

# Boggling the Boardhouse

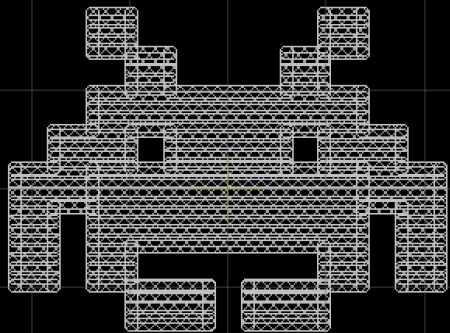
Designing 3D Structures, Circuits, and Sensors from PCBs



**Nick "Reply Bi" Poole**

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Very Powerful Wizard | Engineer for  
@sparkfun | 🏳️‍🌈Bi | [pronoun.is/he](https://pronoun.is/he) |  
┌ Personal Account ┐ | Cyberpunks say  
Trans Rights | 📺 KEOMKA



# The Basics: Bringing Weird Shapes into EDA

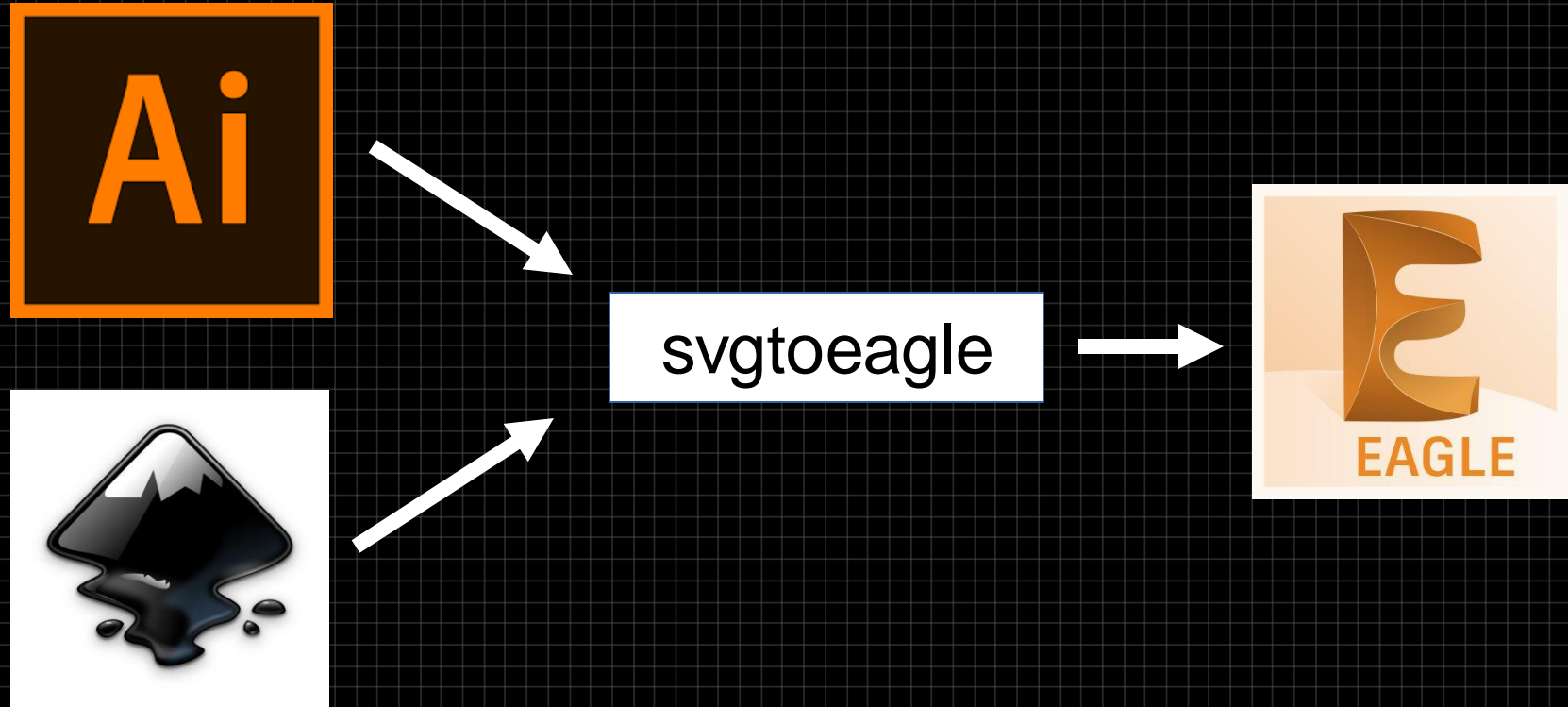
# Bringing Weird Shapes into EDA

## 3 Ways

1. `svgtoeagle` (for people with vectors)
2. Buzzard (for people with bitmaps)
3. Just draw it in your EDA (for masochists)

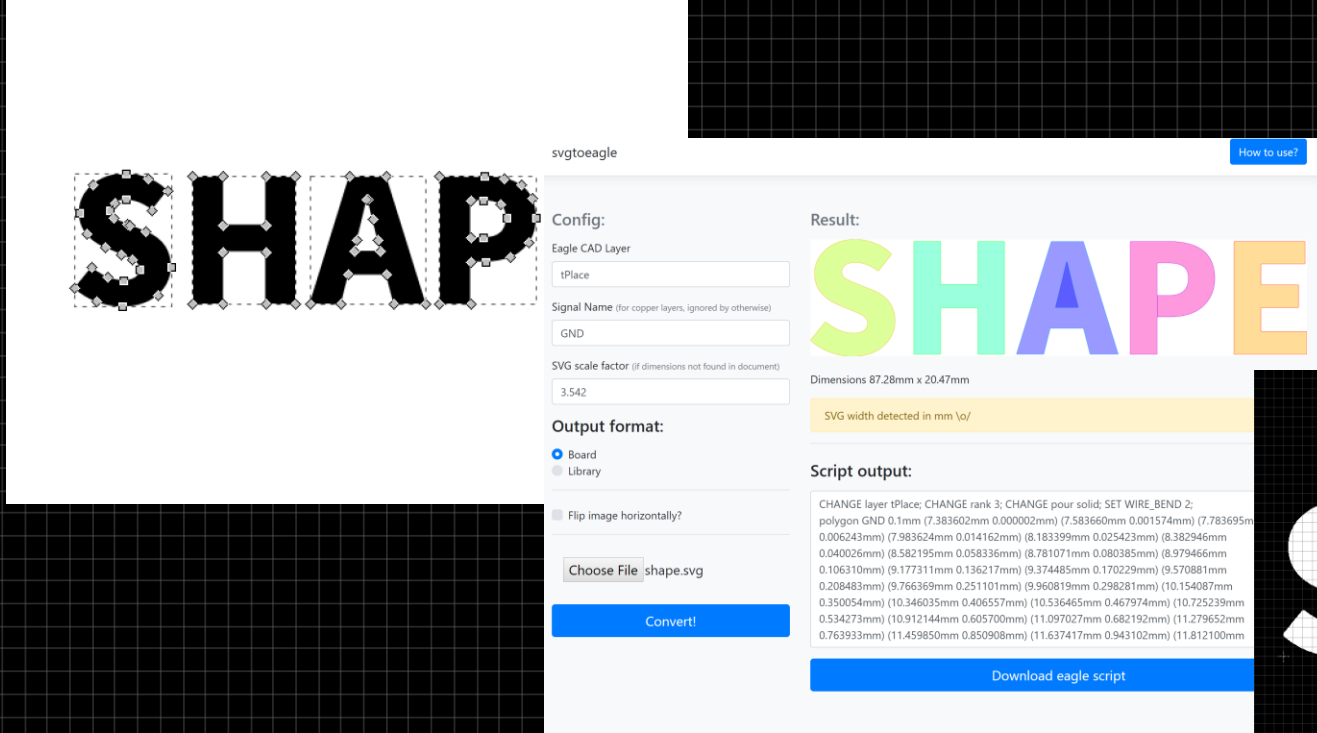
# Bringing Weird Shapes into EDA

## Method 1: “svgtoeagle” by Gordon Williams



# Bringing Weird Shapes into EDA

## Method 1: “svgtoeagle” by Gordon Williams



The screenshot displays the 'svgtoeagle' web application interface. On the left, a pixelated black and white logo of the word 'SHAP' is shown. The main interface is divided into several sections: 'Config:' with fields for 'Eagle CAD Layer' (set to 'tPlace'), 'Signal Name' (set to 'GND'), and 'SVG scale factor' (set to '3.542'); 'Output format:' with radio buttons for 'Board' (selected) and 'Library'; and a 'Choose File' button labeled 'shape.svg'. A 'Convert!' button is at the bottom of the config section. On the right, the 'Result:' section shows a colorful vectorized version of the word 'SHAPE' (S: green, H: cyan, A: blue, P: pink, E: orange) with dimensions '87.28mm x 20.47mm'. Below this is a 'Script output:' section containing a large block of Eagle script code. A 'Download eagle script' button is at the bottom right of the interface.

svgtoeagle [How to use?](#)

**Config:**

Eagle CAD Layer  
tPlace

Signal Name (for copper layers, ignored by otherwise)  
GND

SVG scale factor (if dimensions not found in document)  
3.542

**Output format:**

☒ Board  
☐ Library

☐ Flip image horizontally?

Choose File shape.svg

**Convert!**

**Result:**

Dimensions 87.28mm x 20.47mm

SVG width detected in mm \o/

**Script output:**

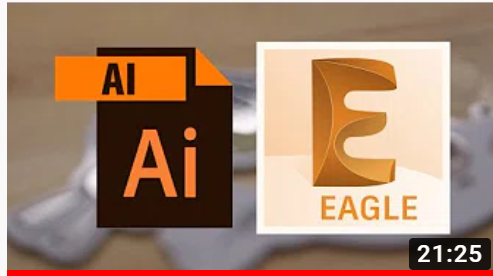
```
CHANGE layer tPlace; CHANGE rank 3; CHANGE pour solid; SET WIRE_BEND 2;
polygon GND 0.1mm (7.383602mm 0.000002mm) (7.583660mm 0.001574mm) (7.783695mm
0.006243mm) (7.983624mm 0.014162mm) (8.183399mm 0.025423mm) (8.382946mm
0.040026mm) (8.582195mm 0.058336mm) (8.781071mm 0.080385mm) (8.979466mm
0.106310mm) (9.177311mm 0.136217mm) (9.374485mm 0.170229mm) (9.570881mm
0.208483mm) (9.766369mm 0.251101mm) (9.960819mm 0.298281mm) (10.154087mm
0.350054mm) (10.346035mm 0.406557mm) (10.536465mm 0.467974mm) (10.725239mm
0.534273mm) (10.912144mm 0.605700mm) (11.097027mm 0.682192mm) (11.279652mm
0.763933mm) (11.459850mm 0.850908mm) (11.637417mm 0.943102mm) (11.812100mm
```

**Download eagle script**

SHAPE

# Bringing Weird Shapes into EDA

## Method 1: “svgtoeagle” by Gordon Williams



### Bringing Vector Artwork into Autodesk Eagle

The Accumulator • 851 views • 11 months ago

Import sophisticated vector artwork from Adobe Illustrator into Autodesk **Eagle** and use it on your PCBs without rasterizing! Enjoy!

# Bringing Weird Shapes into EDA

## Method 1: “svgtoeagle” by Gordon Williams

### Advantages

Small file sizes

Accurate dimensions

Create filled polygons / pours

### Disadvantages

Image must be a vector drawing

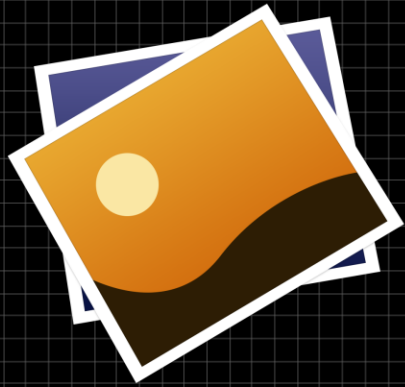
Some pre-processing is required

Moving imported items is a  
pain  
(unless you create a footprint)



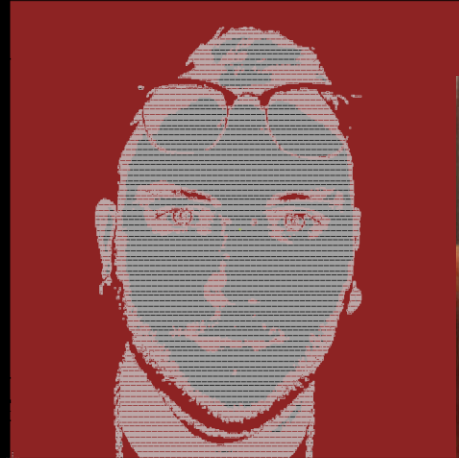
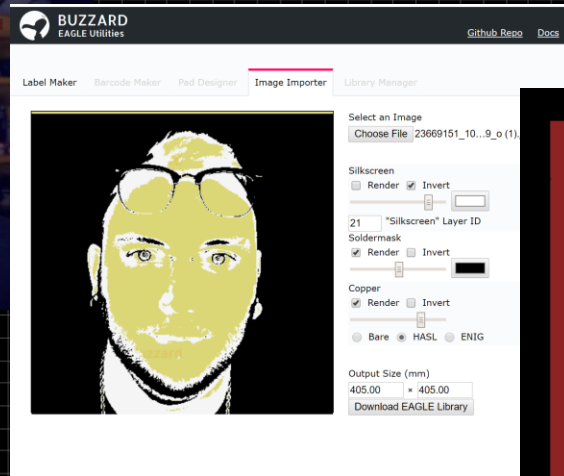
# Bringing Weird Shapes into EDA

## Method 2: Buzzard Image Importer



# Bringing Weird Shapes into EDA

## Method 2: Buzzard Image Importer



# Bringing Weird Shapes into EDA

## Method 2: Buzzard Image Importer

### Advantages

Basically any image format

Preview and generate  
Silk, mask, and copper  
Layers together

Exports library footprint

### Disadvantages

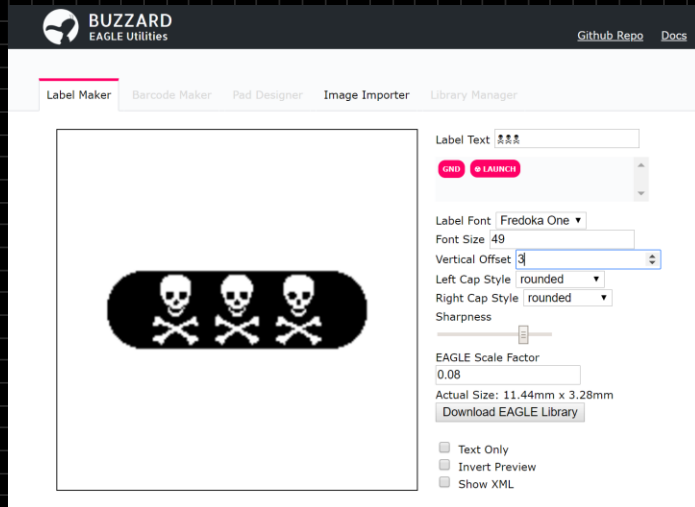
Very large file sizes

Long CAM processing times

Fixed import resolution

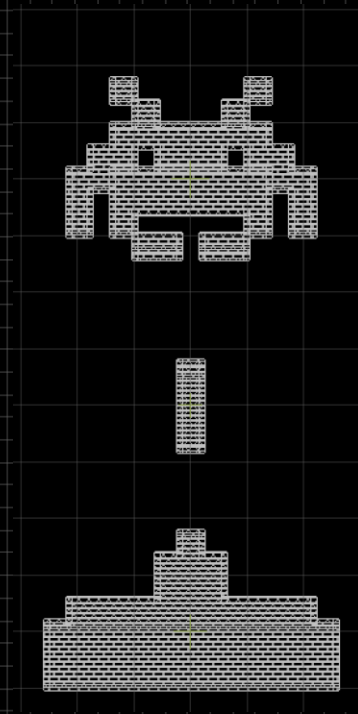
# Bringing Weird Shapes into EDA

## Method 2b: Buzzard Label Maker



# Bringing Weird Shapes into EDA

## Method 3: Just Draw it in your EDA



# Bringing Weird Shapes into EDA

## Method 3: Just Draw it in your EDA

### Advantages

Works in any EDA

No external tools

Great for pixel art

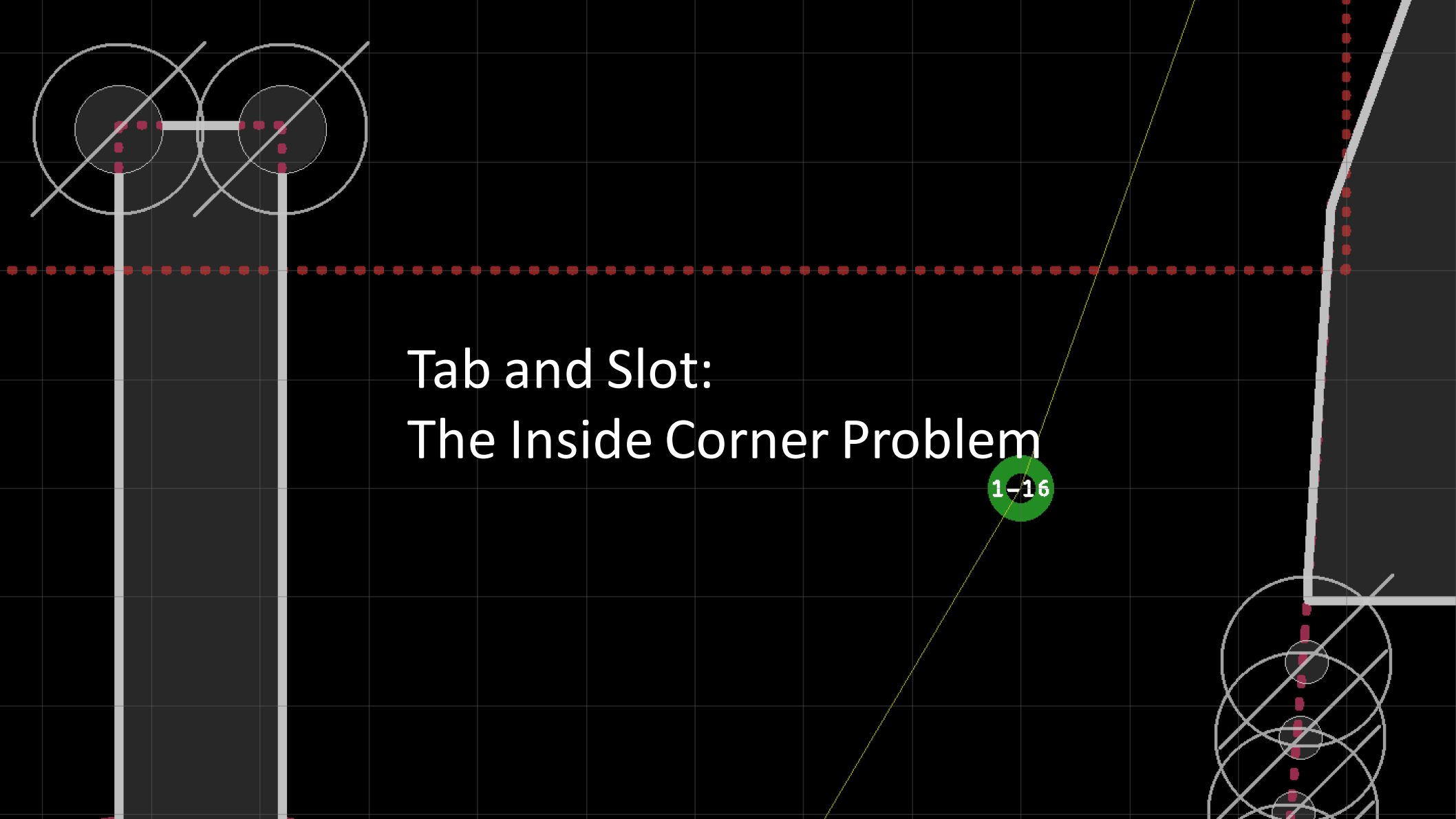
### Disadvantages

EDA tools are bad for drawing

You have to draw a thing

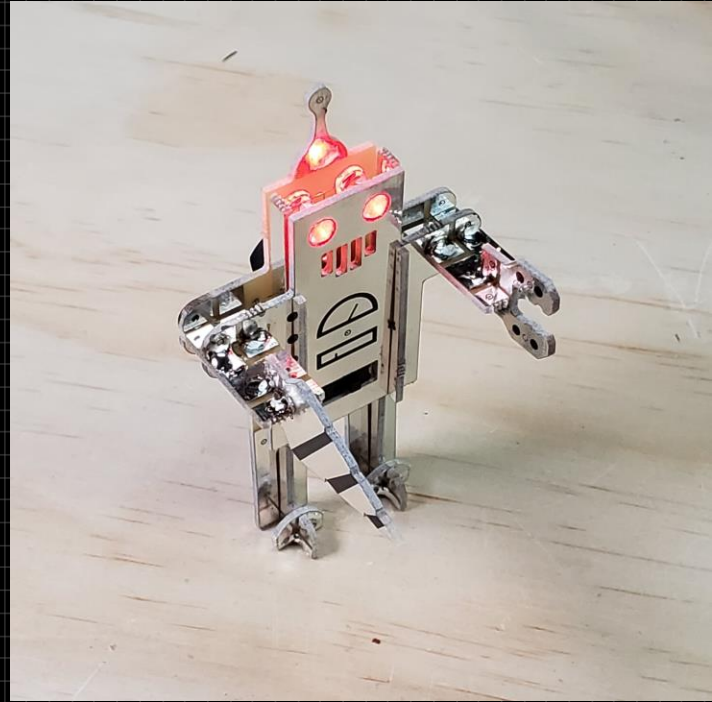
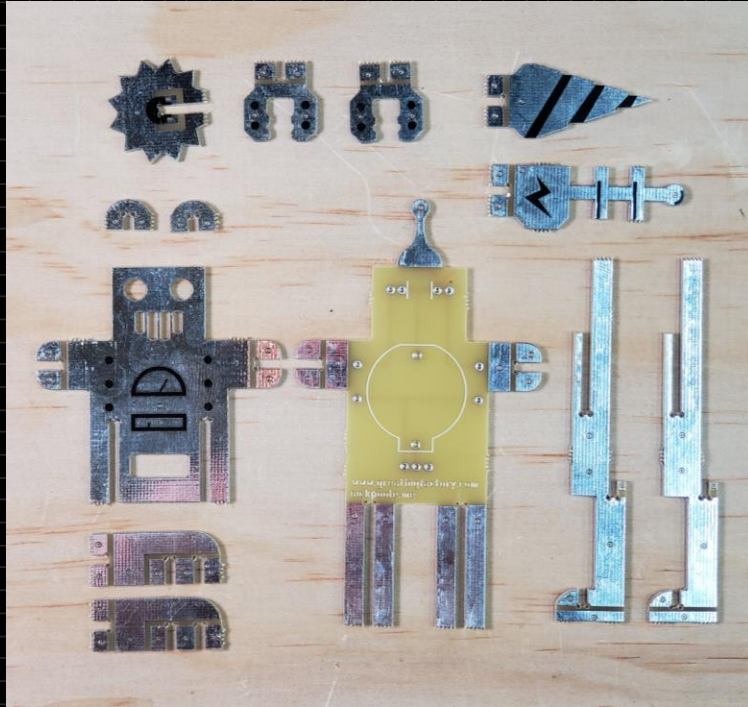
# Tab and Slot: The Inside Corner Problem

1-16



# The Inside Corner Problem

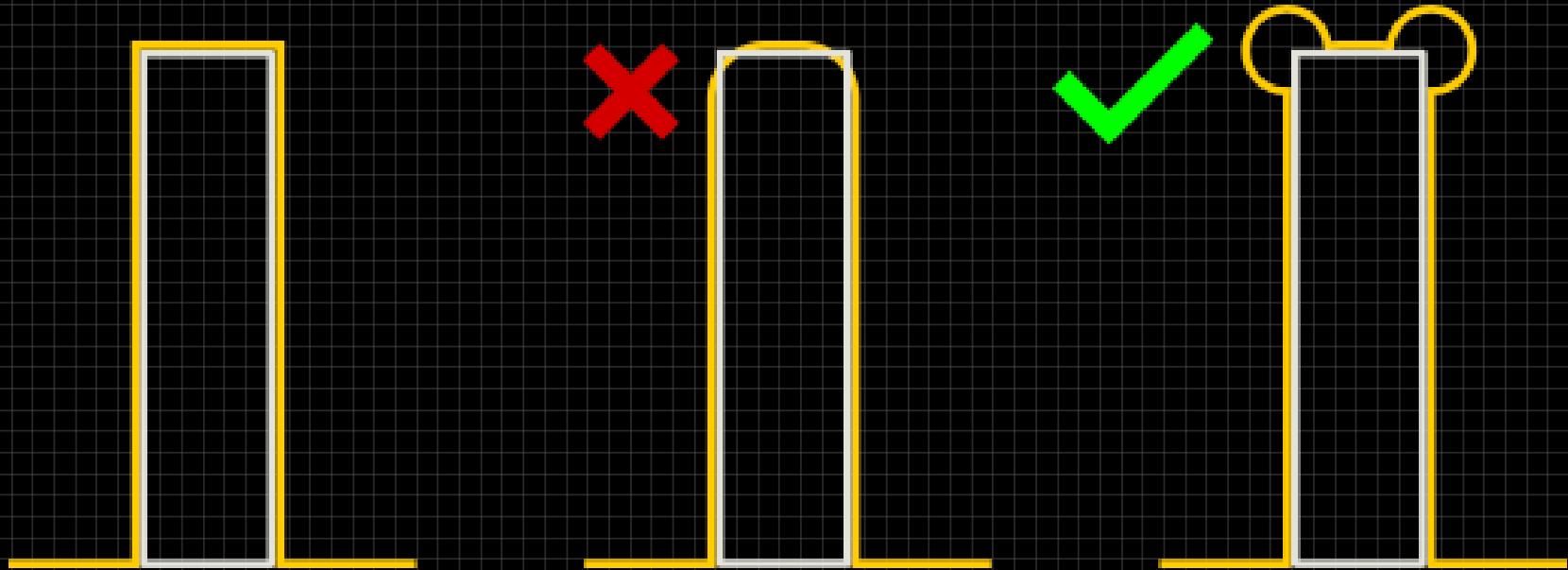
## What's the problem?





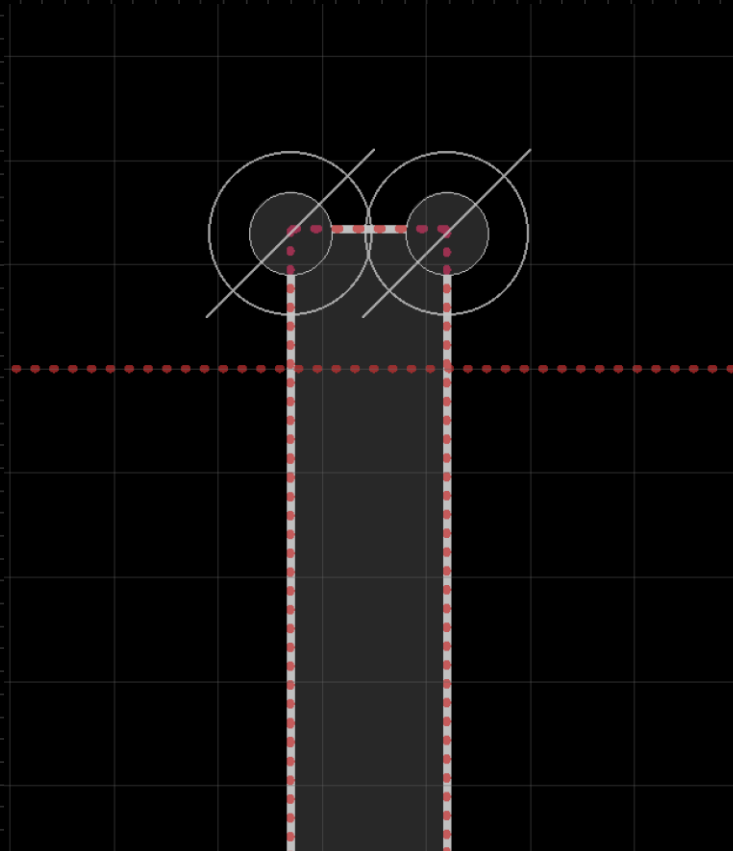
# The Inside Corner Problem

## What's the problem?



# The Inside Corner Problem

## How Do We Solve It? Corner Relief!





1-16

The diagram illustrates a PCB layout with three square pads, each labeled '1-16'. The pads are connected by a horizontal line. The left and middle pads are shown with a fillet soldering technique, where the solder is applied to the top of the pads and the connecting line. The right pad is shown with a different soldering technique, where the solder is applied to the bottom of the pads and the connecting line. The background is a dark gray grid. The pads are red, and the connecting line is white. The text '1-16' is in white on a red circular background. The text 'Fillet Soldering: How to Avoid Lifting Pads' is in white on a dark gray background.

1-16

1-16

## Fillet Soldering: How to Avoid Lifting Pads

# Fillet Soldering

## What's a Fillet?

- Not a “fil-ay”
- Rounded corner
- Joins two surfaces at an angle

**Step 1: Wet the tip of the iron with solder**  
It helps to have a little solder on the tip of your iron to transfer heat to the pad



**Step 2: Add solder to one side of the fillet**  
Apply the iron to one side of the fillet and start feeding solder in until you have a good puddle



**Step 3: Drag solder to the other side**  
Drag the tip of the soldering iron into the corner between the pads and feed solder into the other side to form the fillet.

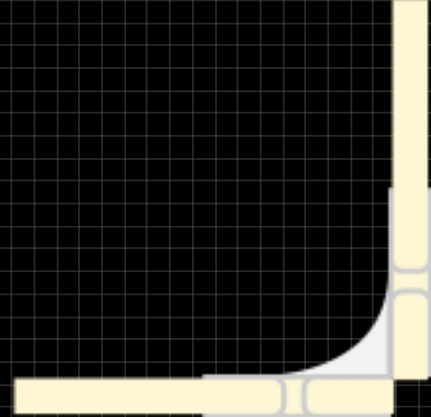
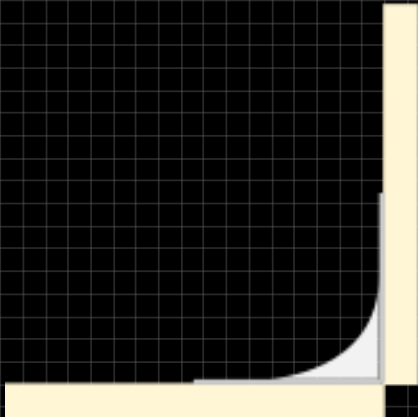
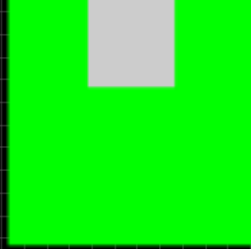


**Step 4: Done!**  
If everything got hot enough, you should have a concave fillet of solder connecting the two pads!



# Fillet Soldering

## Designing a Fillet Joint

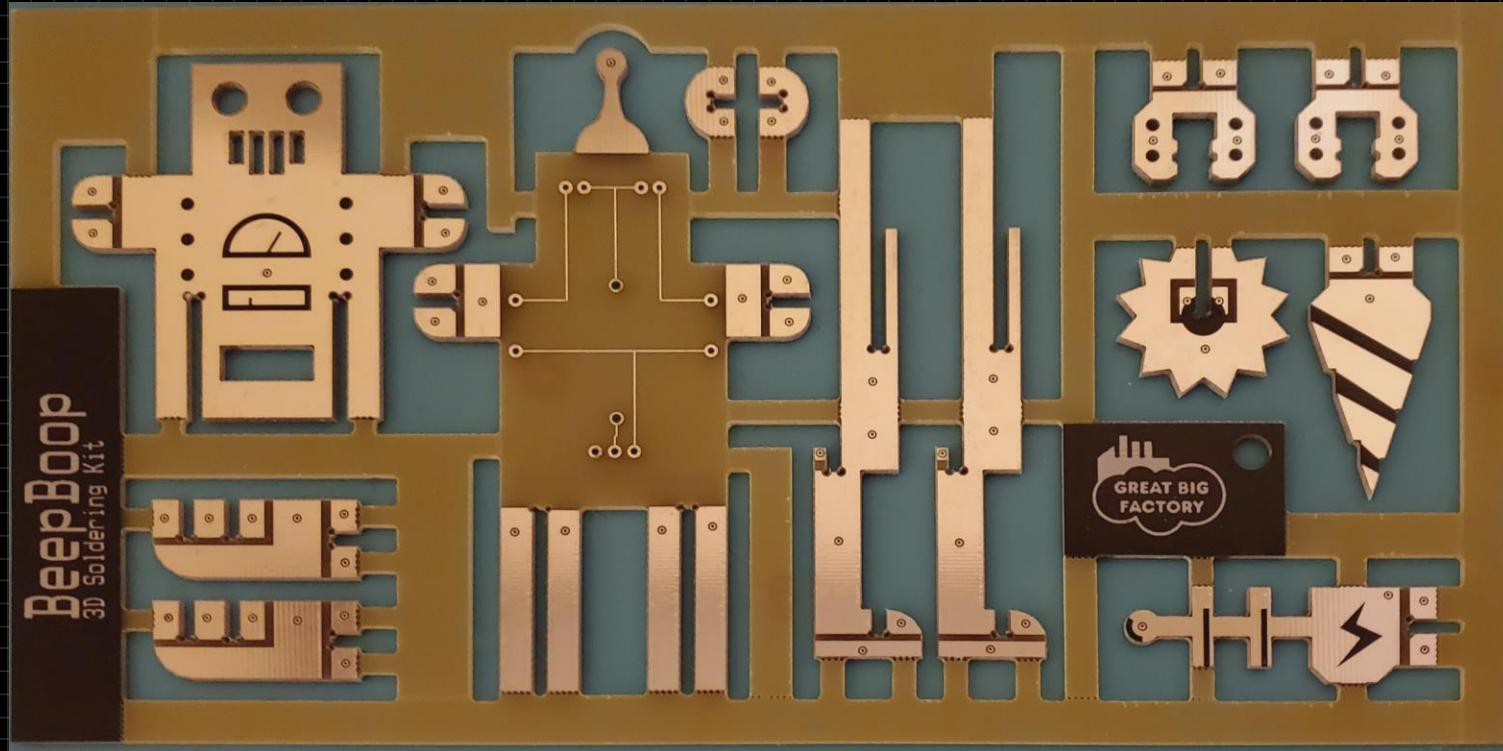


Imitating Model Sprues  
w/ Mouse Bites

# Imitating Model Sprues w/ Mouse Bites



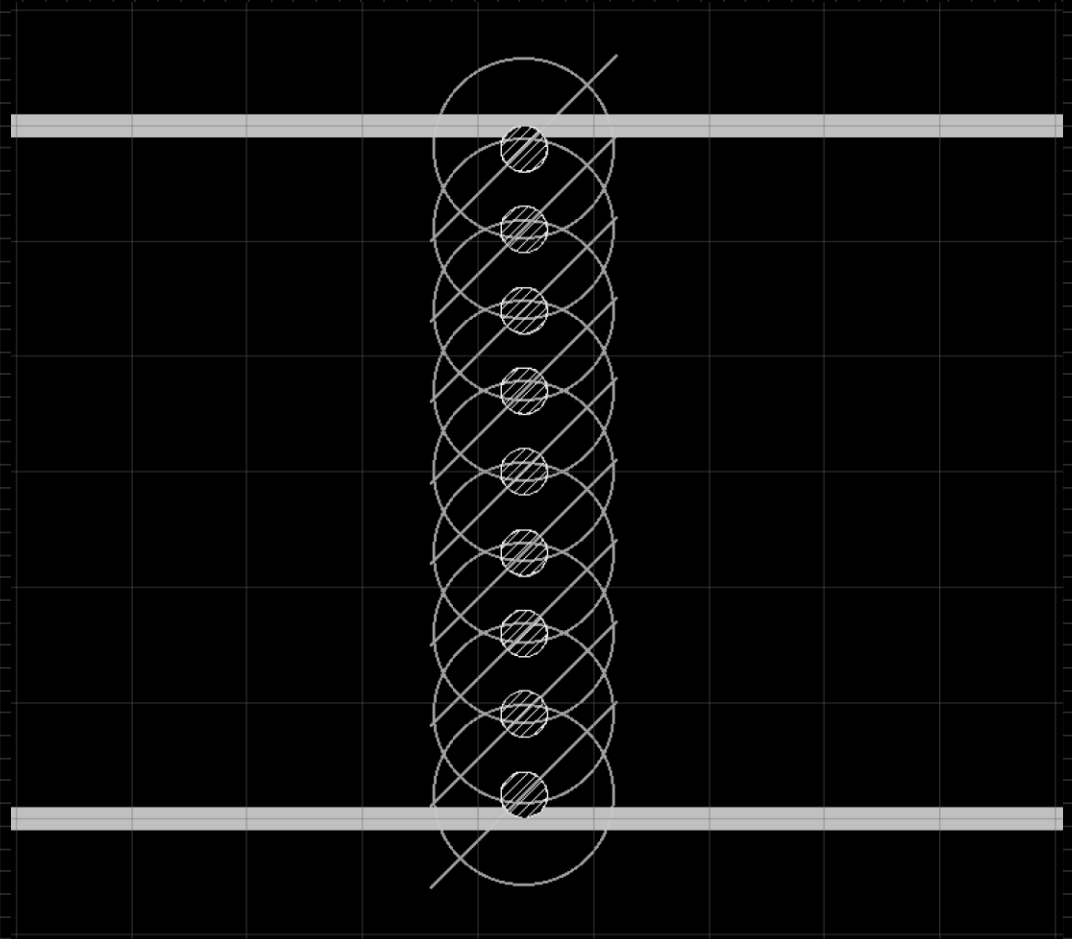
# Imitating Model Sprues w/ Mouse Bites





# Imitating Model Sprues w/ Mouse Bites

- Diameter  
0.02" (20mil/0.5mm)
- Spacing between centers  
0.04" (40mil/1mm)
- Snaps easily by hand at  
0.8mm thickness
- Pliers help at 1.6mm



# Imitating Model Sprues w/ Mouse Bites

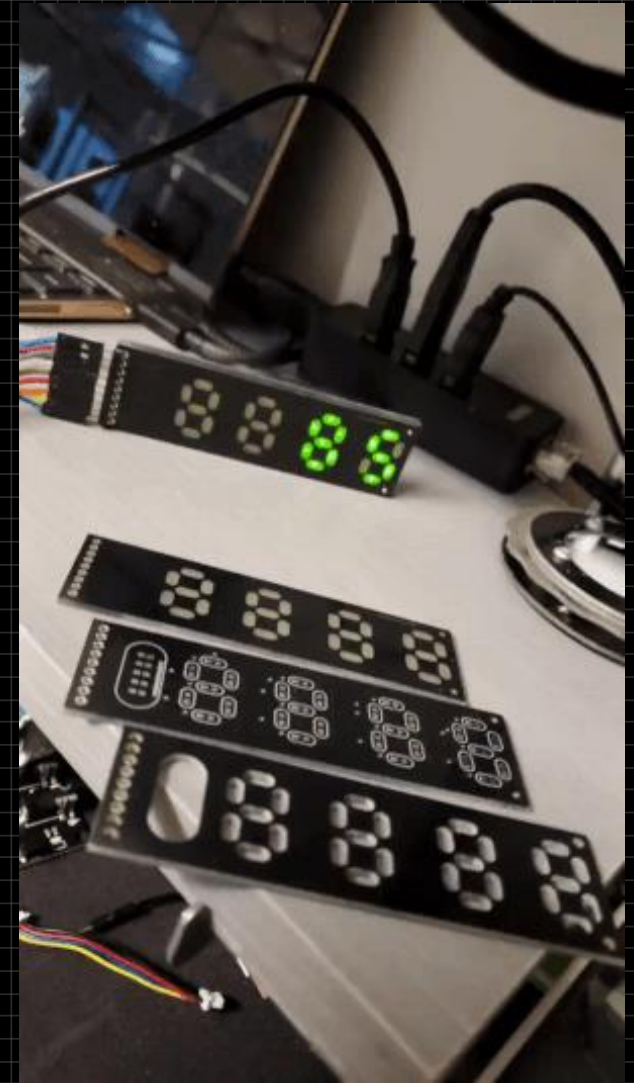
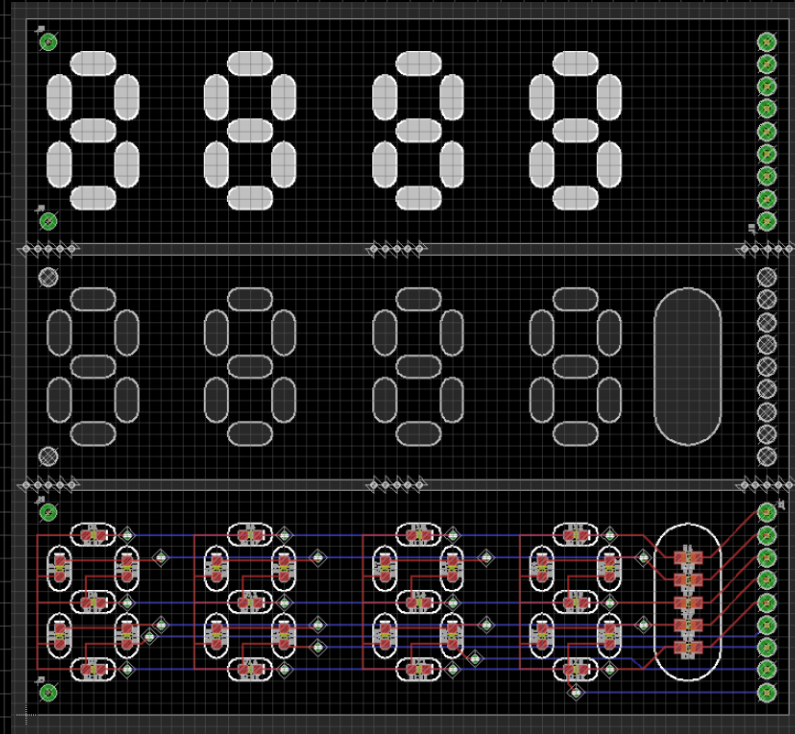




# Manipulating the Mask Layer for Custom Displays

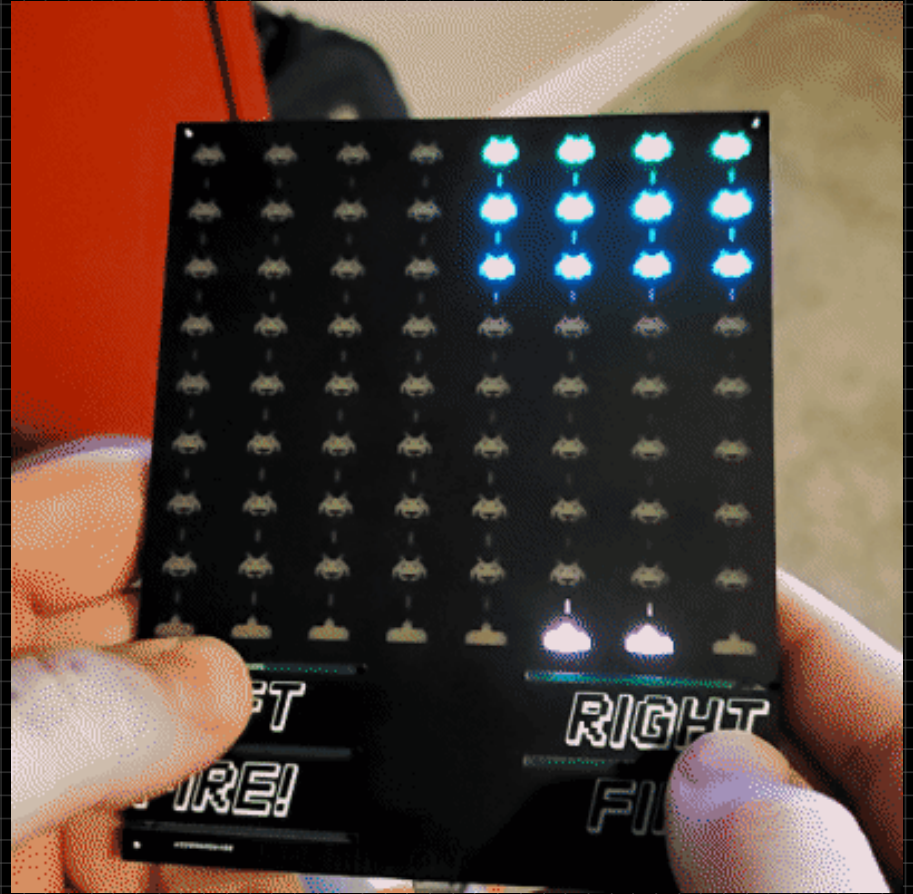
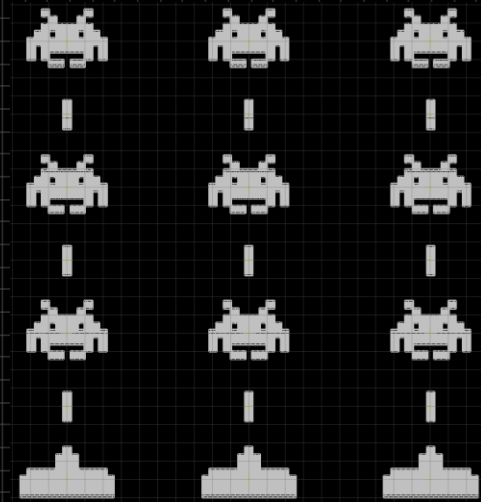
# Manipulating the Mask Layer: Custom Displays

- Fiberglass is translucent!
- tStop & bStop layers
- Make sure the copper layer is clear





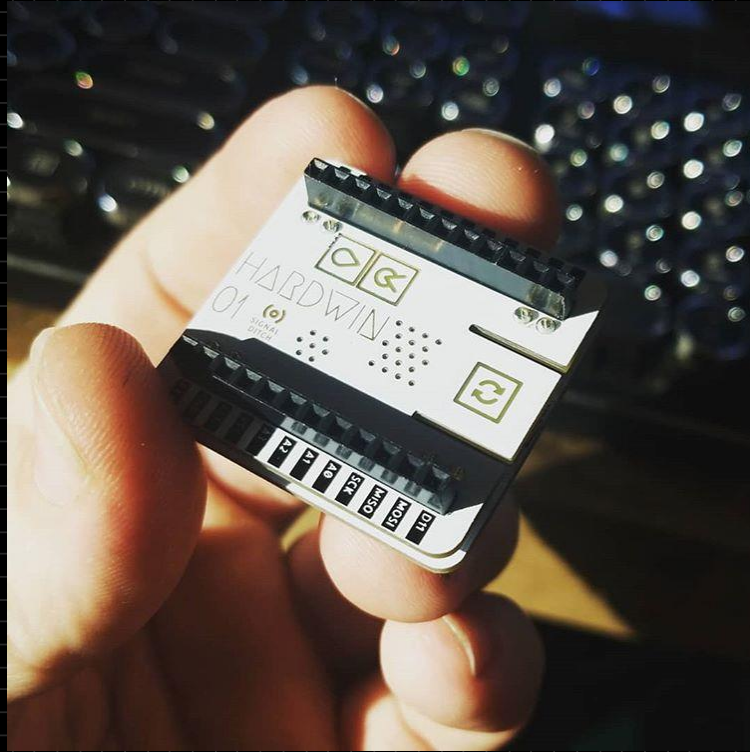
# Manipulating the Mask Layer: Custom Displays



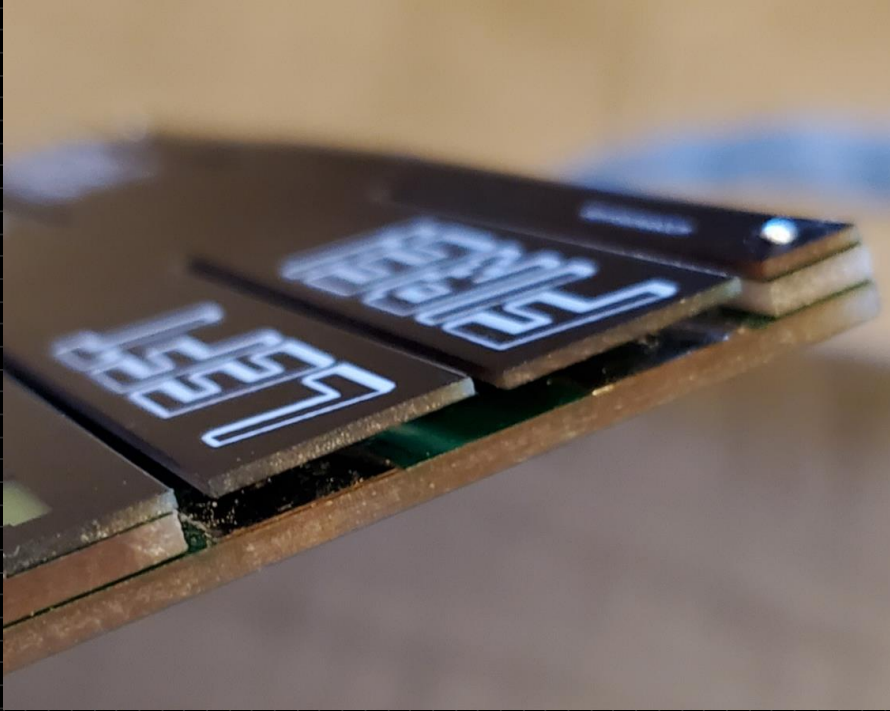
# Bendy Tab Buttons




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# Bendy Tab Buttons



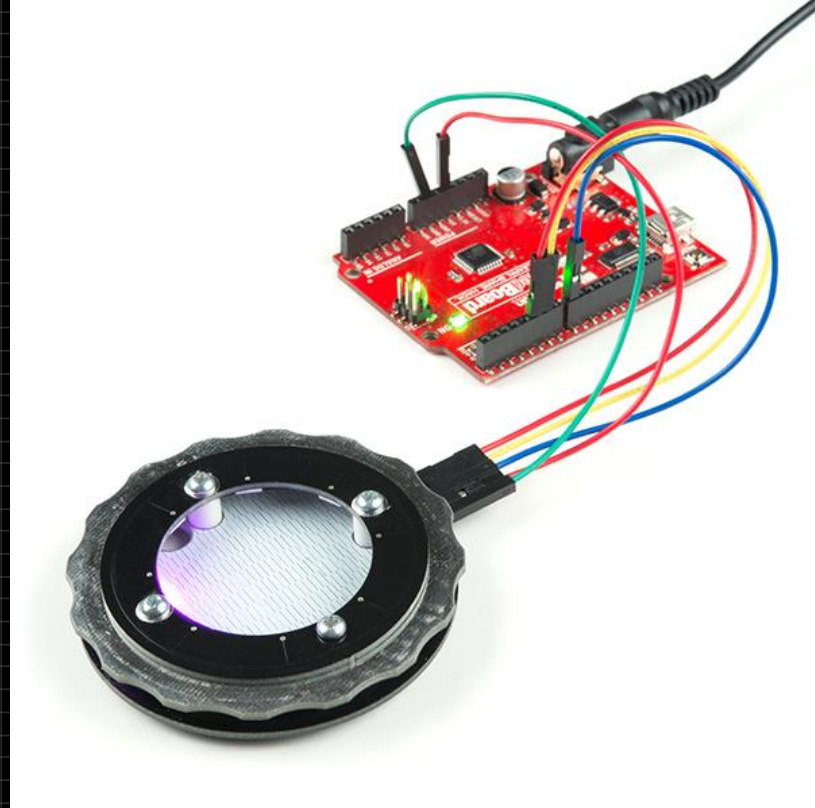




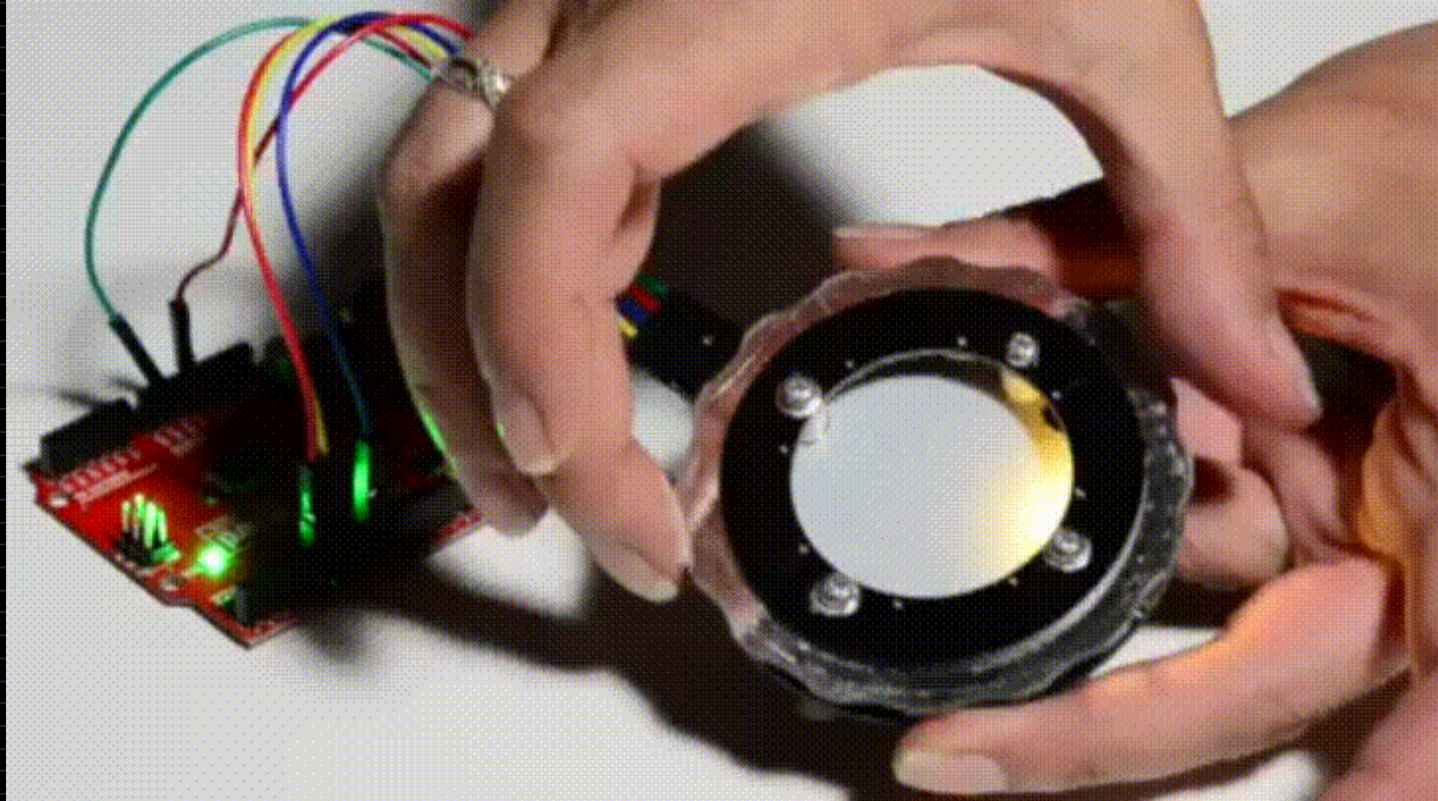
## Wipers and Contacts: A Working Rotary Encoder

# Wipers and Contacts:

## A Working Rotary Encoder



# Wipers and Contacts: A Working Rotary Encoder





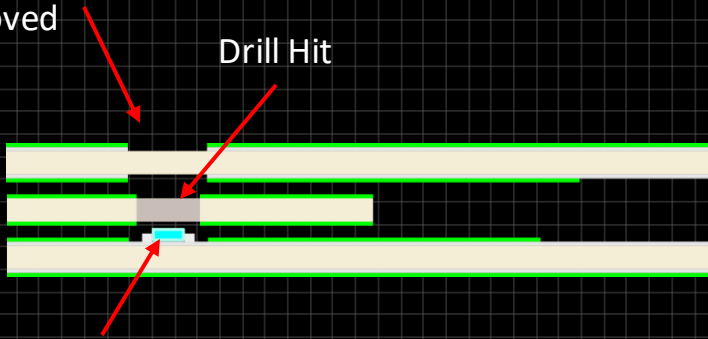


# Stacking Boards

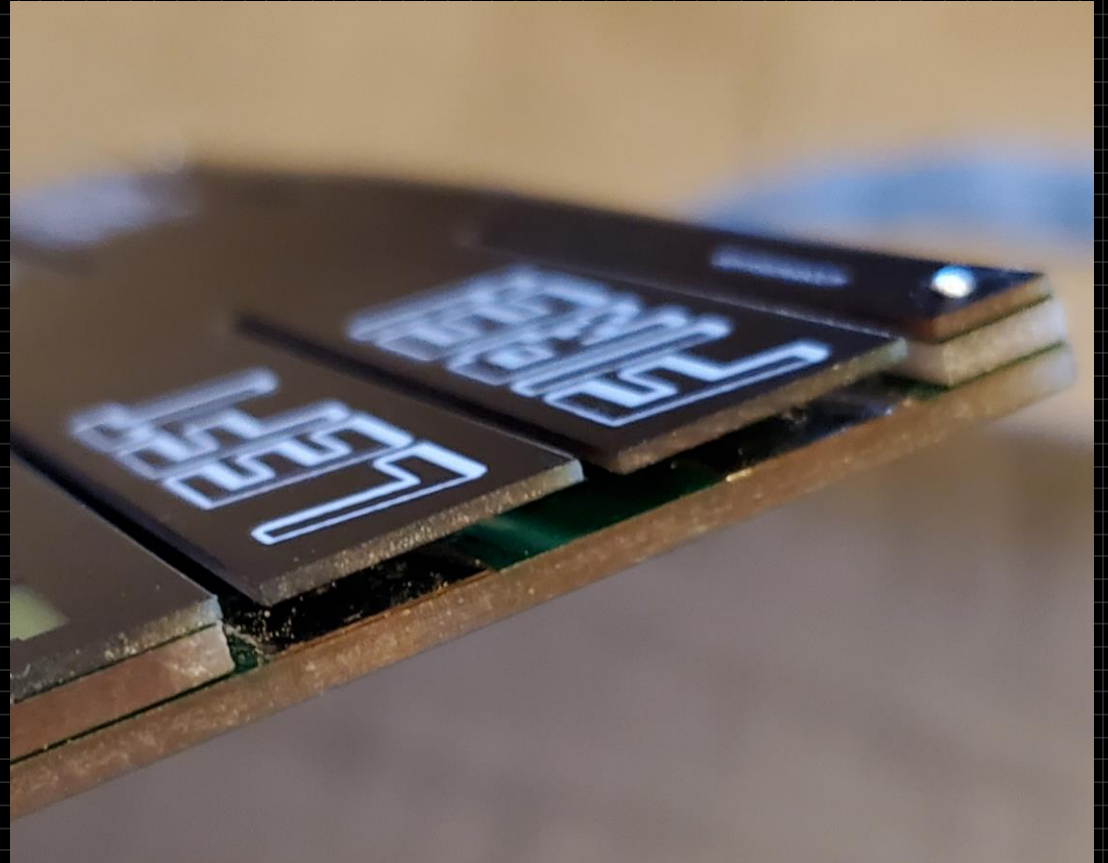
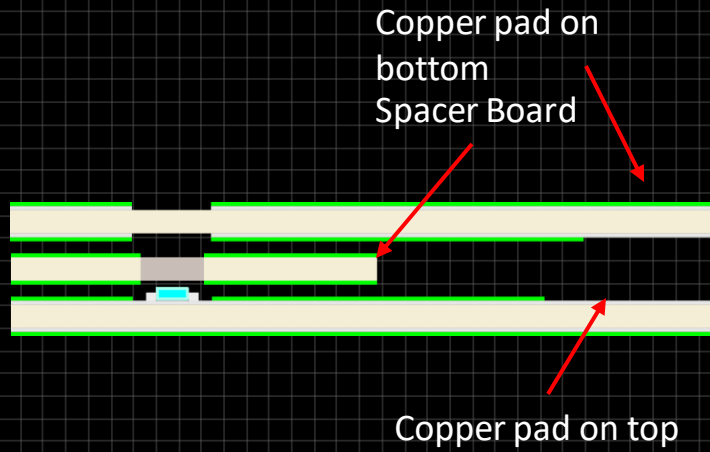
Mask & Copper  
Removed

Drill Hit

LED



# Stacking Boards



# Leaving Clues for the Production Engineer

- Check up on your fabhouse's capabilities (drill sizes, min spacing, min slot width, etc)
- Leave notes (in a layer that makes it to gerbers)
- Label "mill out" or "route out" shapes
- Label v-score lines
- Don't order silk if there's no silk
- If two pours don't connect, make it clear that they're not supposed to

# Thank You!

Slides, Example Projects and Links to Resources



[https://github.com/NPoole/Boggling\\_the\\_Boardhouse](https://github.com/NPoole/Boggling_the_Boardhouse)