

# Designing a musical effect with ECAD-MCAD Workflows

**Jorge Garcia**

Fusion 360 Electronics Community Manager

**Paul Sohi**

Content Marketing Manager





## About the speaker

### Jorge Garcia

I'm a Community Manager for Fusion 360 Electronics/EAGLE, here at Autodesk. I have been working with EAGLE for 10 years. I earned my Bachelor's Degree in Electrical Engineering from Florida International University in 2008. I love electronics and building projects focusing on power and control applications. I have an affinity for embedded systems and programming.



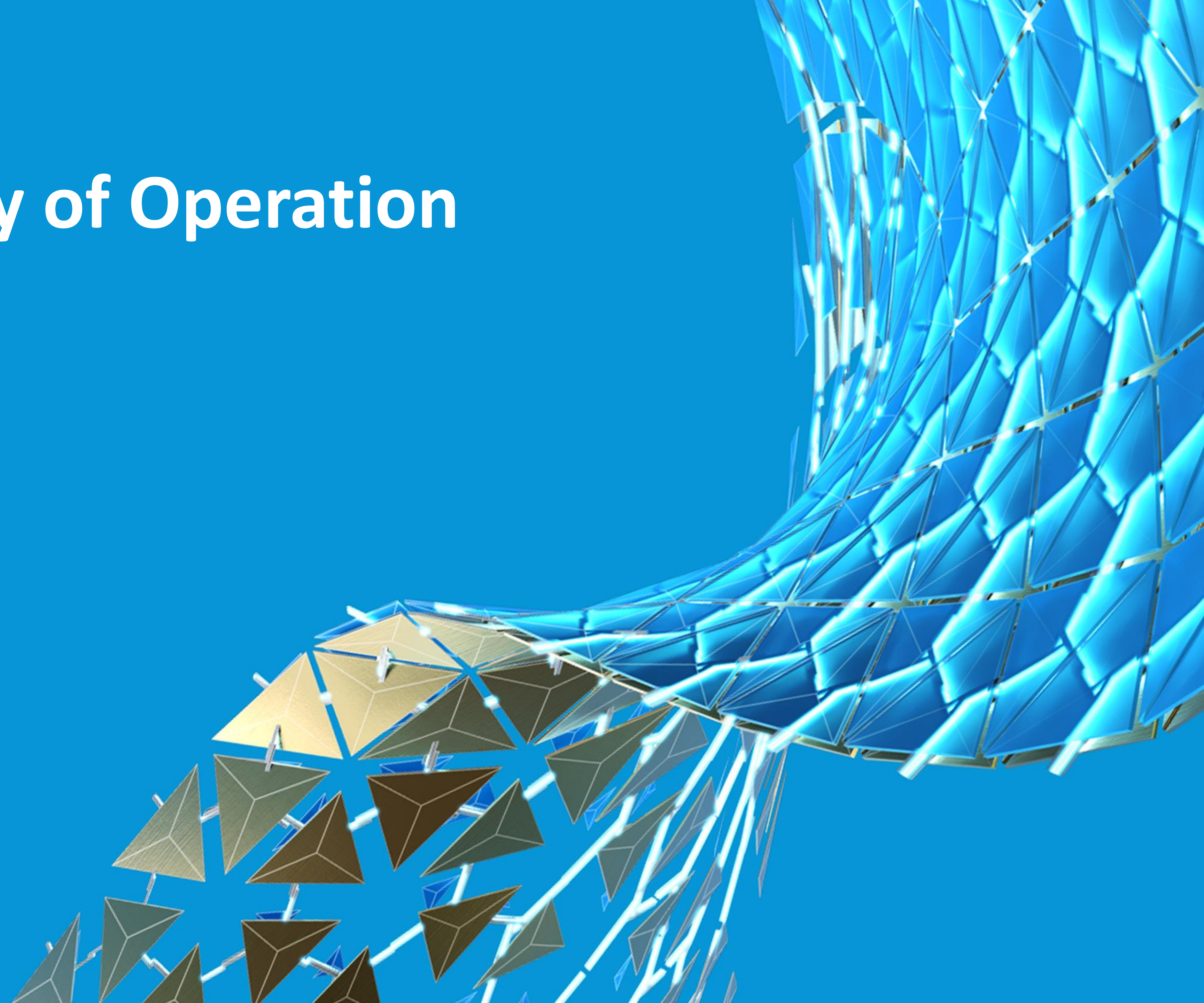
# About the speaker

## Paul Sohi

Paul Sohi is a British born, Iranian architect and industrial designer based in Oakland. Paul focusses on emerging technologies in the additive manufacturing field and their applications across multiple industries

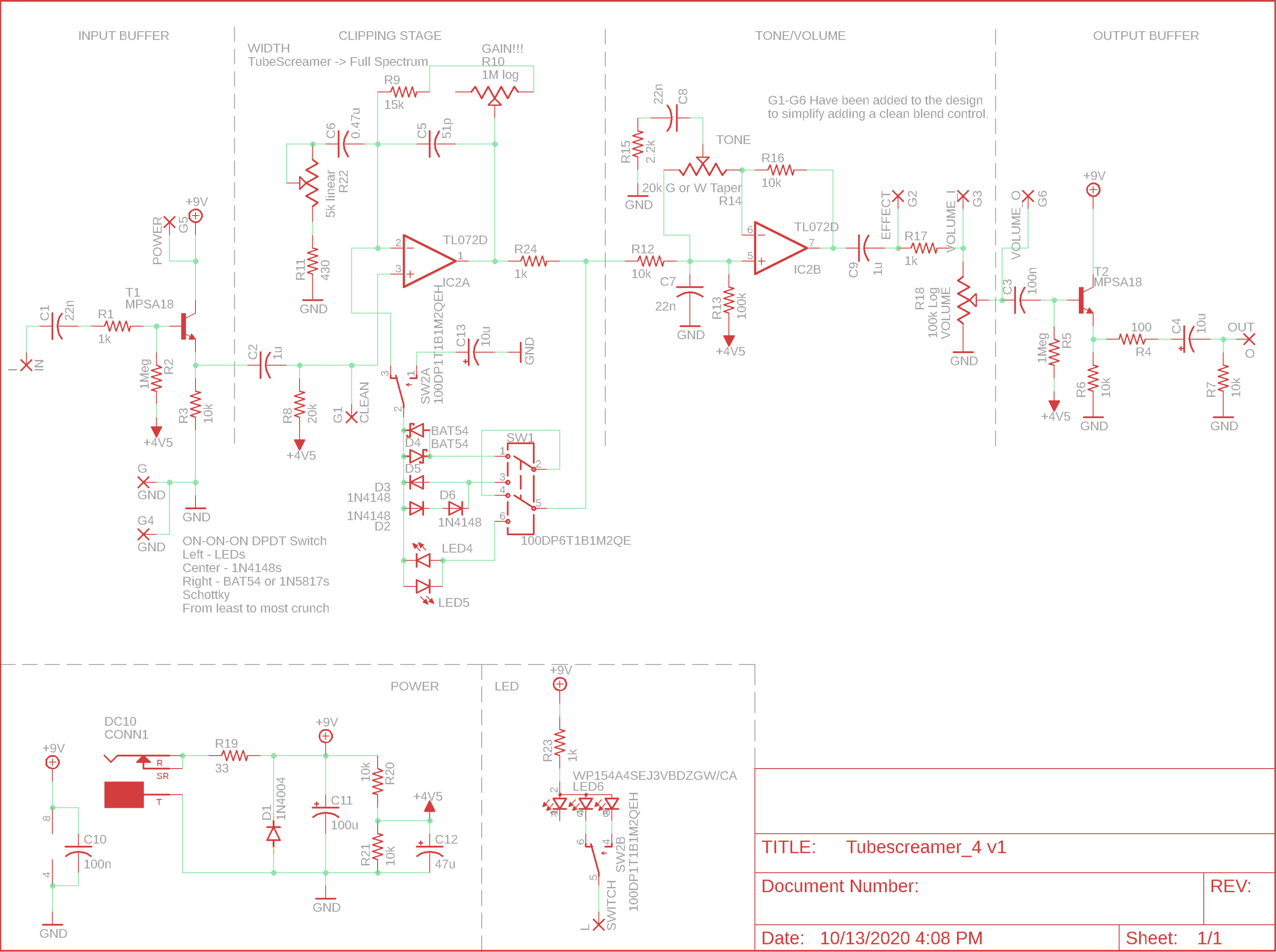


# Design Theory of Operation



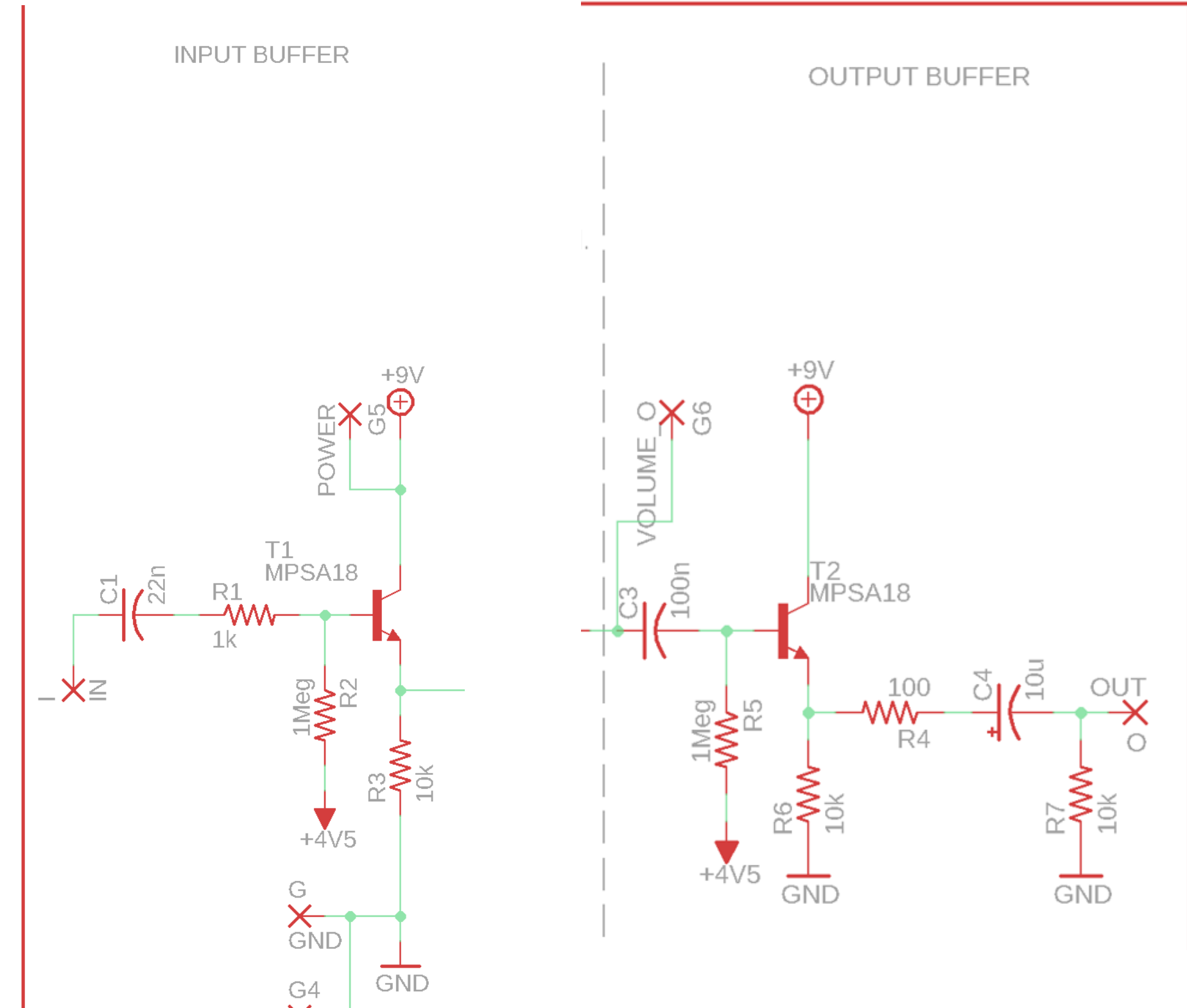


# Main Schematic Overview



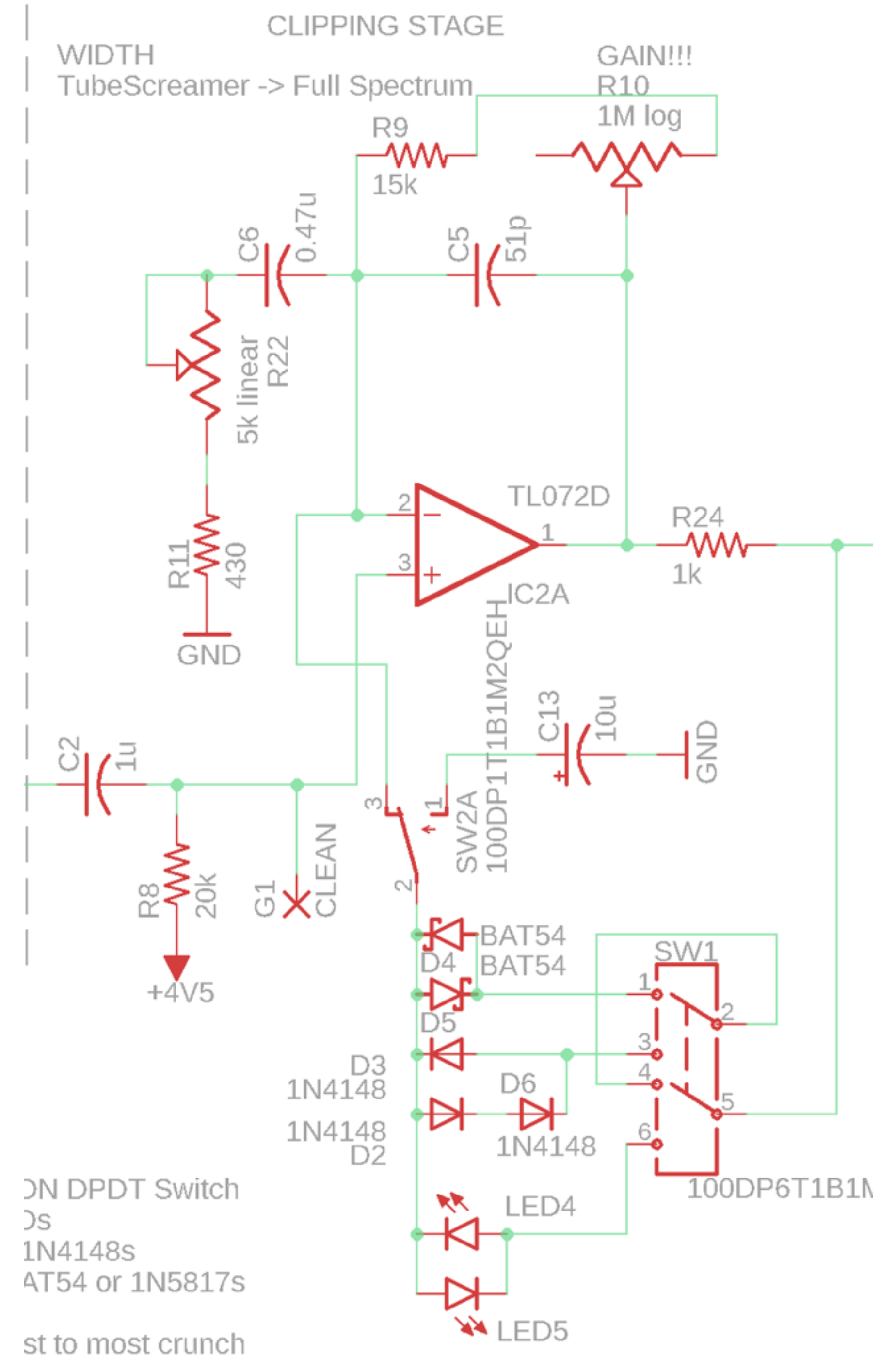
# Input/Output Buffers

- They condition the input and output signals to guarantee fidelity
- High Impedance at the input, Low impedance at the output
- This is good design practice, often you don't know what a user might plug into your circuit or what they might feed from your circuit.



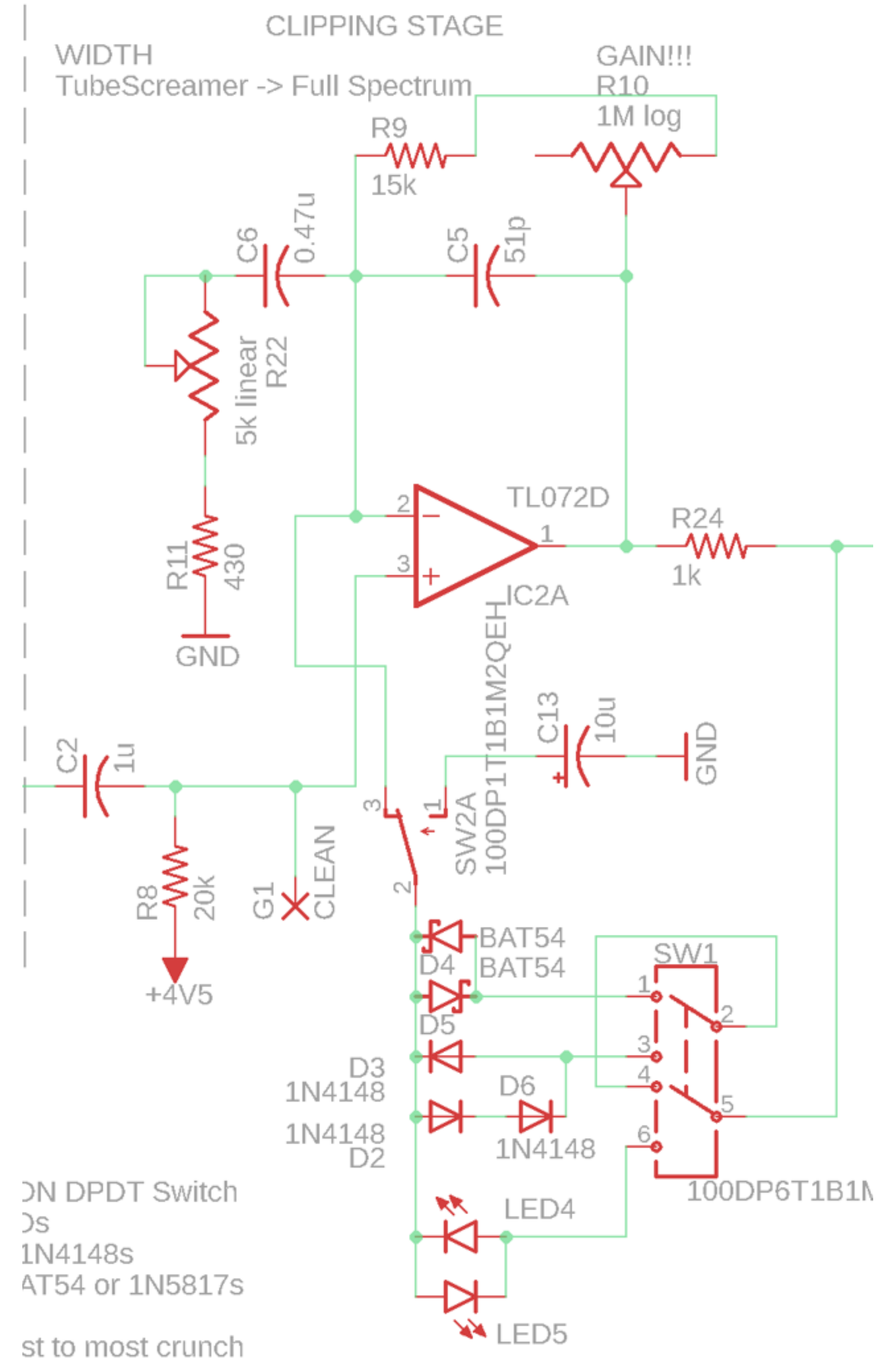
# Clipping Stage

- This stage provides signal gain and distortion
- In one configuration, the diodes are in the feedback loop of the amplifier.
  - This is known as soft clipping and tends to produce a smoother, more compressed sound because the amplifier itself never distorts.
- In the other configuration, the diodes are shunted to ground.
  - This is called hard clipping, produces a stronger distortion because the amplifier can add its own distortion along with the distortion created by the diodes.



# Clipping Stage

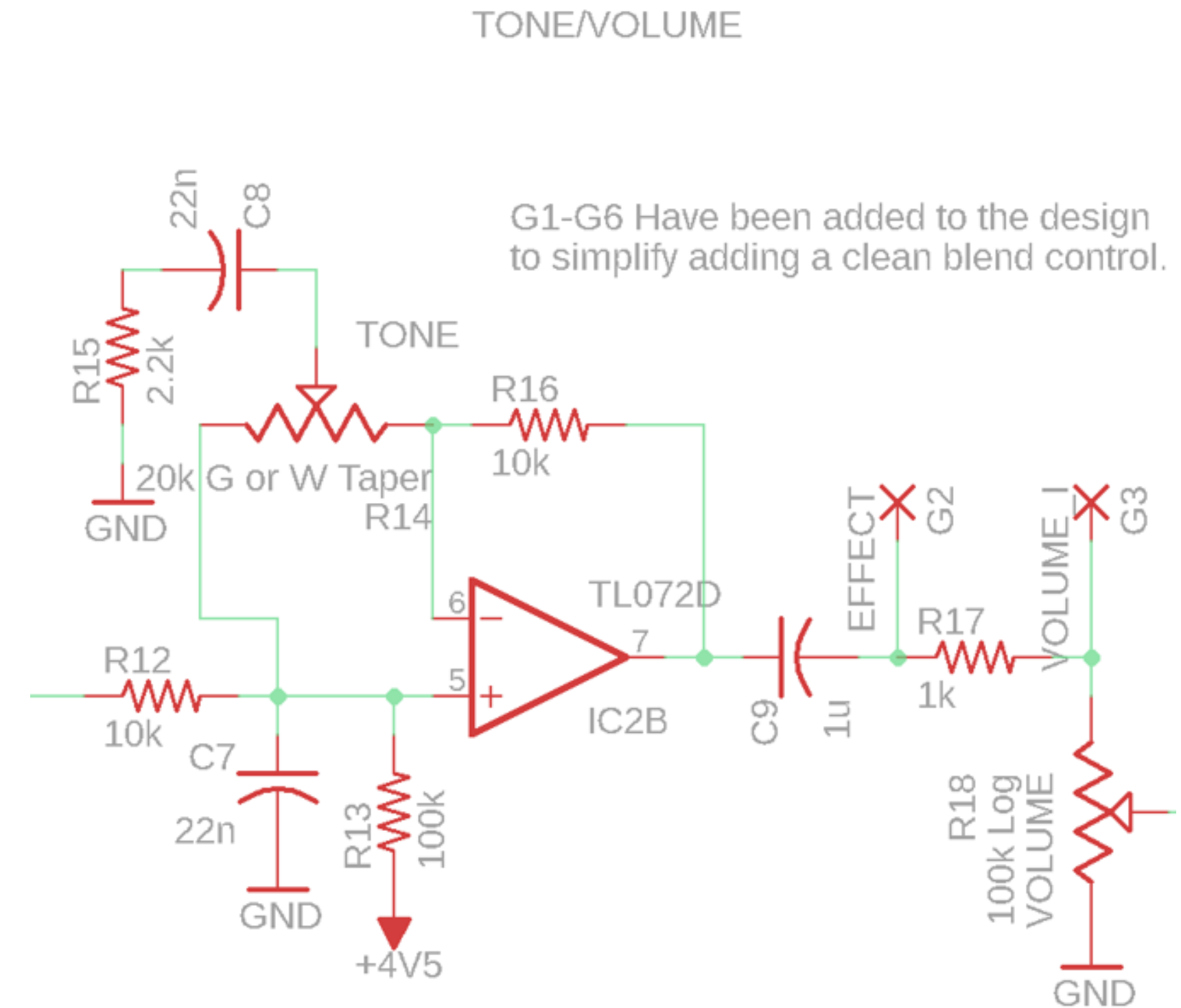
- **The width and gain controls interact to allow for a wide range of tones.**
  - The Width control changes the center frequency of the dominant high pass filter which dictates how much the bass frequencies get distorted. It also limits the maximum gain achievable by the circuit.
  - The Gain control determines how much amplification is applied to the signal. Can go from subtle grind to all out fuzz.
- **There are 3 different diode arrangements for 3 different types of tones**
  - BAT54- Fuzzy, very compressed
  - 1N4148- Asymmetrical arrangement, smooth distortion closest to an original Tubescreamer, emphasizes octave frequency.
  - LEDs- Least compressed, at low gain can be used as a colored boost





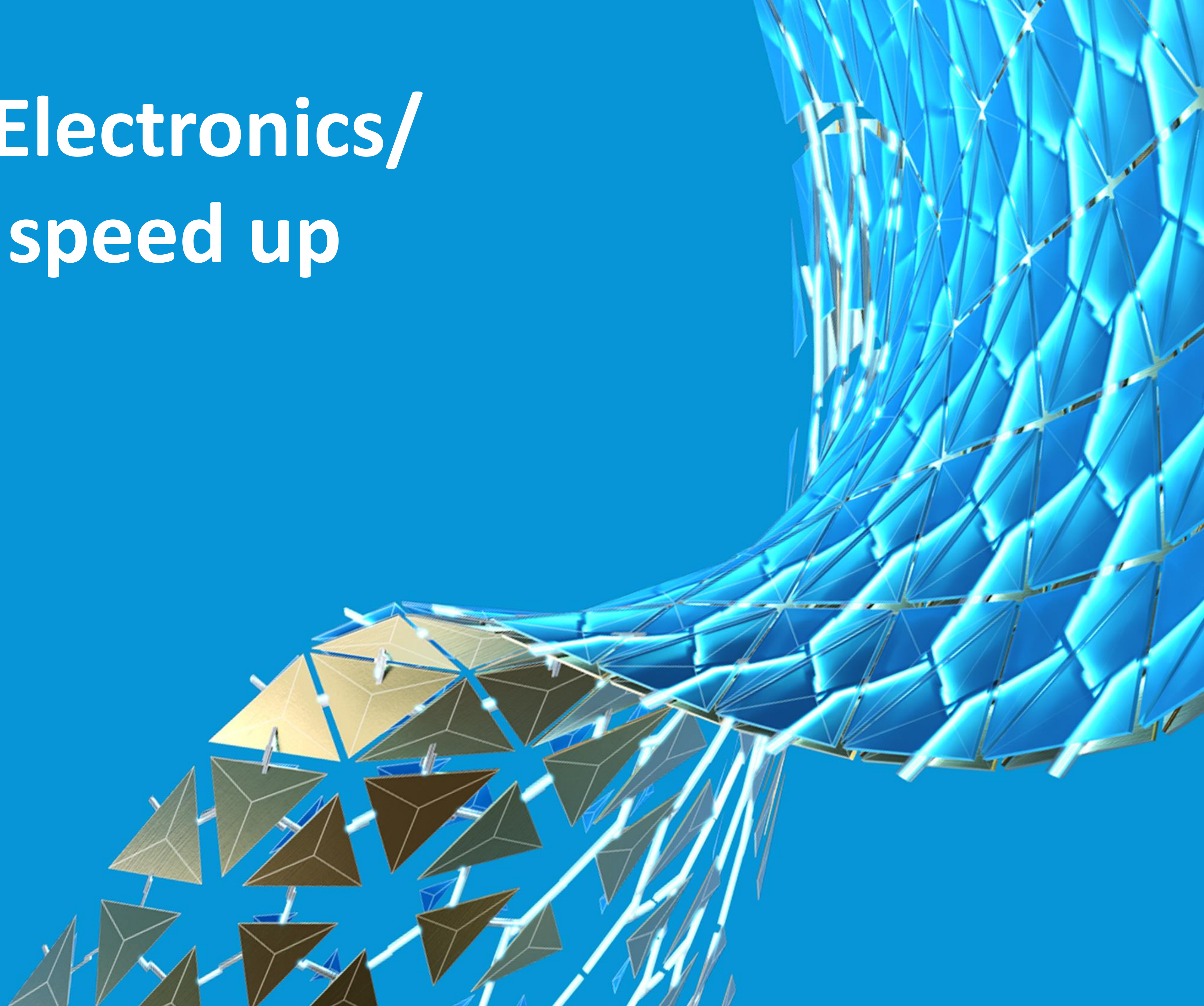
# Tone Control

- Allows the user to control the high-end content of the signal.
- Helps cutout harsh high frequencies
- This is the stock Tubescreamer tone control on the low end could be a little dark but it's good to have the option.





# How Fusion Electronics/ EAGLE helps speed up design



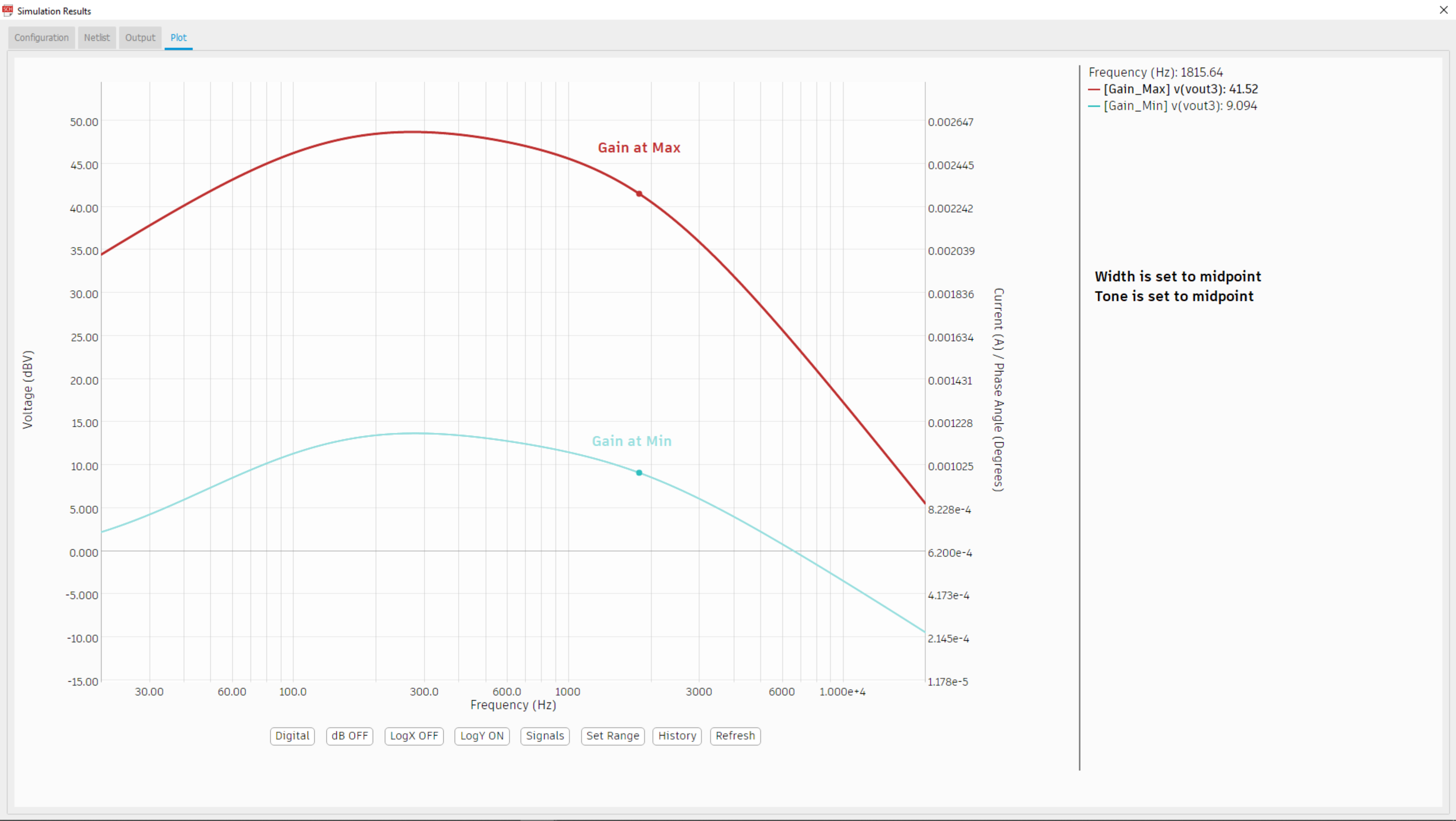


# Simulation

- **Judicious use of simulation can speed up the design process**
- **Design options and variations can be cheaply explored**
- **The quality of the results is directly dependent on the quality of the models and how the simulation is setup.**
- **Allows for performance verification without committing to hardware.**
- **In the following slides we'll explore how some of the range of the controls before the design is ever manufactured**

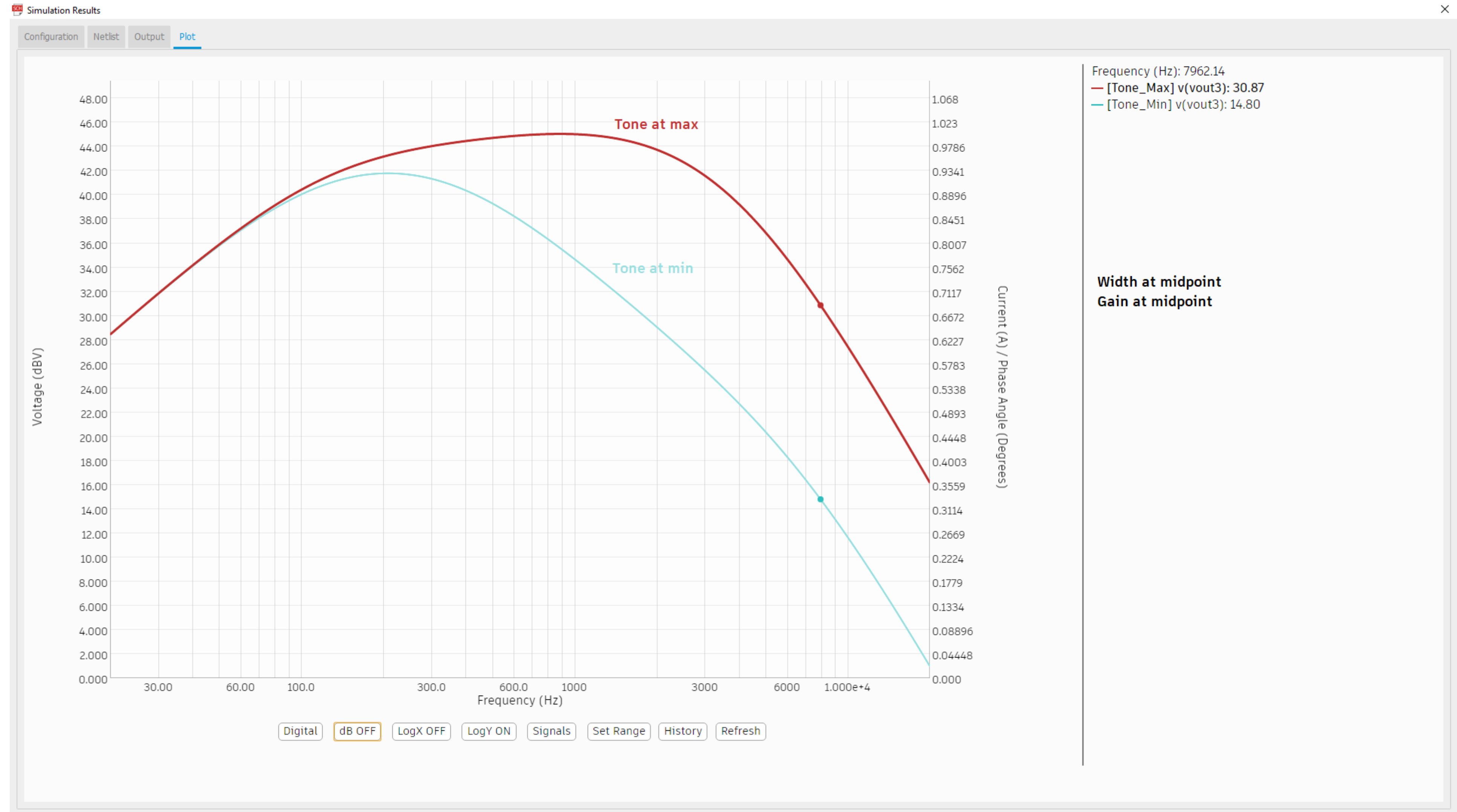


# Simulation – Gain Control

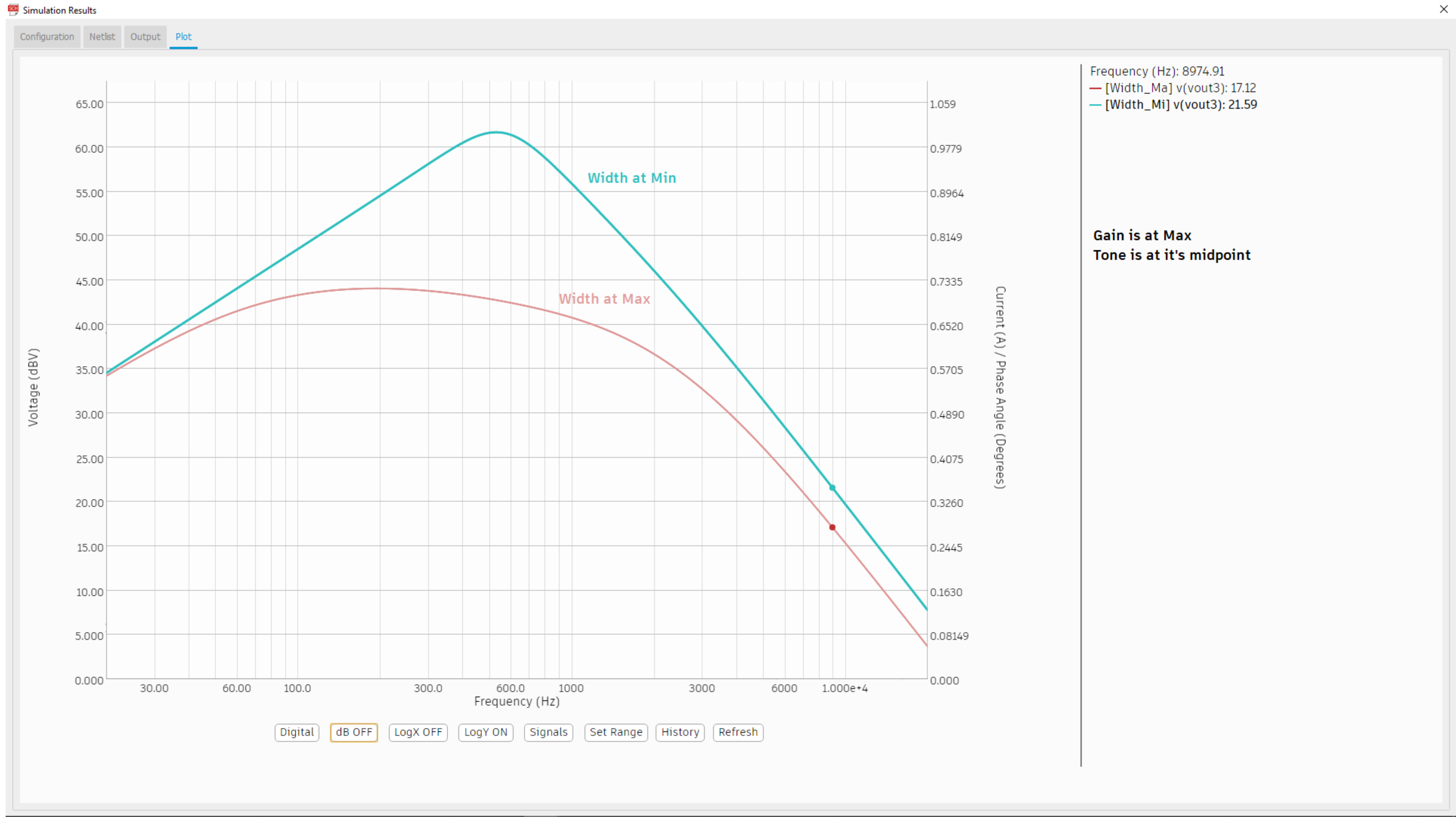




# Simulation – Tone Control



# Simulation – Width Control





# Simulation - Setup

Please view the setup demo video here:

<https://drive.autodesk.com/new/de29810b9/shares/SH56a43QTfd62c1cd9683bc6edd5e321ab8a>

Or watch it in context in our class presentation at AU2020

# Advanced Routing Features

- **Audio Circuits operate in the range of human hearing 20Hz – 20,000Hz**
  - From an electronics point of the view these are very low frequencies at which all interconnects are transparent and intrinsic(aka parasitic) impedances can be ignored
  - This means that the layout itself is non-critical(generally speaking) and is a good candidate for a first time PCB since the design requirements aren't difficult to meet.
  - This also means that we can leverage more of the automation that Fusion 360 Electronics/EAGLE provide to speed up our design



# Push/Shove and Walkaround Obstacles

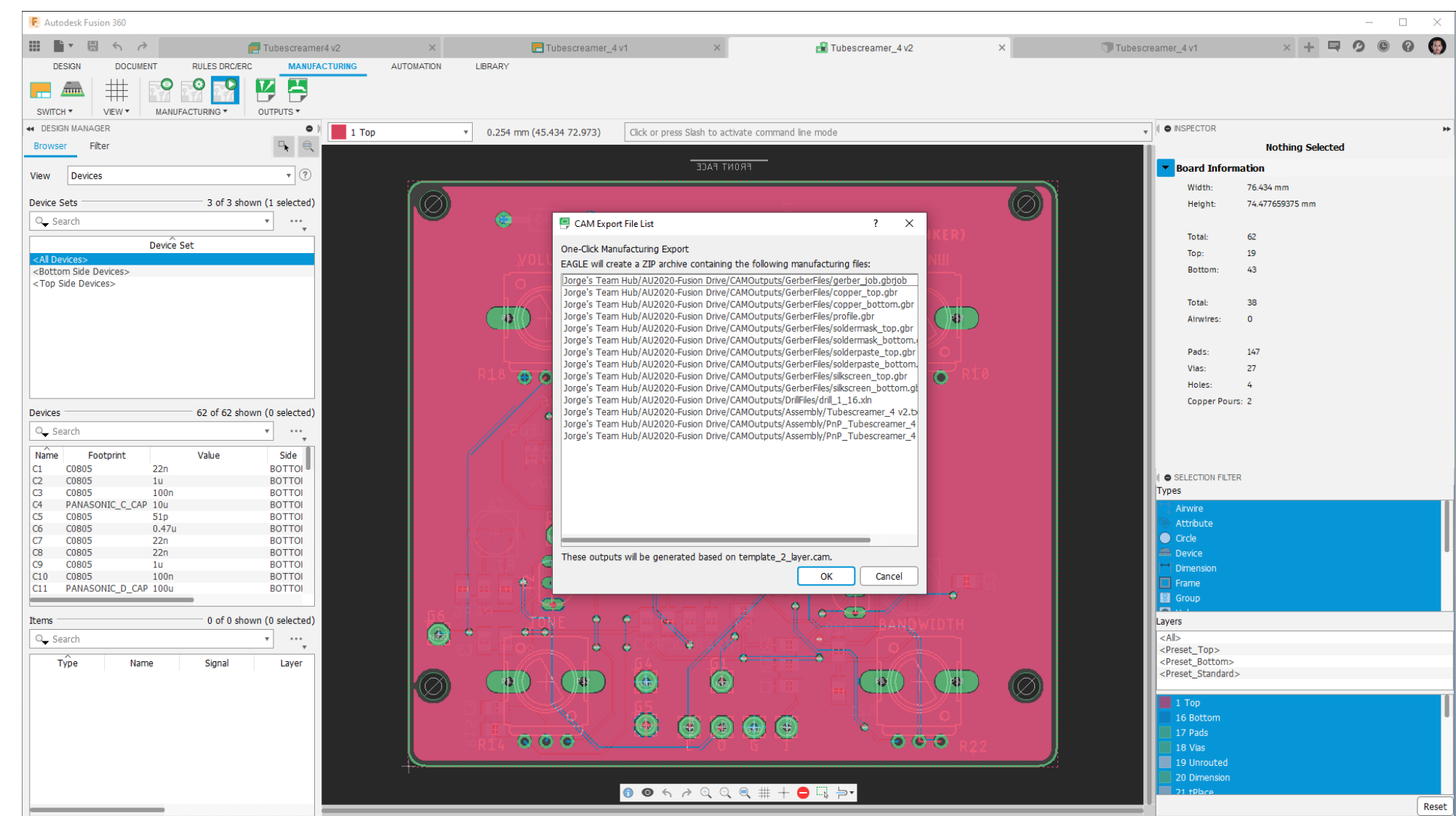
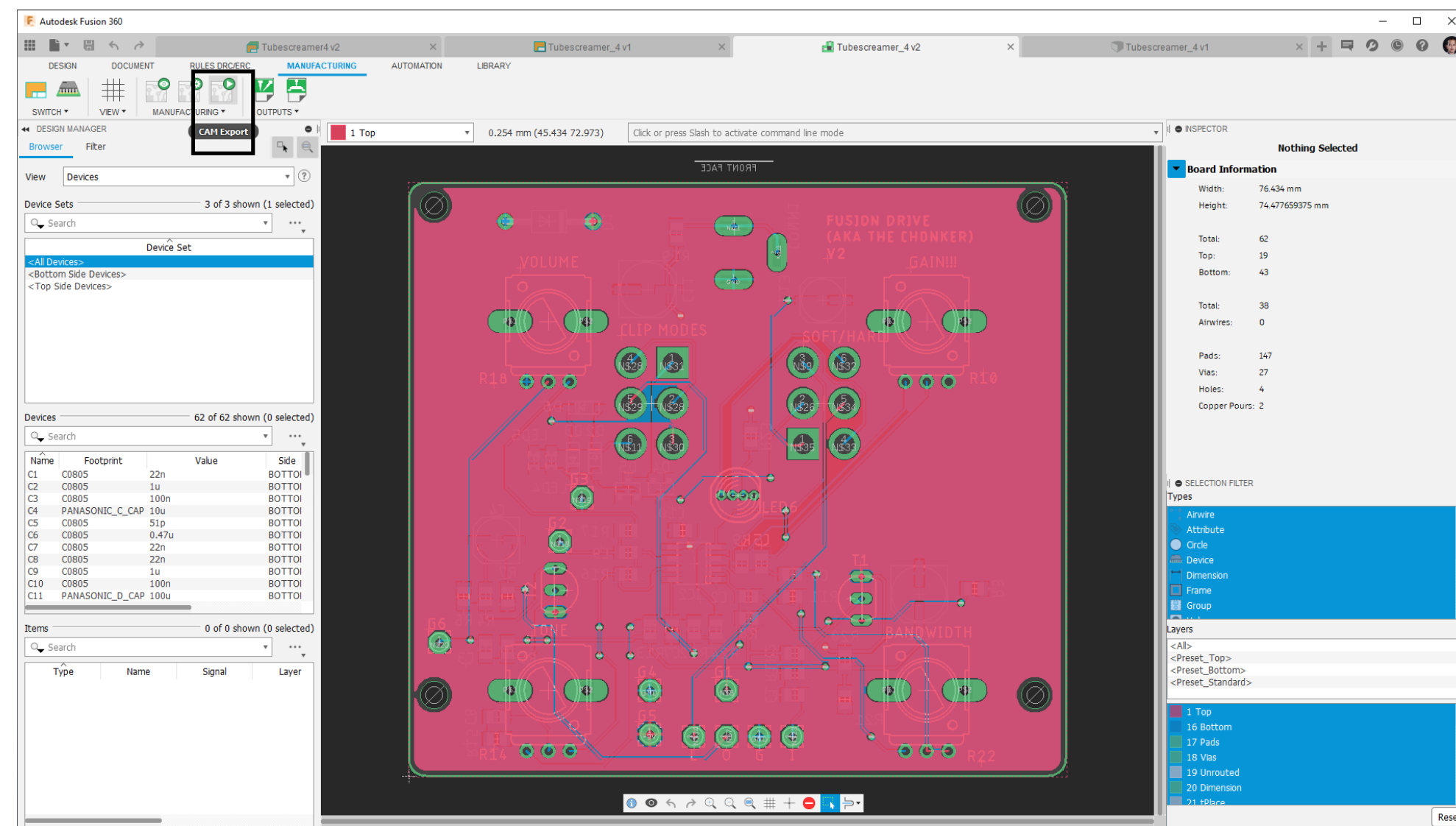
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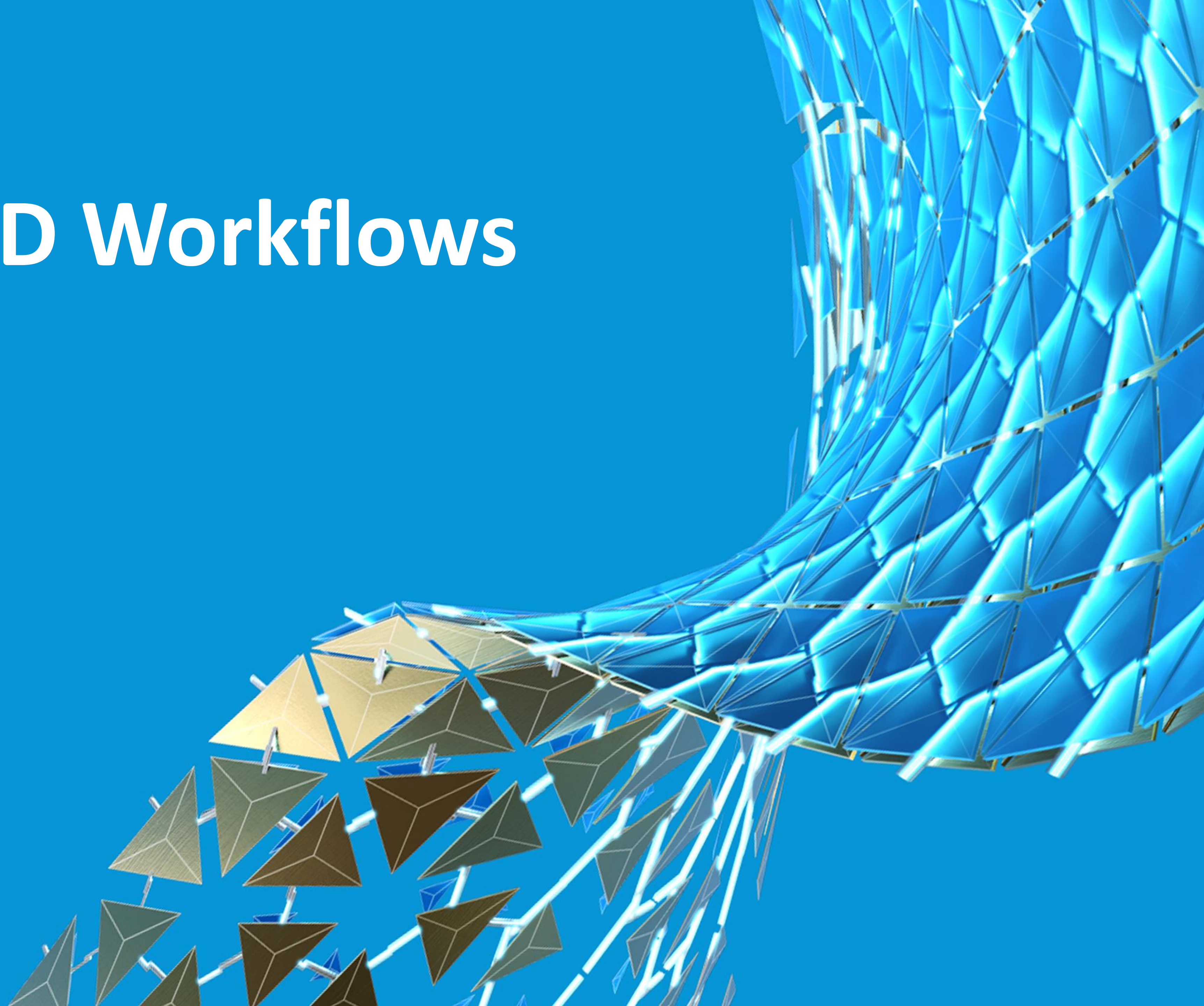
# Simplified Manufacturing Process

- The CAM processor export gives a gentle introduction to generating Gerber files and drill files since it covers most use cases.
  - With one click you can generate all your manufacturing data and send it to your manufacturer
  - It analyzes your design and picks the most suitable template.





# ECAD/MCAD Workflows





# Demonstration

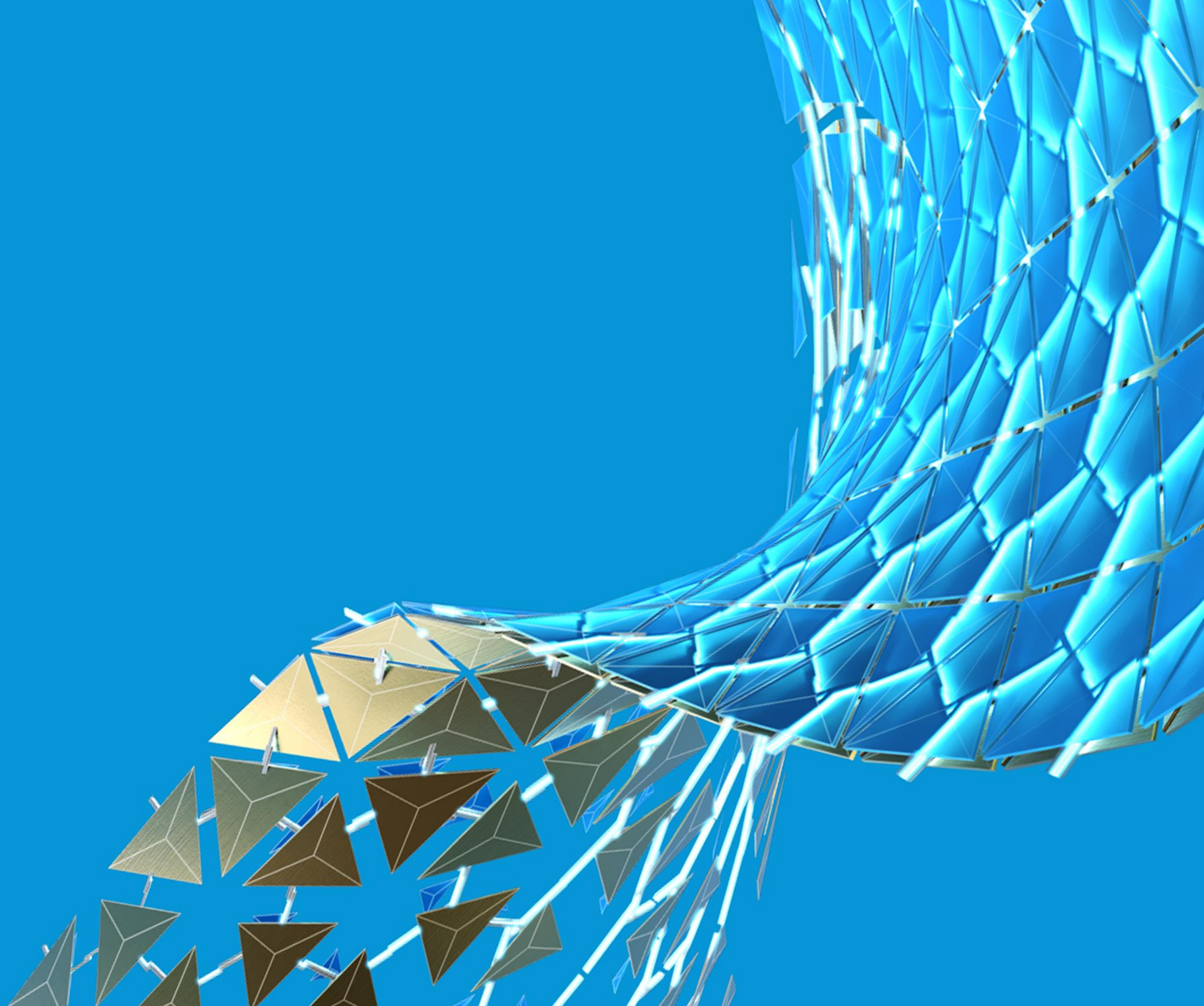
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# Wrap-up



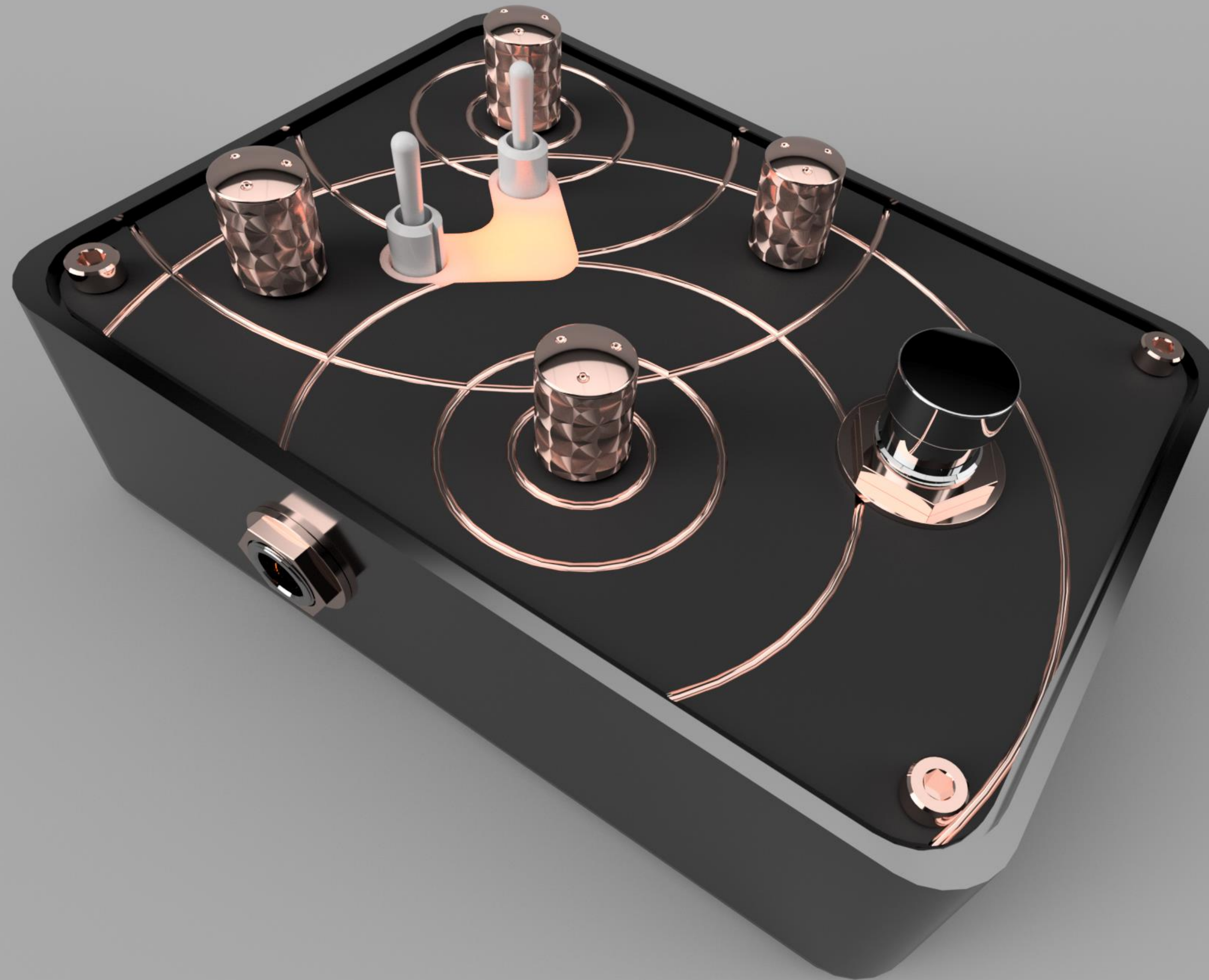


# Wrap up

- **Parametric** - nothing is set in stone with fusion 360, you can change *anything, any time*
- **sketch tool** - build out a quick framework of what you're making here, keep it light
- **Extrude** - there are multiple ways to use it. normal, symmetrical, 2 sided, and from reference geometry. don't forget about draft angles if you need them!
- **Construction planes** - need references for 3d tools? look no further
- **Split body** - does what it says on the tin. split bodies like katanas split bamboo!
- **Hole tool** - make holes, make holes with threads, make holes with threads and counter sink heads!
- **Move** - point to point, global, or constrained, mix it up!
- **Advanced Routing modes**- Speed up the layout task by avoiding time consuming rework using the shove and workaround modes.
- **QuickRoute**- Automates the non-critical traces saving you time and effort
- **Improved Polygons**- Higher resolution, no manufacturing data bloat!



Wrap up







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