The Educational DIY Synth Thing

External Acive Circuit Projects

Introduction

This carries on from the previous chapters and assumes that one has a working Synth Thing and has worked through all of the starter projects.

There are five sections in this chapter covering the following:

- Basic Principles and Connections

In each case once general amplification and power are required as used previously.

Core Components Required

The following basic additional components are required to perform all the experiments in this chapter:

- Solderless breadboard – ideally a “half+” type.
- Optional: Oscilloscope, adaptors and probes (see previous chapter on oscilloscope use).
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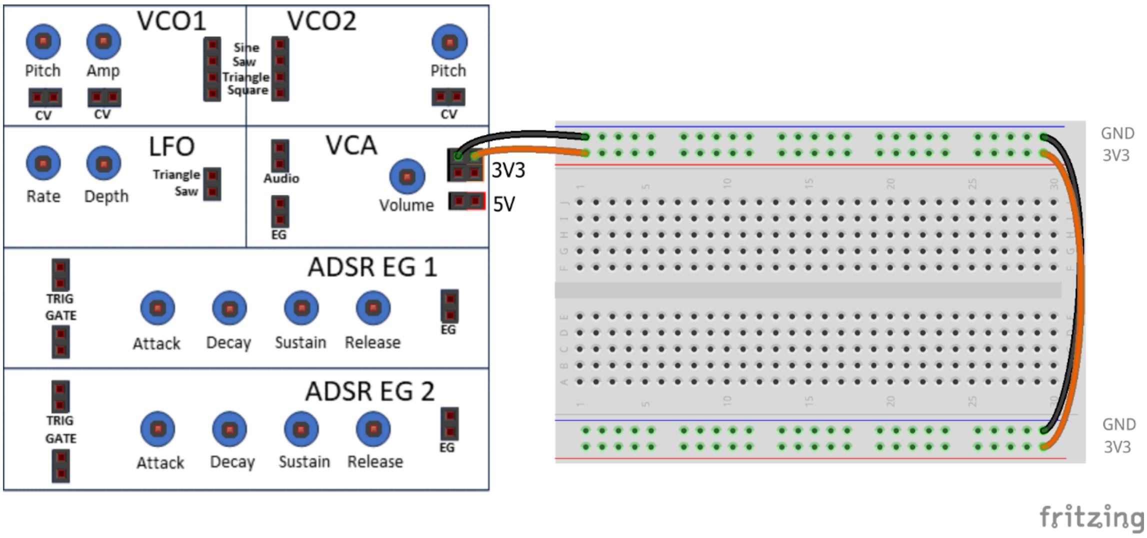
Basic Principles and Connections

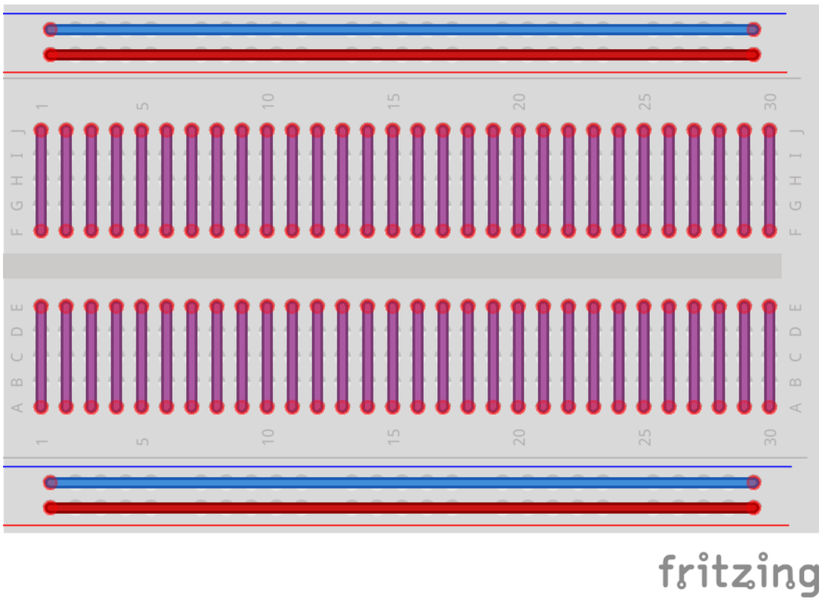
Repeating the notes from the previous section, this again shows how to connect a solderless breadboard ready to start some experiments.

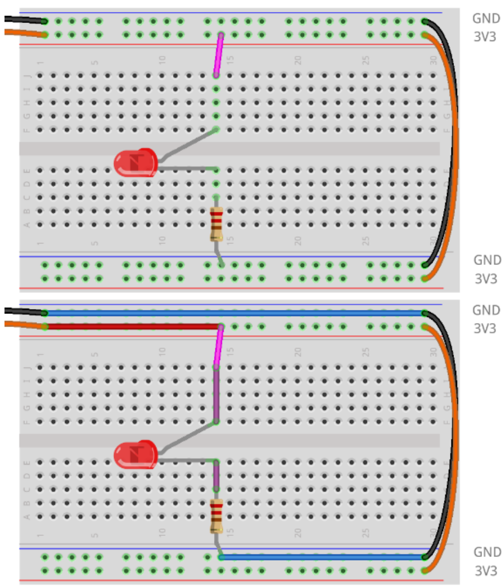
The power should ideally be kept within the 0-3V3 range, so it is recommended that, unless it is stated otherwise, the solderless breadboard is connected to GND and 3V3 as shown below.

It is also recommended that the blue row is used to signify GND and the red row is used for 3V3.



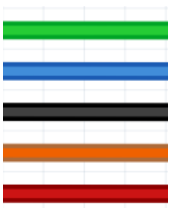
The holes in a solderless breadboard are internally connected as show below, making joining circuits relatively straightforward. Anything plugged into one of the holes in a row or column is automatically connected to anything plugged into any of the other holes in the same row or column.





The top (right) diagram shows how an LED could be wired to 3V3 and GND. The bottom (right) diagram shows the path of the completed circuit through the solderless breadboard.

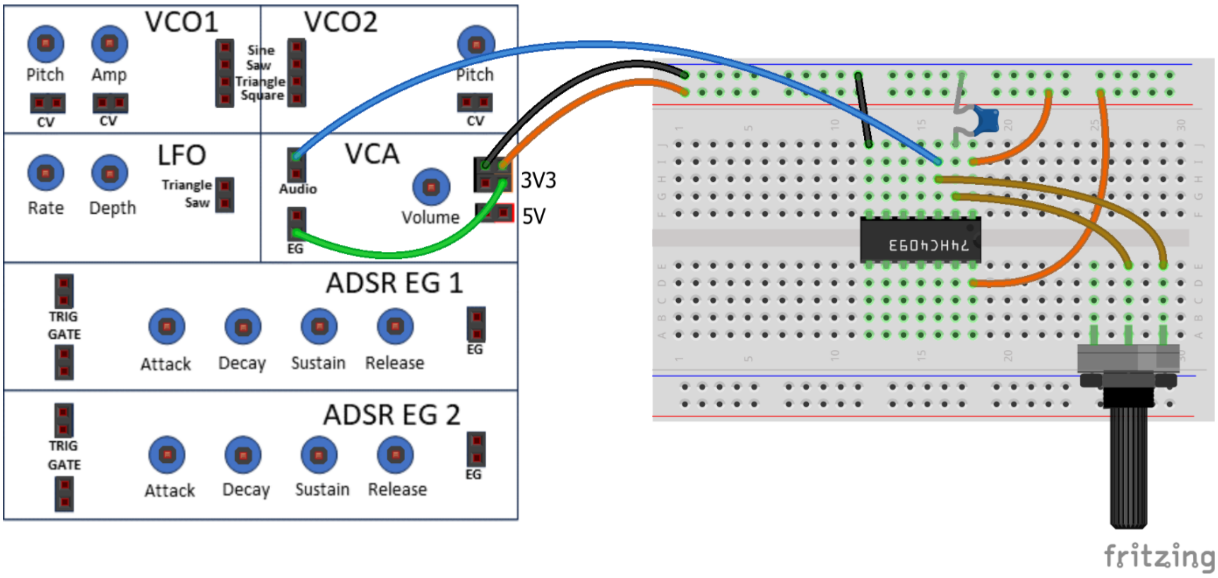
Summary of the colours used in these project diagrams:

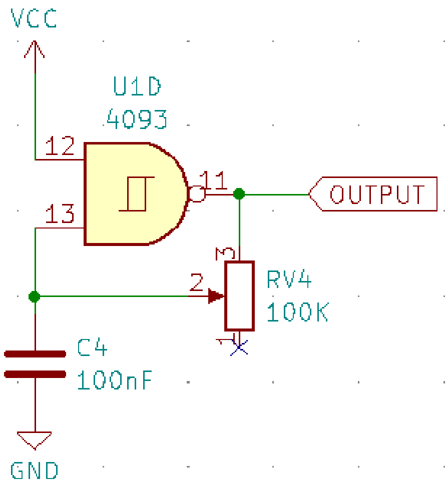


- Green – internal connections between patch points on the Synth Thing.
- Blue – external connections between the Synth Thing and the breadboard.
- Black – GND connections.
- Orange – 3V3 connections.
- Red – 5V connections.
- Other Colours – other connections on the breadboard as required.

Oscillators

1. NAND Schmidt Trigger Oscillator





This circuit is a Schmidt Trigger NAND simple square wave oscillator. A NAND gate has the following sequence of logic states:

IN 1	IN 2	OUT
0	0	1
0	1	1
1	0	1
1	1	0

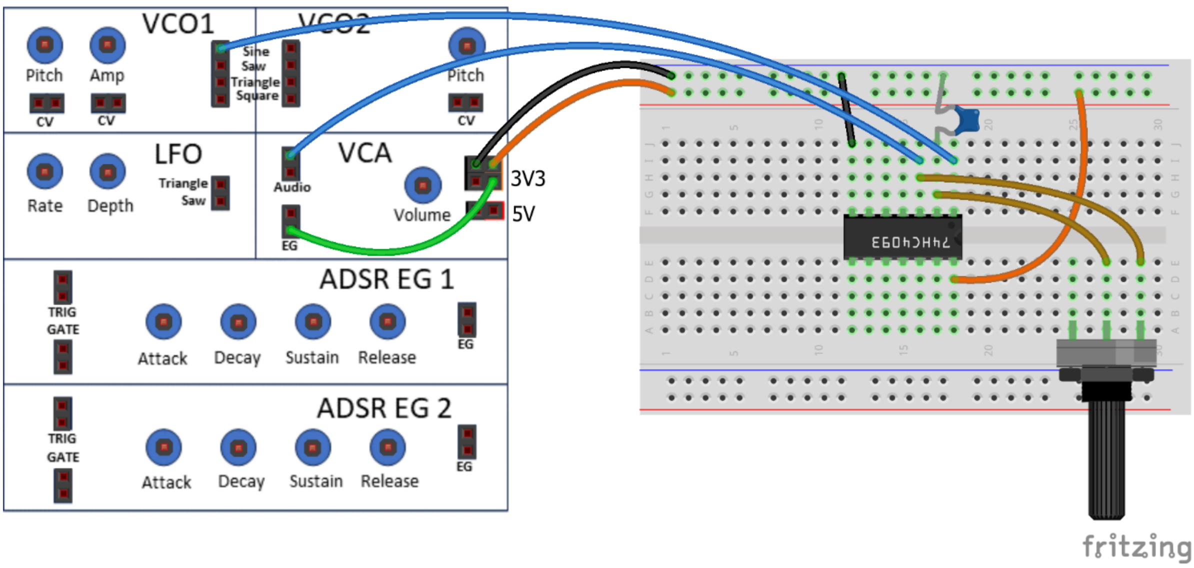
On power up, with the second input LOW the output will be HIGH thus charging the capacitor.

At some point the capacitor will be charged sending the second input HIGH.

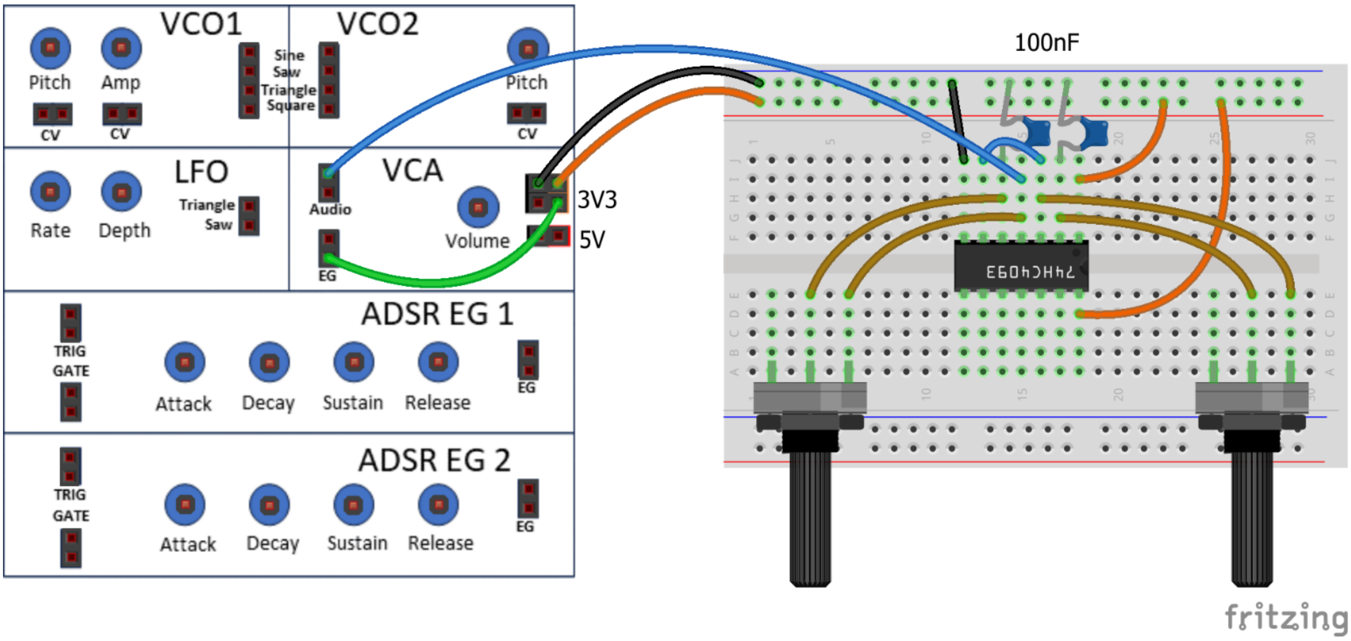
With both inputs HIGH the gate will output LOW and the cycle repeats. The resistor (potentiometer) and capacitor values determine how long it takes for the charging and discharging to happen.

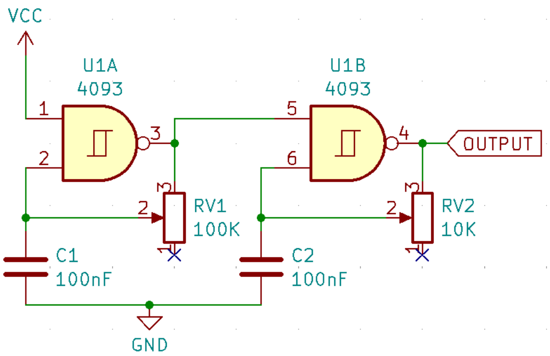
As the NAND gate has a threshold for registering a HIGH input and a specified HIGH or LOW output, this creates a square wave.

For a further experiment, replace the fixed HIGH signal into the NAND gate with the output from one of the VCOs as shown below.



2. NAND Schmidt Trigger Dual Oscillator





This circuit uses two Schmidt trigger NAND gates from a 4093 quad NAND IC.

Each NAND gate is configured as a simple square wave oscillator with one input via a capacitor to GND, the other to a voltage source, and with feedback controlled by a potentiometer.

The first oscillator starts with a constant VCC. The second oscillator is fed from the output of the first leading to some fascinating dual-oscillator effects.

Once again replace the fixed input to the NAND gates with the output from VCO and now experiment with all three potentiometers and different waveforms. For an additional experiment use the output of the LFO instead.