

# Backpack Speaker

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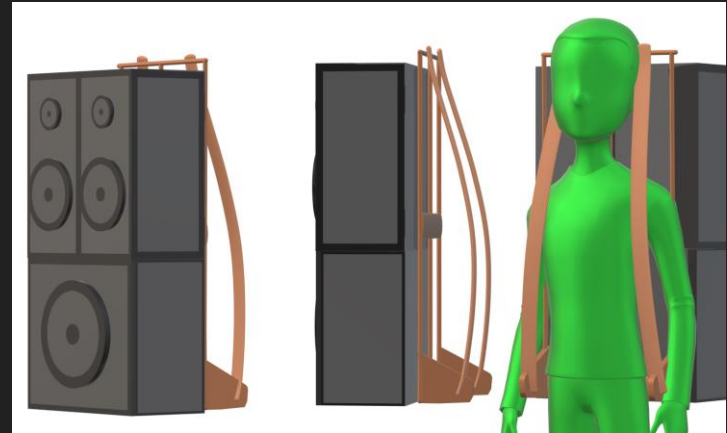


# Introduction

*A portable, high-fidelity, powerful, low-power, wireless and wired speaker system.*

## Agenda:

1. Original goals
2. Parts
3. System Overview
4. Impact of COVID-19
5. Final system
6. What we would've done differently.



# Original Goals

## System-Level:

- Lightweight (<40lbs)
- Fit on backpack frame (2'x1.5'x3')
- Low-cost (<\$500)
- Durable, weather resistant materials

## Mobile App:

- Source input over Bluetooth
- Choose equalization settings
- Adjust volume levels

## Speakers:

- High-quality sound
  - Low-frequency response (<0.5dB)
  - High output power (200W)
  - Frequency range 20-20,000 Hz
- Internal amplification system
- Ability to switch to battery power
  - 24V
  - 1 hr of life @ 200W



# Parts

## ADC - TLV320ADC6140IRTWT

- I2C & I2S
- Sampling rate up to 768kHz



## Amplifier - TAS3251DKQR

- I2C & I2S
- 175W to 285W
- Programmable crossover and filters

## LaunchPad MC w/ CC2454MODA

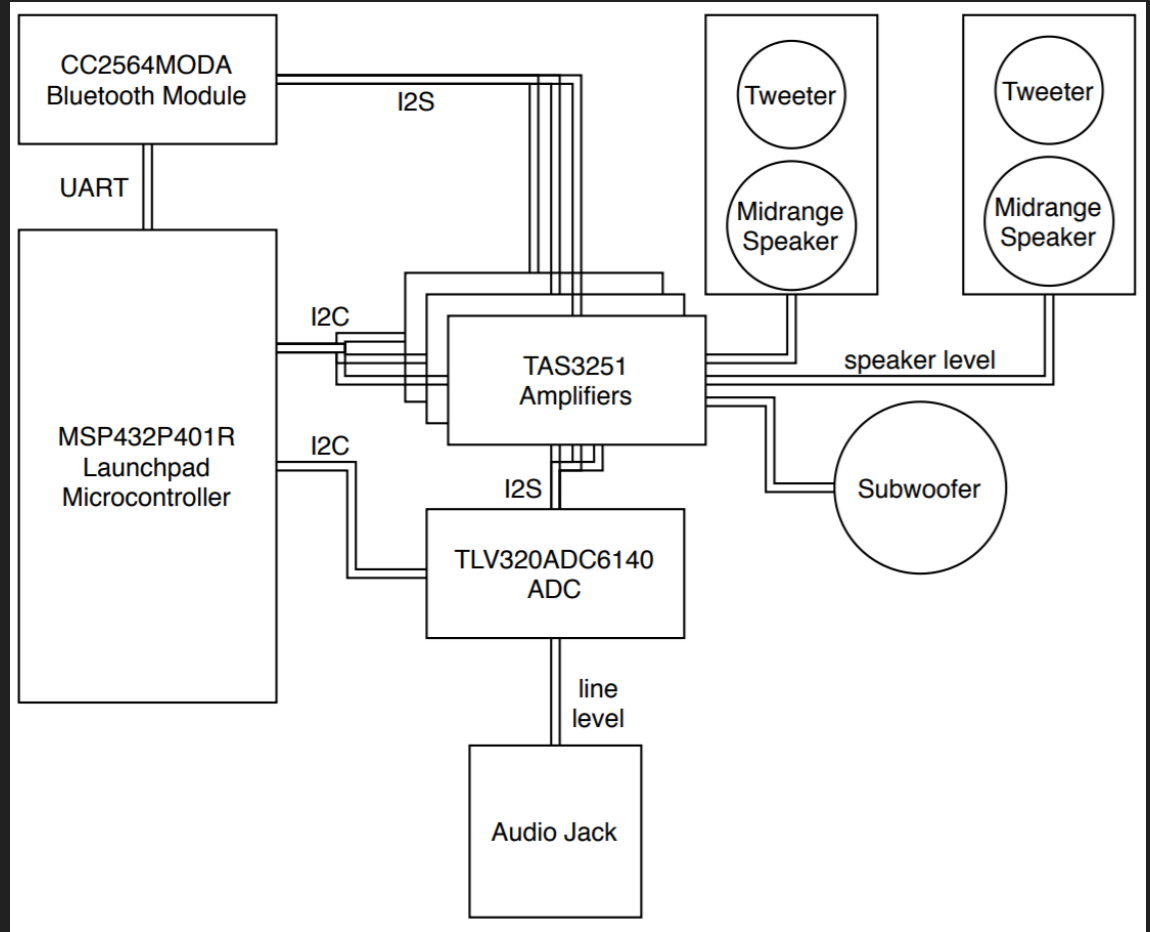
- I2C & I2S



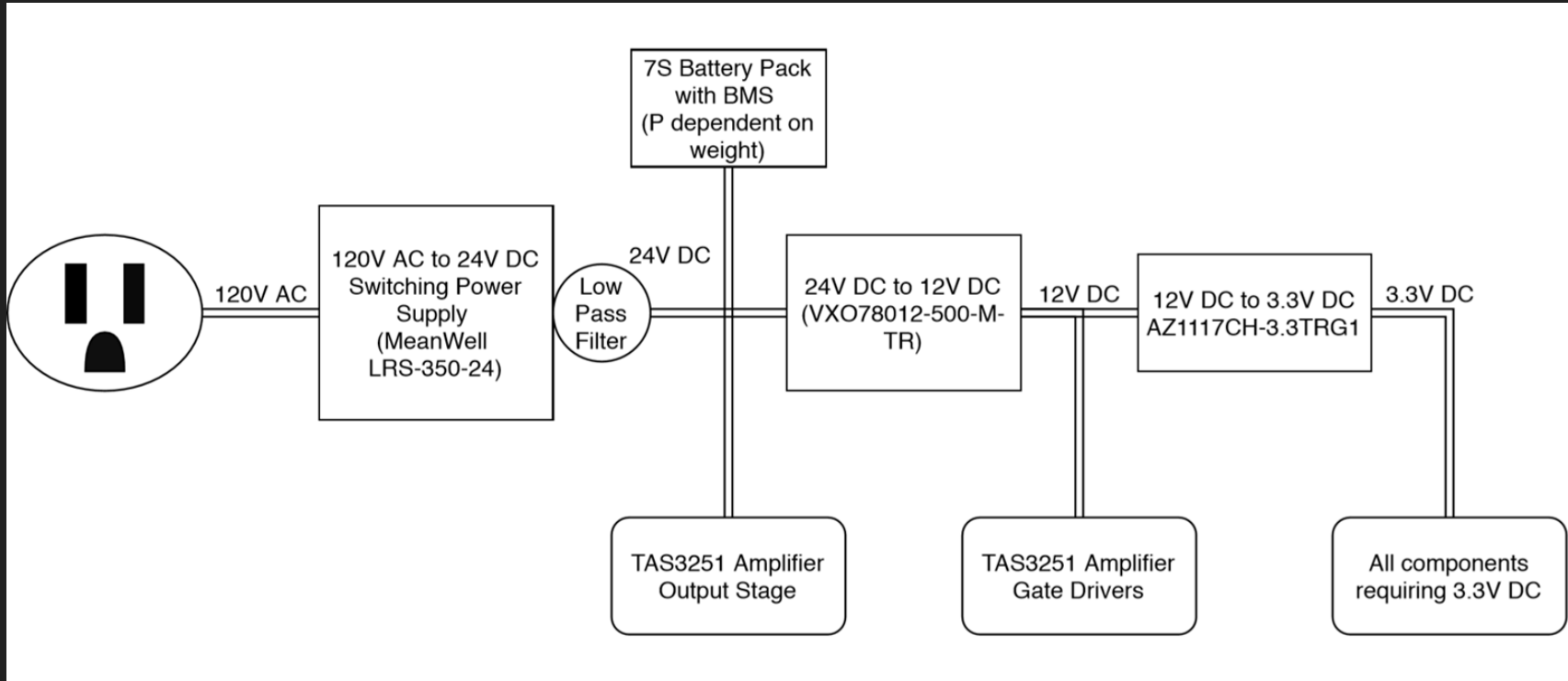
# System Layout

Communication over I2C and UART

Audio signal over I2S and analog line level

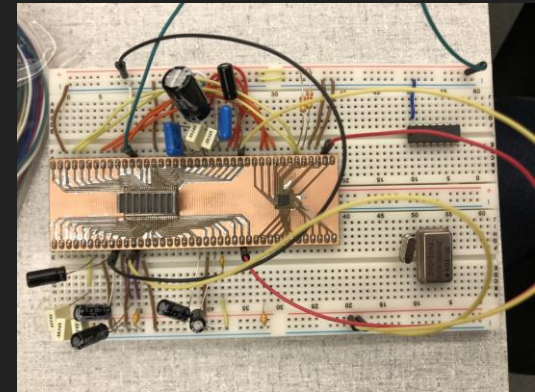
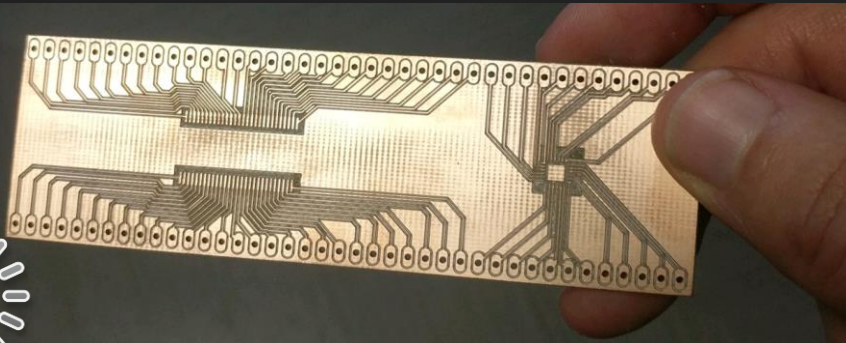
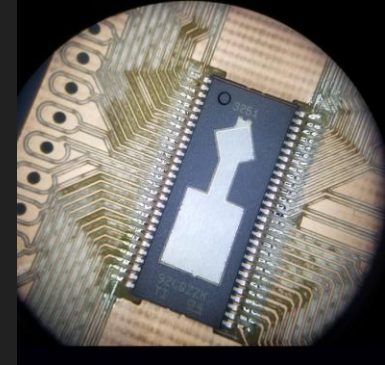


# Power System Layout



# Before COVID-19

- Soldering amp and ADC to breakout board
- Wired the many required resistors and capacitors to the amp and ADC as listed by the datasheet



# Before COVID-19

- Setting register values
  - Huge number of registers to look through in datasheet(~100+)
- Using Logic Analyzer, Oscilloscope, and function generator for testing
  - Continued to not produce sound despite many tweaks to code(e.g. changing different register bits, changing CLK frequencies, double checking wiring)

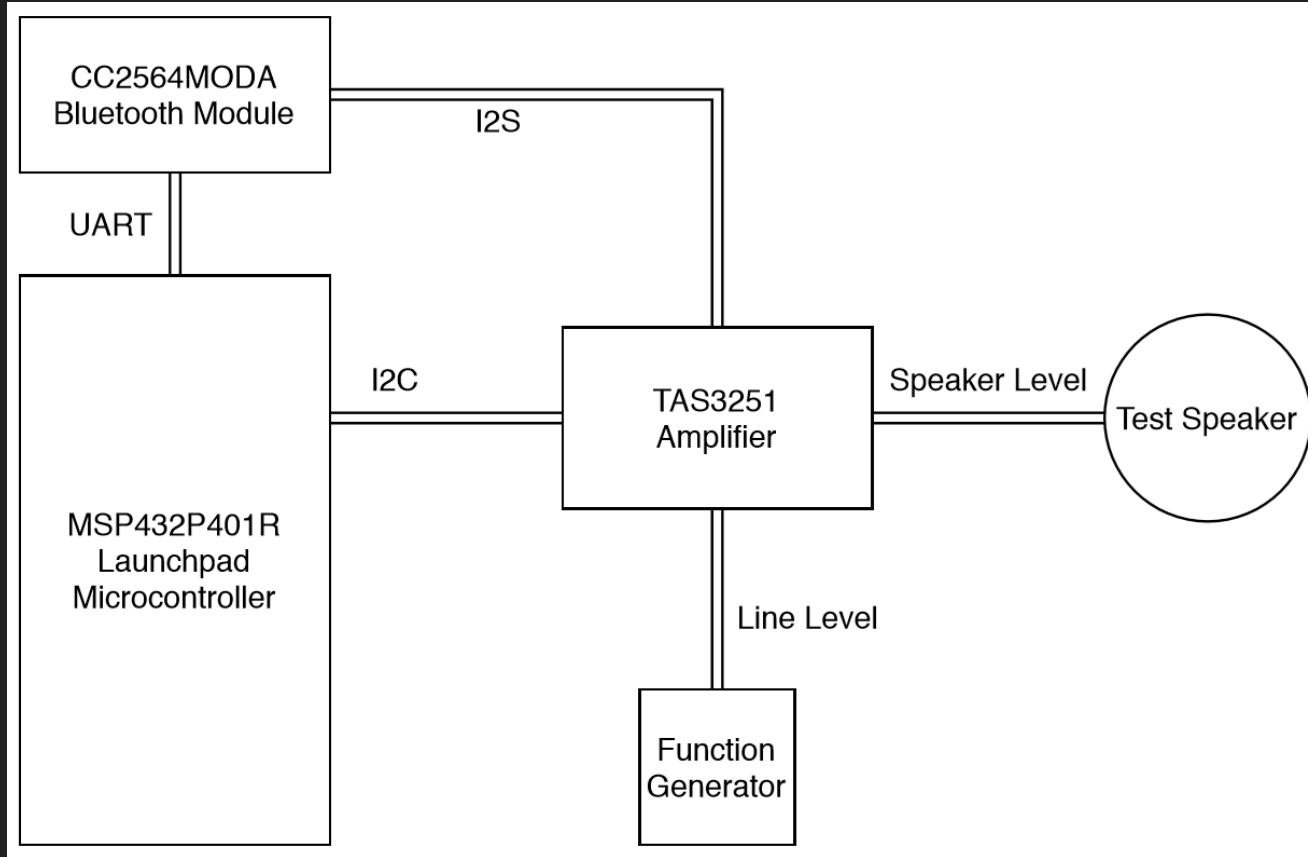


# COVID-19 Limitations

- Limitations on ordering:
  - New Parts: Including PCB, Speakers, Power Supply
  - Replacement parts: ADC and amplifier
- Limitations on meeting and equipment:
  - Only one member had access to the parts and equipment
  - Went from an 8 channel oscilloscope to a 2 channel oscilloscope
- Granted access to:
  - 2 channel oscilloscope
  - Stationary power supply
  - Arbitrary wave function generator



# New System Layout

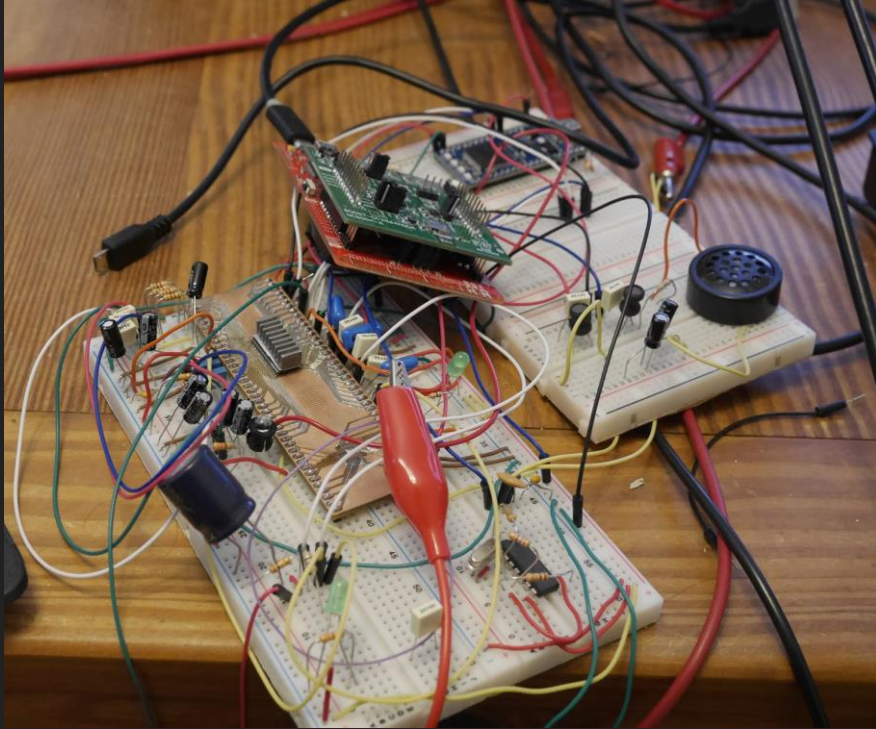


# After COVID-19

- Moved equipment to a member's house
- Continued debugging only amp and bluetooth module
- No new parts or PCBs
- Amp's heatsink got bumped into and shorted several traces (April 23rd)



# Resulting System



- Amp SNR = ? without digital conversions.
- Amp SNR = 8dB
  - White noise interference likely from MBED ADC
- Bluetooth works
  - Pair after restart
  - Single connection
  - Quick startup ( $\ll 1s$ )



# What We Could Have Done Better

- DAC / DSP and amp that were not integrated
- More modules means more parallelism
- Make many PCB prototypes instead of single no-silkscreen protoboard
  - Less reliability of discrete components that can become loose or fall out in transport

