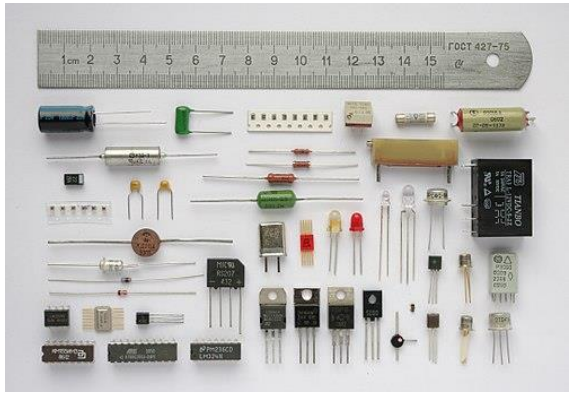
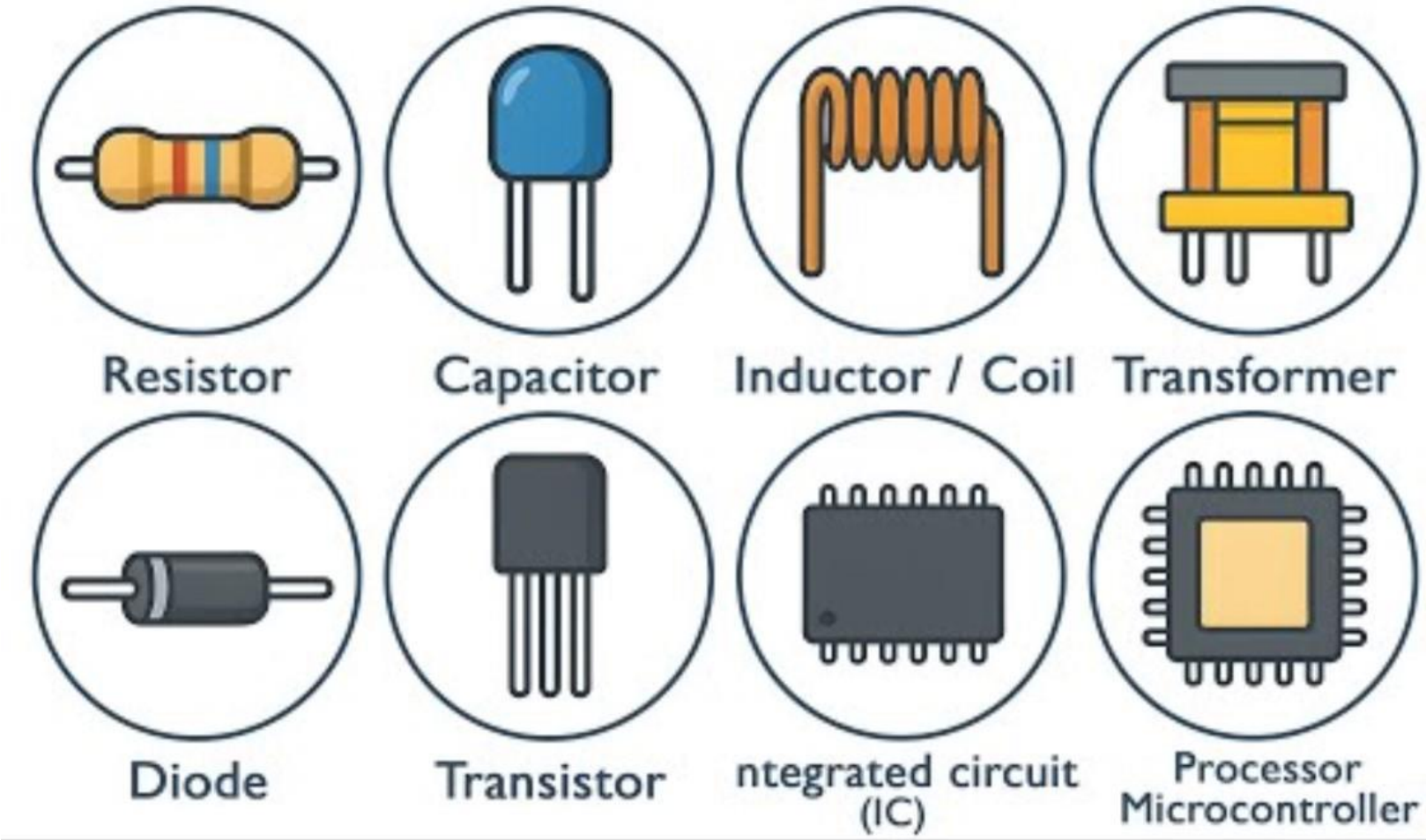
EP1001 FURTHER DIGITAL FABRICATION & PROTOTYPING

Electronics Design

REFRESHER: ELECTRONICS COMPONENTS

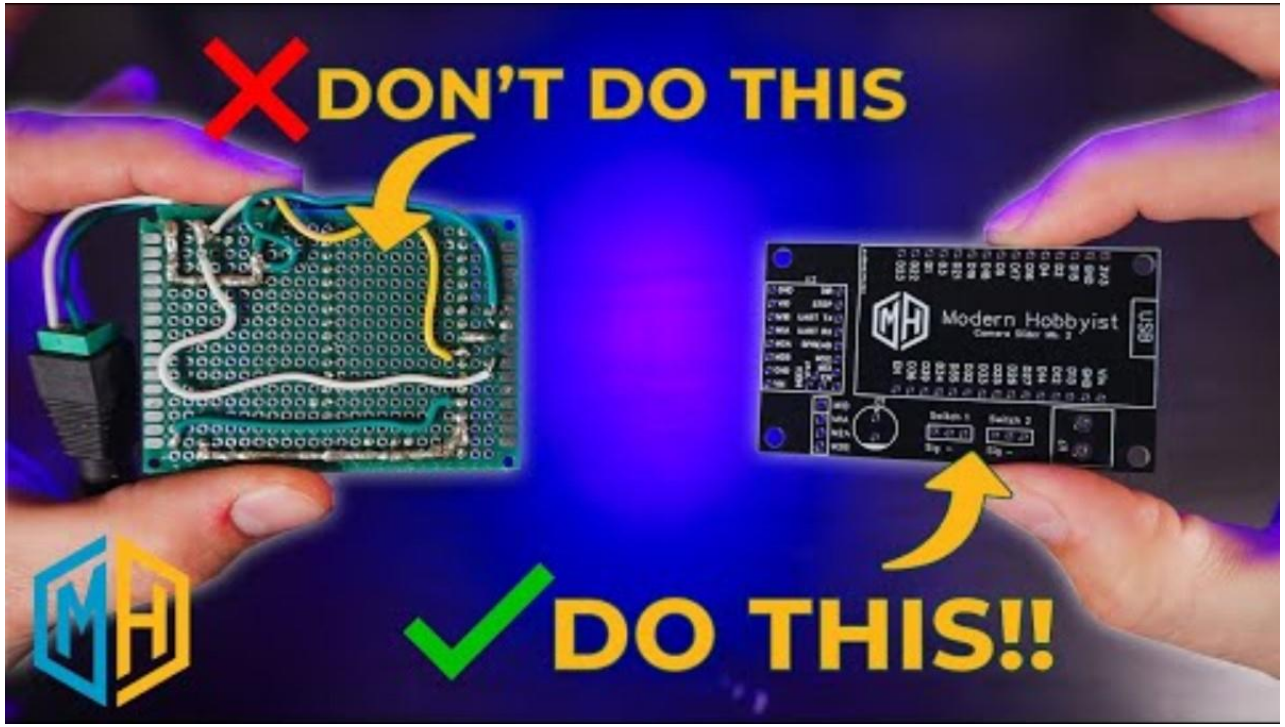


- Wires
- Switches
  - Pushbutton
  - Slide
  - Toggle
- Resistors
- Capacitors
  - Non-polarised
  - Polarized
- Inductors
- Diodes
  - Standard
  - Schottky
  - Zener
  - LED
  - RGB led
- Transistors
  - Bipolar
  - MOSFET
- Op-Amps
- Microcontrollers



BASIC BUILDING BLOCKS OF ELECTRONICS

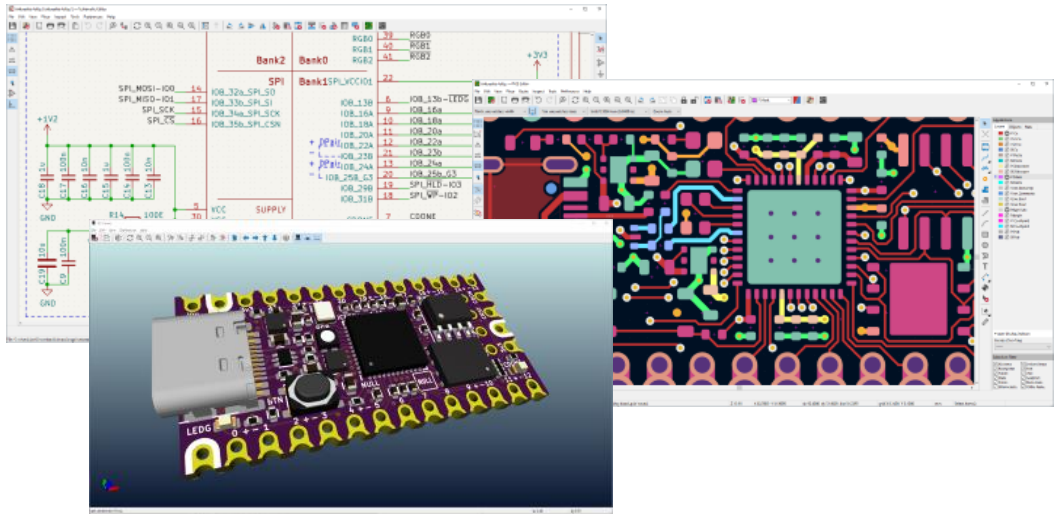
ELECTRONICS DESIGN WORKFLOW

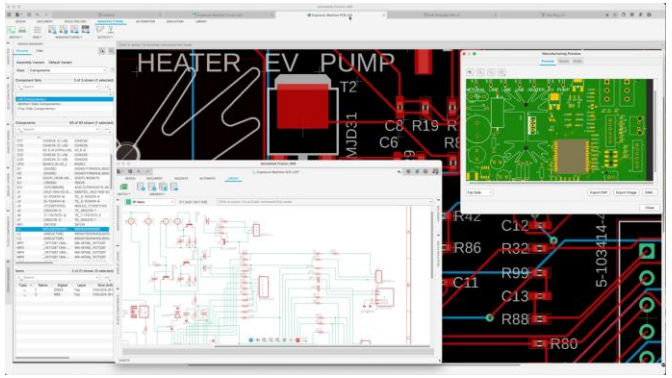


- (Understand basic electronics)
- Start with an idea
- Sketch design (on paper)
- (Test on breadboard)
- Draw schematic in EDA software
- Layout PCB design
- Fabricate PCB
- Stuff & test design

ELECTRONICS DESIGN SOFTWARE

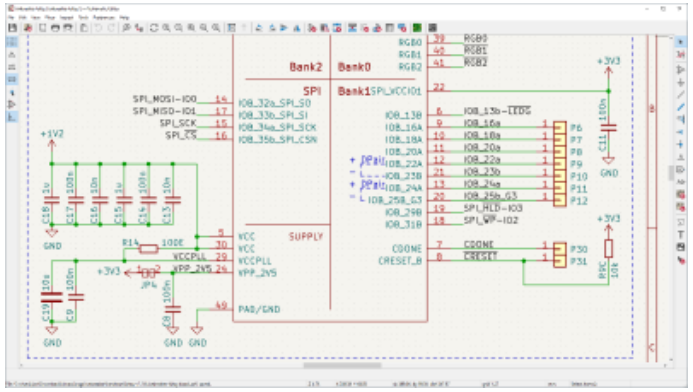
- KiCad
- Autodesk Eagle (Standalone)
- Autodesk Fusion
- EasyEDA
- Altium Designer
- LibrePCB
- Fritzing

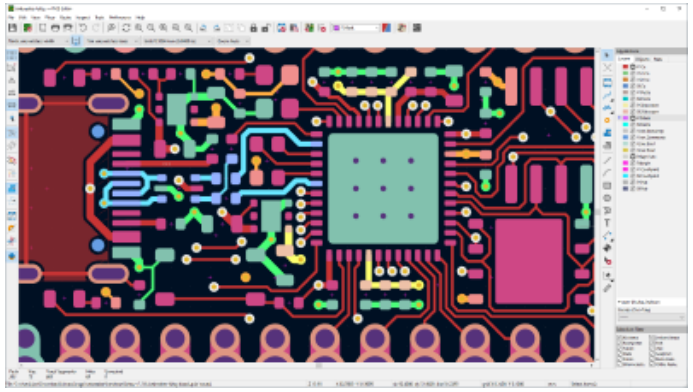


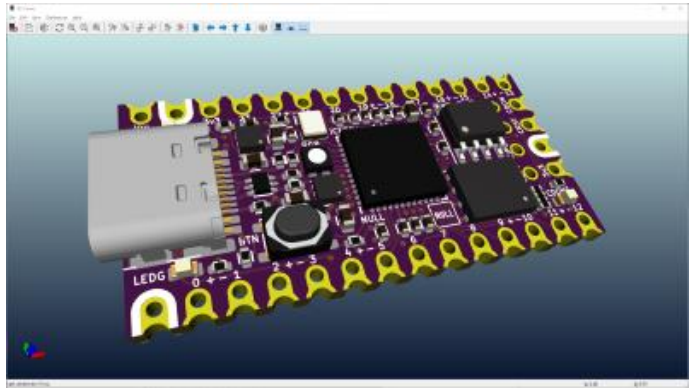


EDA WORKFLOW

- Schematic Capture
- Board Layout
- (auto)routing
- (simulation)
- Fabrication
  - In-house
  - External

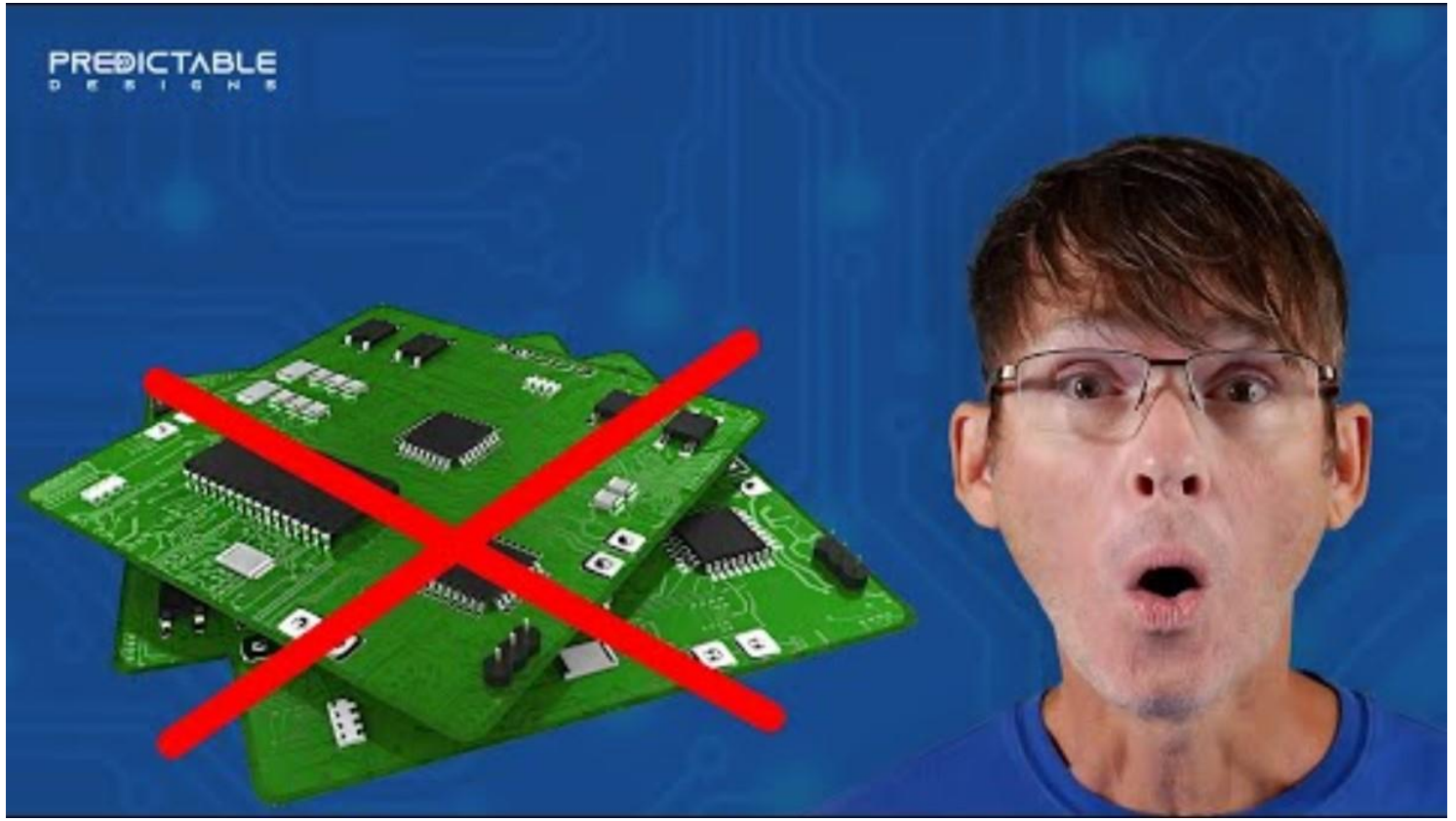






EDA CONSIDERATIONS

- Power
  - Voltages
  - Currents
- Component Footprints
- Libraries
  - Fab library (kicad, eagle)
  - SnapEDA
- Design rules:
  - ERC (schematic)
  - DRC (pcb layout)
- Component placement
- Routing layers



https://predictabledesigns.com/pcb-design-top-5-mistakes-on-printed-circuit-boards-layout/

EDA DESIGN TUTORIAL (REFERENCES)

Eagle Tutorial

- Schematic Capture
- Board Layout
- PCB-gcode, pcb-gcode (modified w/slice for outline milling)
- How to create SMD-based PCBs
- Fusion 360 Electronics
- Getting started with Fusion 360 Electronics

Kicad Tutorial

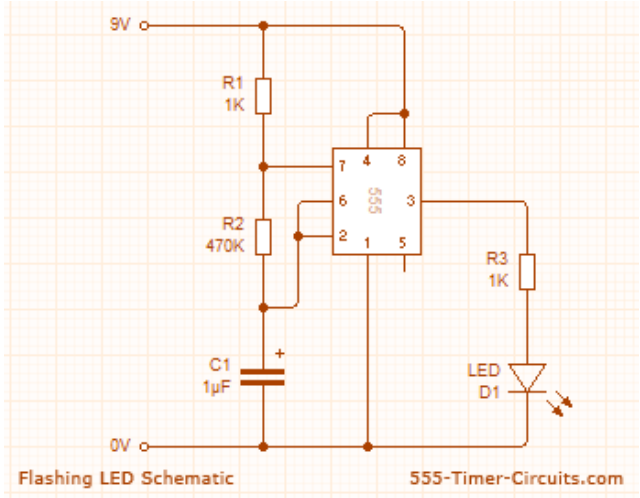
- Getting started with KiCad 9
- PCB design in KiCad
- Design your first mcu circuit in 10 minutes

EasyEDA Tutorial

- Quick start guide
- Designing PCBs with EasyEDA
- PCB creation for beginners

ELECTRONICS DESIGN #1: EASYEDA

- Go to the EasyEDA website
  - https://easyeda.com
- Register for an account
- Click “Design Online”
- Select “Pro Edition”
- We will design the PCB layout for the Blinky 5.0 project (555 blinking circuit)

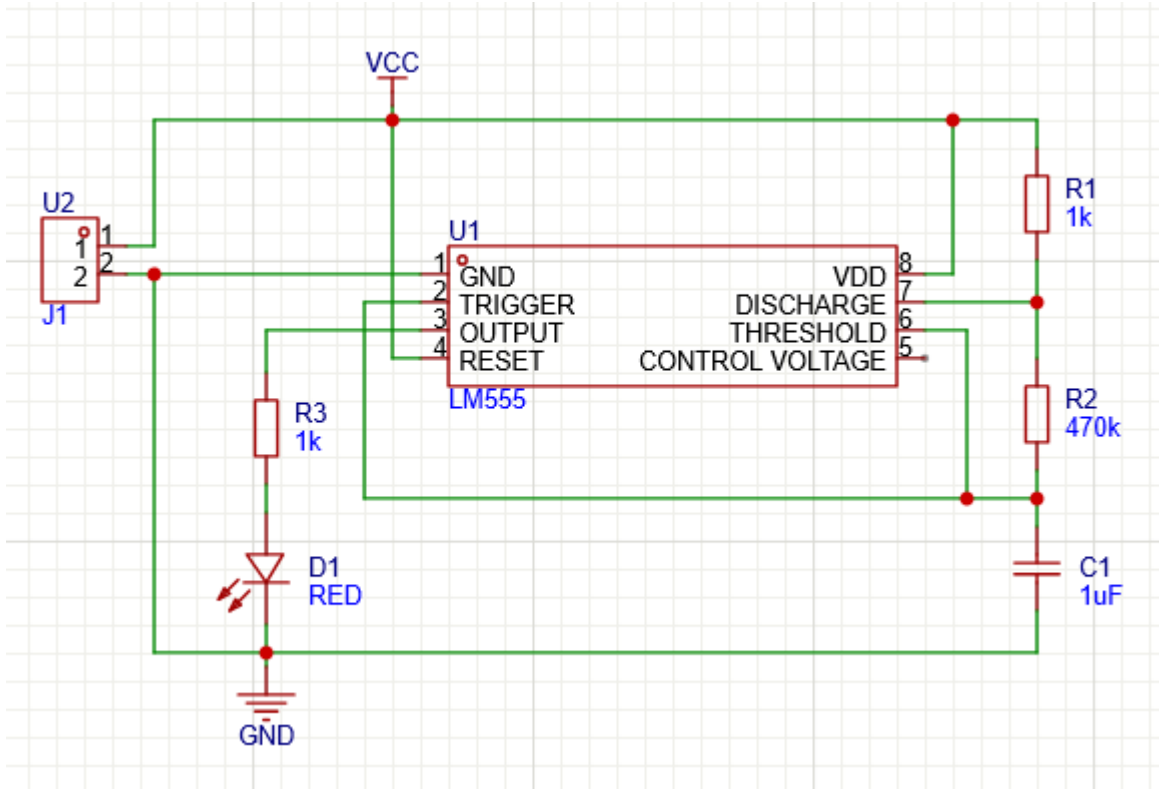


Ref: Contextual Electronics Blinky 5.0

(30 min)

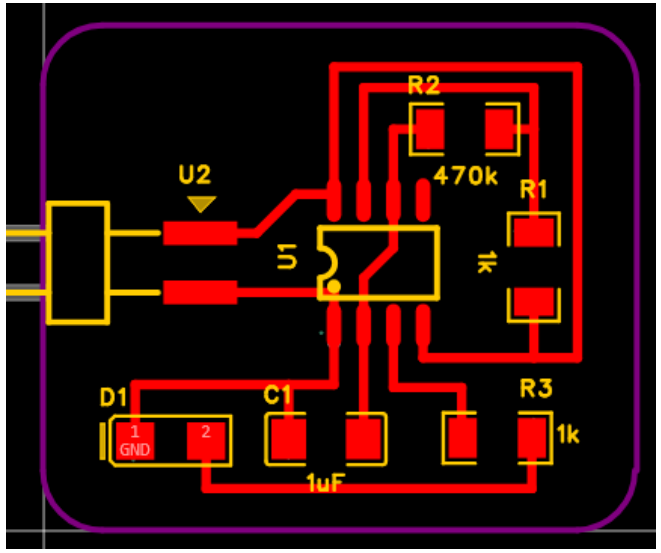
ELECTRONICS DESIGN #1: EASYEDA

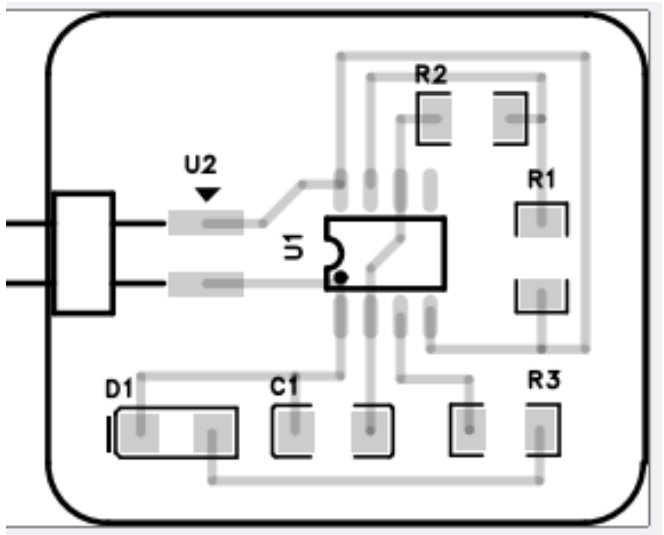
- Start a New Project
- Expand the Schematic section and double-click on the schematic file (1.P1
- Select Place (P) > Device
- Type “555” in the search bar and select the 555 IC in SOP-8 packaging (ICM7555DRG)
- Click “Place” to place the component and “ESC” to come back out
- Press <spacebar> to rotate the component before placing it
- Place the rest of the circuit components:
  - Resistors (1206) x 3
  - Capacitor (1206) x 1
  - LED (1206) x 1

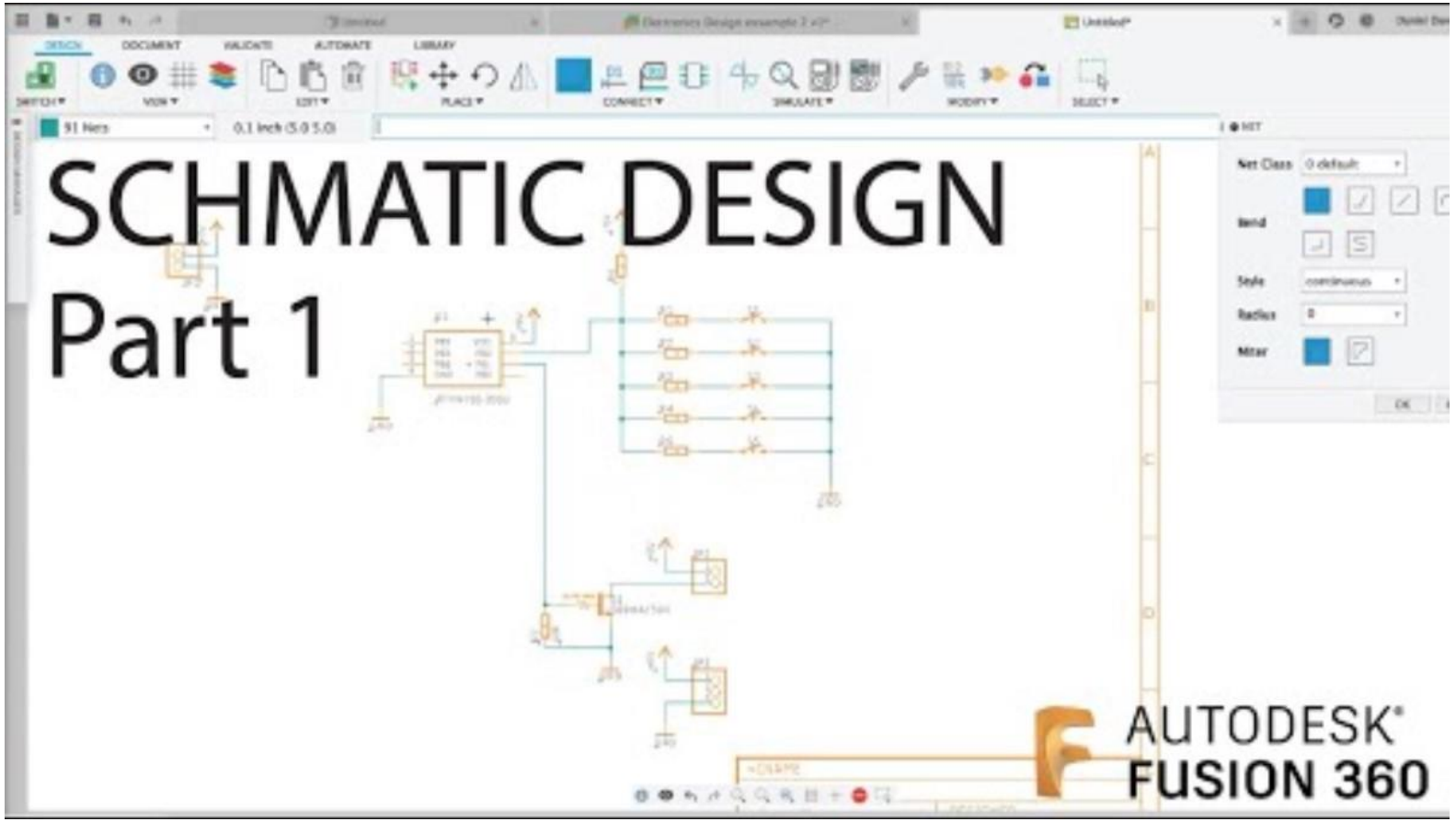


ELECTRONICS DESIGN #1: EASYEDA

- Click on Design (D) > Update/Convert Schematic to PCB to switch to PCB layout editor
- Click “Apply Changes” to add the components to the PCB layout
- Place the components on the pcb
  - Headers & connectors at the edge
  - Minimize ratsnest length & crossovers
- Route the components
  - Set design rules
  - Route the traces using ratsnest as guide
- Add the board outline
- Save your work





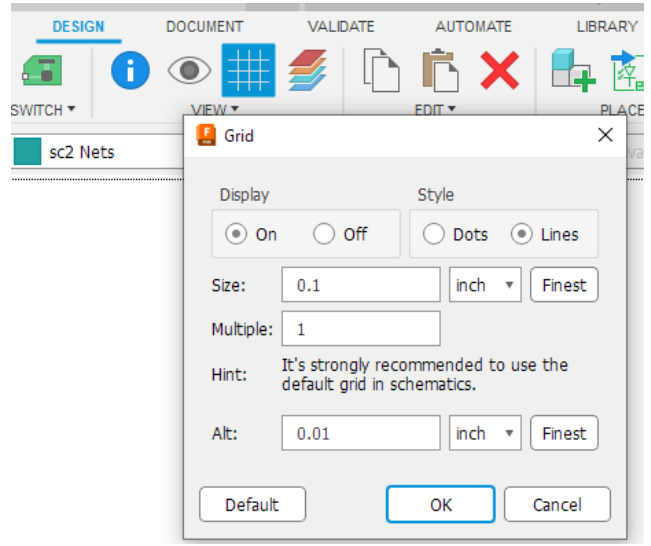


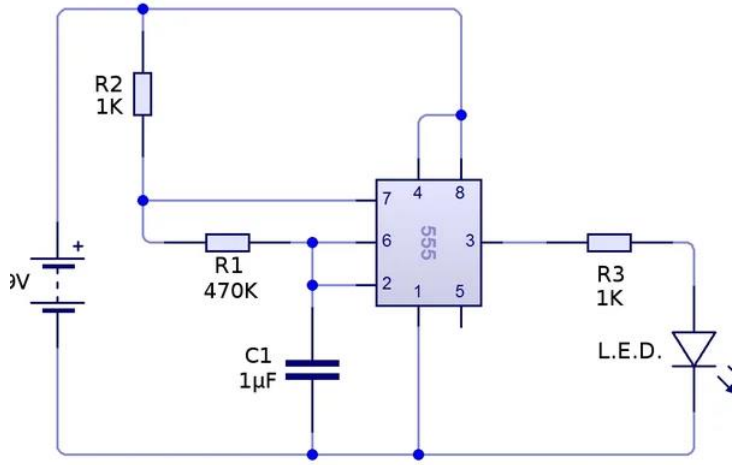
ELECTRONICS DESIGN #2: FUSION 360

(45 min)

ELECTRONICS DESIGN #2: FUSION 360

- We will revisit the 555 Blinky circuit, this time using Fusion 360 Electronics
- Start Autodesk Fusion and switch to the Electronics workspace > New Electronics Design
- Create a new Schematic
- Click “Grid” icon to set up your workspace settings.



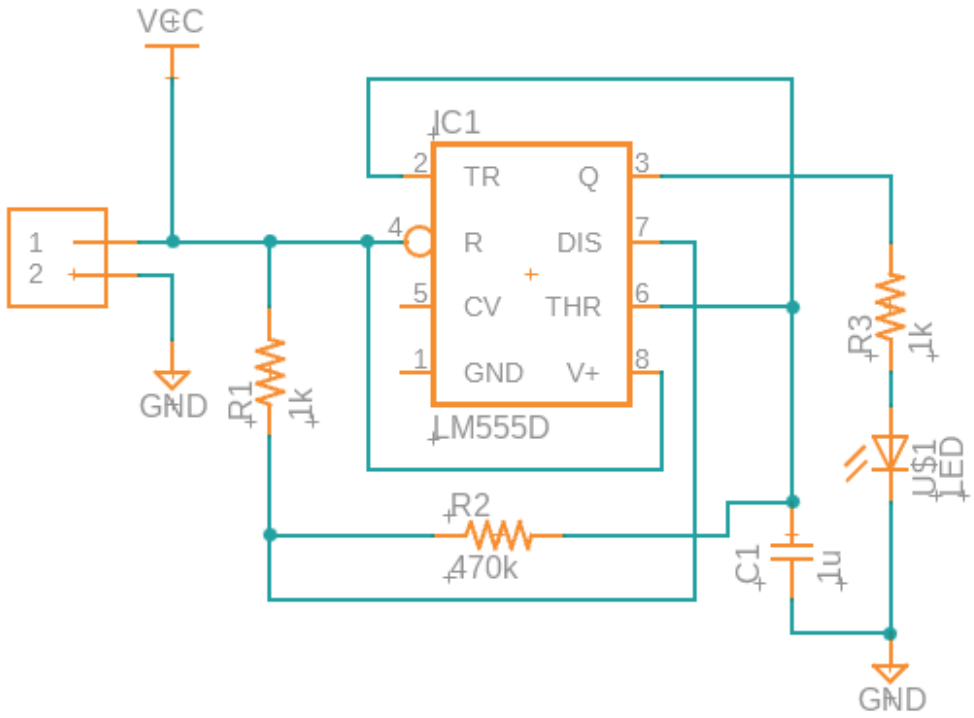


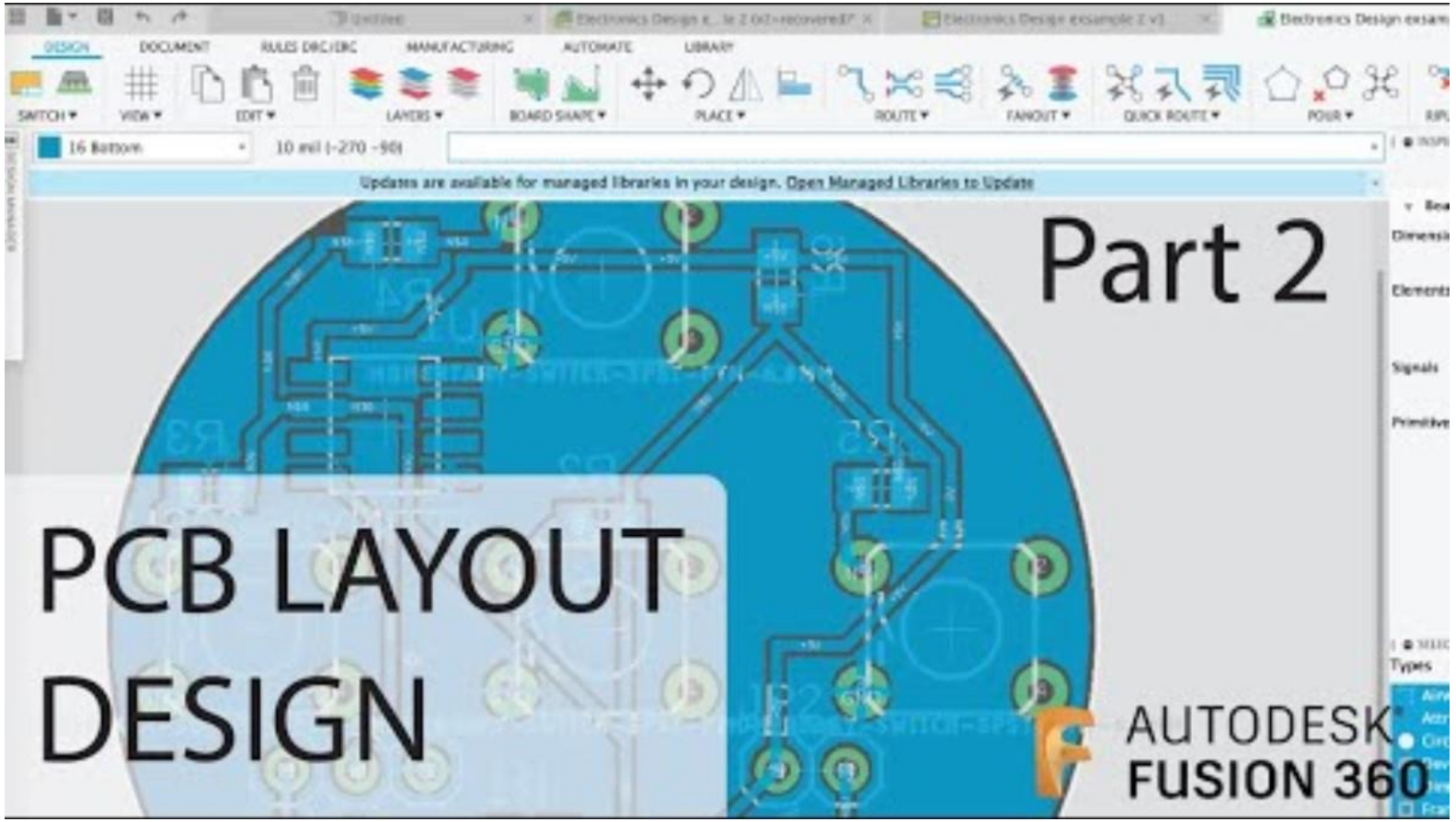
https://www.instructables.com/Flashing-LED-using-555-Timer/

(45 min)

ELECTRONICS DESIGN #2: FUSION 360

- Click “Place Components” and add an A4L-LOC frame to the workspace.
- Click “Place Components” and add the remaining components to the workspace
  - LM555 timer (SOP-8)
  - Resistors x 3 (1206)
  - Capacitor x 1 (1206)
  - LED x 1 (1206)
  - 2 pin header x 1 (Terminal Block)
- Wire the components as per the reference

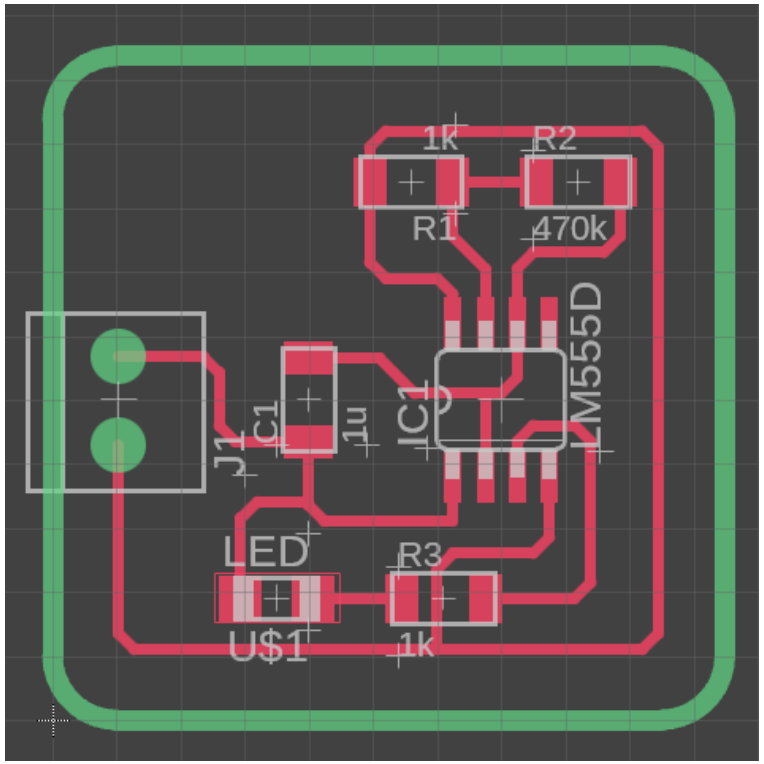




ELECTRONICS DESIGN #2: FUSION 360

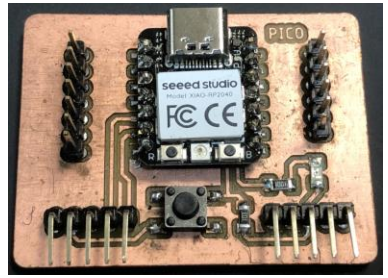
ELECTRONICS DESIGN #2: FUSION 360

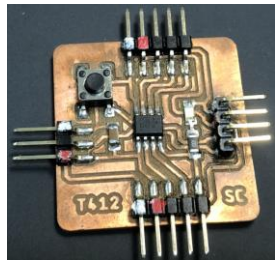
- Switch to Board (PCB) view
- Place the components within the board outline
- Move/rotate the components so that the terminal block is at the edge, ratsnest length and crossing is minimized
- Route the traces until all the nets are routed.
- Run a DRC and edit your board until DRC reports no errors.

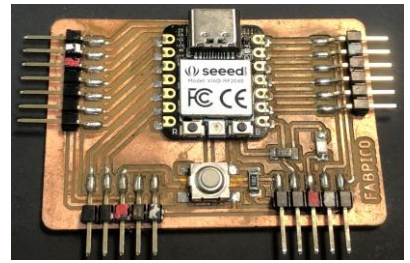


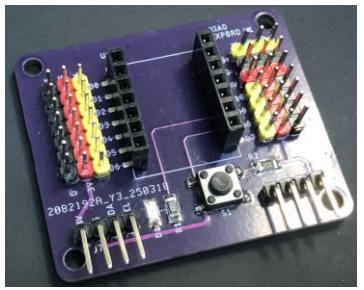
ELECTRONICS DESIGN ASSIGNMENT

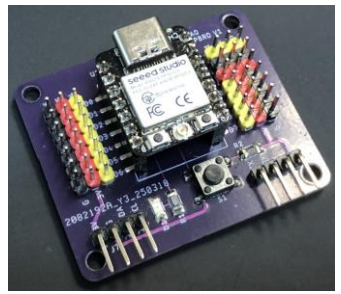
- Use an EDA tool to design an embedded microcontroller system that has:
  - at least a pushbutton
  - at least an LED/RGB led
  - Unused digital I/O pins available
  - (optional) TX/RX pins as separate connections
- Sketch out your design on paper
- Simulate your design (wokwi, tinkercad)
- Draw the schematic of your design in EDA
- Layout your design as a pcb
- Apply design rules
- Document the process on your website







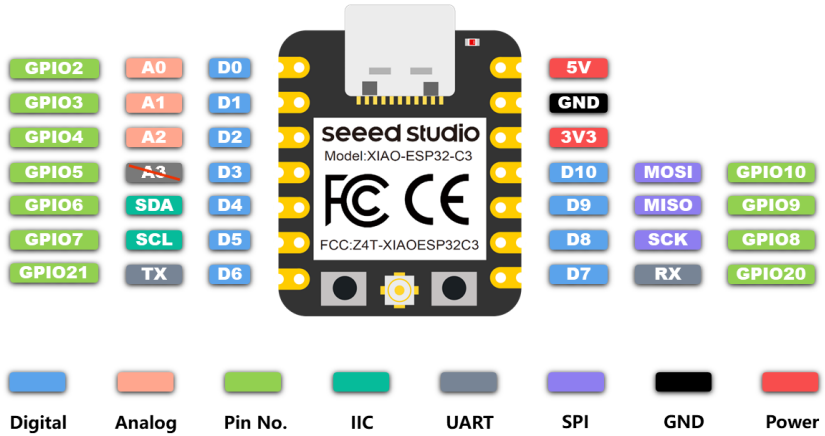


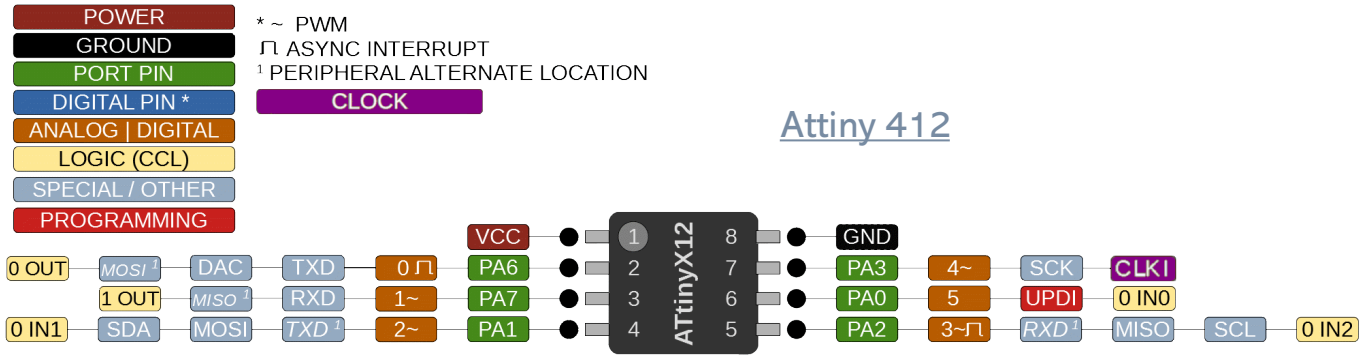


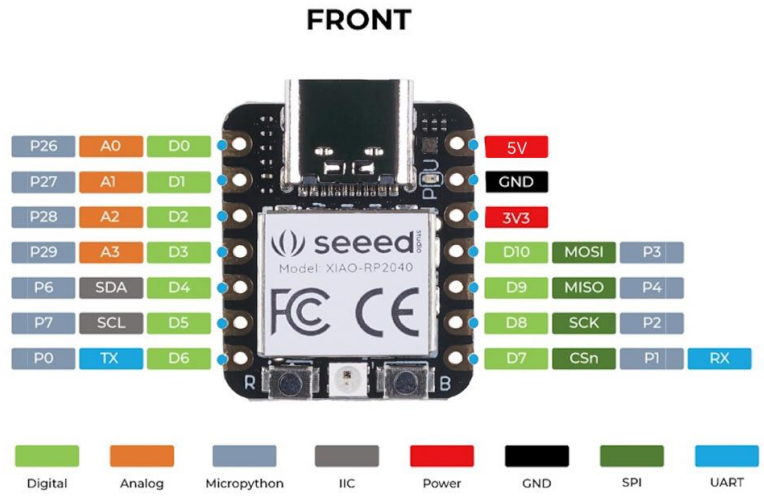
(120 min)

DATASHEETS & PINOUTS

- 3 possible designs (choose 1):
  - ATtiny412
  - Xiao ESP32-C3
  - Xiao RP2040







Xiao RP2040