PNW IEEE PCB Fabrication Workshop

Karthik Banakar

Structure

1. Welcome
2. What is a PCB
3. Benefits of PCB
4. PCB Design Workflow
    - Schematic
    - PCB Routing
    - Gerber

Karthik Banakar

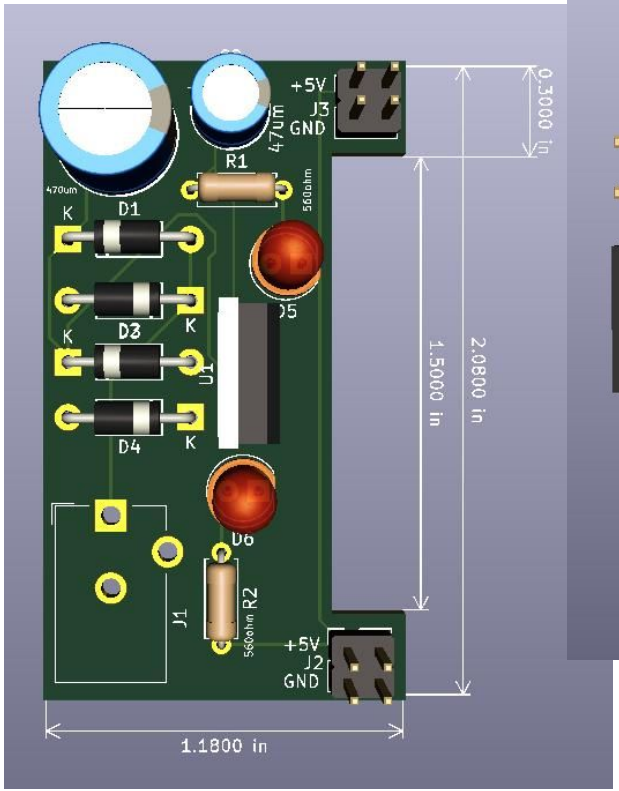
Graduate in Electrical and Computer Engineering

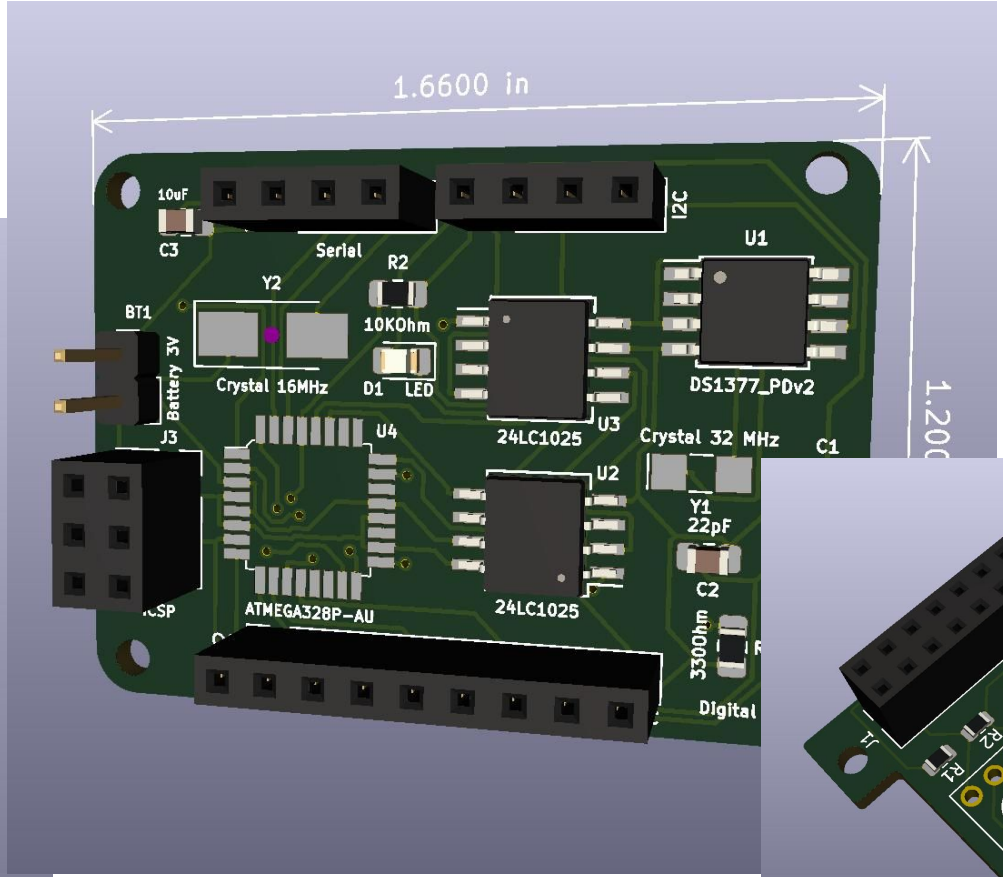
Interests: PCB design, Digital Electronics, RTL Design and Verification

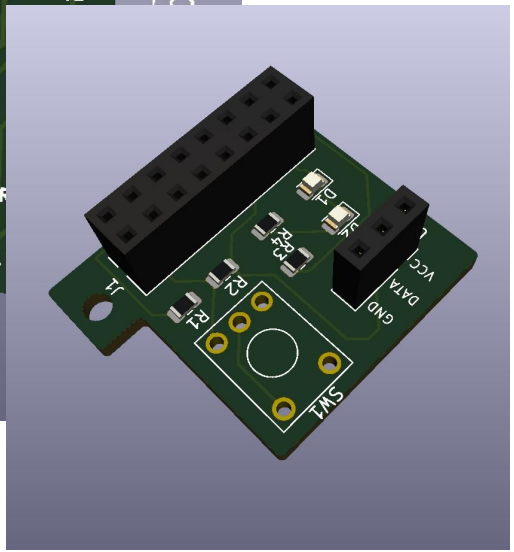
Contact:

- Email : kbanaka@pnw.edu
- Website : https://ikarthikmb.github.io/
- Github : https://github.com/ikarthikmb
- LinkedIn : https://www.linkedin.com/in/karthik-mb/

PCB Designs

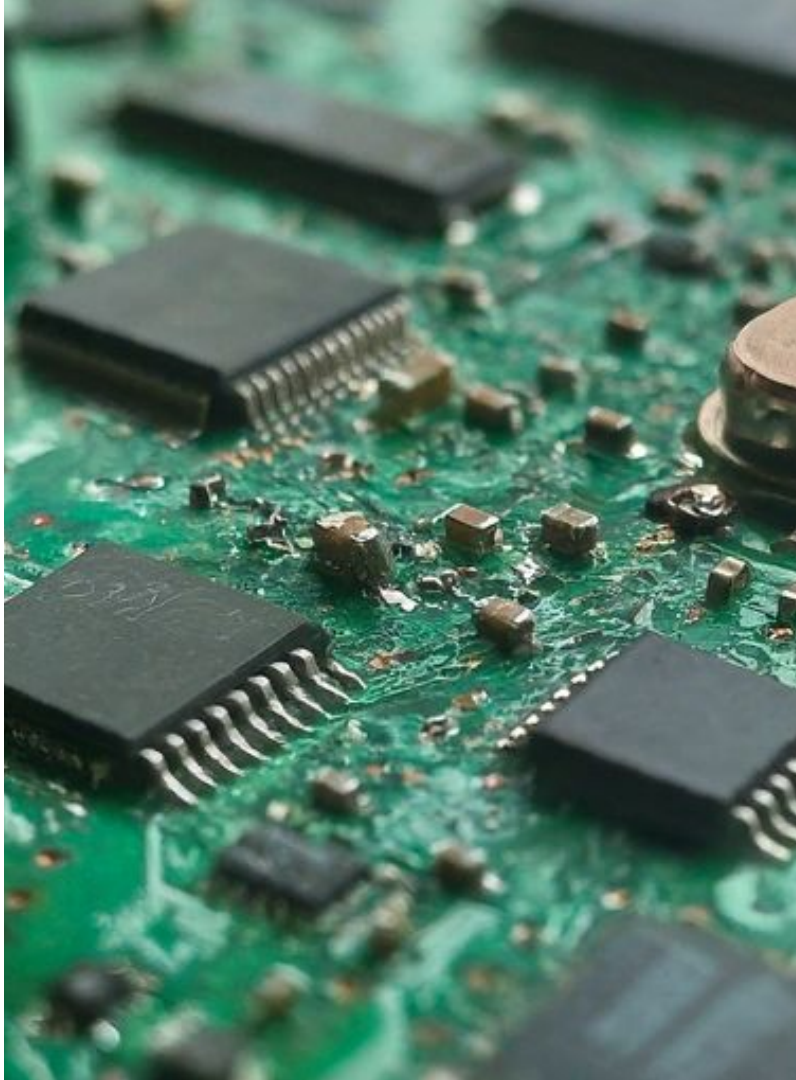

+5V
J3
GND
R1
D1
D3
D4
J1
R2
+5V
J2
GND
0.3000 in
1.5000 in
2.0800 in
1.1800 in


1.6600 in
10uF
C3
Serial
I2C
U1
R2
Y2
BT1
Battery 3V
Crystal 16MHz
10KOhm
D1
LED
DS1377_PDv2
U3
24LC1025
J3
U4
Crystal 32 MHz
C1
U2
Y1
22pF
C2
ATMEGA328P-AU
24LC1025
3300hm
Digital

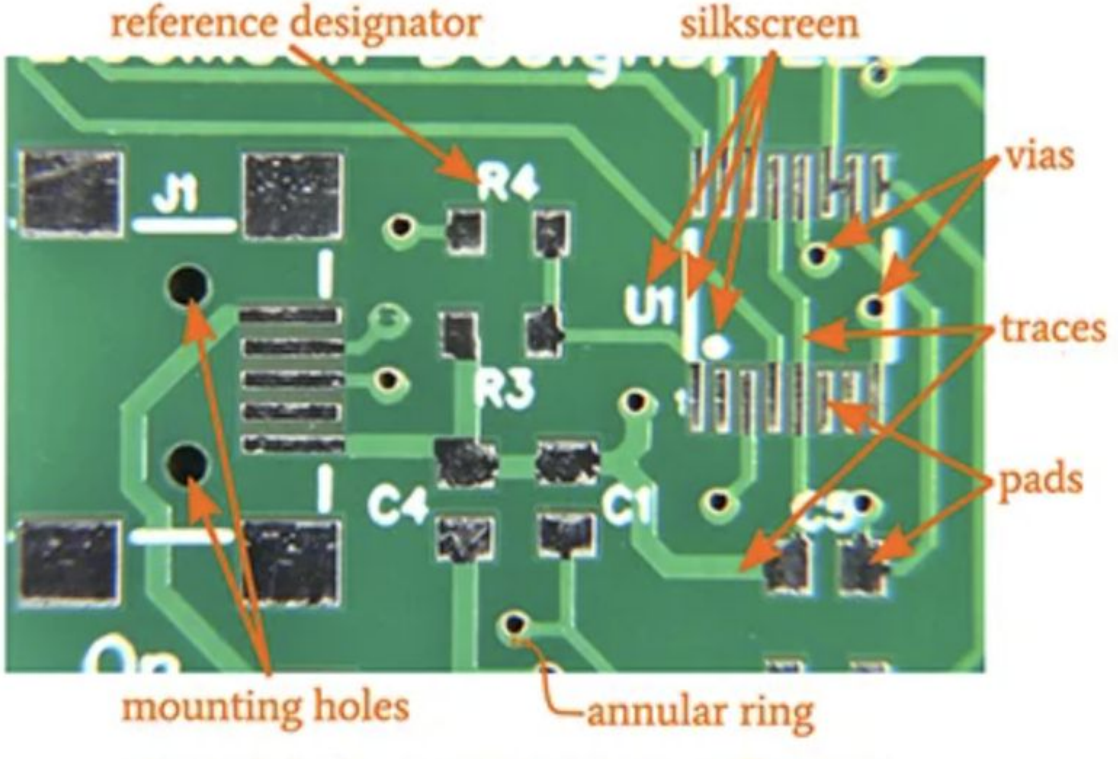

J1
R3
R2
R1
C1
C2
VCC
DATA
GND
TMS

What is a PCB?

- A PCB (Printed Circuit Board) is a thin laminated board made of insulating material (usually FR4) with copper tracks etched onto its surface.
- These tracks provide electrical connections between electronic components soldered onto the board.
- PCBs offer a compact, reliable, and cost-effective way to build electronic circuits.

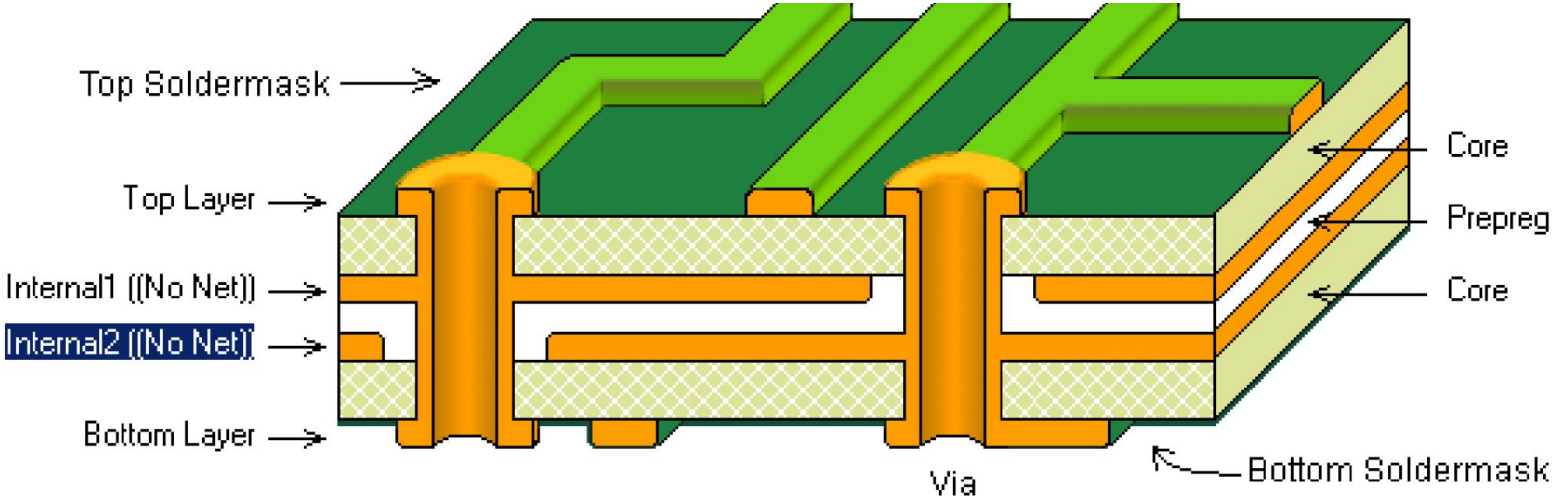


Basic Terminology



Cross-section of a PCB

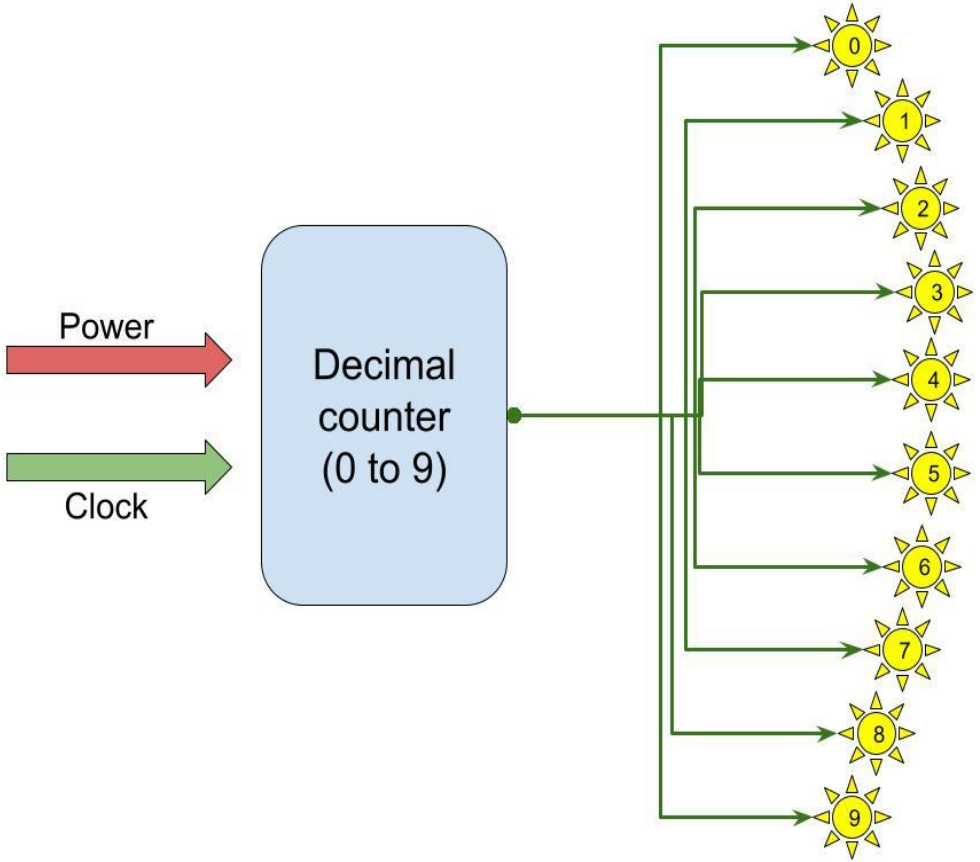
Stack of layers: substrate, copper, soldermask, silkscreen



EngScope

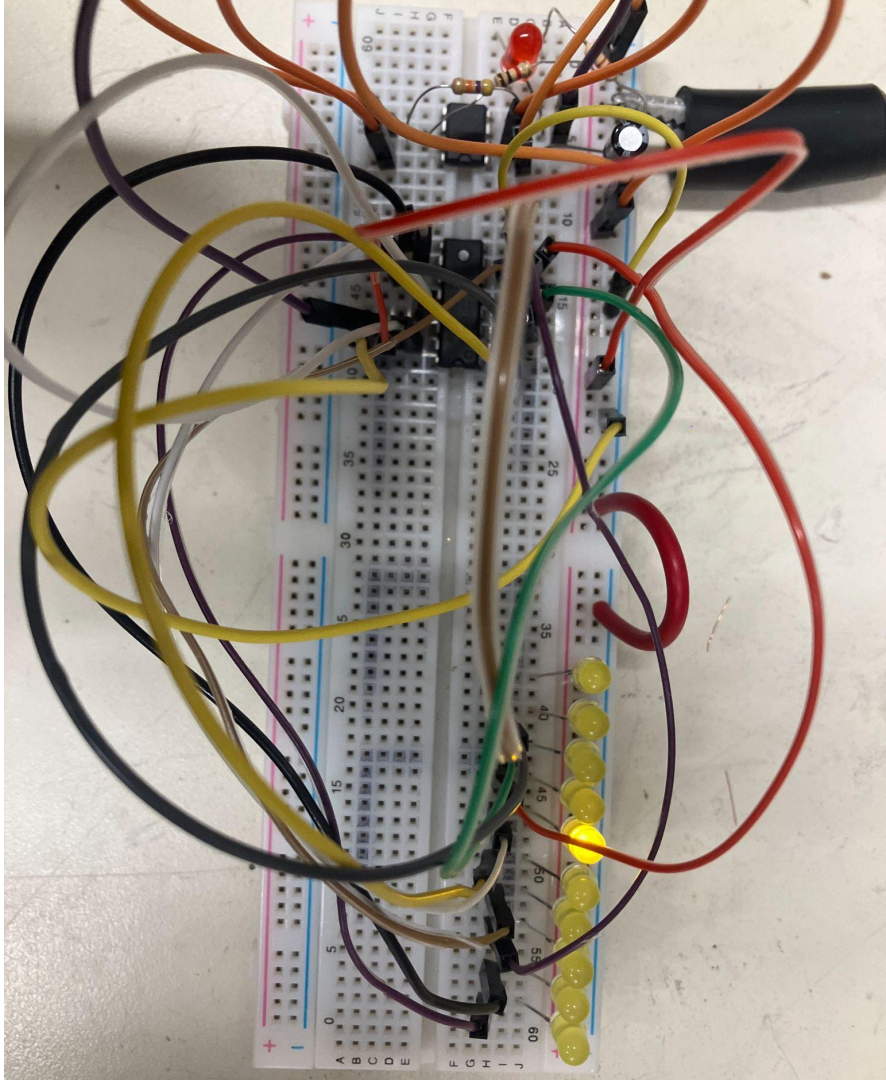
Circuit Design

- Blueprint of an electronic circuit
- What the circuit should do and how it will achieve that function



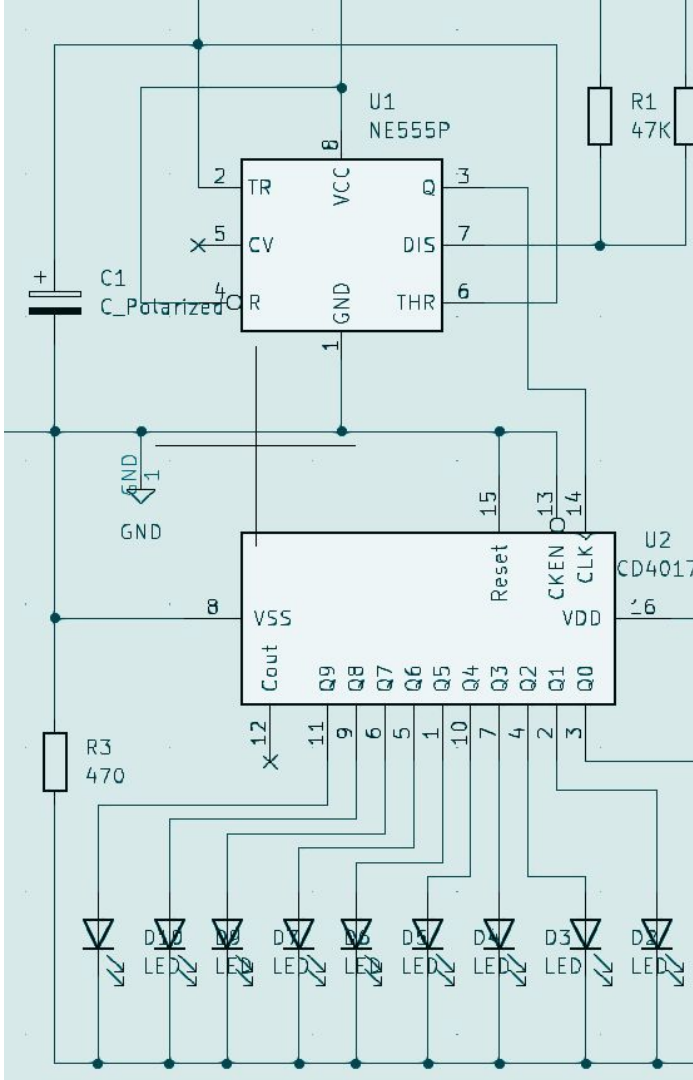
Breadboard

- Physical connection of a schematic
- Reusable platform for prototyping electronic circuits
- Tedious to wire up things
- Complex connections for large circuits



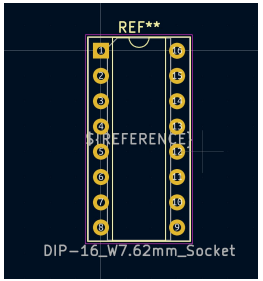
Schematic

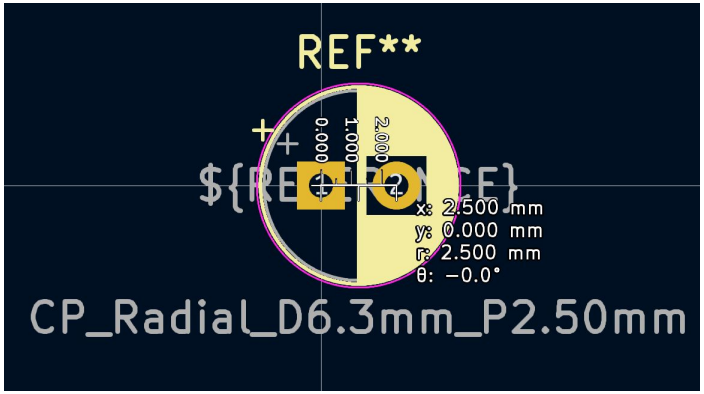
- Map of your circuit
- Uses standardized library of symbols to represent different electronic components and their connections



Patterns

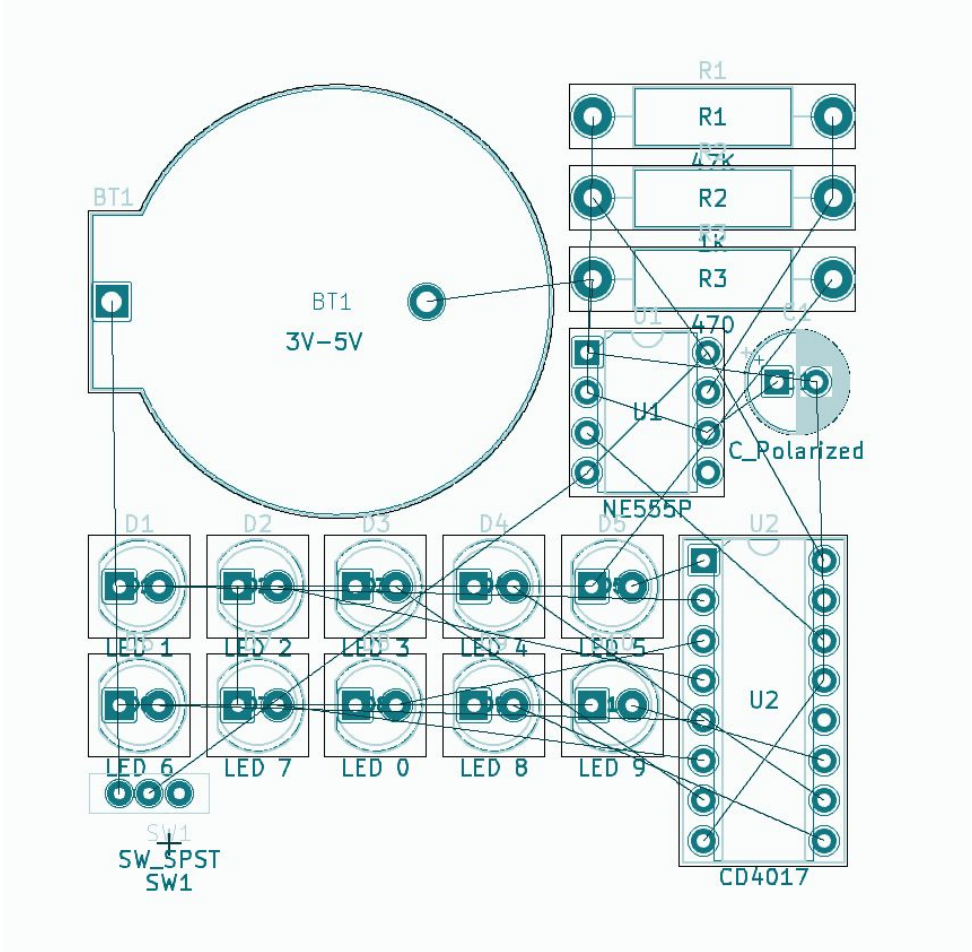
- Once you know what it is you want to build, you need to figure out how to lay it out the board
  - You need to know how big each piece is, where the holes need to be places.
- Each device has a pattern which shows the information
  - Might have to create a pattern if not present





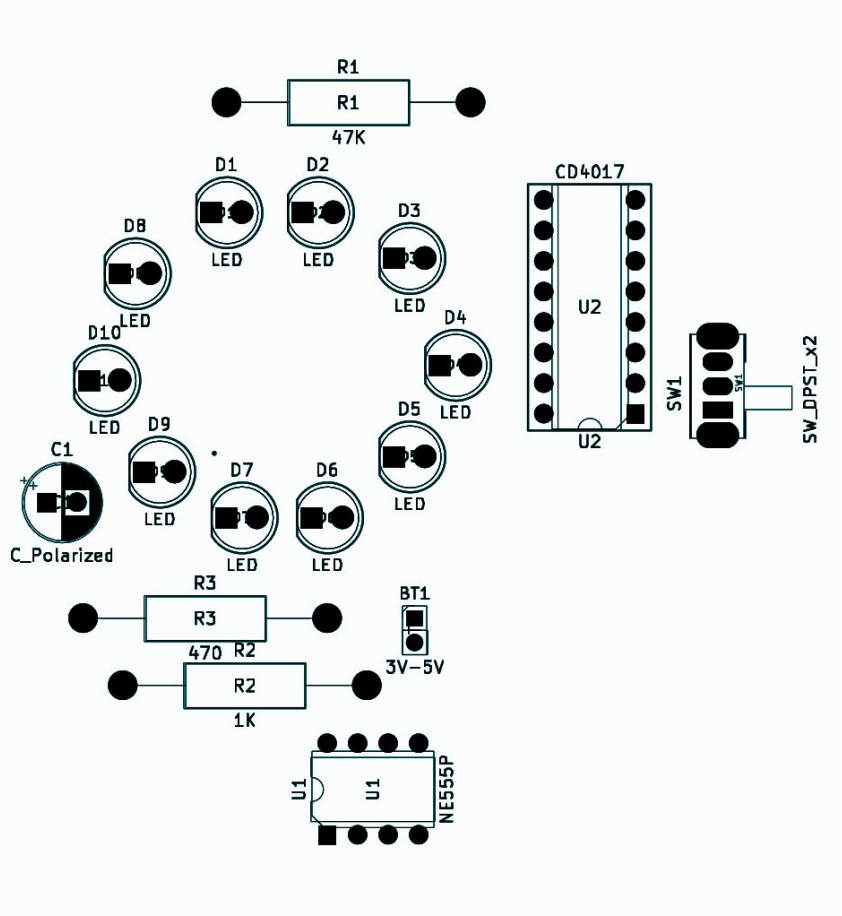
Rat’s Nest

- Shows the visual representation of the electrical connections between the components before the traces are routed



Placement

- Place the patterns on the board and make sure you don’t overlap them.
- This is as fun as sorting puzzles
- Some softwares can do this for you
  - Ex: freerouting for KiCAD

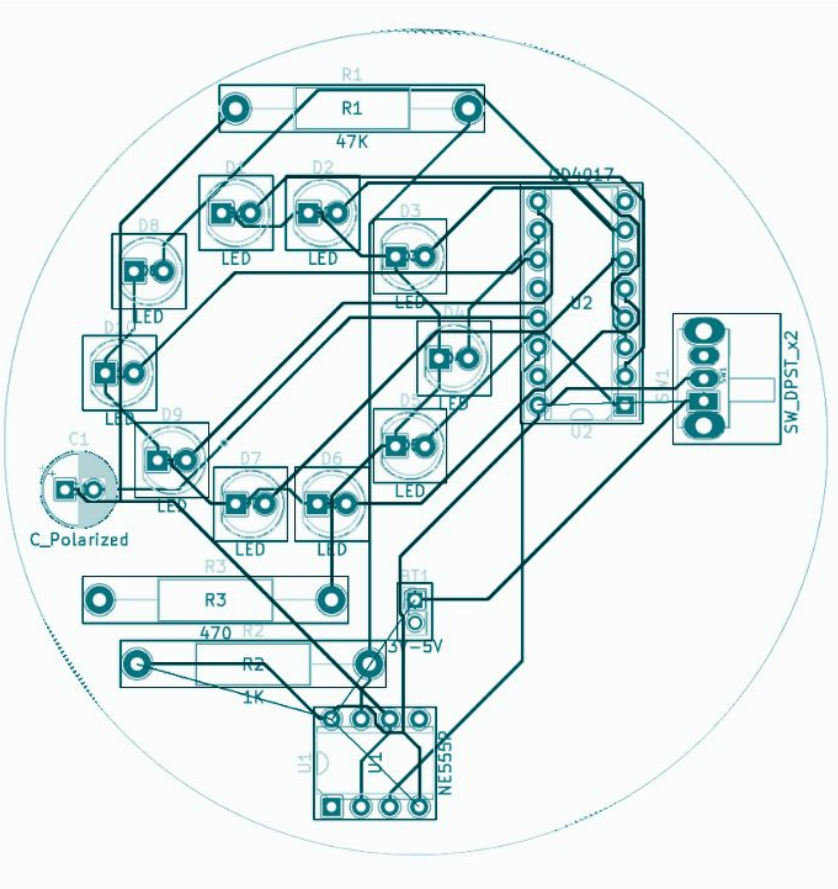


Routing

A route (or net) is a connection between components on the PCB using copper traces

The goal of routing is to create efficient and reliable connections while considering:

- Design Rules
- Layer Utilization
- Signal Integrity



Measurements

PCB tools uses some interesting measurements

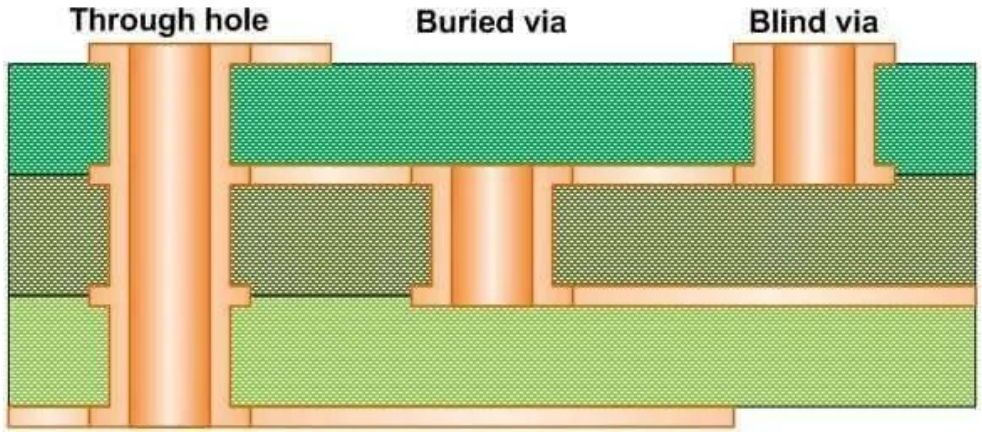
- A “mm” is a millimeter
- A “thou” is a thousandth of an inch
- A “mil” is a thousandth of an inch

Trace widths

- Refers to the thickness of the thin copper lines you see on the PCB’s

Vias

Vias are essentially plated holes that drill through one or more layers of a PCB making a connection

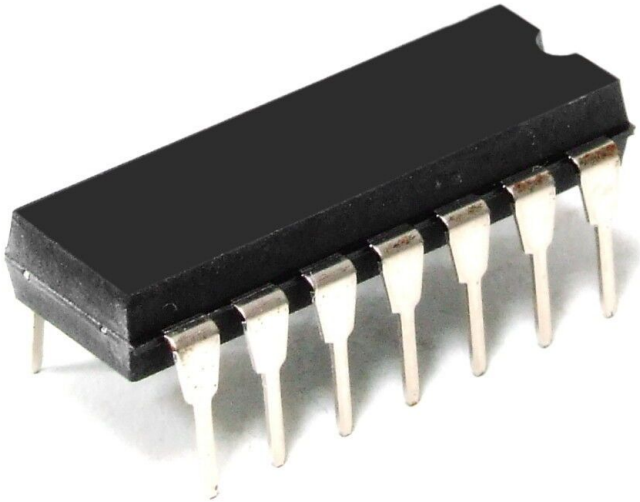


Clearances

There will be spaces between the traces, plated holes, and each other. One has to meet the requirements of the manufacturer.

Components

Through-hole Technology (THT)



Surface Mount Technology (SMT or SMD)

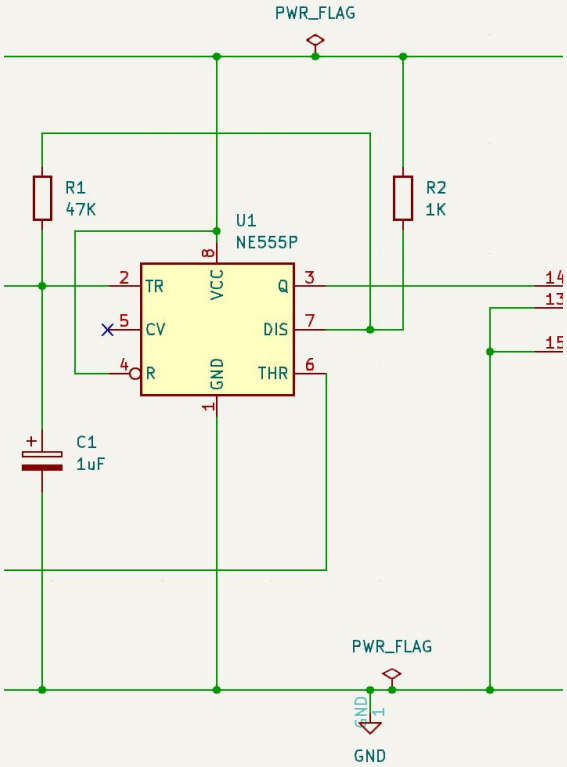
Silkscreen

The silkscreen acts like a label, containing various markings and information printed directly onto the PCB surface.

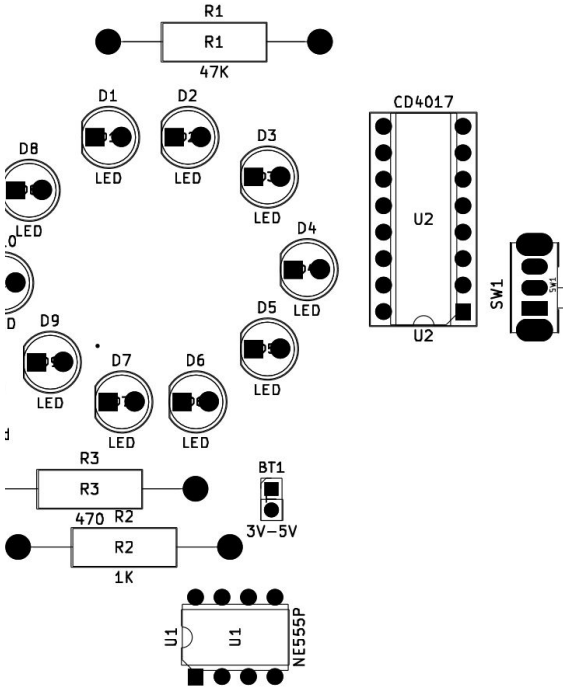
Solder mask

- A lacquer- like layer of polymer that provides a permanent protective coating for the copper traces of a (PCB) and prevents solder from bridging between conductors, thereby preventing short circuits
- Solder mask is traditionally green but is now available in many colors

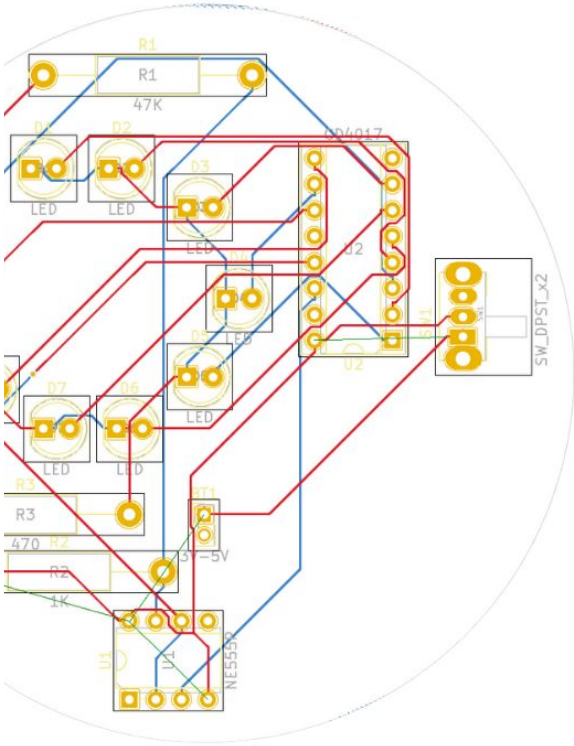
1. Schematic design



2. PCB Editor

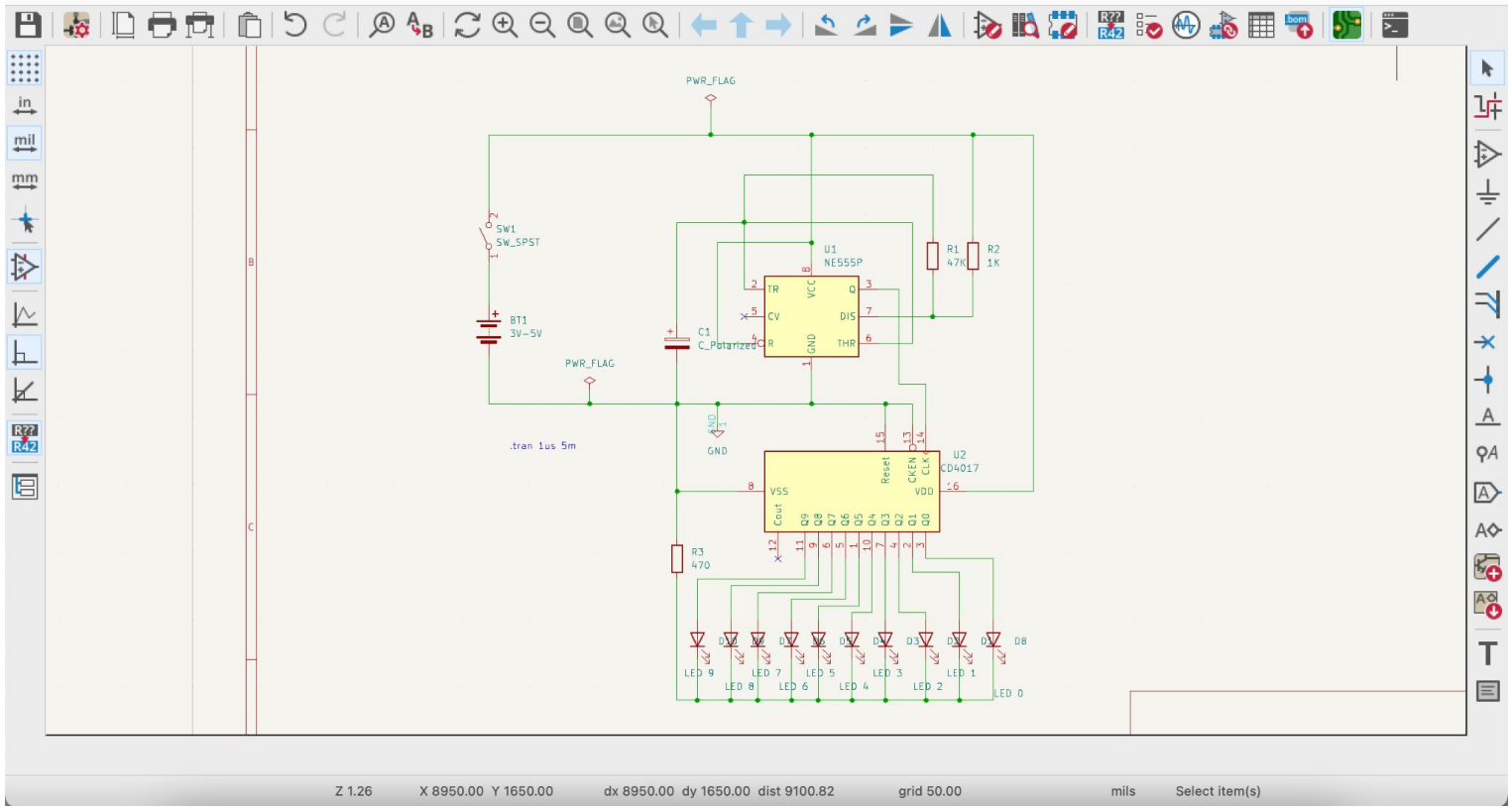


Placement

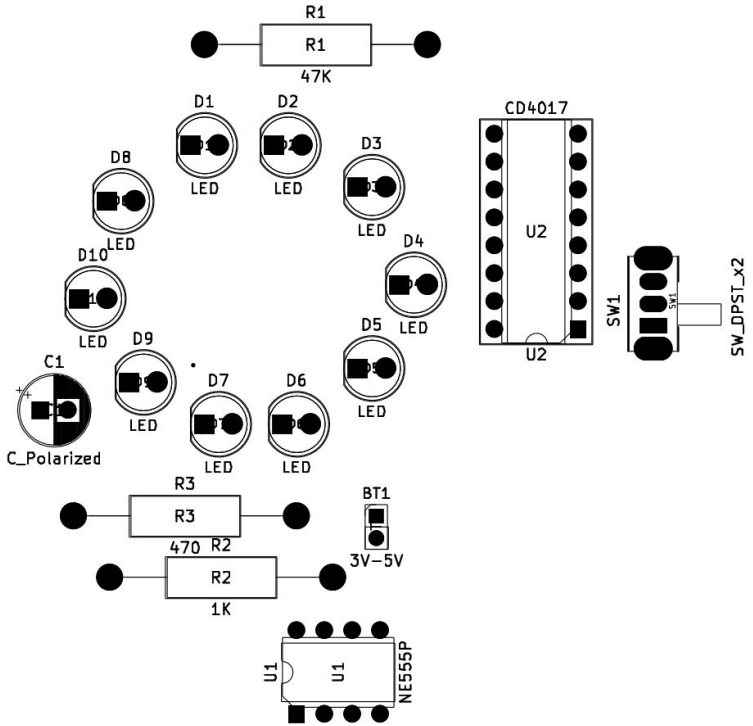


Routing

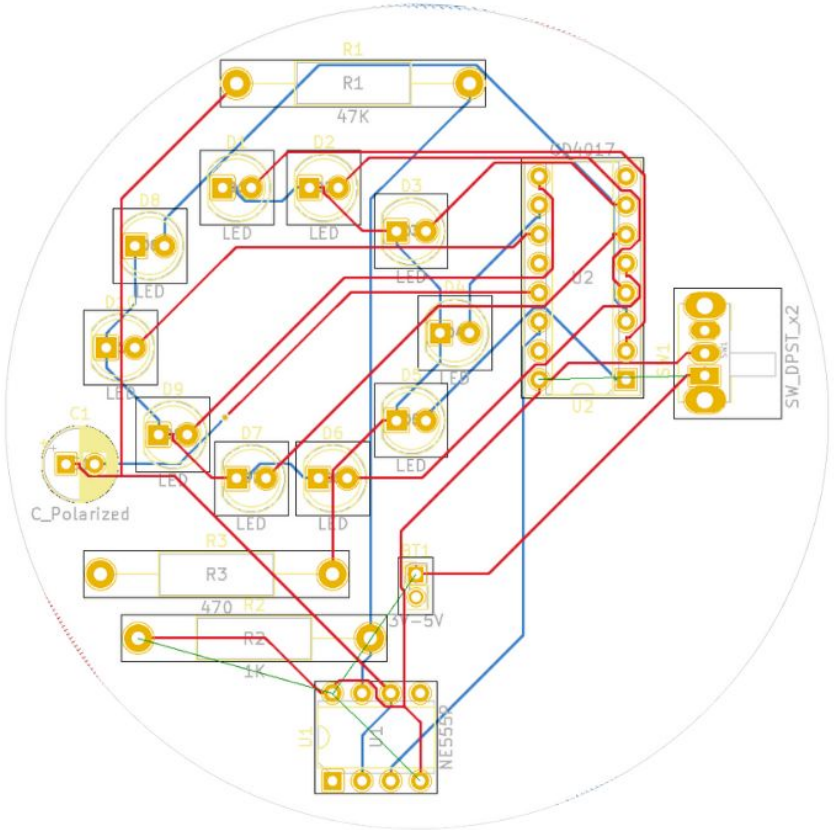
1. Draw Schematic



2. Place the components

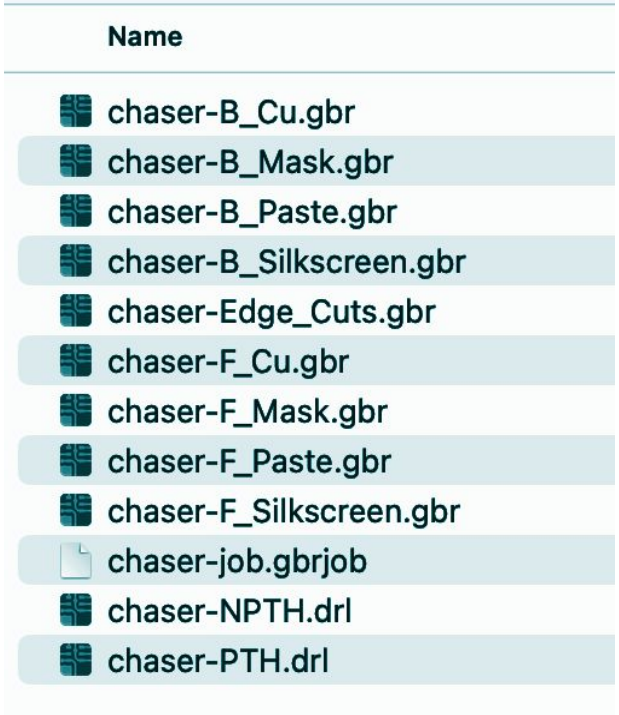


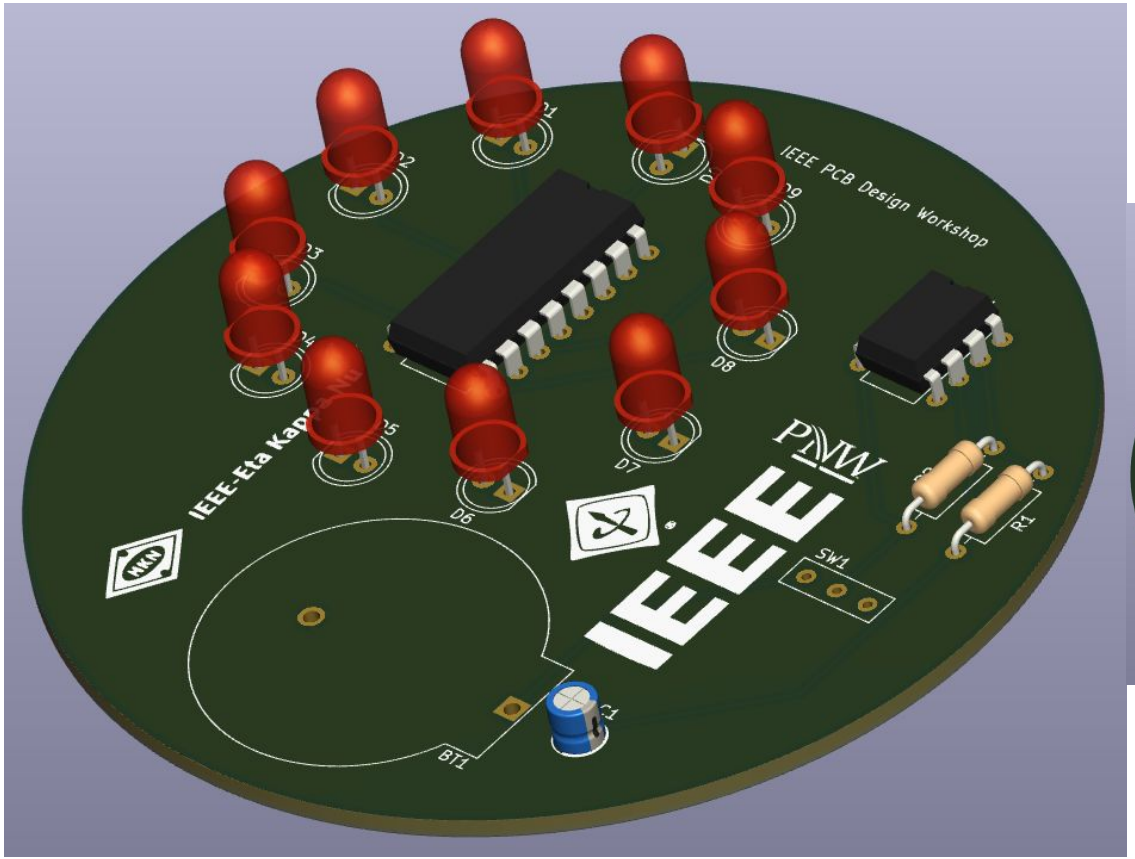
3. Route traces



4. Generate Gerber

- Industry-standard files used to represent the various layers and elements that make up a PCB
- It describes the printed circuit board images: copper layers, solder mask, legend, drill data, etc




IEEE PCB Design Workshop
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C1
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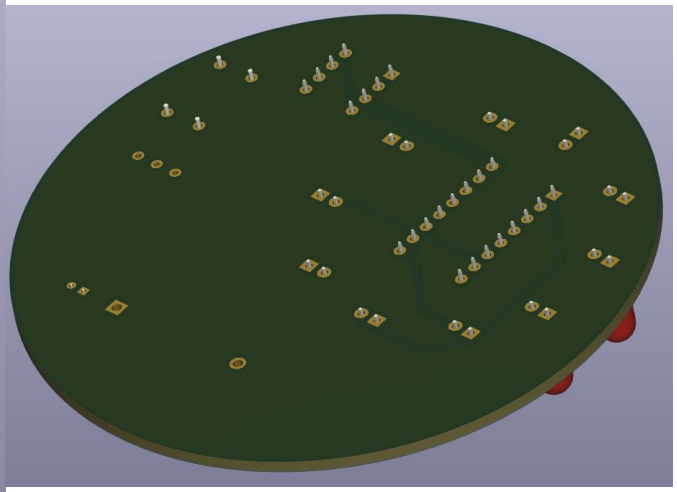
Front



Back

References

- Printed circuit board - Wikipedia
- Intro PCBs (berkeley.edu)
- PCB Design Overview - Univ of Michigan
- What Is a Printed Circuit Board (PCB)? - Technical Articles (allaboutcircuits.com)
- Gerber format - Wikipedia

Images:

- Airwires / Ratsnest - TARGET 3001! PCB Design Freeware is a Layout CAD Software|Support, Tutorials, Shop (ibfriedrich.com)
- PCB Via Filling Explained | Fineline Global (fineline-global.com)
- All Kinds of Vias in PCB - PTH, Blind, Buried Vias | Viasion


Thank You