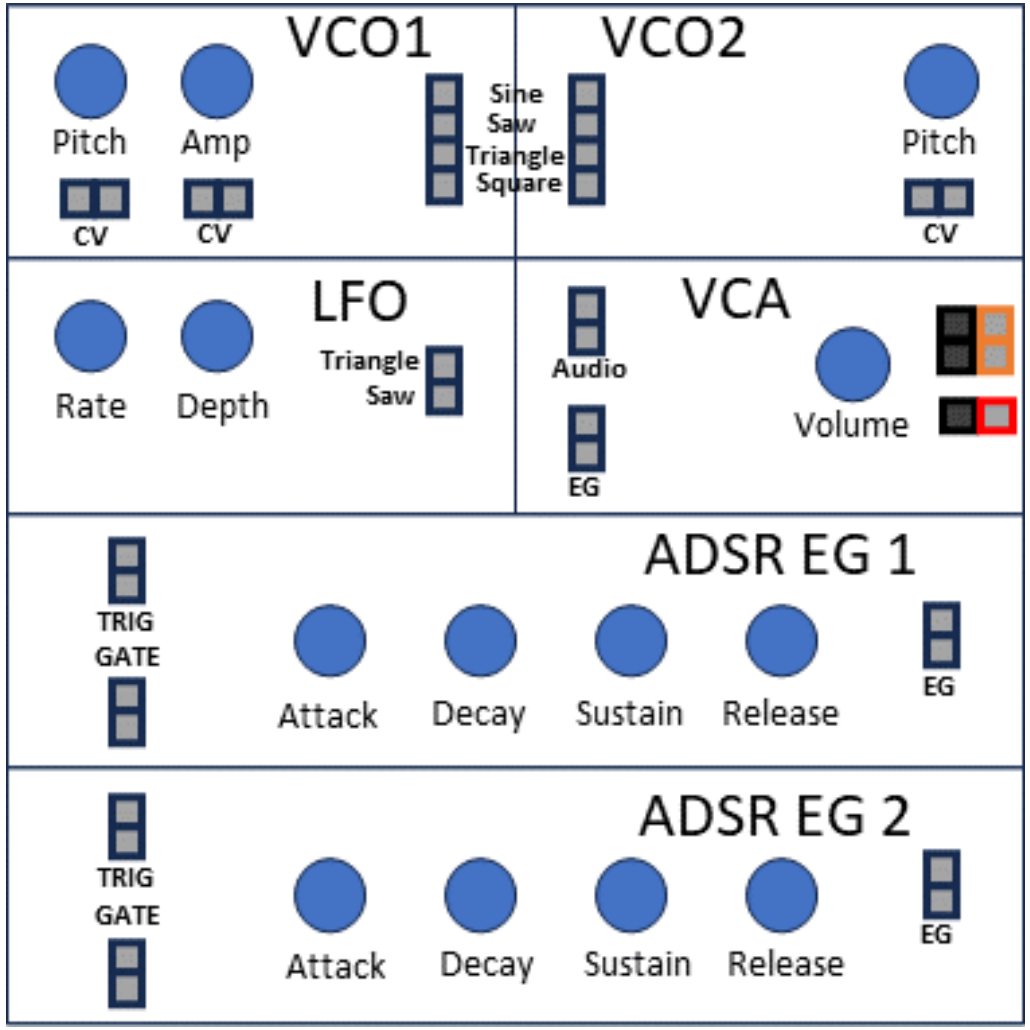
< Gate

Key Points of Analog, Modular Synths

- (Pretty much) Everything can be voltage controlled.
- (Pretty much) Any signal can be a control voltage!

The Synth Thing

The Synth Thing

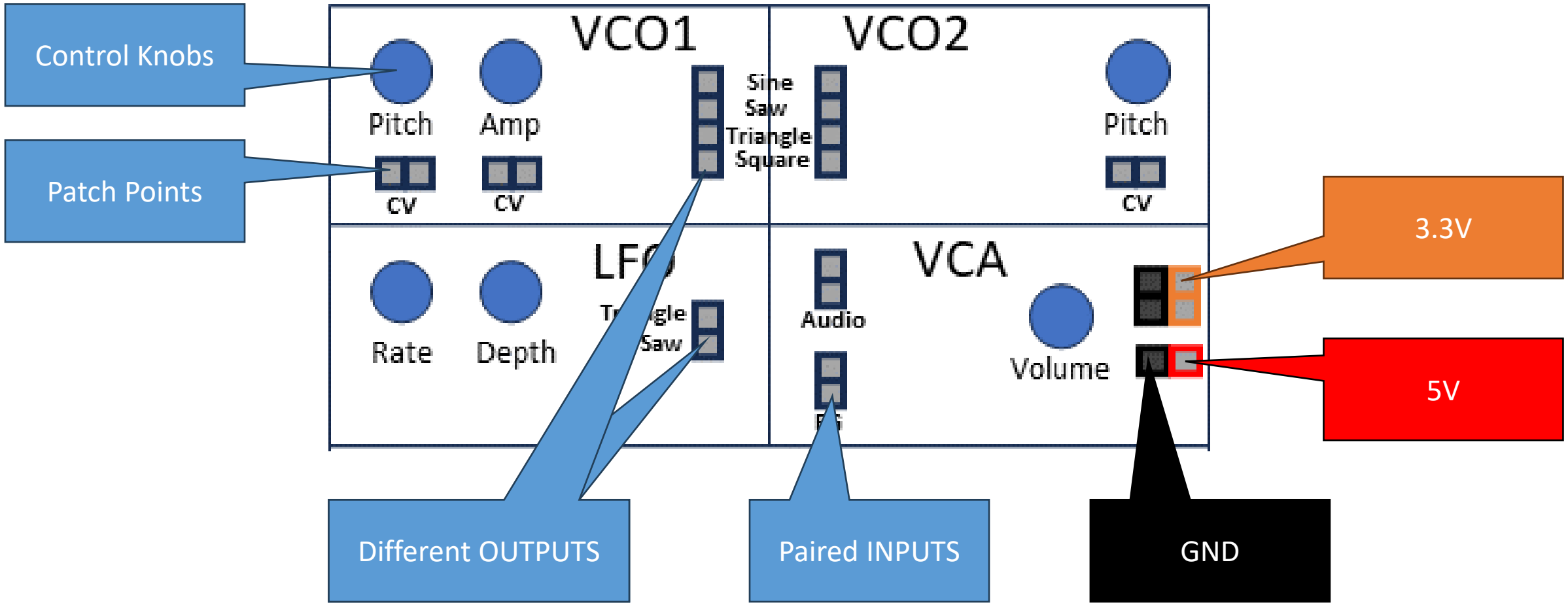


Modules:

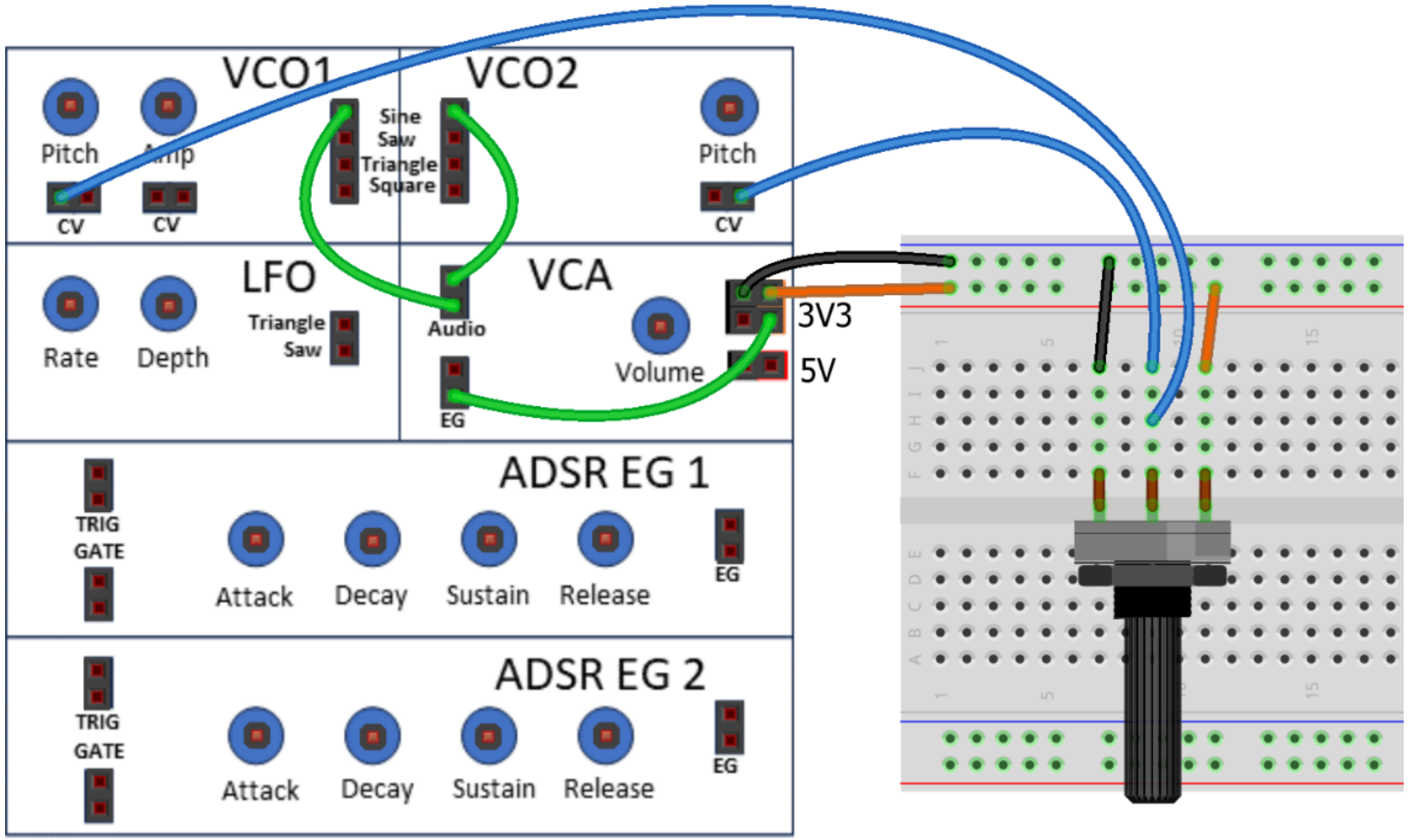
- 2x Voltage Controlled Oscillators.
  - 4x VCO waveforms.
- 1x Low-Frequency Oscillator.
  - 2x LFO waveforms.
- 1x Voltage-Controlled Amplifier.
  - Audio output.
- 2x Envelope Generators.
  - ADSR.

- *Every patch point is a real signal!*

Patch Points: control, audio, power

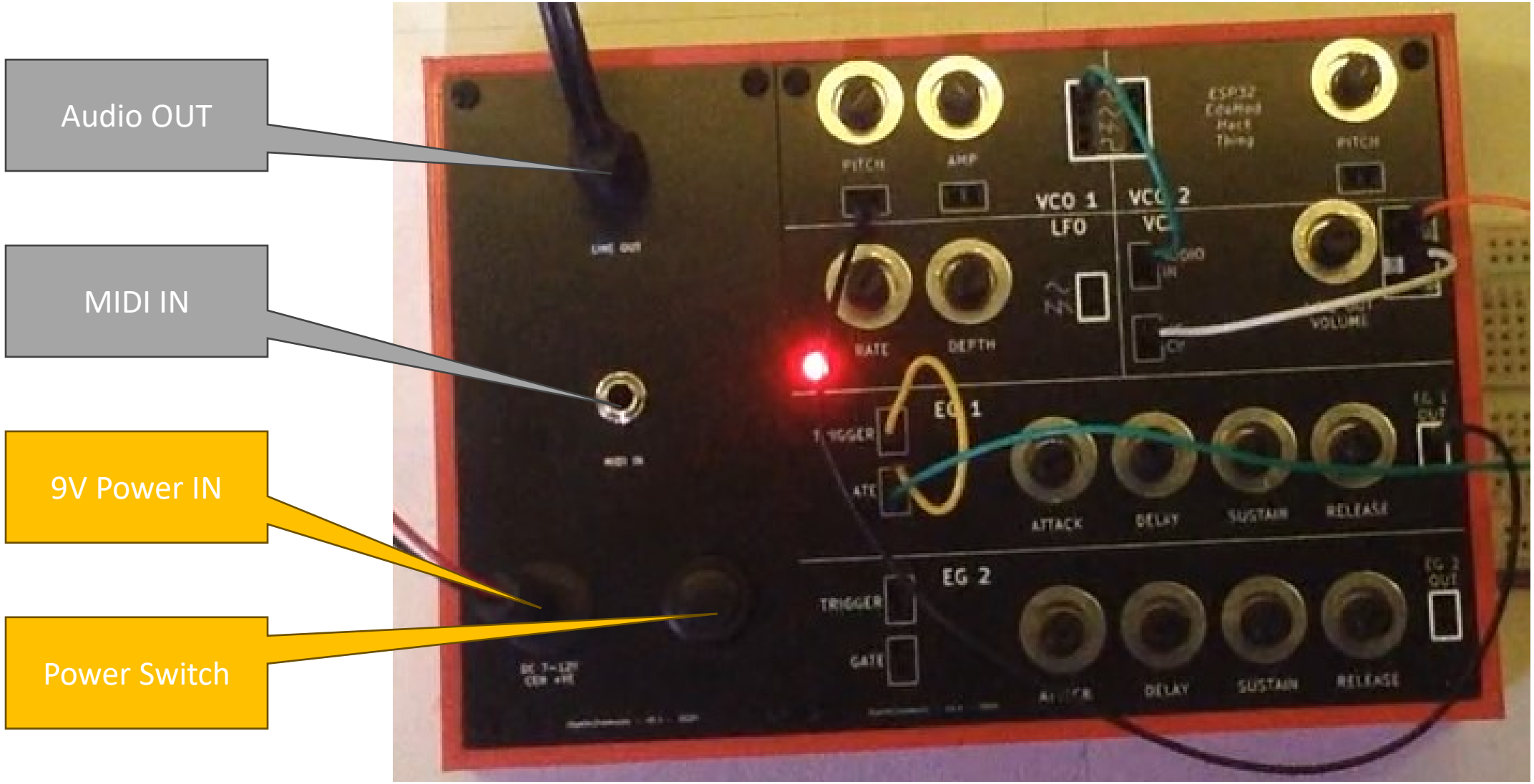


Patch Diagrams

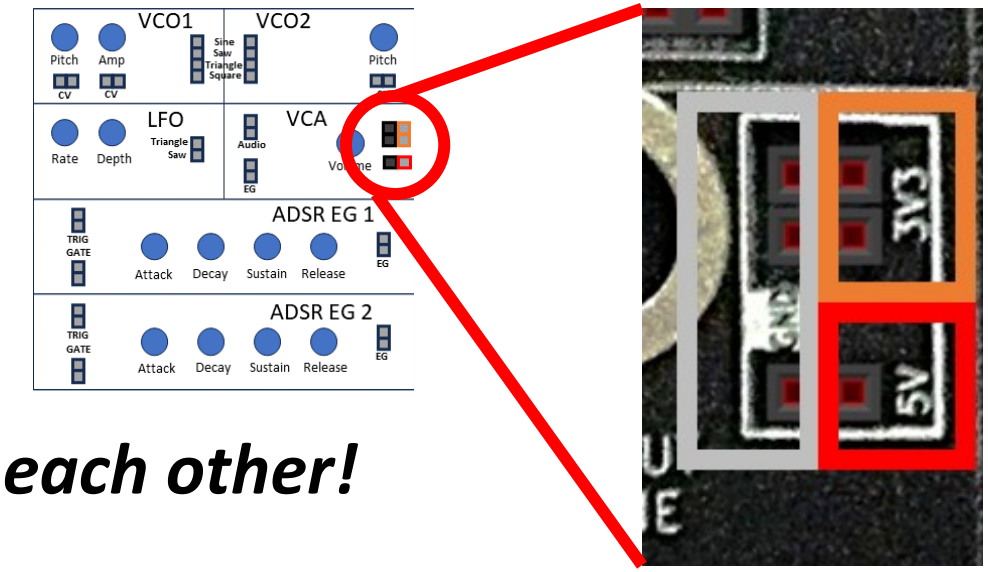


- Green: Internal Links
- Blue: External Links
- Black: GND
- Orange: 3.3V
- Red: 5V

Extra Connections



Basic Dos and Don’ts



Don’ts:

- ***DO NOT CONNECT 3V3 or 5V or GND to each other!***

Dos:

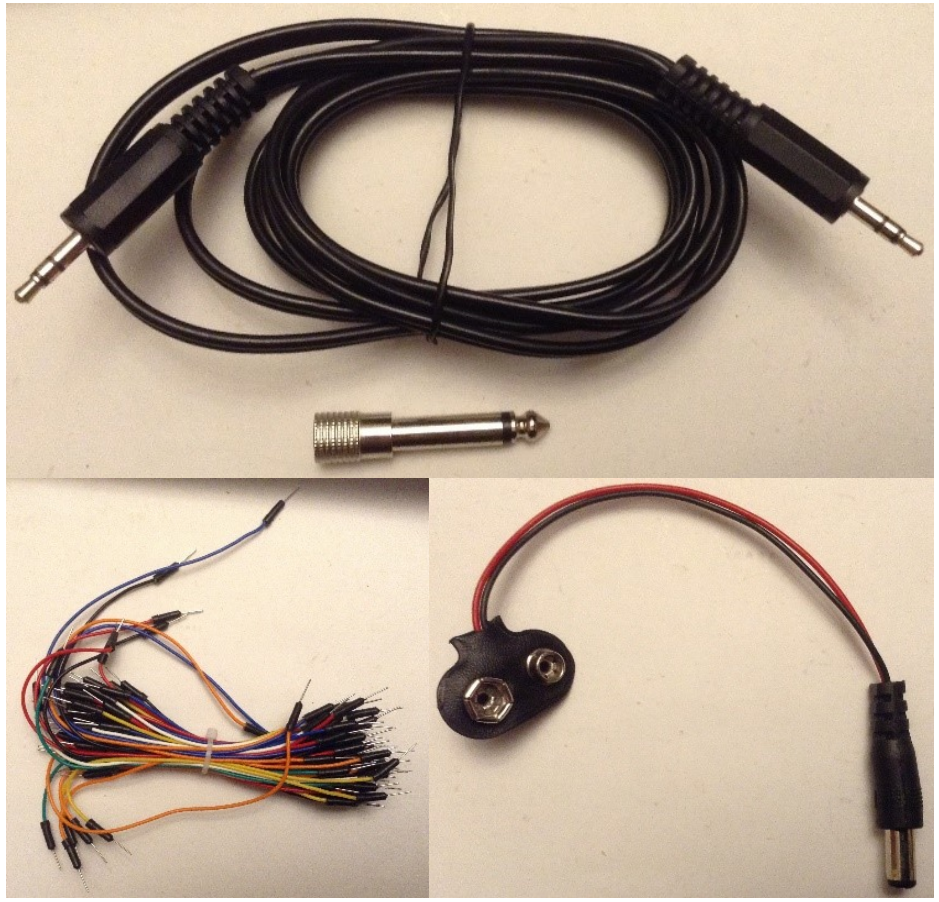
- Experiment with the different signals!
- Link to a solderless breadboard to make new circuits.
- Look at signals with an oscilloscope.
- Use MIDI.

Starter Projects

Getting Started

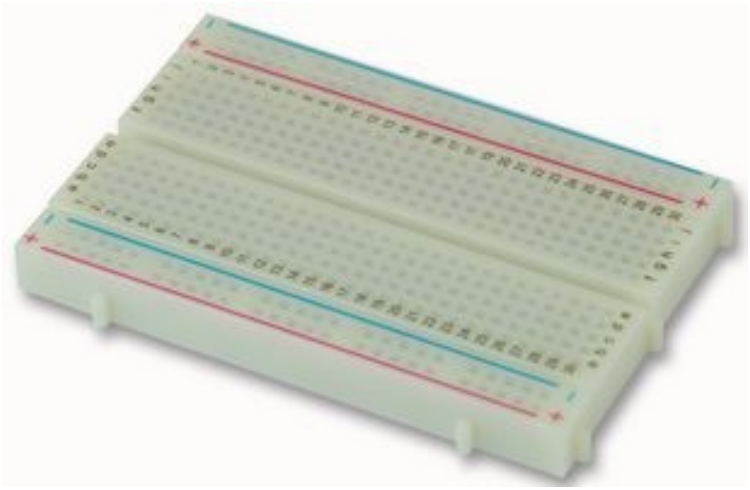
3.5mm
STEREO
AUDIO OUT

7-12V
DC IN

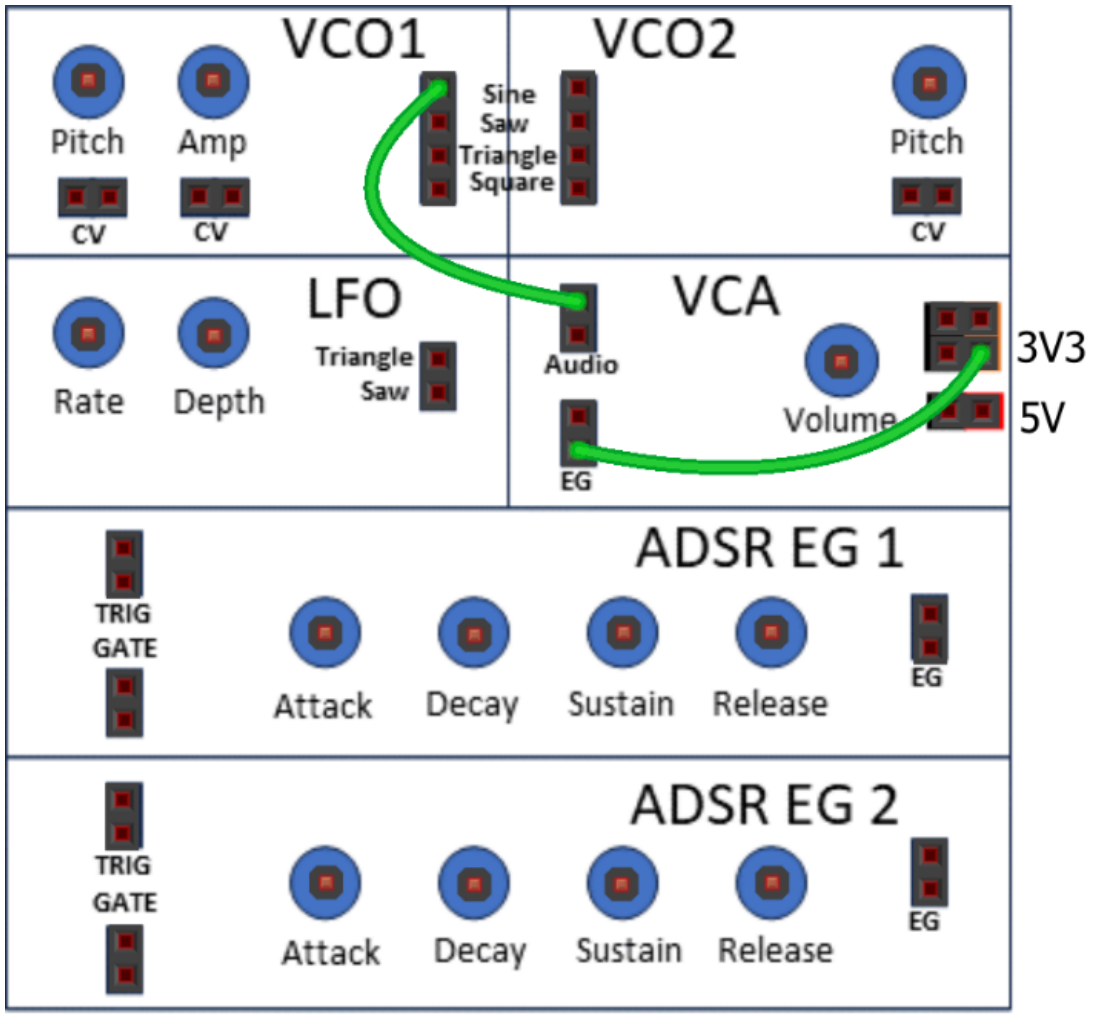


Other Equipment

- Optional: Oscilloscope
- Solderless breadboard
- Potentiometer (10K to 100K)
- Button
- (Cheap/Old) Amplification



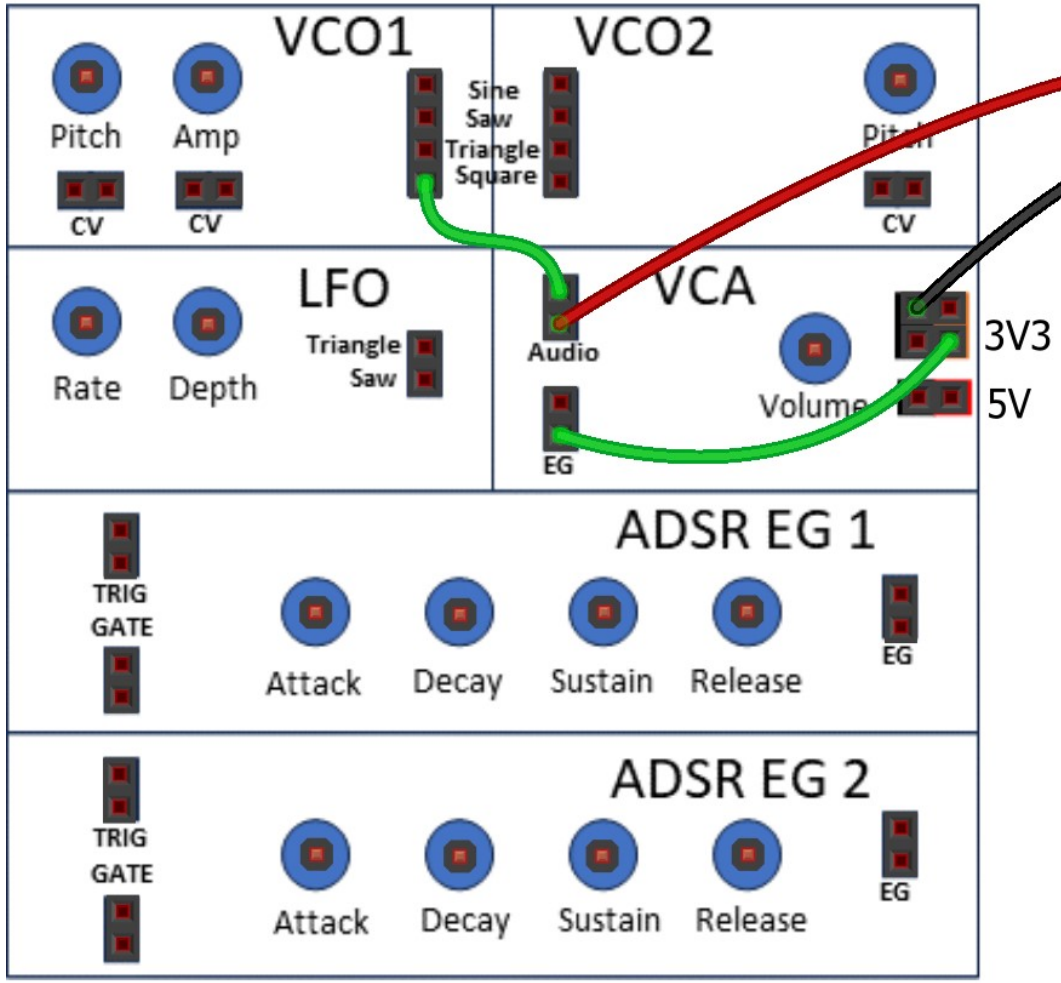
1. Basic Oscillator (VCO) Output



- VCA EG fixed at 3V3.
- Turn up VCA Volume.
- Experiment with:
  - VCO1 Amp.
  - VCO1 Pitch.

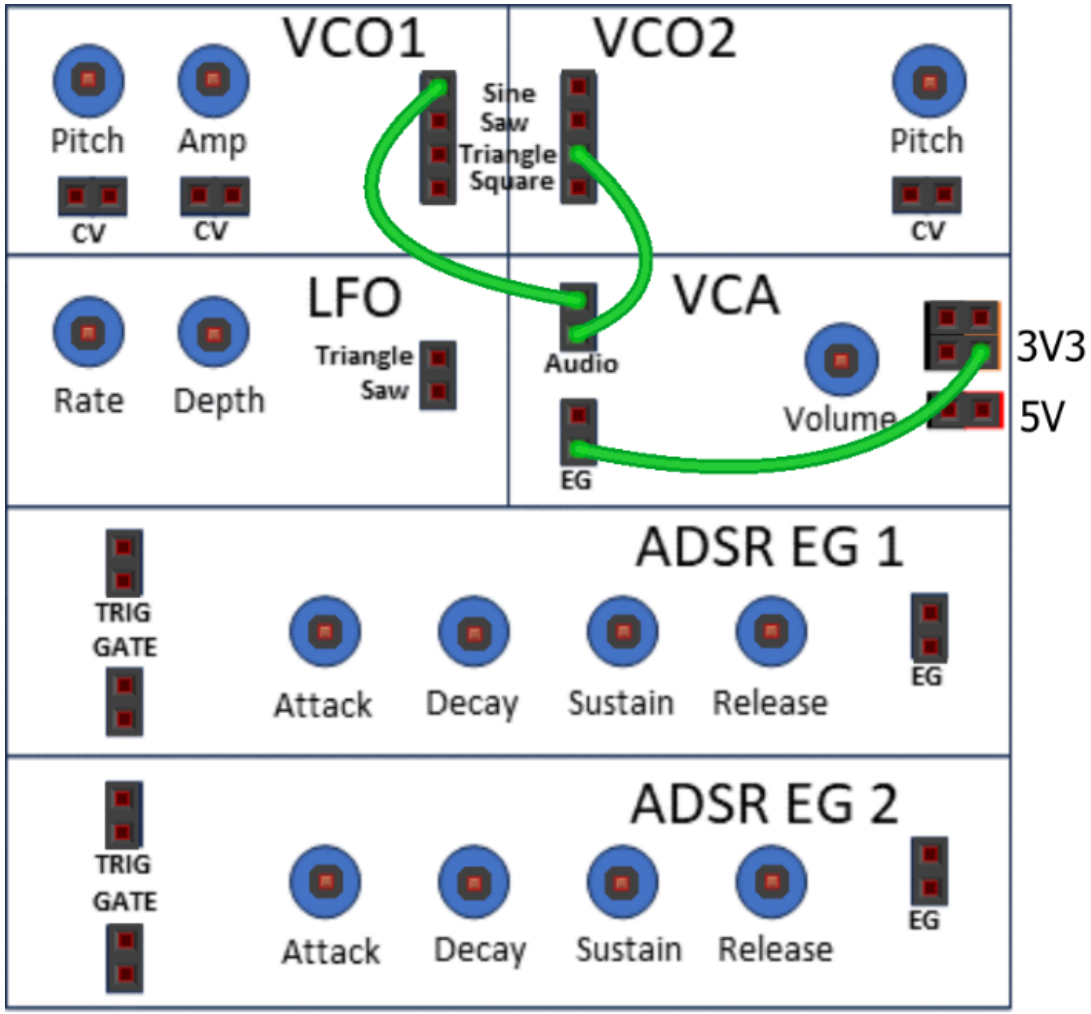
- What are the highest and lowest frequencies?

2. VCO Waveform on an Oscilloscope



- **Note: Needs a GND connection.**
- Try all four VCO1 waveforms.
- Change the VCO1 Amp and Pitch.
- Measure highest and lowest frequencies.

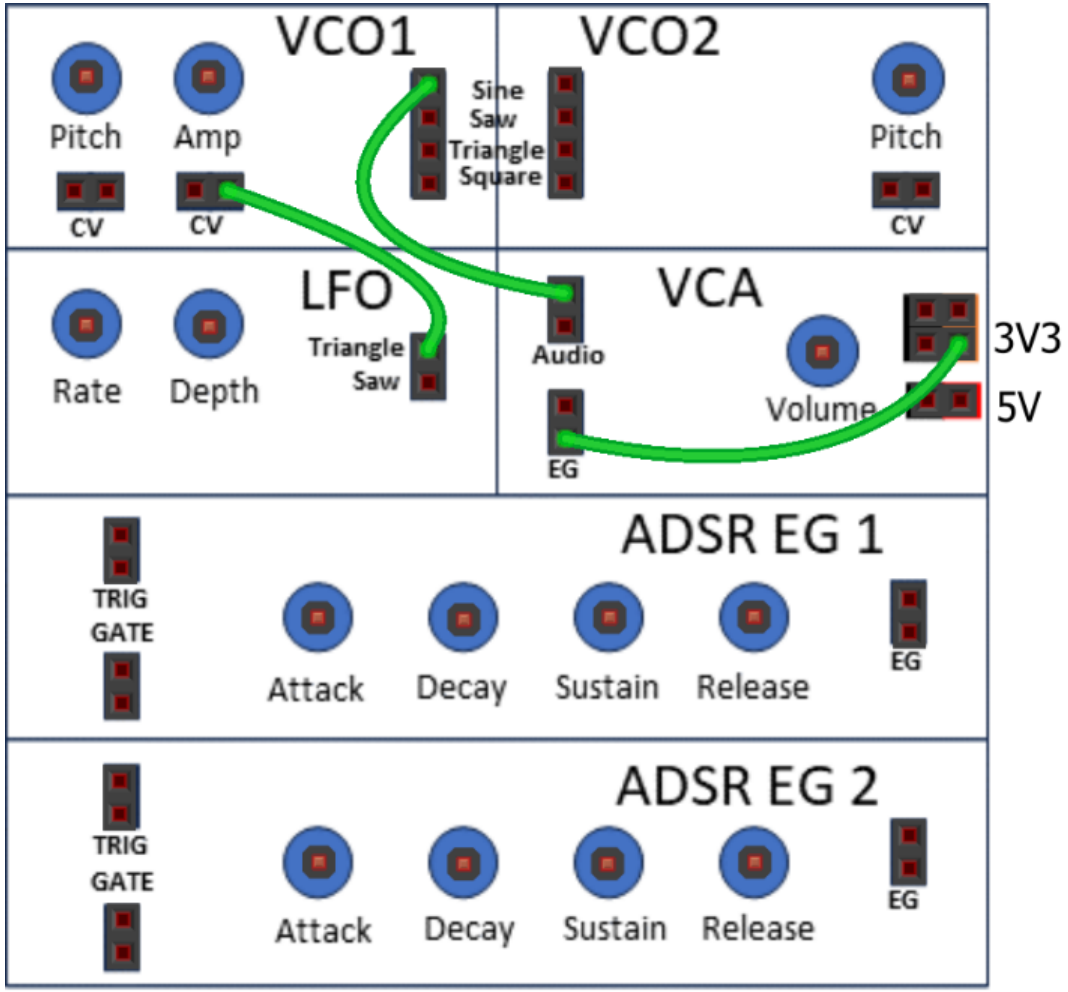
Dual Oscillator Output



- Change:
  - VCO1 and VCO2 Pitch.
  - VCO1 Amp.
  - VCO1 and VCO2 Waveforms.

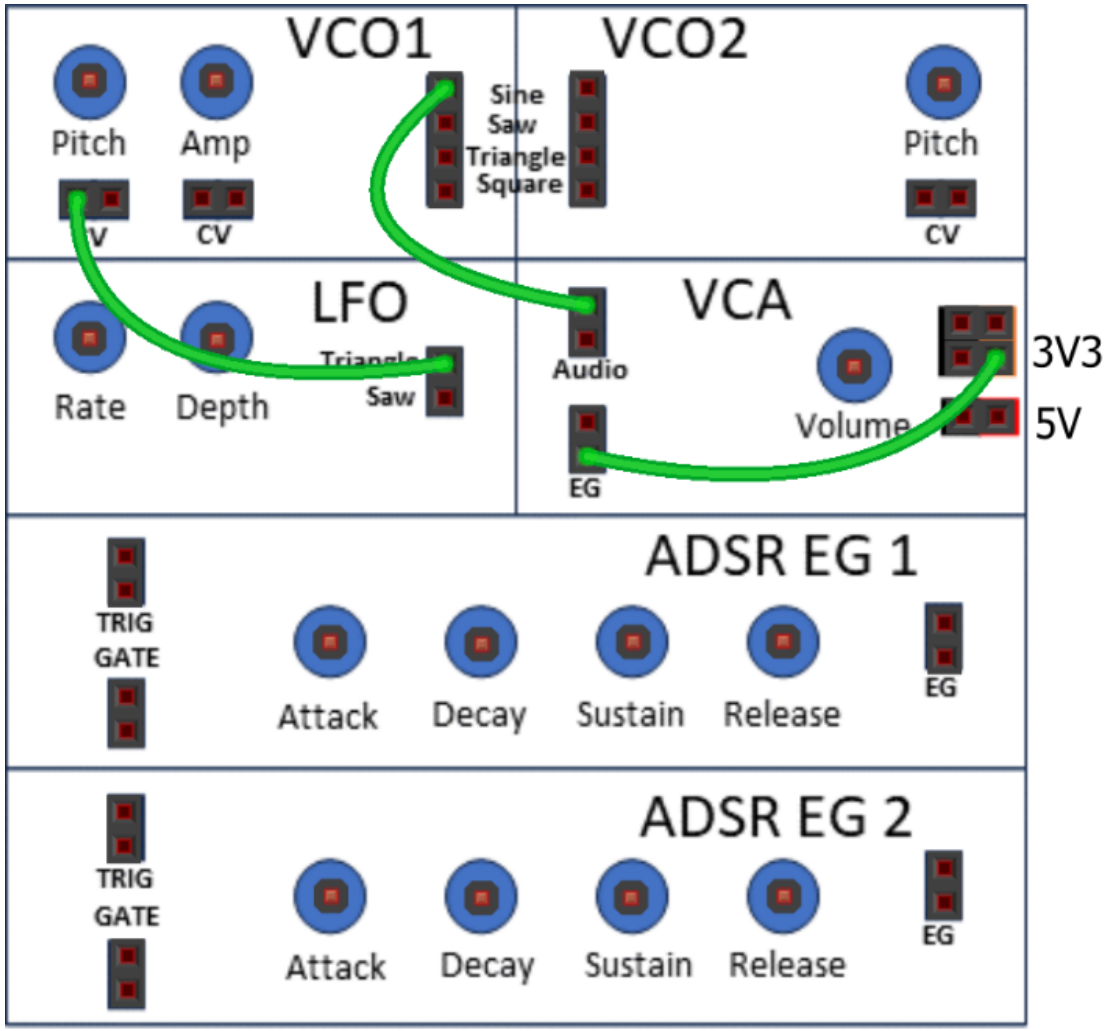
- Experiments:
  - Tune to same pitch.
  - Detune one slightly.
  - Tune to 1 octave apart.
  - Tune to 2 octaves.
  - Find other intervals.

4. LFO Amplitude Modulation



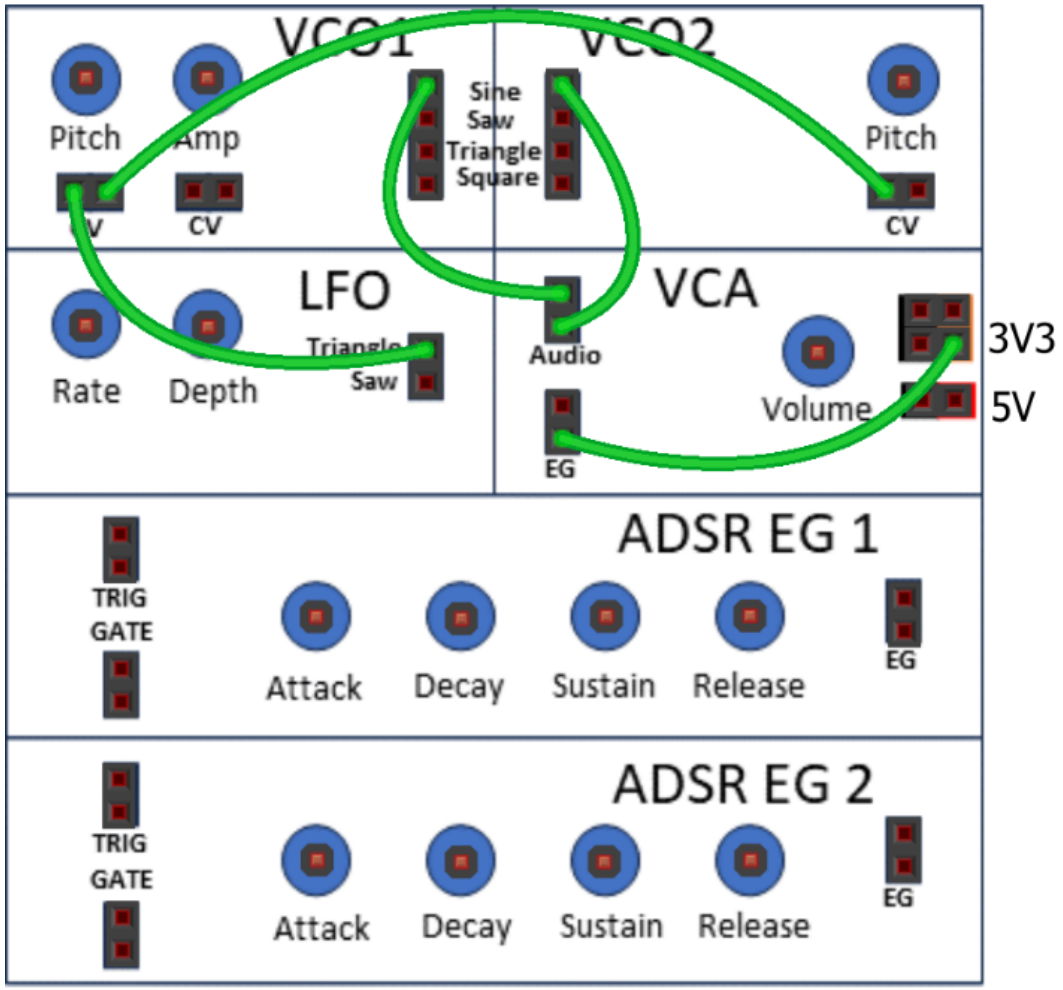
- VCO1 Amp must be turned down.
- Try LFO Rate and Depth.
- Try both LFO waveforms.

5. LFO Pitch Modulation



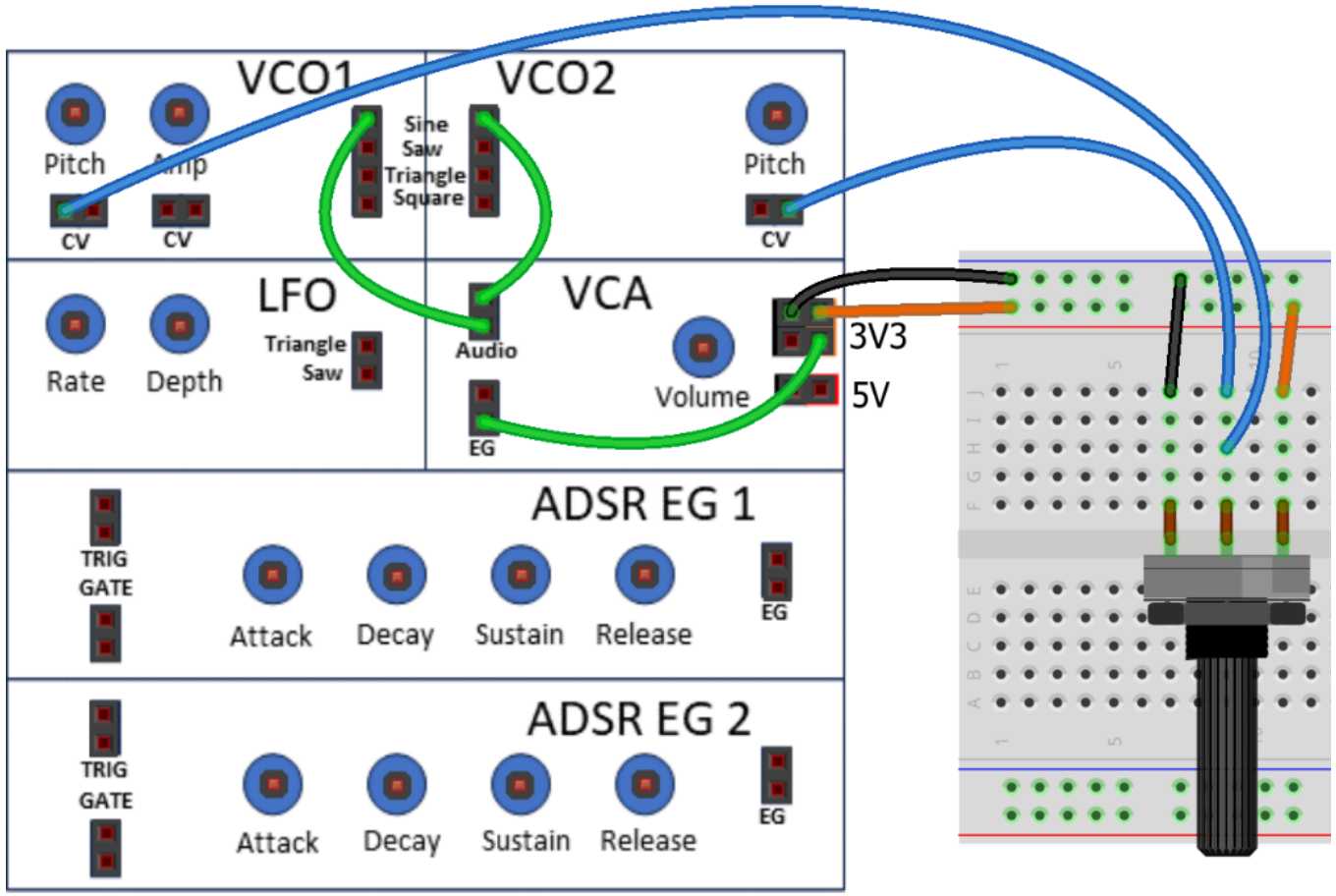
- Turn VCO1 Amp up.
- Try LFO Rate and Depth.
- Try both LFO waveforms.
- Combine Pitch and Amp modulation using both LFO waveforms at the same time.

6. Dual VCO+LFO Pitch Modulation



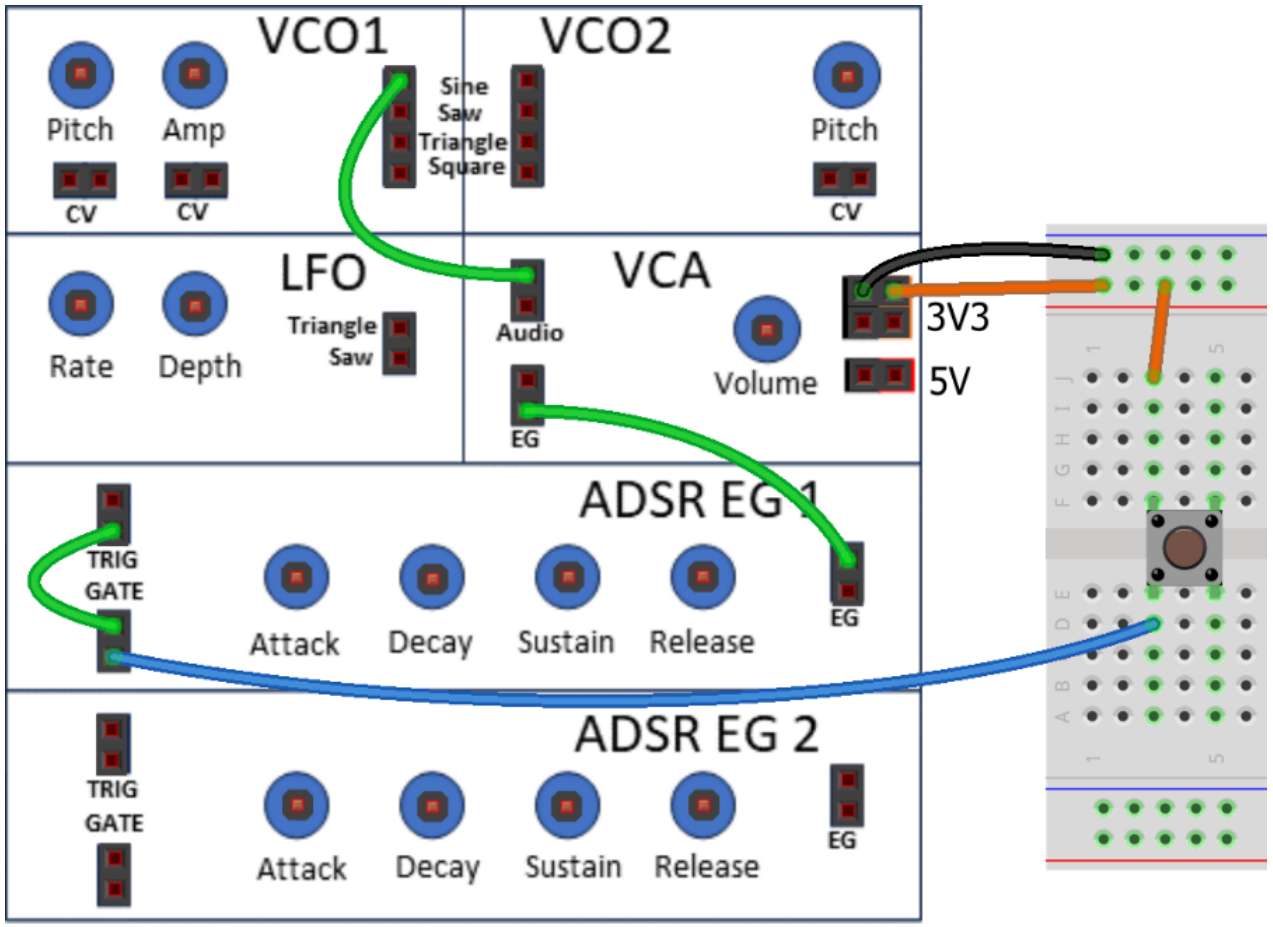
- Links VCO1 and VCO2 CVs.
- Turn LFO off and tune VCOs to 1 octave.
- Try LFO Rate and Depth.
- Try LFO waveforms.
- Connect one LFO waveform to VCO1 and one to VCO2.

7. External Dual VCO Pitch Control



- 3V3 and GND to breadboard.
- Potentiometer to VCO1 and VCO2 CVs.
- Detune one VCO.
- Try:
  - Tune to one octave or different intervals.
  - Different waveforms.
  - Add LFO to amplitude modulate VCO1.

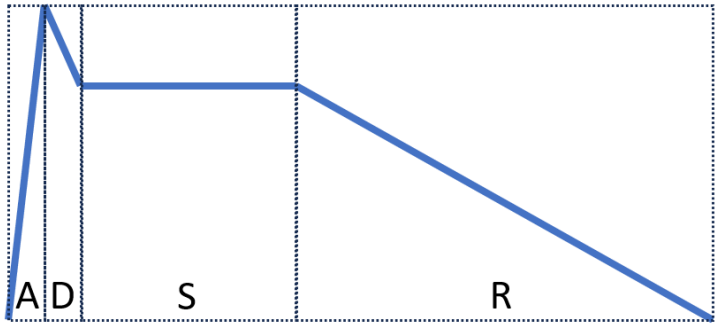
8. ADSR Envelope Generator



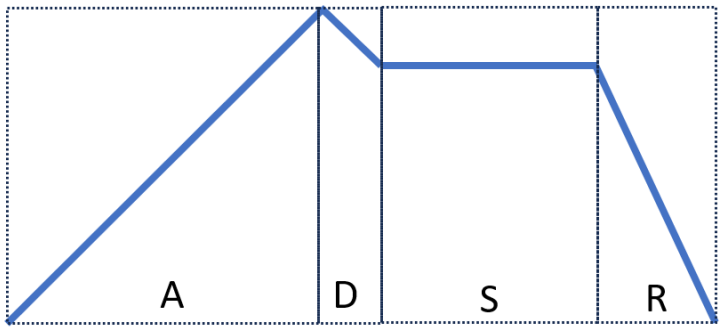
- 3V3 and GND to breadboard.
- ADSR EG1 EG to VCA.
- EG1 TRIG and GATE linked.
- Start with:
  - A: almost full anti-clockwise.
  - D: almost full anti-clockwise.
  - S: fully clockwise.
  - R: in the middle.
- Try different A, D, S, R settings.

9. ADSR Envelope Generator – Part 2

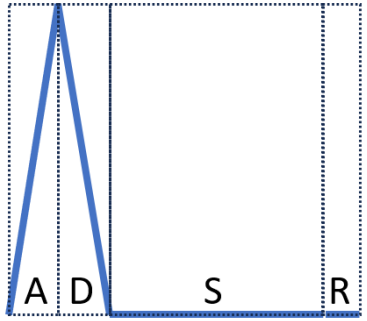
- Attempt to create the following envelopes:



Short attack.
Short decay.
High sustain.
Long release.

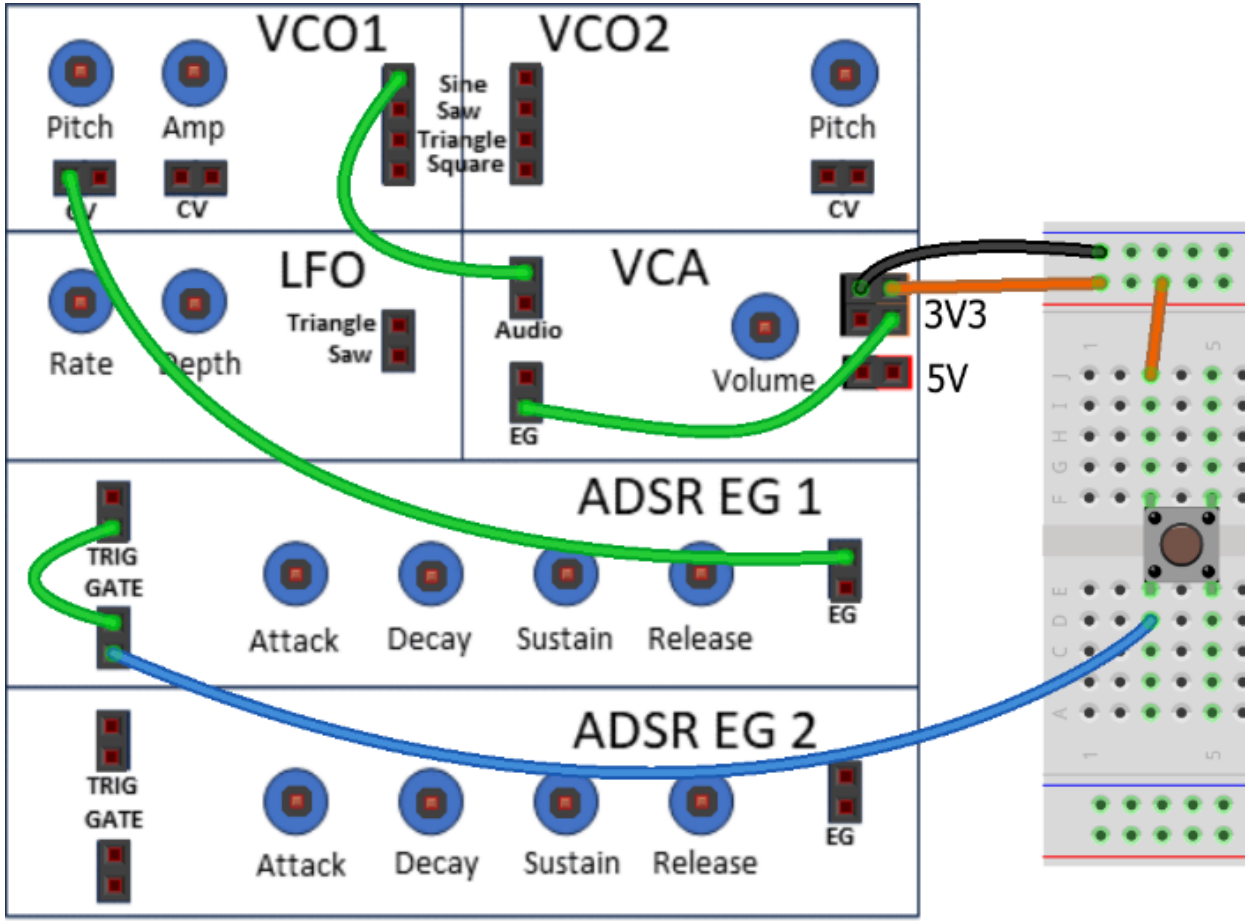


Long attack.
Short Decay.
High sustain.
Short release.



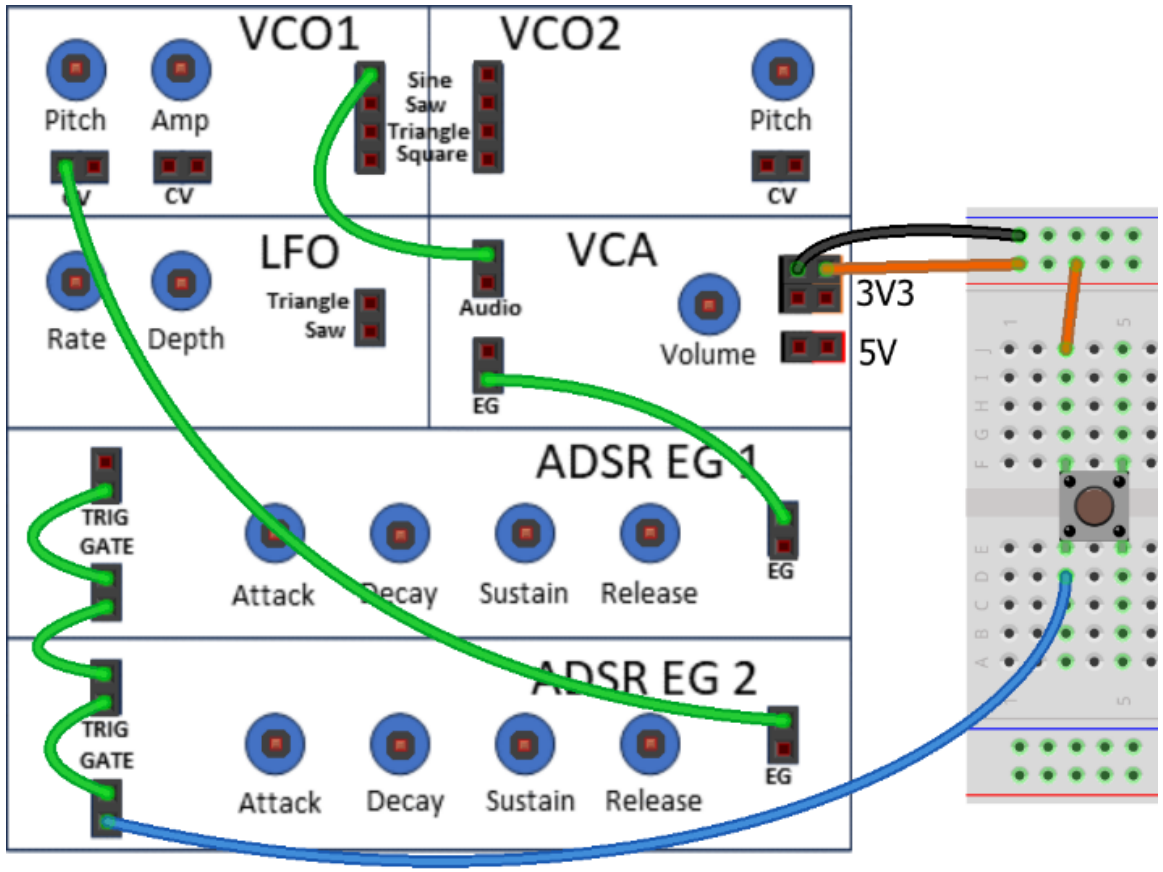
Short attack.
Short decay.
No sustain.
No release.

10. ADSR Envelope Generator for Pitch



- VCA EG to 3V3 again.
- EG1 to VCO1 Pitch.
- Try different A, D, R timings.
- Try different S level.

11. ADSR Envelope Generator for Amplitude and Pitch



- EG1 back to controlling VCA.
- EG2 now controlling VCO Pitch.
- Try different A, D, S, R settings for both amplitude and pitch.

End of Starter Projects