

# Audio Controlled Circuit Using Android Headphone Jack



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## Overview

- ▶ Project Goal
- ▶ Replacing a switch
- ▶ App Development
- ▶ Controlling Multiple Devices
- ▶ Improvements
- ▶ Conclusion

## Project Goal

- ▶ First objective: Replace the switch on the Powerstorm Capital board with a relay that is controlled by an Android tablet headphone jack
- ▶ Second objective: Develop an Android app to control relay(s)
- ▶ Third objective: Design and develop a circuit in which multiple devices can be controlled from the Android app, still utilizing the Android tablet's headphone jack

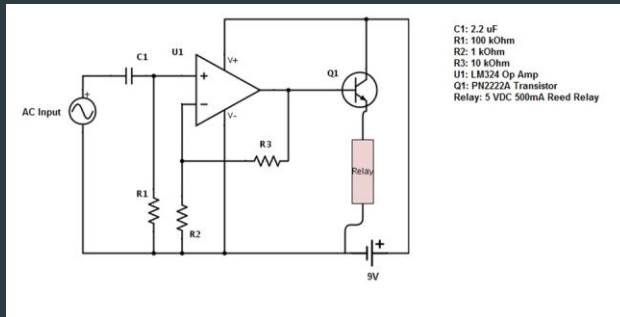
## Android Hardware

- ▶ Tablet used: Prontotec Axius 8 inch TabletPC
- ▶ Peak voltage output at full volume: .75V
- ▶ Output frequency range = 1-18kHz

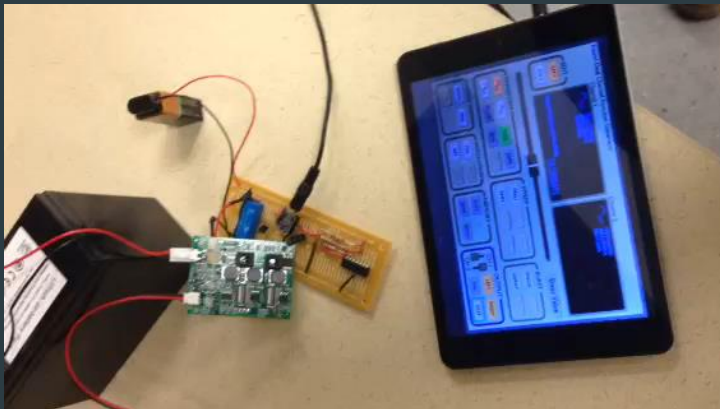


## Replacing a switch

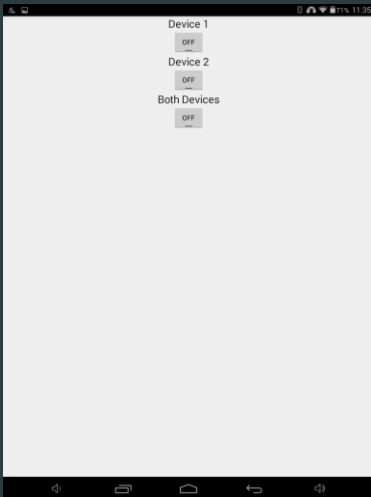
- ▶ App Used: Keuwl Dual Channel Function Generator
  - ▶ 18kHz Sine wave
  - ▶ 100% Amplitude
  - ▶ Tablet set to full volume



## Replacing a switch



## App Development



- ▶ Software Used: Android Studio
- ▶ Main Activity: Calls upon PlayWave when toggle button is pressed
- ▶ PlayWave: Where the sine wave is generated
- ▶ Activity: User interface file
- ▶ Frequency Range: 11-3000Hz

## Controlling Multiple Devices

- ▶ Original Idea: To isolate the left and right channels of the Android's headphone jack, and use a 2x4 Decoder chip to control 4 devices
- ▶ Problem: The Android app that was developed is only able to output a monotone sine wave
- ▶ Current Approach: Send different frequency sine waves for each device, then create band-pass filters to only allow each respective device's sine wave thus selecting the proper device

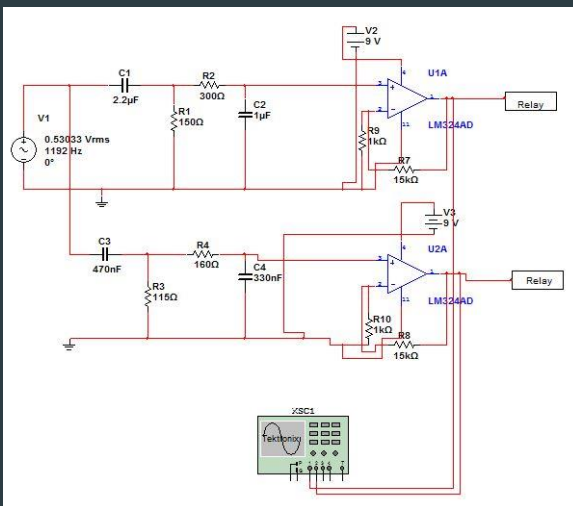
## Controlling Multiple Devices

### Circuit equations

- ▶ Cutoff frequency for high pass filter:  $f_h = \frac{1}{2\pi RC}$
- ▶ Cutoff frequency for low pass filter:  $f_l = \frac{1}{2\pi RC}$
- ▶ Center Frequency:  $f_c = \sqrt{f_h f_l}$
- ▶ Gain from op-amp:  $G = \frac{R_3}{R_4}$

## Controlling Multiple Devices

### 2 Device Simulation



- ▶ Device 1 Bandwidth: 482-531Hz
- ▶ Device 1 Center Frequency: 506Hz
- ▶ Device 2 Bandwidth: 2945-3014Hz
- ▶ Device 2 Center Frequency: 2979Hz

## Controlling Multiple Devices

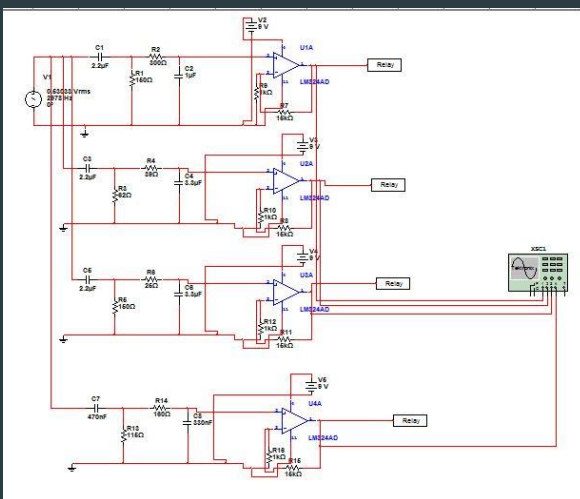
### 2 Device Simulation

Input Frequency \ Device	506Hz	2979Hz
Device 1	5.08V	1.42V
Device 2	1.92V	4.47V

Peak voltage output of each device for different input frequencies

## Controlling Multiple Devices

### 4 Device Simulation



- ▶ Device 1 Bandwidth: 482-531Hz
- ▶ Device 1 Center Frequency: 506Hz
- ▶ Device 2 Bandwidth: 1167-1217Hz
- ▶ Device 2 Center Frequency: 1192Hz
- ▶ Device 3 Bandwidth: 1854-1929Hz
- ▶ Device 3 Center Frequency: 1892Hz
- ▶ Device 4 Bandwidth: 2945-3014Hz
- ▶ Device 4 Center Frequency: 2979Hz

## Controlling Multiple Devices

### 4 Device Simulation

Input Frequency	506Hz	1192Hz	1892Hz	2978Hz
Device				
Device #1	5.08V	4V	2.95V	2.01V
Device #2	3.05V	3.48V	3.36V	3V
Device #3	2.47V	3.34V	3.46V	3.34V
Device #4	1.91V	3.54V	4.23V	4.47V

Peak voltage output of each device for different input frequencies

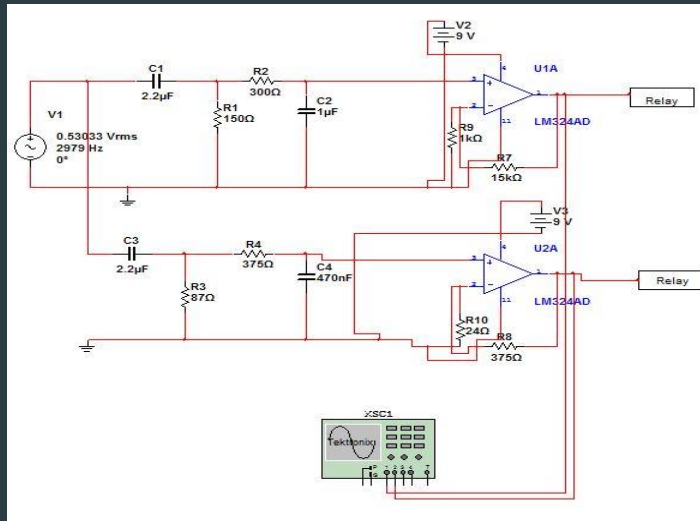
## Controlling Multiple Devices

### Hardware Development

- ▶ Problems with 4 Devices: The output of the simulation shows that the wrong devices could potentially be selected when they are not supposed to
- ▶ Problems creating hardware for 2 devices: Circuit was created, but when it was tested only Device 1 was working properly
- ▶ Solution: Redesigned the band-pass filter for Device 2, also the input frequency for Device 1 had to be adjusted, so Device 2 would not be selected

## Controlling Multiple Devices

### Final Design



## Controlling Multiple Devices

### Final Design

- ▶ Device 1 Bandwidth: 482-531Hz
- ▶ Device 1 Input Frequency: 225Hz
- ▶ Device 1 Gain: 15
- ▶ Device 2 Bandwidth: 832-903Hz
- ▶ Device 2 Input Frequency: 867Hz
- ▶ Device 2 Gain: 15.625
- ▶ Controlling Frequency for both Devices: 529Hz



## Improvements

- ▶ Increase the frequency range that the app can output
- ▶ Alter the app to output a more accurate sine wave
- ▶ Increase the order of the band-pass filters, to increase the accuracy of the cutoff frequency
- ▶ Use a higher controlling frequency
- ▶ Add more devices to the circuit

## Conclusion

- ▶ Project Goal
- ▶ Controlling One Device
- ▶ App Development
- ▶ Controlling Multiple Devices
  - ▶ Simulations
  - ▶ Hardware Development
- ▶ Improvements

Questions?