

TOF-D-BEAM

Time-of-flight D-Beam MIDI controller

Built with ESP32 – Micro Python

INSPIRED BY INTERACTIVE LIGHT

Background

- The **D-Beam** was originally manufactured by Interactive Light, as a stand-alone unit, around 1996.
- It was then soon purchased by Roland Corporation, becoming trademarked and rebranded as **D-Beam Controller** for their own music equipment.
- It was then introduced on a larger scale through the Roland MC-505 in 1998, was further incorporated into a large number of Roland's grooveboxes, workstations, keyboards, and digital samplers over the years.
- The controller is usually mounted in the equipment's panel facing upwards, and senses the performer's hand (or other body part) at a height of up to 15" (~40 cm) or so above the device. Although controlled in a similar manner to a theremin, the operating principles are fundamentally different; the theremin uses capacitive sensing.

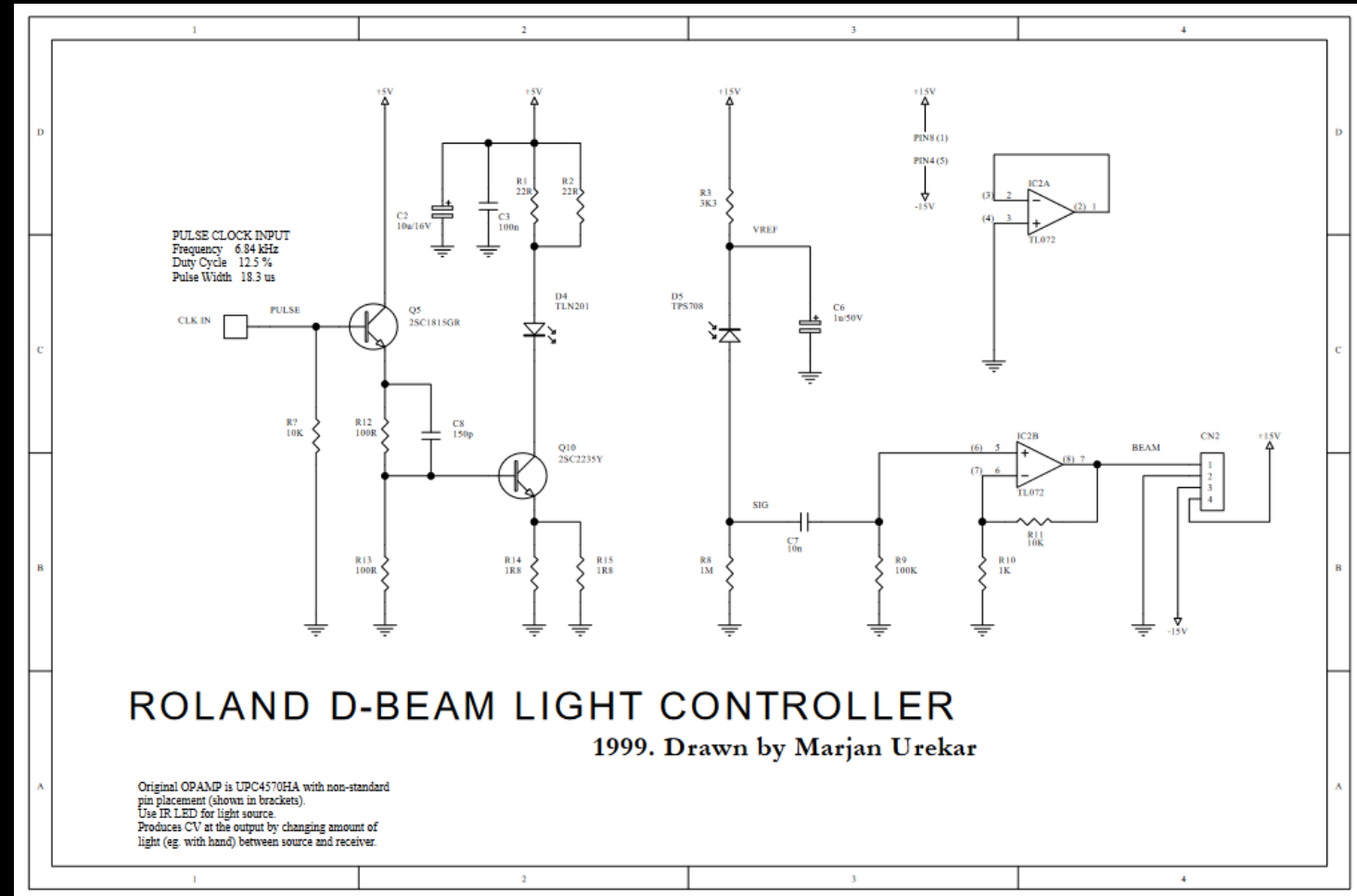
THE ORIGINAL ANALOG DESIGN:

I have not tried to replicate this analog circuit.

I was aiming for MIDI out and analog out, but also the clock and trigger.

In order to have a versatile design that facilitates both the modular analog synthesizers as MIDI based equipment.

That provided a challenge but the design fulfills both worlds!



BASED ON ST VL53L0X USING FLIGHTSENSE TECHNOLOGIE

I started with Ultrasonic (HC-SR04) but the signal was to unstable, creating unwanted effects.

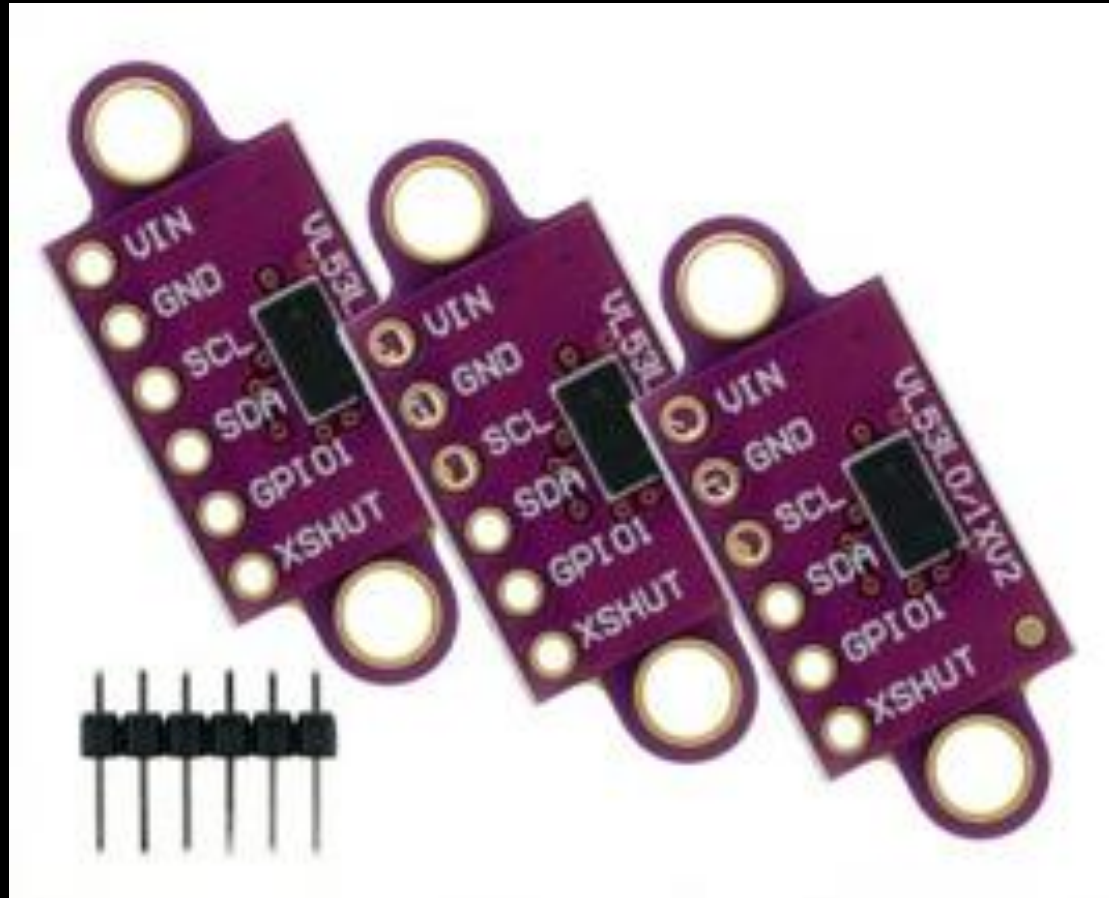
The VL53LOX is very cheap and only direct sunlight can cause some interference.

I found a micropython library that made a great step up. Many thanks to Kevin McAleer:

<https://www.youtube.com/watch?v=YBu6GKnN4Ik>

Import library vl53lox.py:

<https://github.com/kevinmcaleer/vl53l0x>



DESIGN SPECS

MIDI out:

- Clock out, start/stop
- Pitch bend and 2 CCs
- Theremin (alike)

Analog out:

- PitchBend (+/- 5Volt)
- VC out (0-5 Volt for VCF, VCO, etc)
- Analog clock out
- Trigger pulse

Analog out is continuous, MIDI out by button

Configurable (and saving settings)

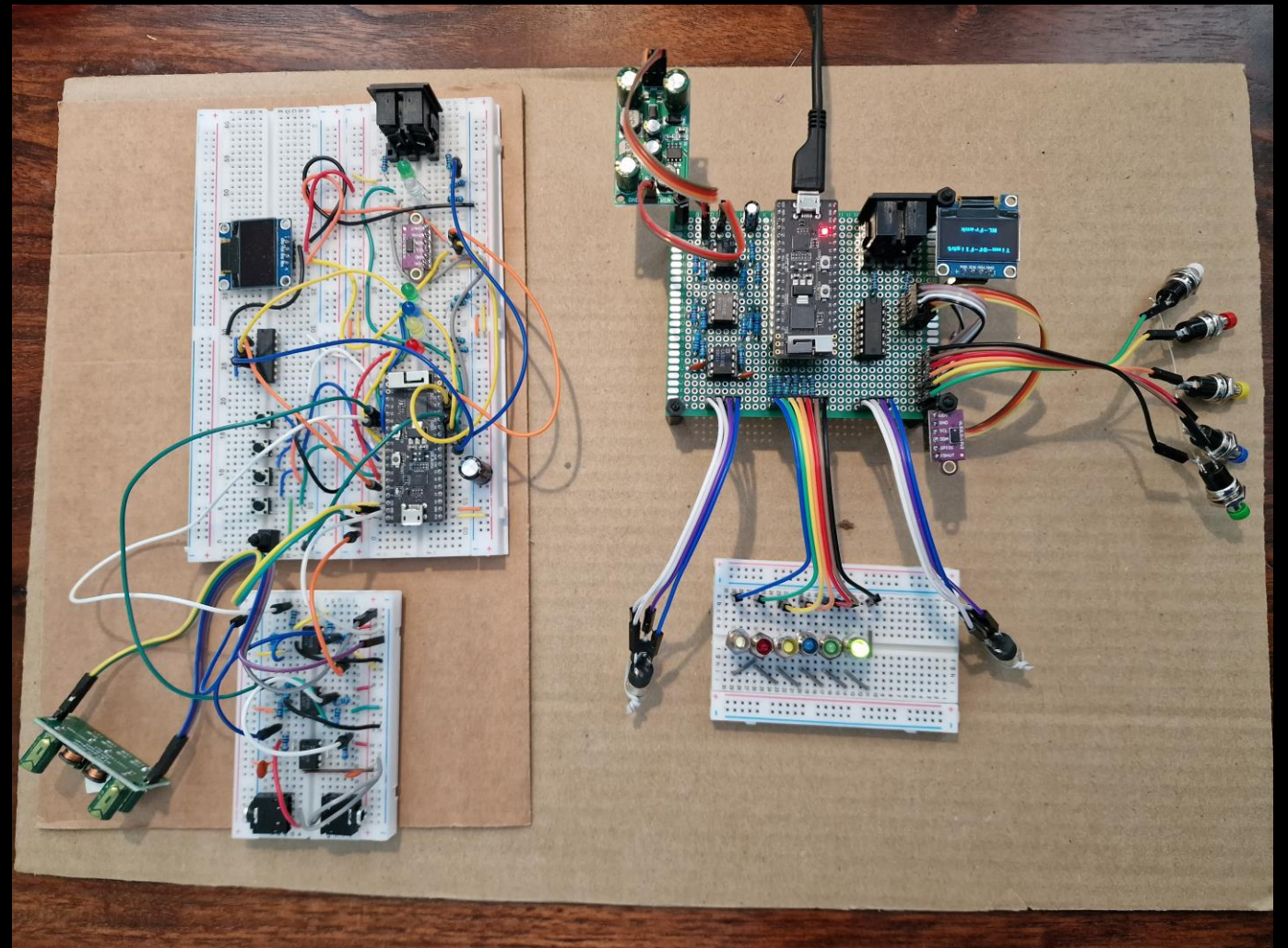
5 pushbuttons and LEDs

Small display

MicroPython

ESP32-PICO-KIT V4

1XUART (MIDI), 2XDAC (Analog), many GPIOs



FINAL DESIGN

SSD1306 OLED display

4 push buttons to enable MIDI out:

CC1, CC2, Notes, PitchBend

Configuration: set value by hand
distance

CC1, CC2 : any MIDI CC command

Input/Output:

MIDI out

Analog Output:

Trigger out

Clock out

Voltage Control out PitchBend

Voltage Control out CC

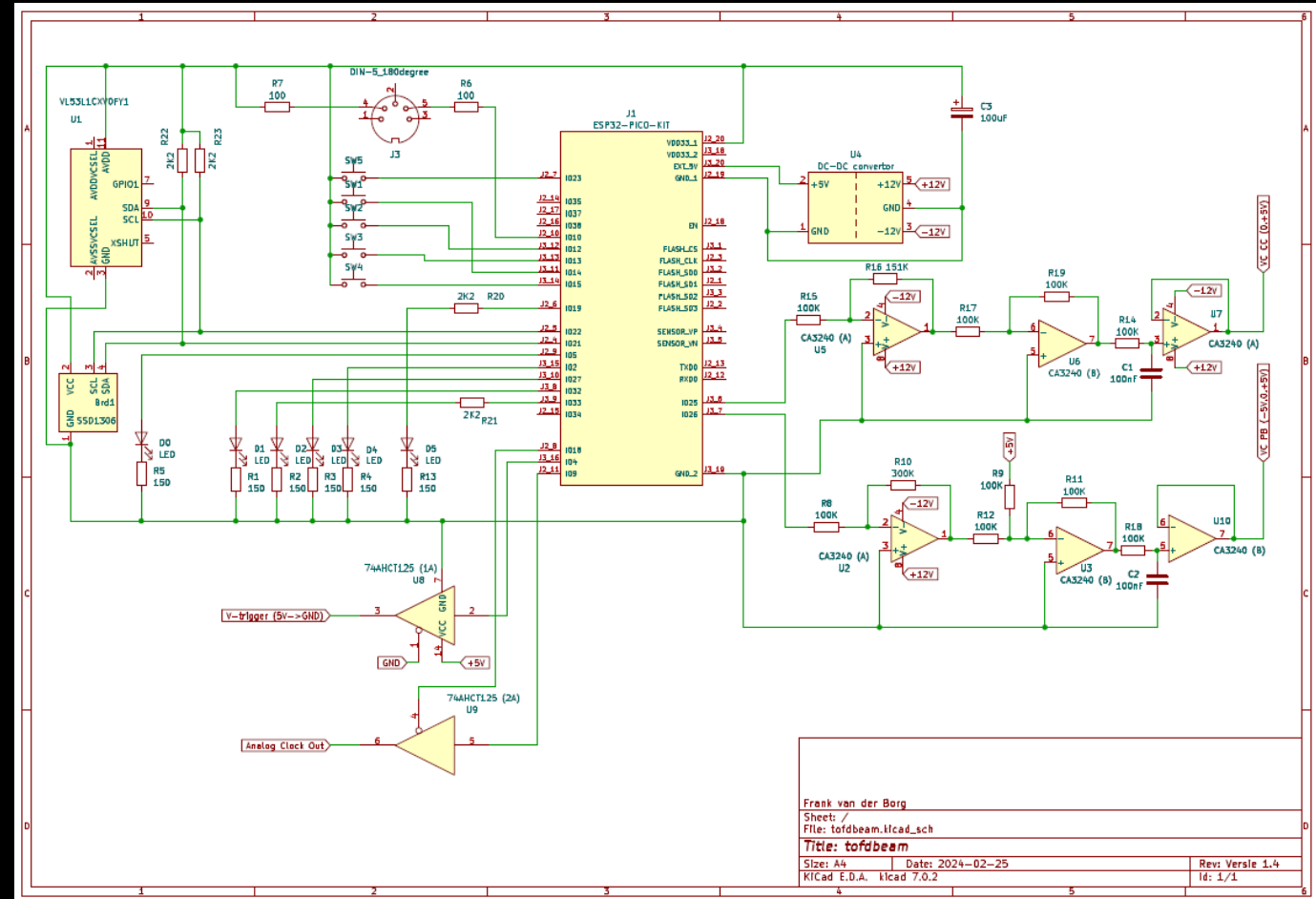


ELECTRONICS

Extra DC-DC converter +/- 12 Vpower supply for the Opamps

Opamps to create control voltage from 0-3,3 Volts to 0-5 Volts and also -5 to +5Volt (PitchBend)

Trigger and Clockout are buffered by 74HCT125



MICRO-PYTHON CODE

Timer based Interrupt routine to
generate stable clock

Saving and loading MIDI parameters
(json based) to and from non-volatile
memory

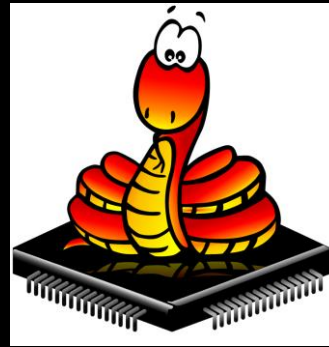
UART to enable MIDI DATA out

Richly commented and can be easily
adapted to specific MIDI needs

tofdbeam_final.py

esp32-20220117-v1.18.bin

uPyCraft V1.1.exe



ESP32-PICO-KIT V4



uPyCraft



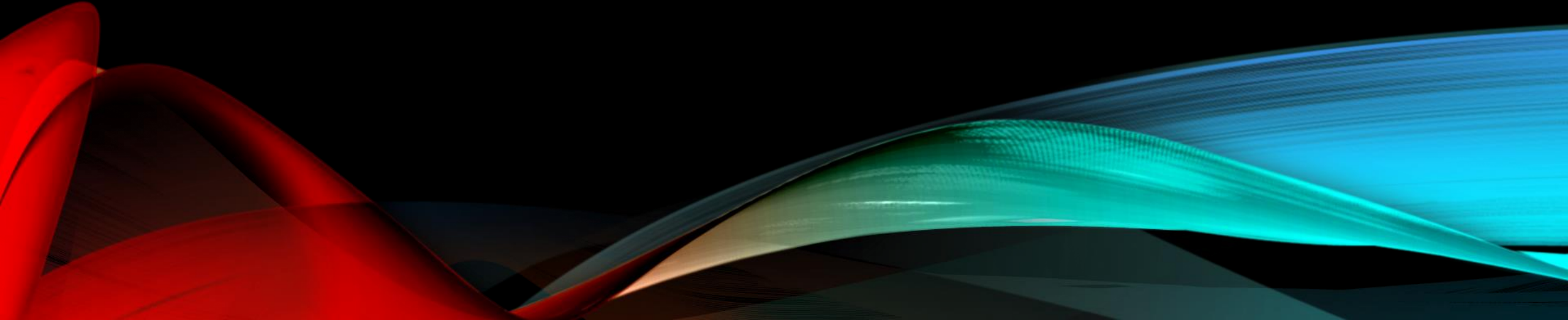
DEMO DRUMCOMPTER TRIGGER AND VCF

The ToF-D-Beam starts the clock and the DrumBrute starts the drum-pattern, the audio output goes through the VCF of the MS-20, the control voltage controls the VCF on the MS-20. With the movement of the hand the filter changes and also starts/stops the DrumBrute.



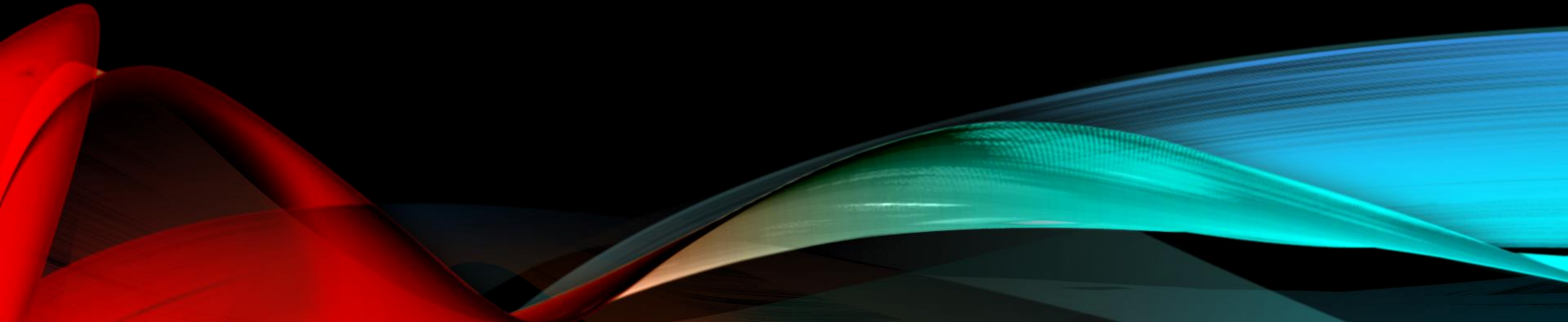
2 X DEMO THEREMIN STYLE NOTE GENERATION

The ToF-D-Beam generates notes based on the distance of the hand. The notes are snapped to scale by the DAW (Reaper).



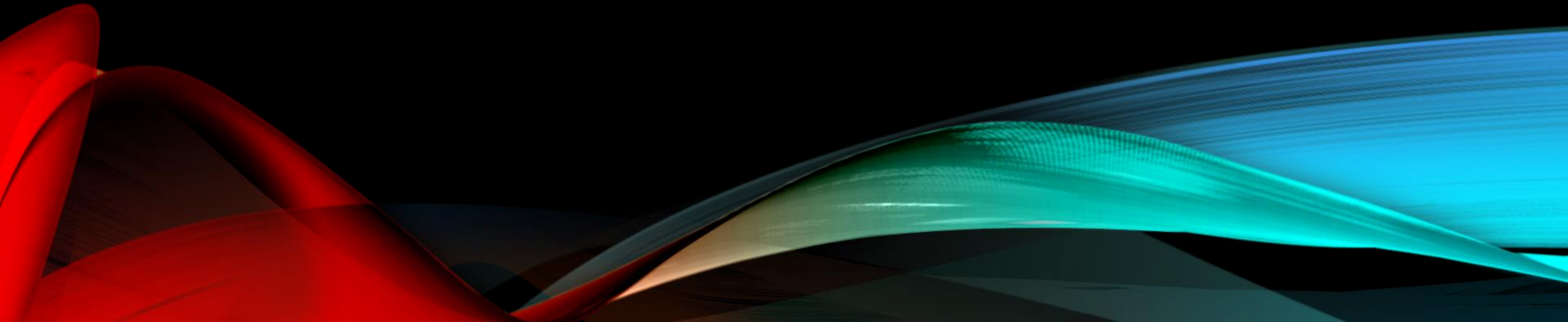
DEMO PITCHBENDING

The ToF-D-Beam controls the pitchbend based on the distance of the hand.



DEMO MODULATION WHEEL

The ToF-D-Beam controls the modulation based on the distance of the hand. A low pass filter in this case.



The ToF-D-Beam design information
(python script and schematics) will be
shared.

Thank you for watching

