



ECE477 MIDTERM DESIGN

REVIEW: TEAM #18

PURDUE
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OUTLINE

- Project Overview
- PSSCs
- Block Diagram
- Major Components
- Prototyping Progress
- Electrical Schematic
- PCB Layout
- Software Development Status
- Packaging Design
- Project Timeline
- Questions

PROJECT OVERVIEW

Audio visualizer that lights up an LED display to correspond with input audio

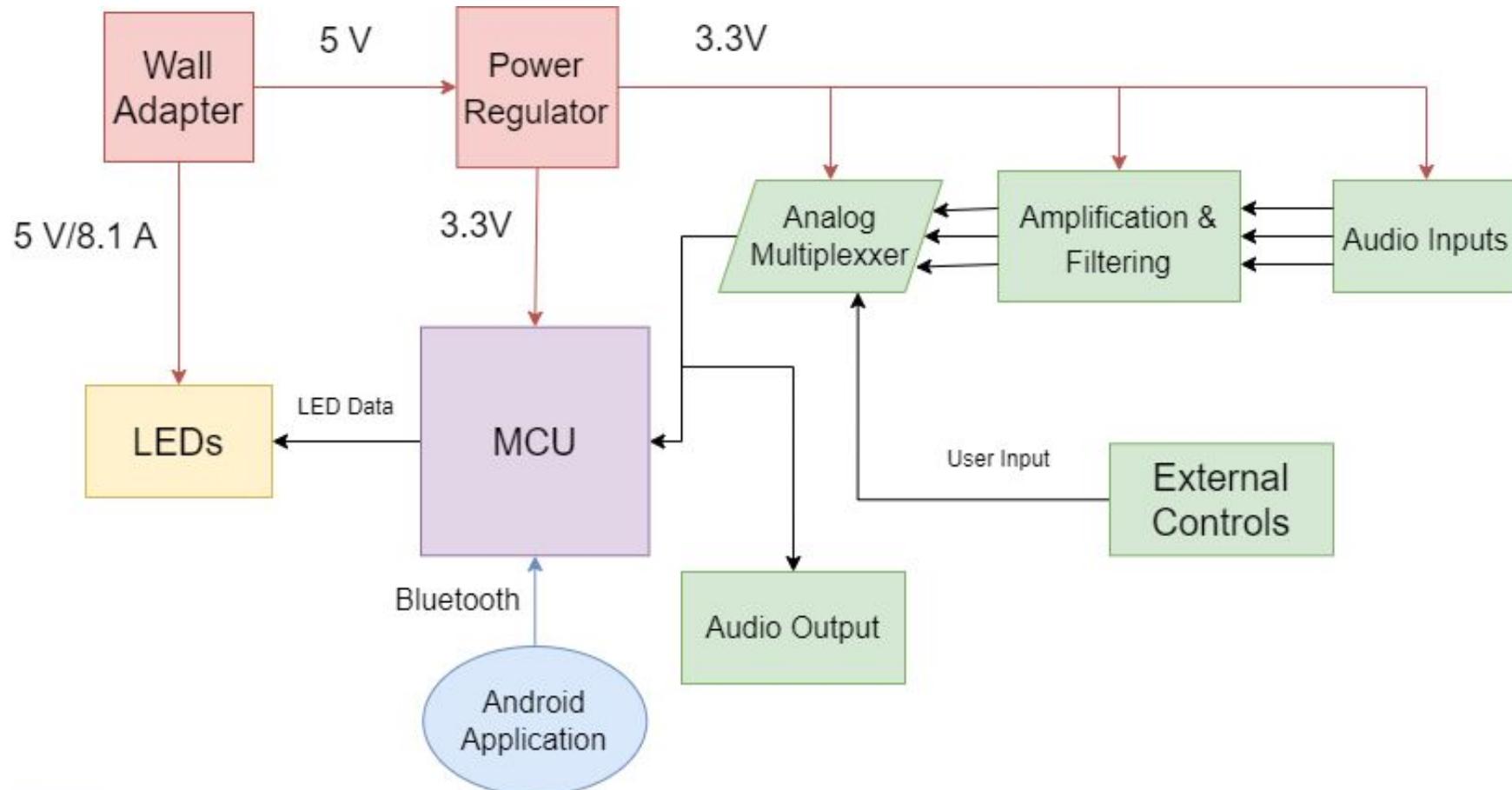
- Real time analysis of input audio
- Easily configure patterns and colors through associated Android app
- Multiple audio input modes: Microphone, AUX, Bluetooth



PSSCS

- PSSC #1 (Software): The ability to reduce noise on analog inputs through the use of a 1-D Gaussian Filtering algorithm.
- PSSC #2 (Software): The ability to control and configure multiple connected LED devices through a in-built bluetooth module that connects with Android app through UART.
- PSSC #3 (Hardware): The ability to amplify and filter analog input of the microphone using a sequence of operational amplifiers.
- PSSC #4 (Hardware): The ability for the user to toggle between input modes through multiplexed external controls. These modes will be Microphone (default), AUX-in, and Bluetooth audio.
- PSSC #5 (Hardware): The ability to drive multiple WS2812B LED strips with PWM signals and reactively display patterns in response to audio signals.
- Stretch Goal #1: The ability to isolate frequencies using the FFT algorithm.
- Stretch Goal #2: The ability to regulate power down from 5V DC to 3.3V DC with a switching regulator.

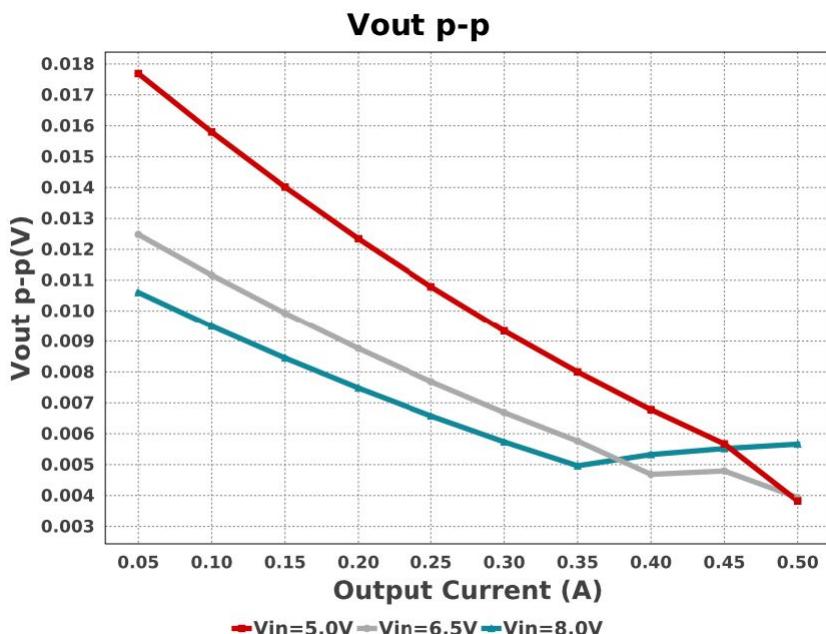
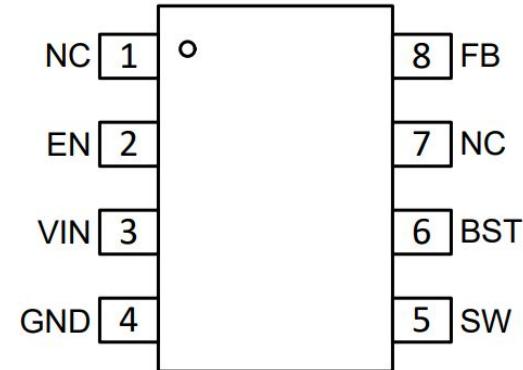
BLOCK DIAGRAM



Component Selection: Synchronous Buck Converter

TPS56330

- 3.8V to 28V input voltage range
- 0.8V to 22V output voltage range
- 3-A continuous output current



Voltage Input	3.8V-28V
Voltage Output	0.8V-22V
Current Output	0A-3A

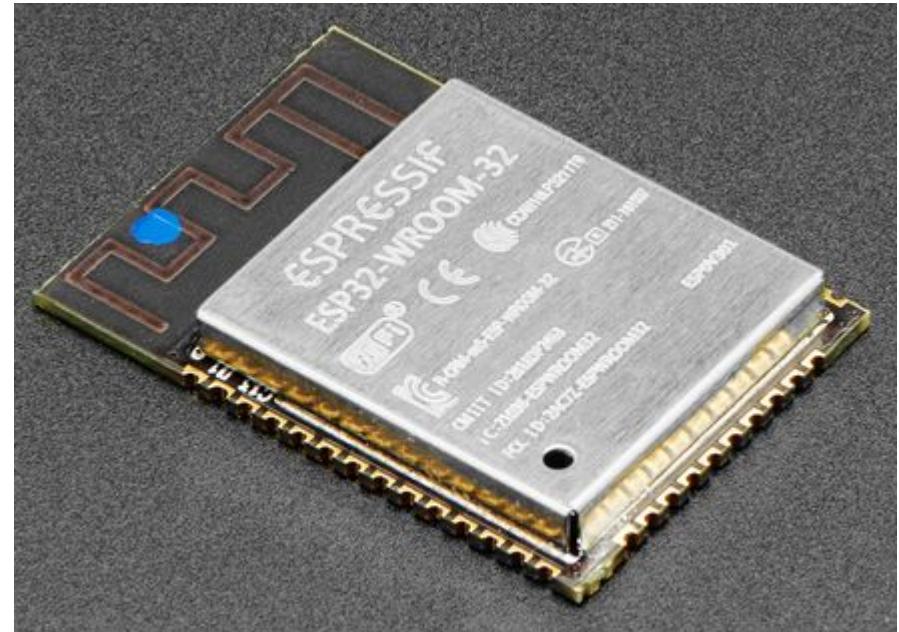
Recommended Characteristics

Component Selection: Microcontroller

ESP32-WROOM32

Selection Rationale:

- High Clock Speed: 80-240MHz
- Wi-Fi and Bluetooth capabilities
- Dual-Core CPU
- 520KB of RAM
- 4MB of Flash Memory
- 12-bit internal ADC peripheral
- Familiarity
- Cost effective

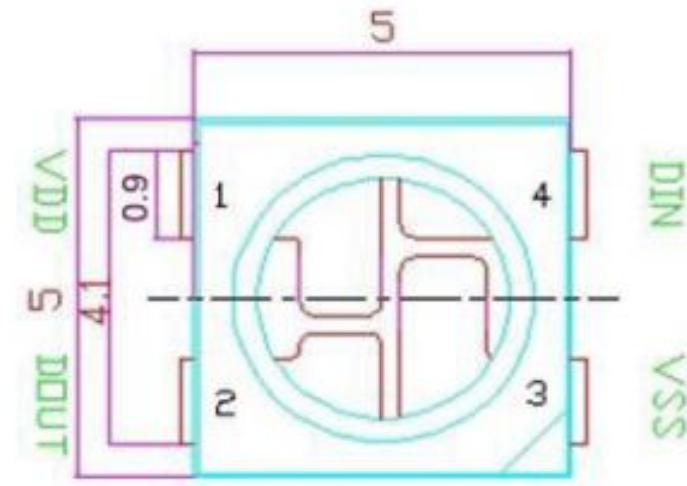
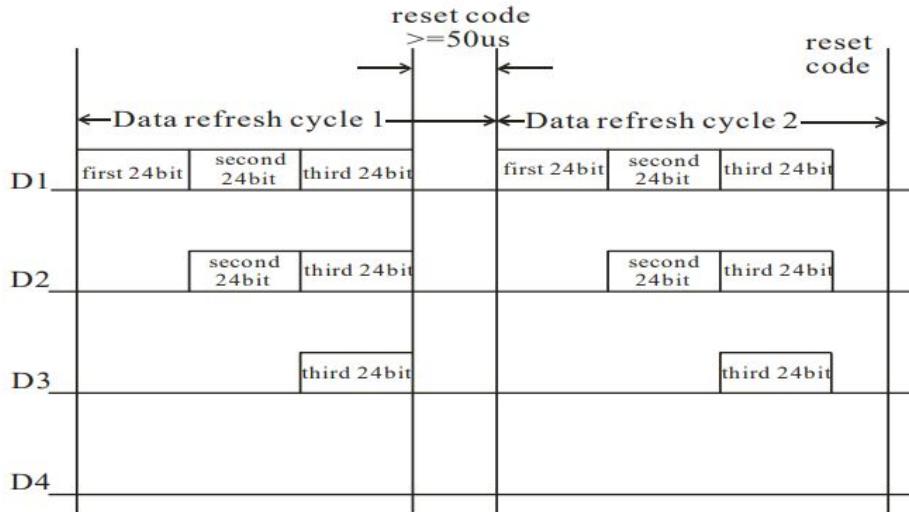


Component Selection: LEDs

WS2812B

Selection Rationale:

- 3-pin channels allow for individual addressability
 - Previous generation of LEDs (WS2811) only had separate channels for RGB
- Send data speed of 800 Kbps
- Scan frequency 400Hz



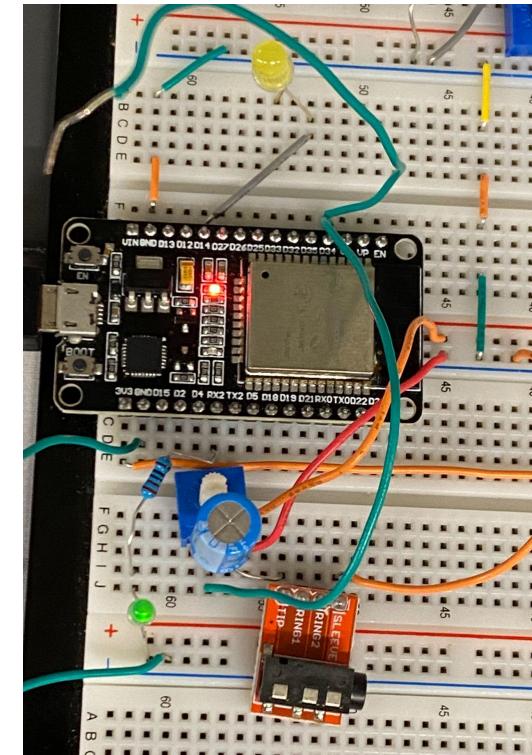
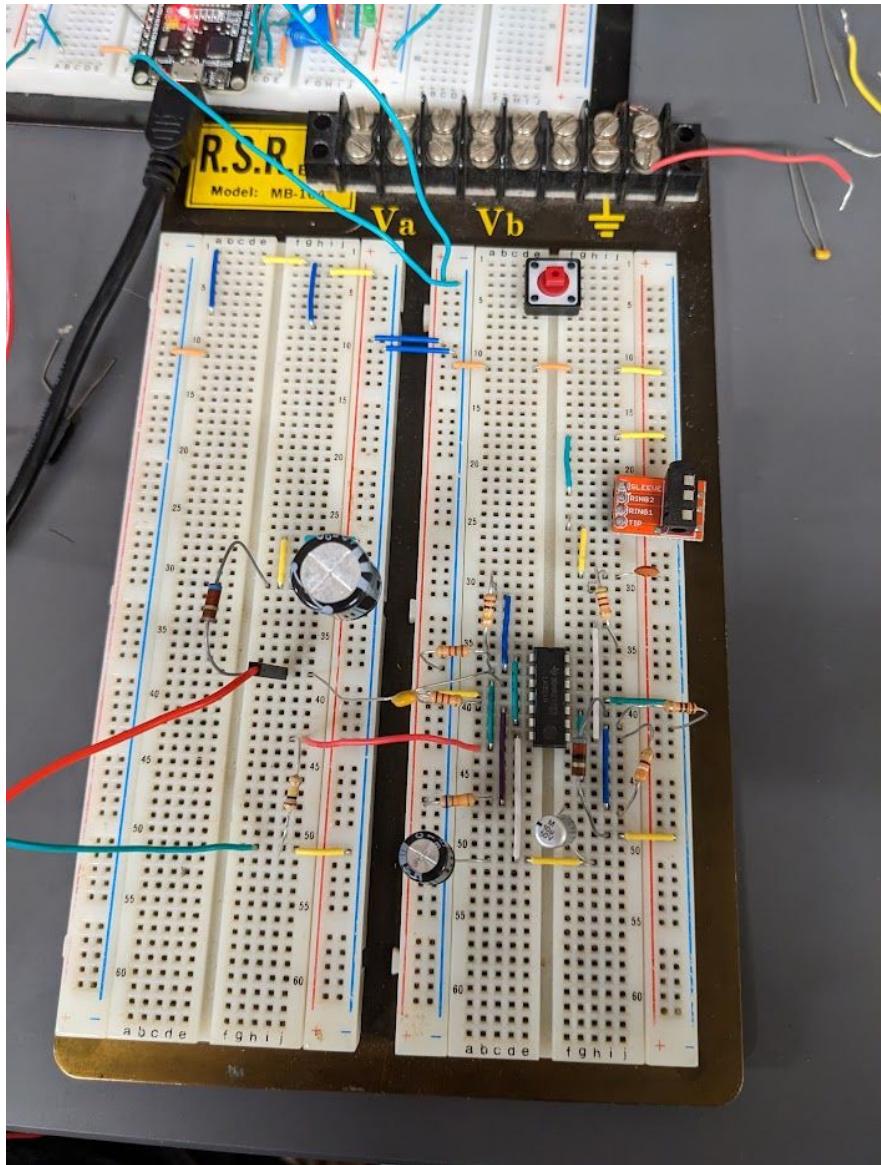
Prototyping Progress

Component	Status
Microphone Audio Filtering	60%
Aux Input/Output	80%
Power Circuit	0%
Audio Multiplexer	0%

The remaining progress in each of this component is primarily focused on software development:

- Audio filter through Gaussian Filtering algorithm
- AUX input output routing through Analog Multiplexer to AUX
- Audio input sampling, FFT, and visual pattern generation combined system

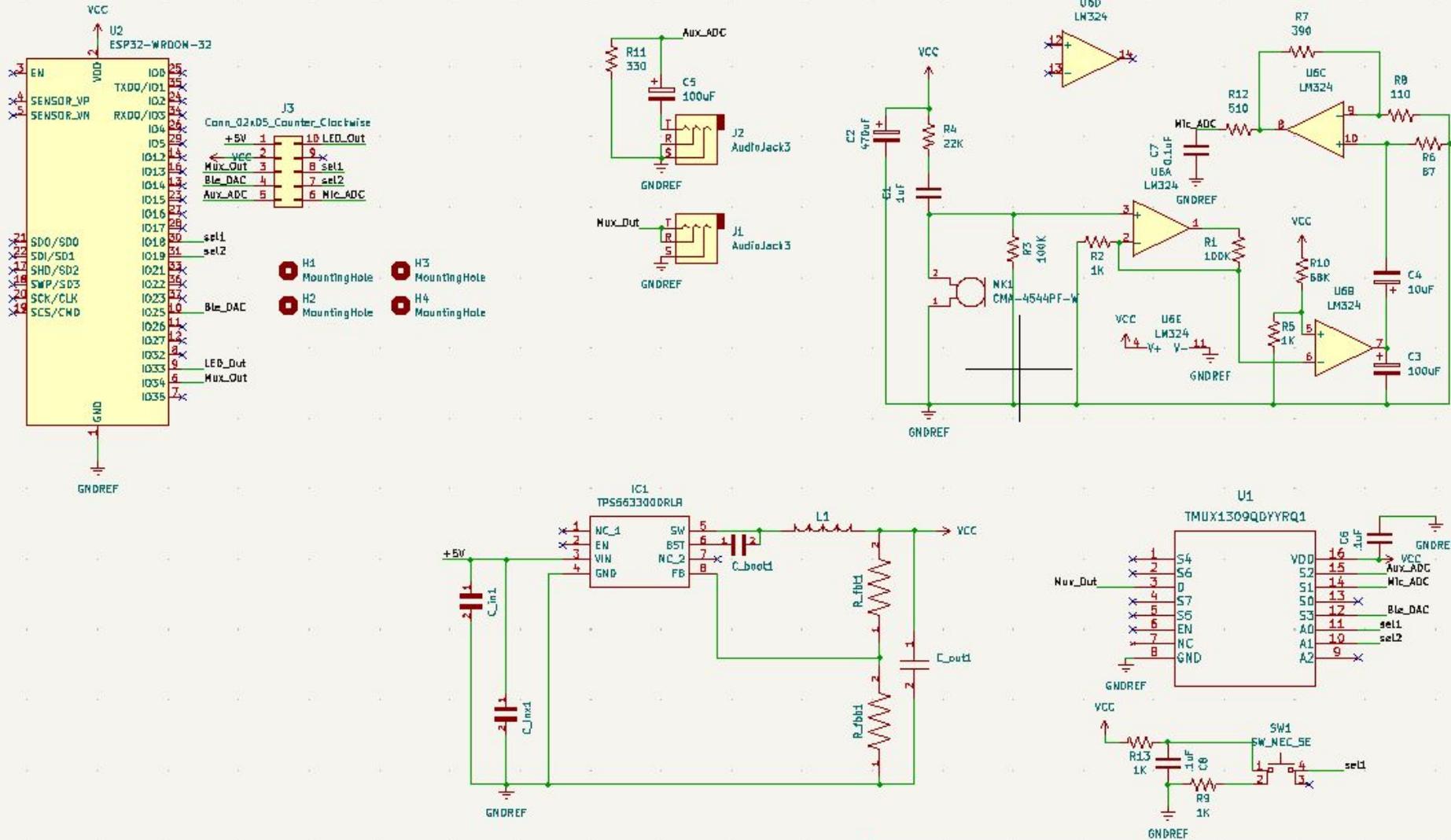
Prototyping Progress



Microphone and AUX prototyping circuit, with oscilloscope readings

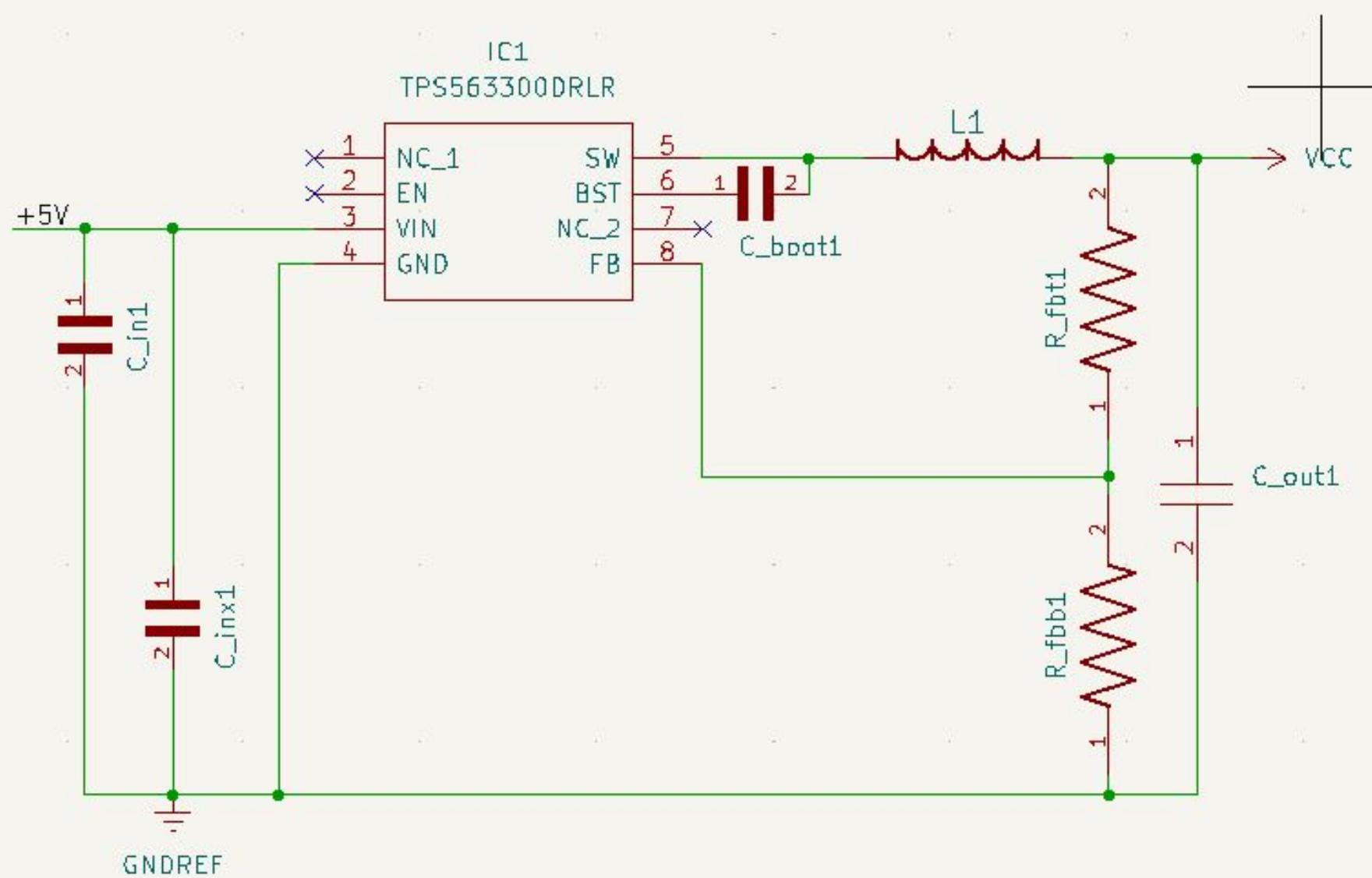
ELECTRICAL SCHEMATIC

Full Schematic



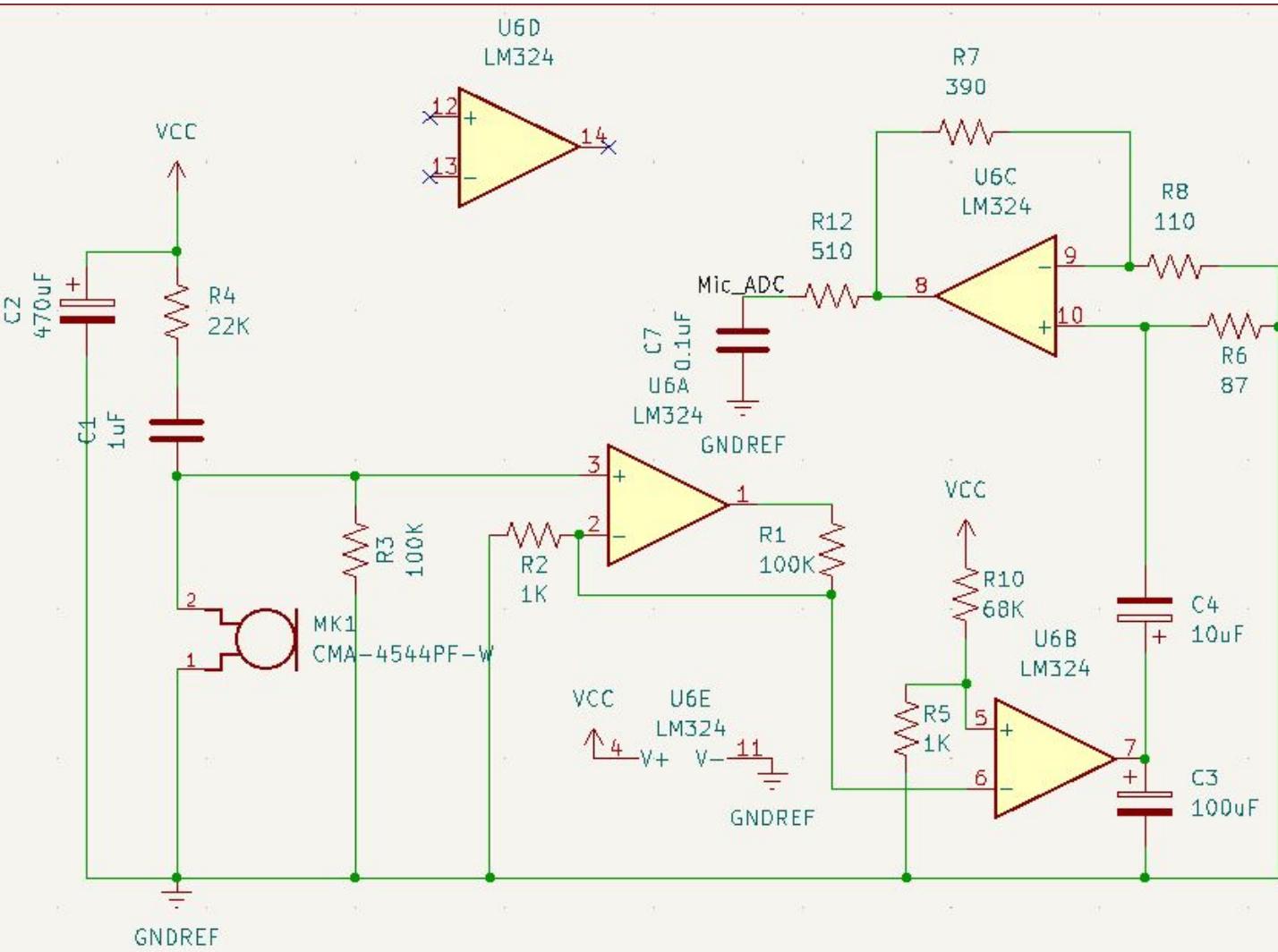
ELECTRICAL SCHEMATIC

Power



ELECTRICAL SCHEMATIC

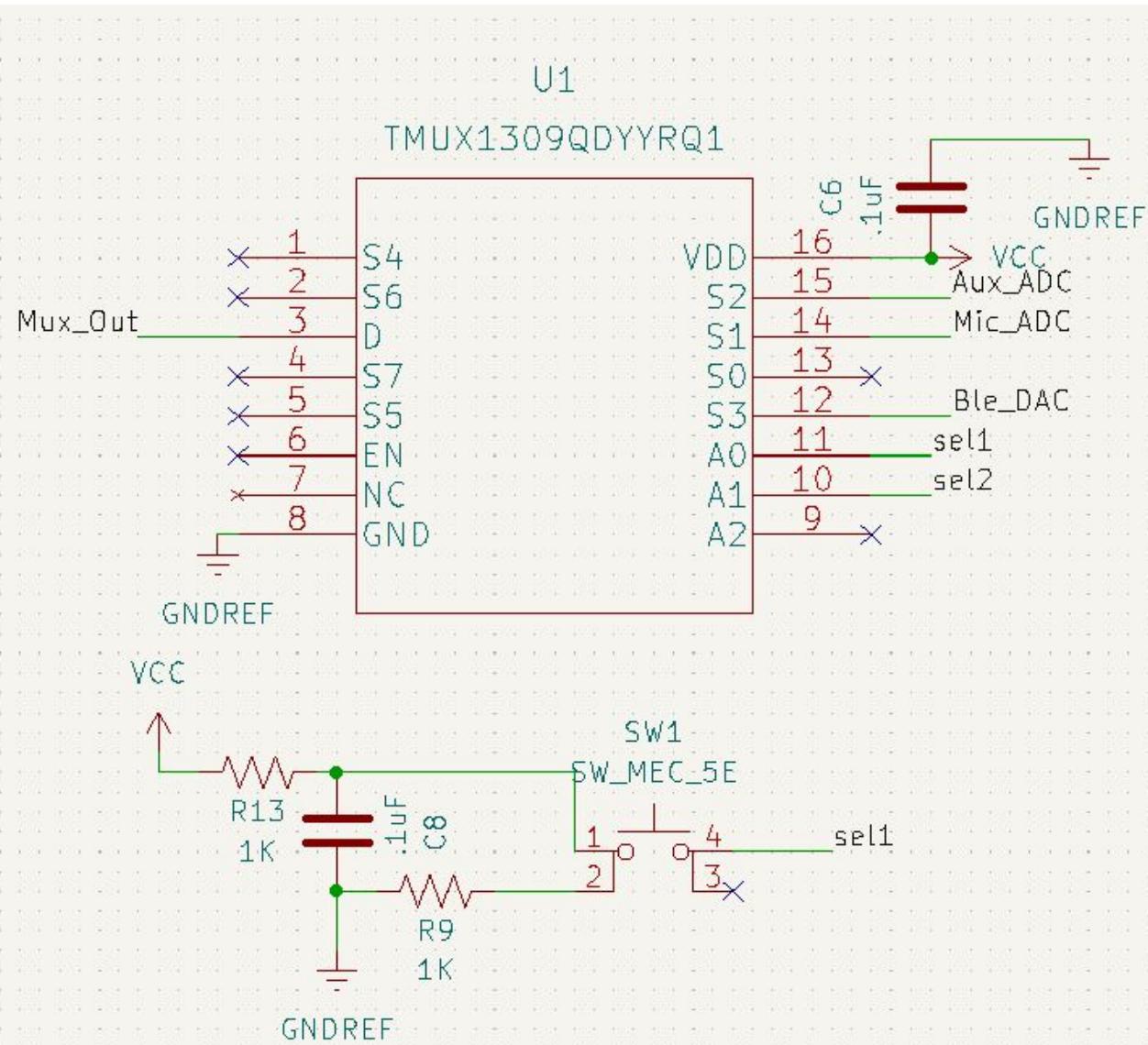
Mic Amplifier and Filtering



- Non-inverting op amp with a gain of 101x
 - $V_{out} = V_{in}(1+R1/R2)$

ELECTRICAL SCHEMATIC

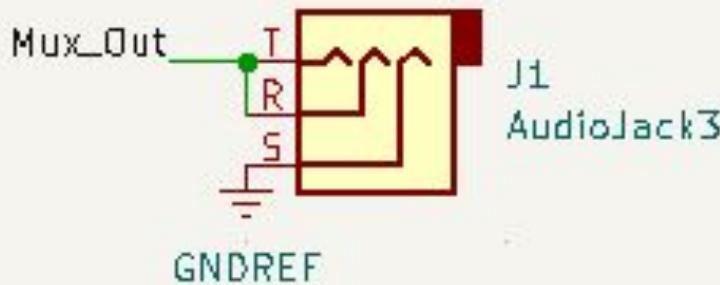
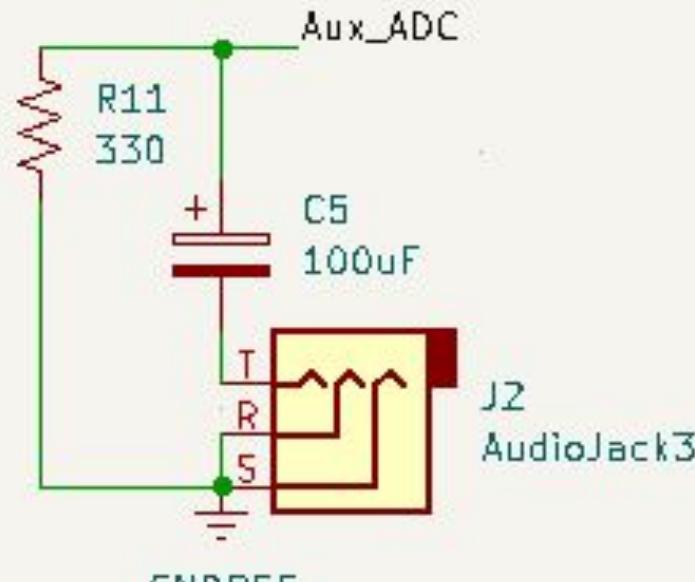
Analog Mux



- Debouncing done on the mode-switching button
- Analog inputs are chosen through select lines controlled by MCU/push button

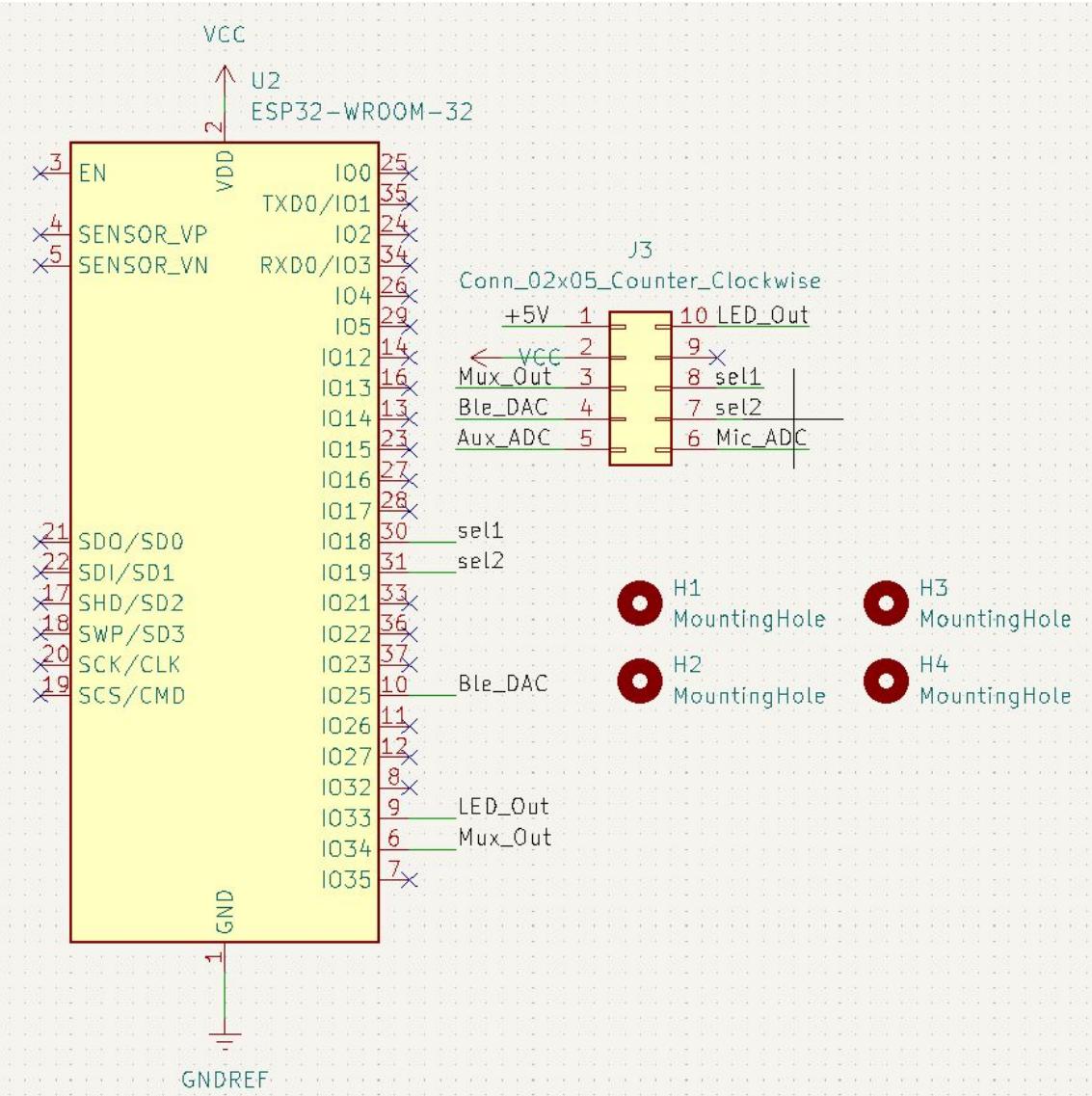
ELECTRICAL SCHEMATIC

Aux Audio



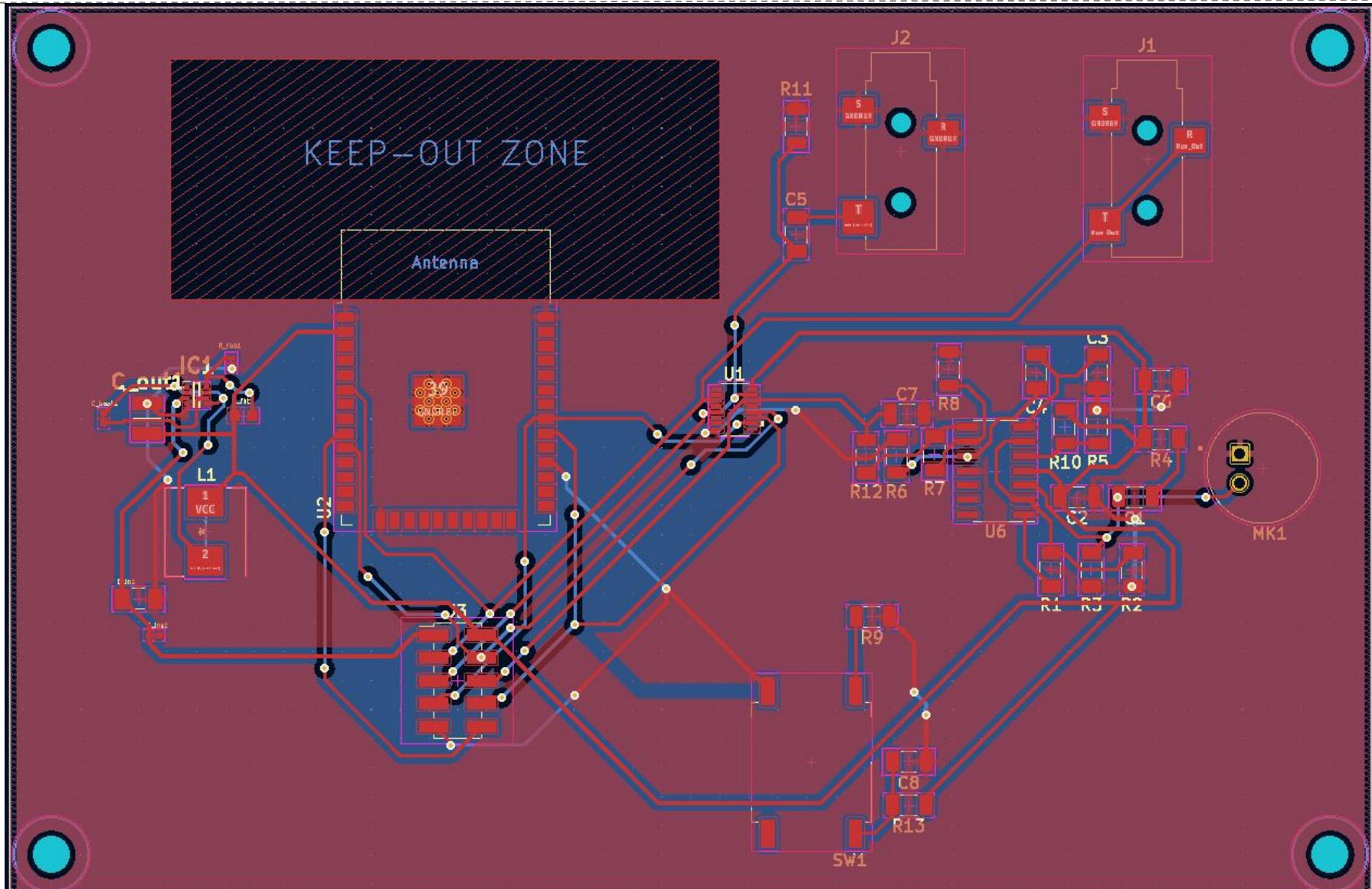
ELECTRICAL SCHEMATIC

Microcontroller



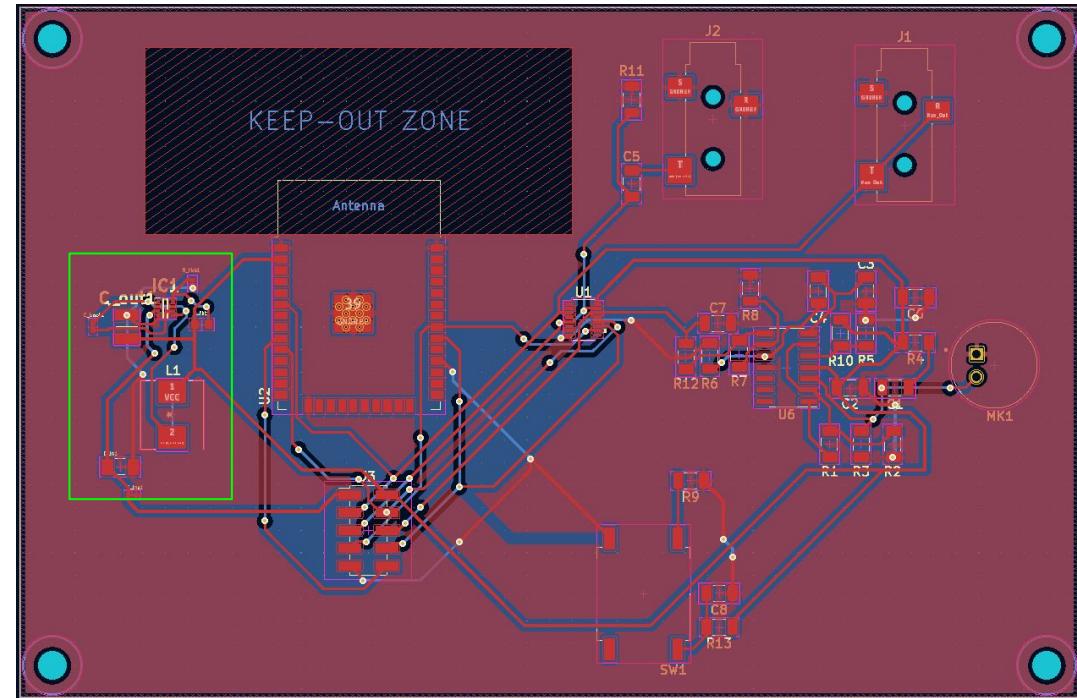
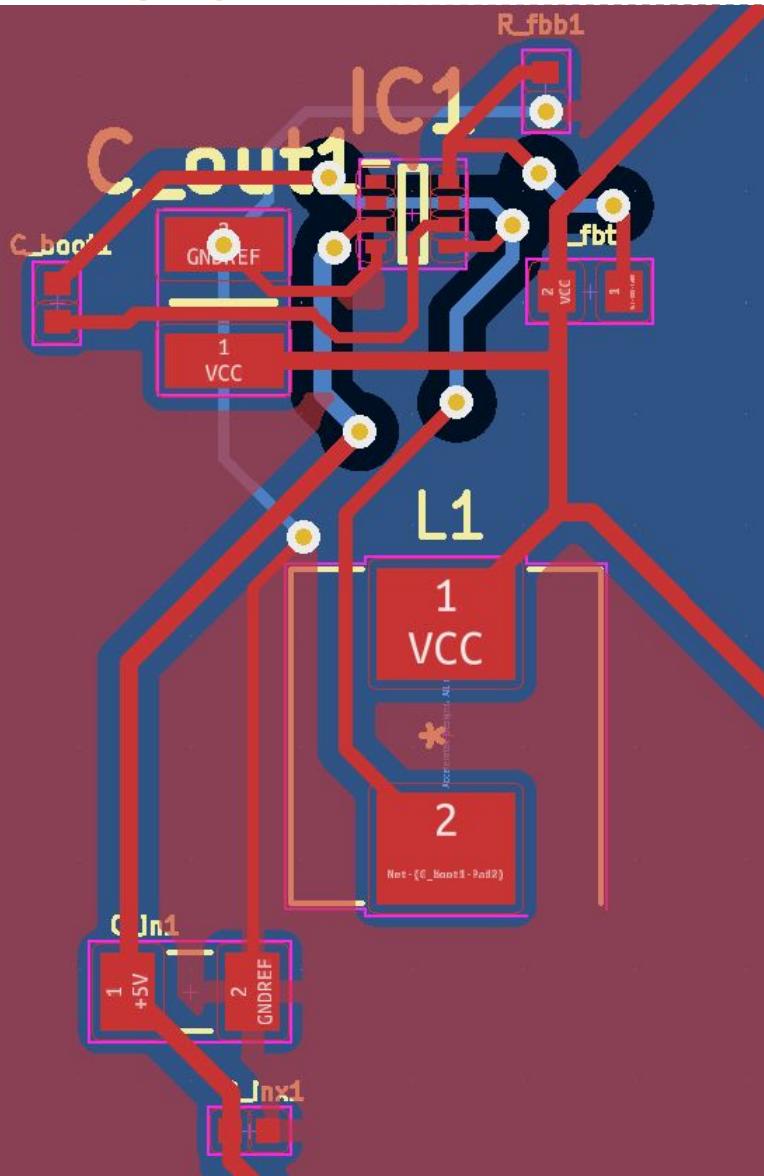
PCB LAYOUT

Full PCB



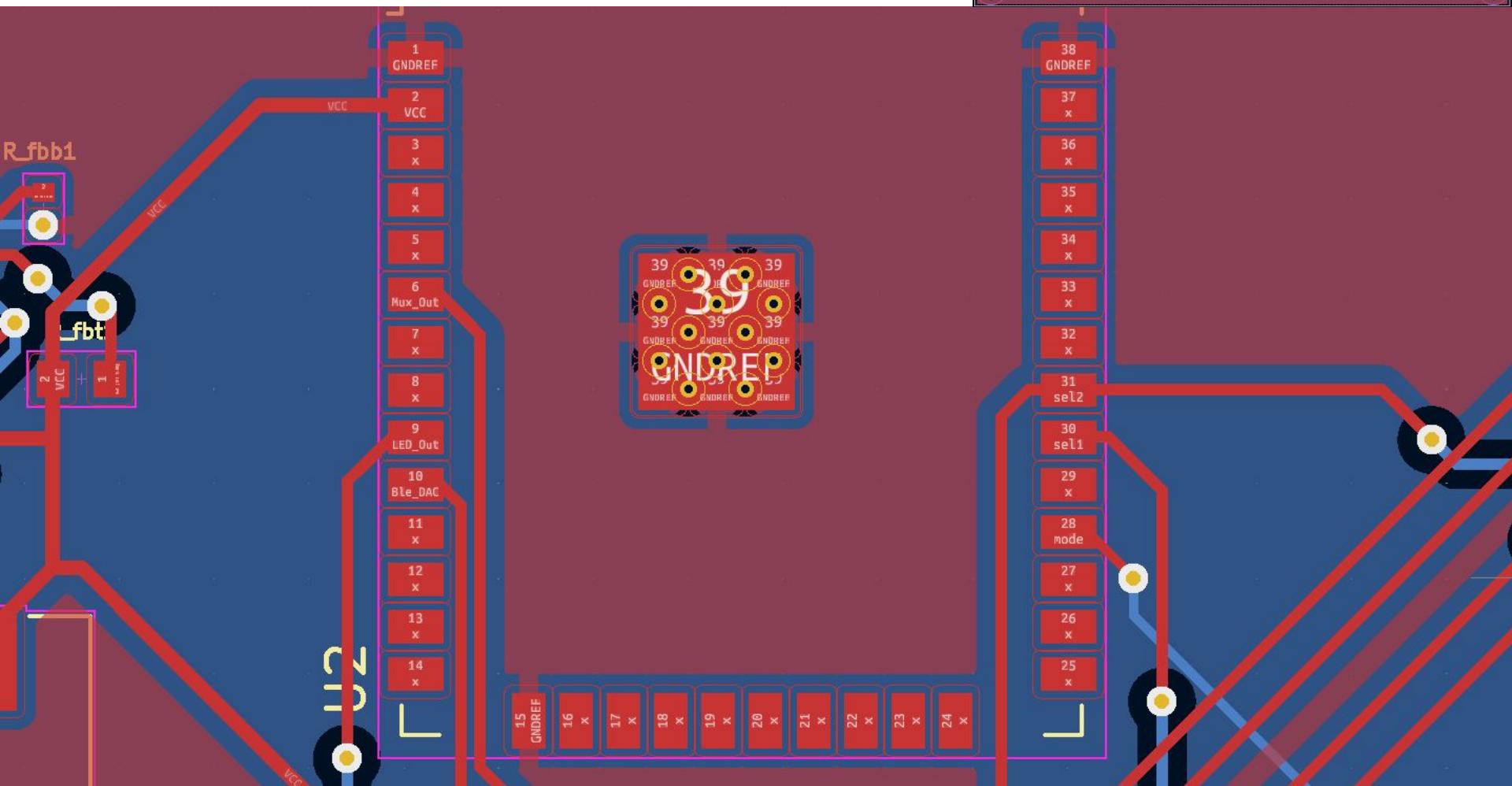
PCB LAYOUT

Power



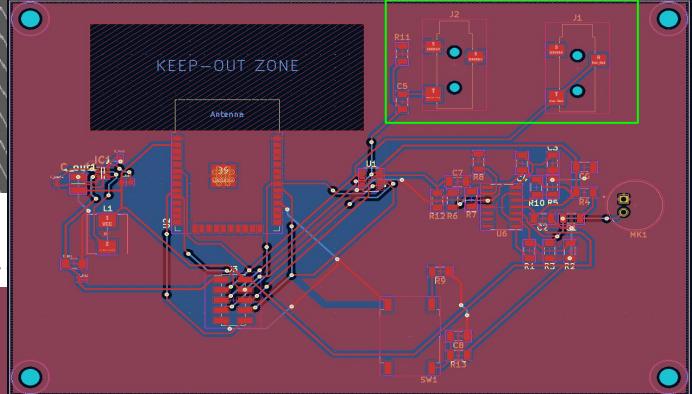
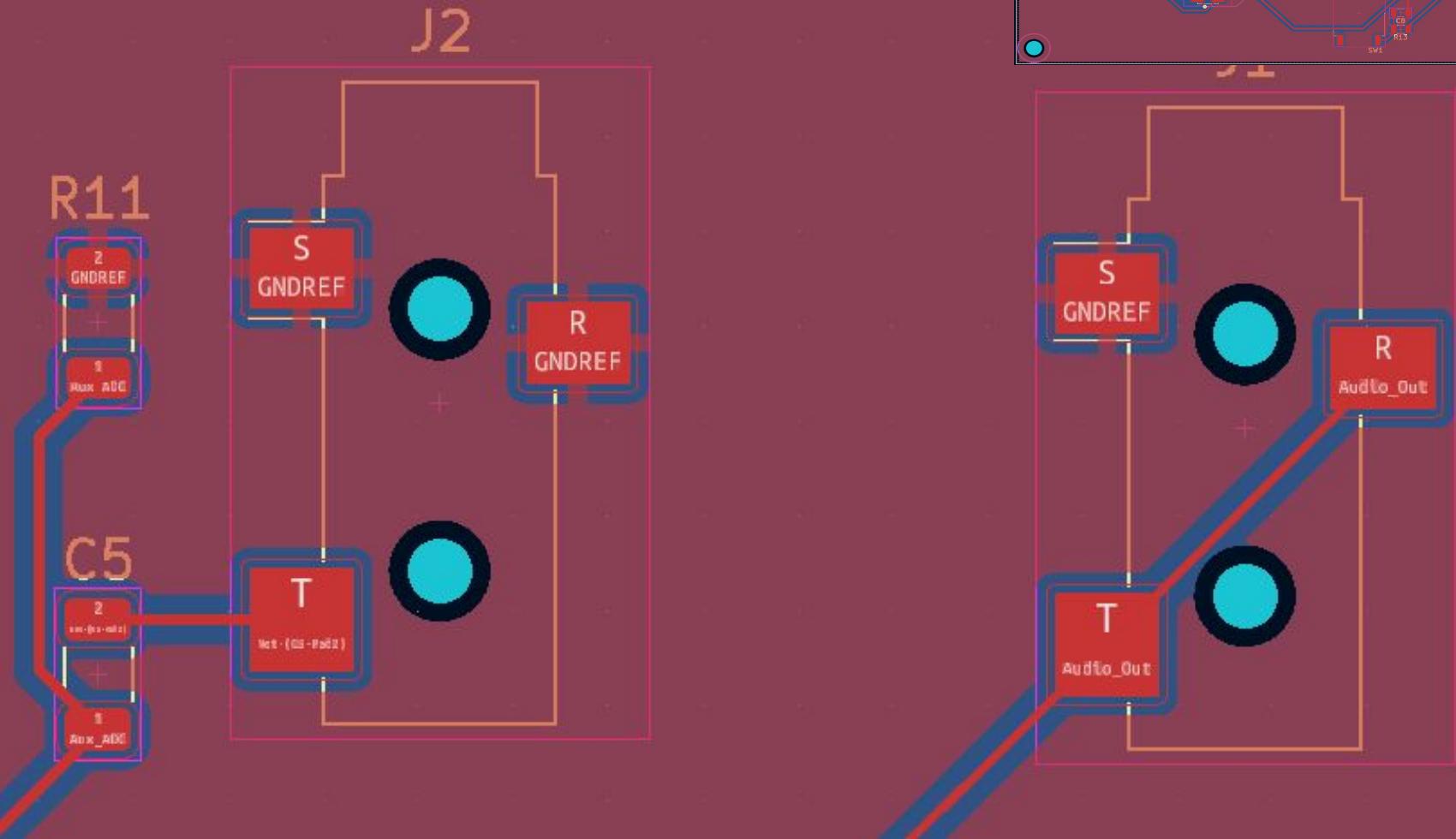
PCB LAYOUT

Microcontroller



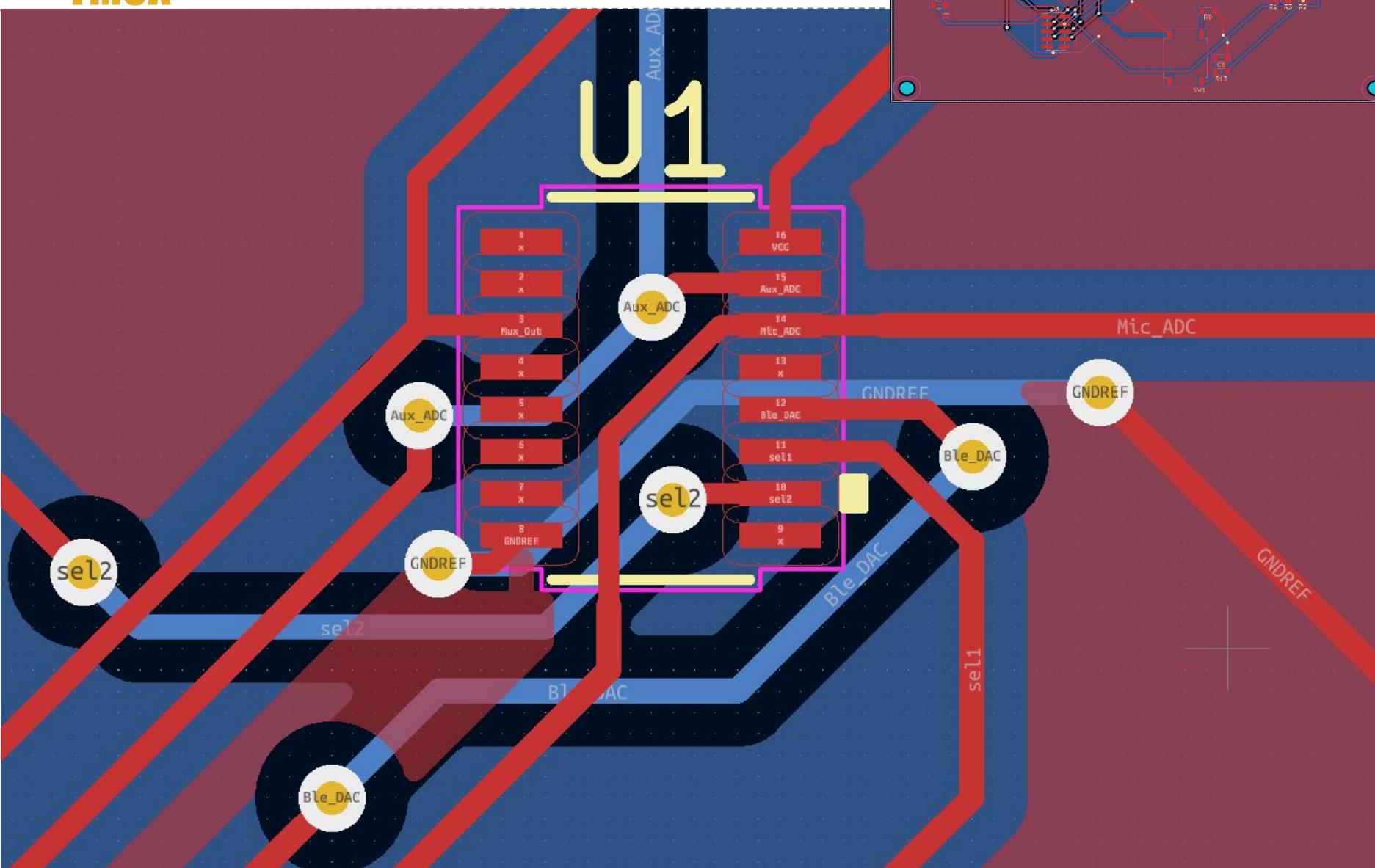
PCB LAYOUT

Aux Jacks



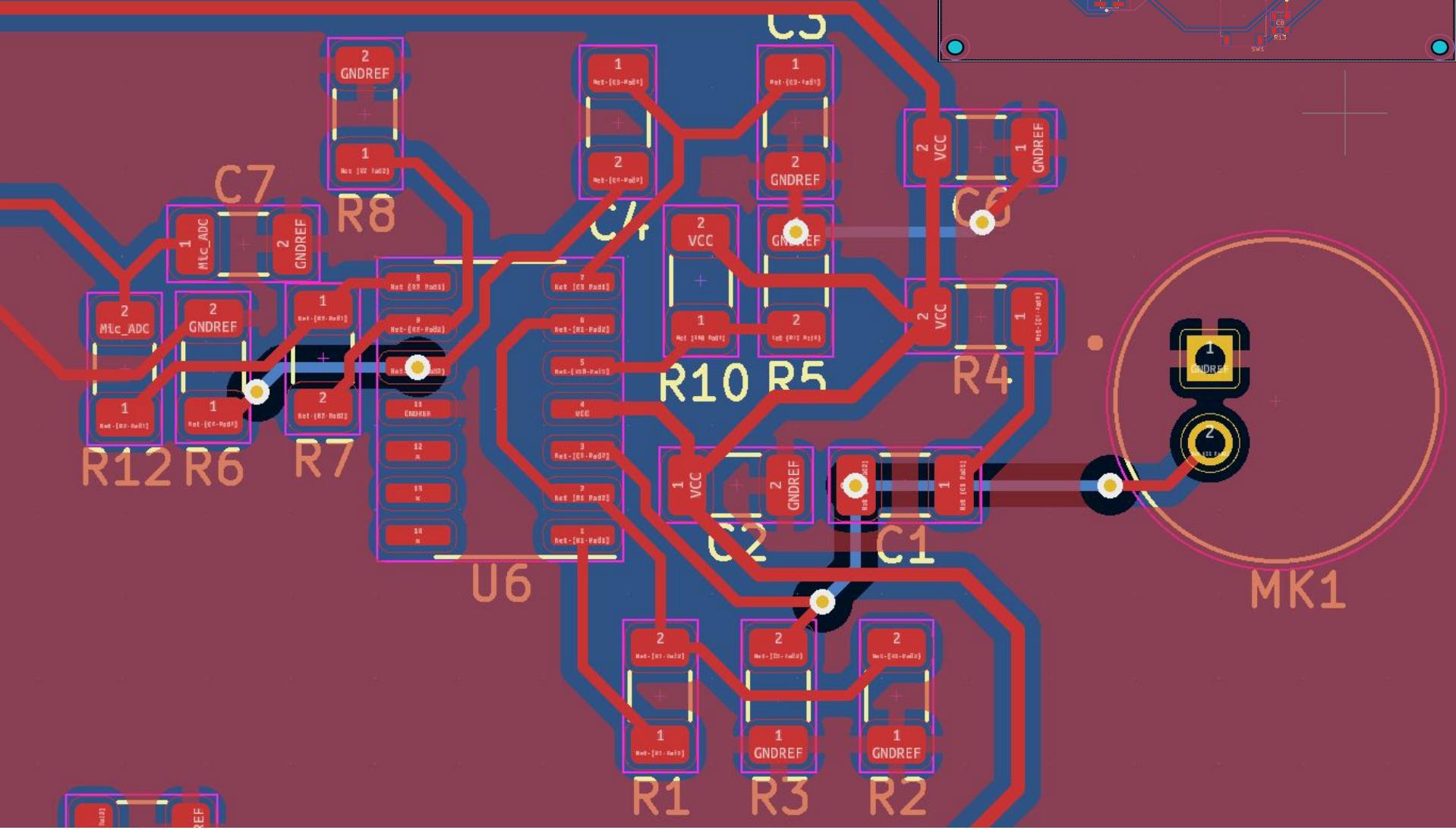
PCB LAYOUT

TMUX



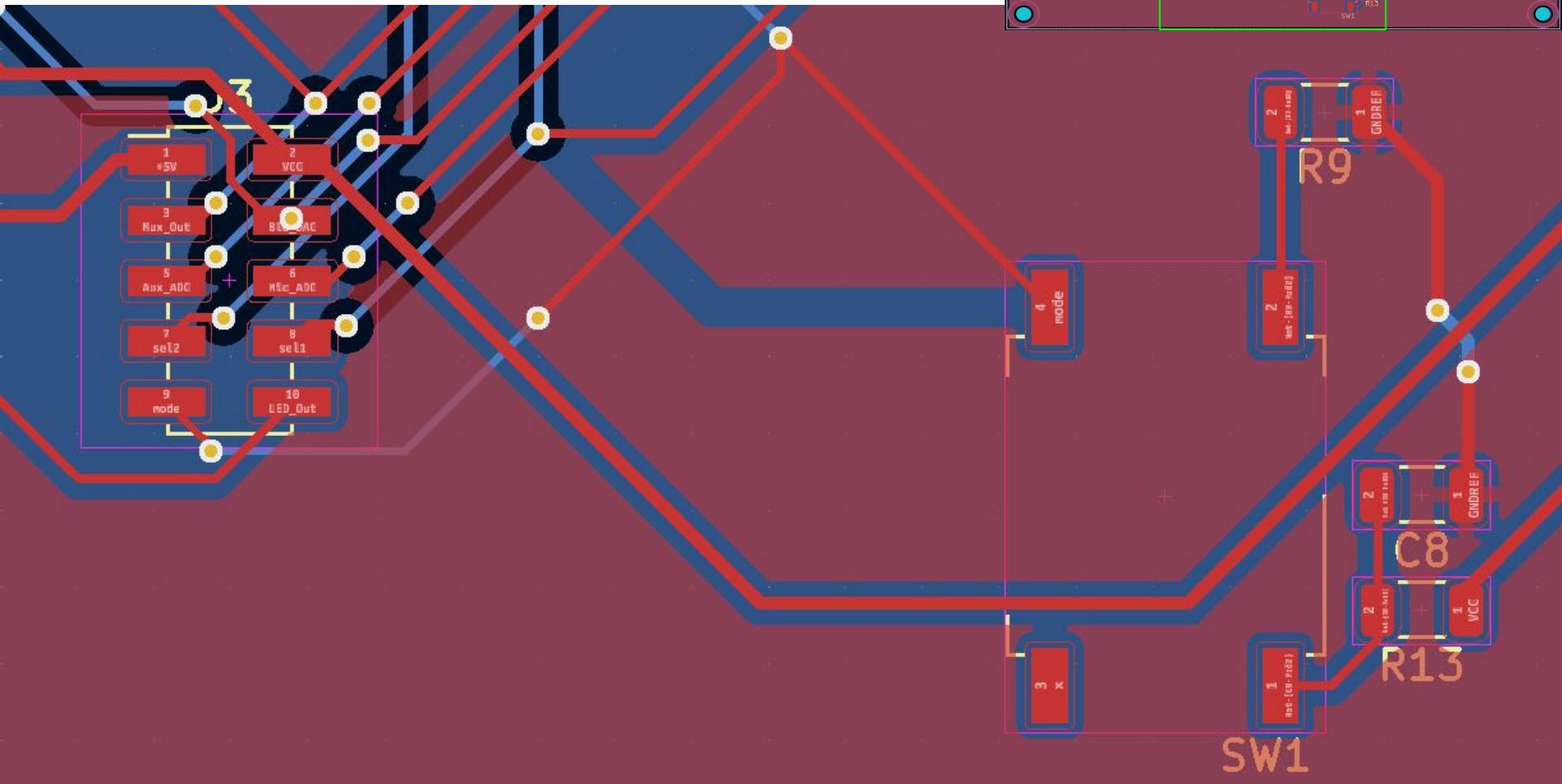
PCB LAYOUT

Mic



PCB LAYOUT

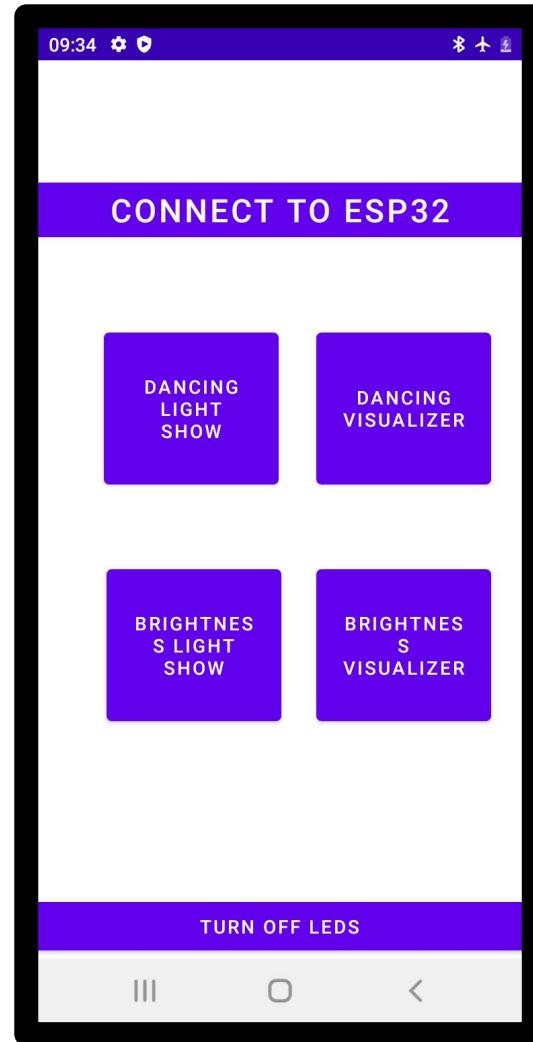
Debug Port and Mode Switch Button



SOFTWARE DEVELOPMENT STATUS

App Development

- *Connect/Disconnect*
- *Turn On/Turn off Leds*
- *2 Core Features*
 - *Dancing*
 - *Light Color Control*
 - *Preset Menu*
 - *Brightness*
 - *Light Intensity Control*
 - *Preset Menu*



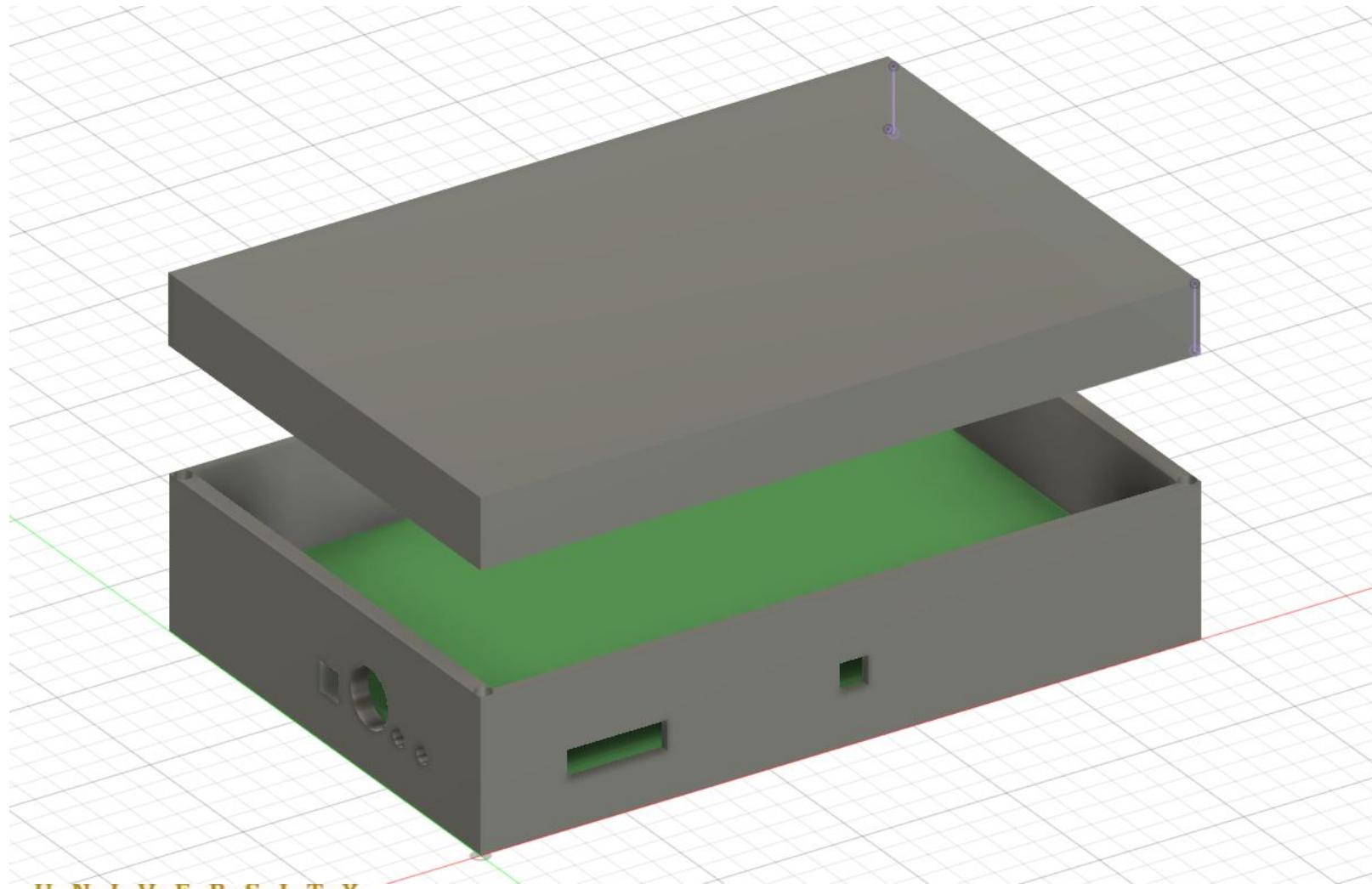
SOFTWARE DEVELOPMENT STATUS

Firmware Development

Component	Status
Continuous ADC sampling	100%
Continuous DAC output	0%
Gaussian Smoothing	100%
FFT Algorithm	80%
LED control	66%
Input Mode Switching	0%
Communication with Android App	10%

PACKAGING DESIGN

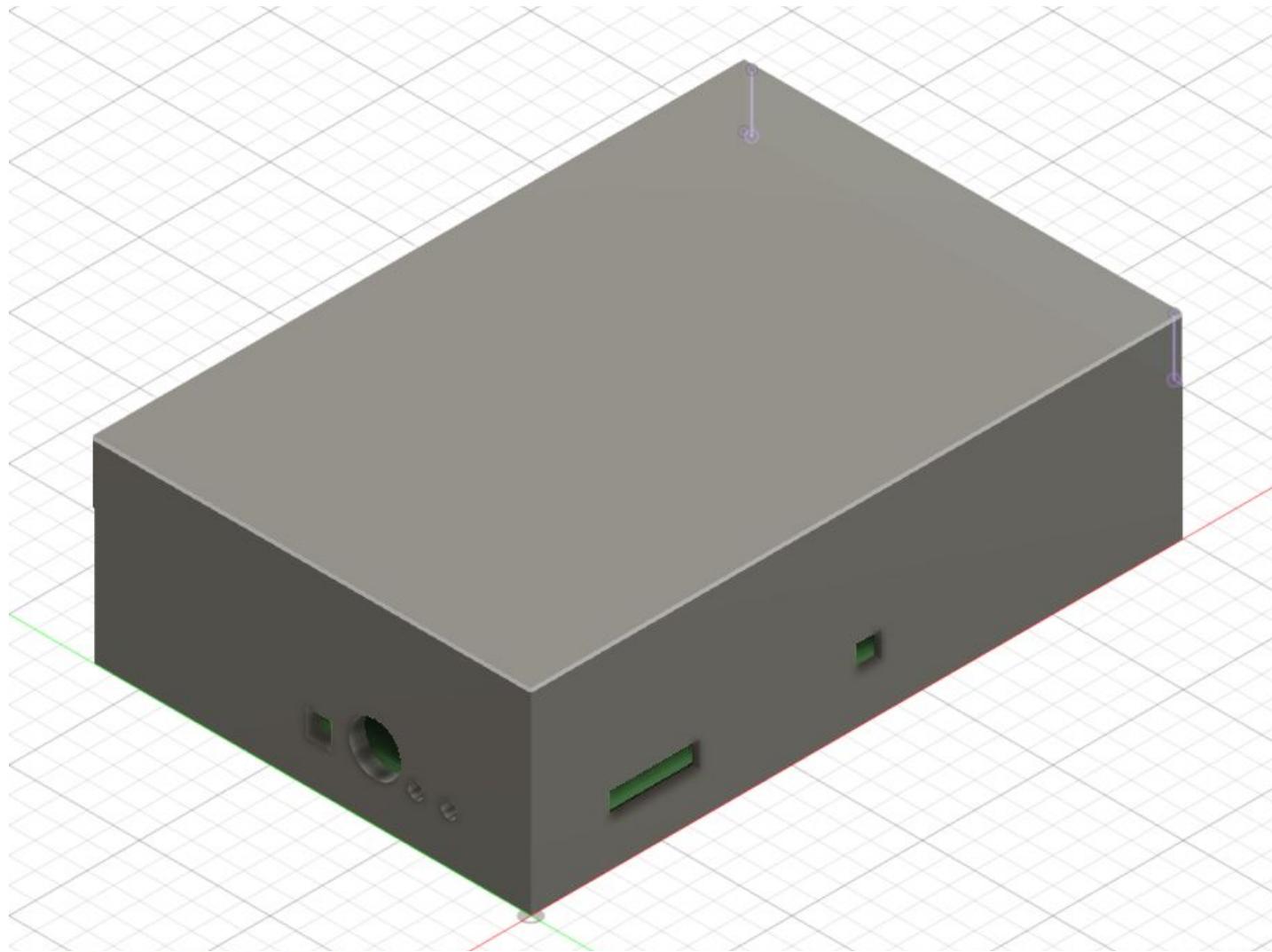
PCB Housing (Open)



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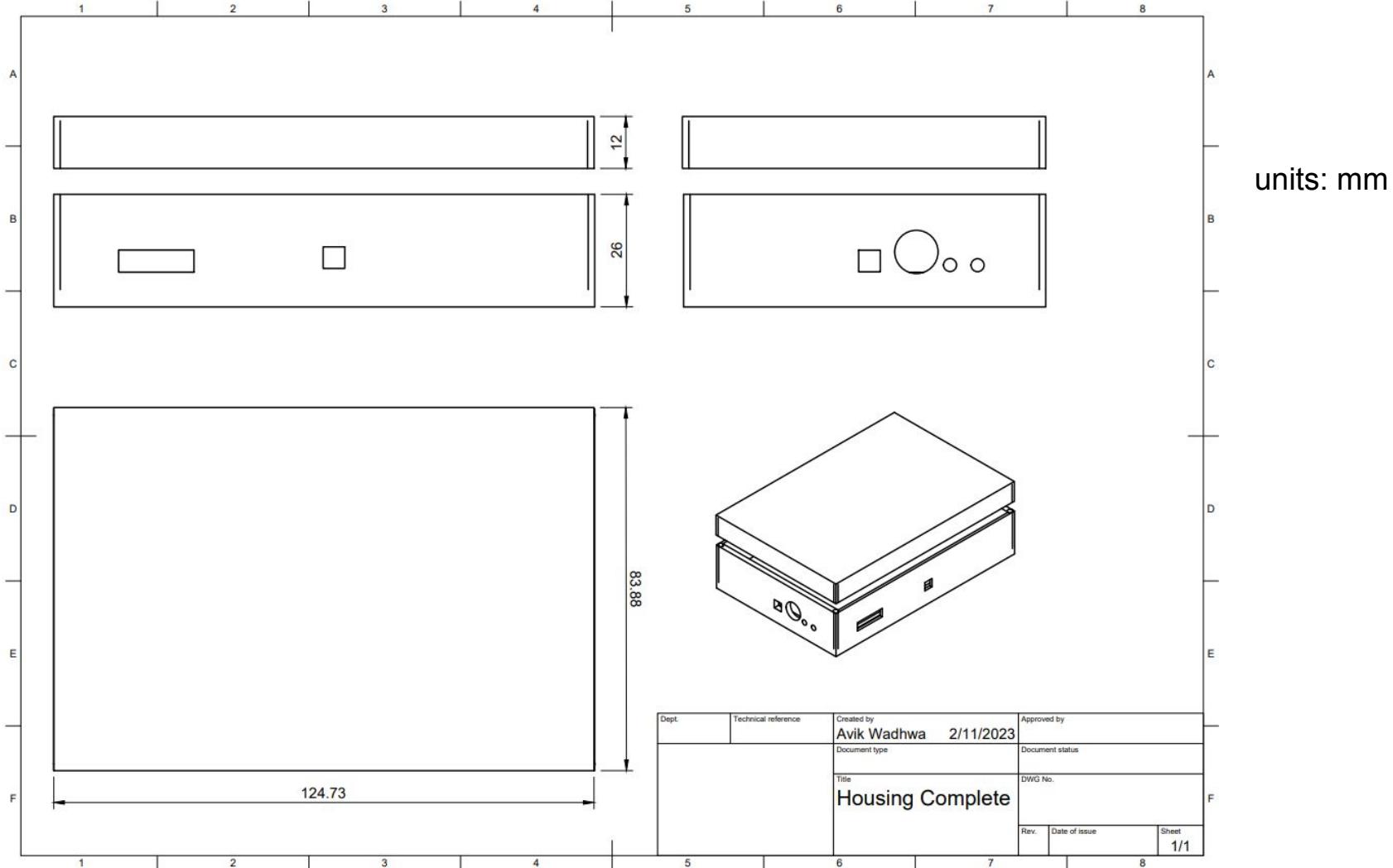
PACKAGING DESIGN

PCB Housing (Closed)



PACKAGING DESIGN

PCB Housing Dimensions



PACKAGING DESIGN

LED Fixture Dimensions



Dept.	Technical reference	Created by Avik Wadhwa 2/11/2023	Approved by
	Document type	Document status	
	Title LED Fixture	DWG No.	
Rev.	Date of Issue	Sheet	1/1

PROJECT TIMELINE

Task Title	Phase One			Phase Two			Final
	Week 9	Week 10	Week 11	Week 12	Week 13	Week 14	
PCB Packaging							
PCB Design	Start						
PCB Verification	Start						
PCB Order	Start						
PCB Post-Order Testing		Start	Start				
PCB Soldering		Start	Start				
PCB Housing Packaging			Start	Start			
Final Project Testing				Start	Start	Start	
Embedded Software							
Continuous DAC Output	Start						
Driving LEDs with Patterns		Start			Start	Start	
Input Mode Switching		Start					
FFT Configuration		Start	Start				
Android App Communication			Start	Start			
Final Code Base Testing				Start	Start	Start	
Android Application							
Design Input							
Bluetooth Component on Device Side							
Communication with ESP32							
Fragmenting Sub States							
Project Delivery							
Deployment							
Display	Start						
Order Parts	Start						
First Prototype		Start					
Testing First Prototype		Start	Start				
Final Construction				Start	Start	Start	
Logistics							
Final Presentation							Start

Questions?