




GROUP 17

# KARAOKE PORTABLE SYSTEM

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# Motivation



- Karaoke is a newer form of entertainment in America
  - It's origins lie within the Asian market, starting with the first Karaoke machine in the 1970's.
  - The basic premise of Karaoke is to provide a backing track for artists or hobbyist to sing songs without the need for a complete band
  - Karaoke is often accompanied by lighting effects and multiple monitors to display lyrics to everyone in attendance, including the performer.
  - Bring together family and friend to enjoy a time of singing and fun.
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# Goals and Objectives



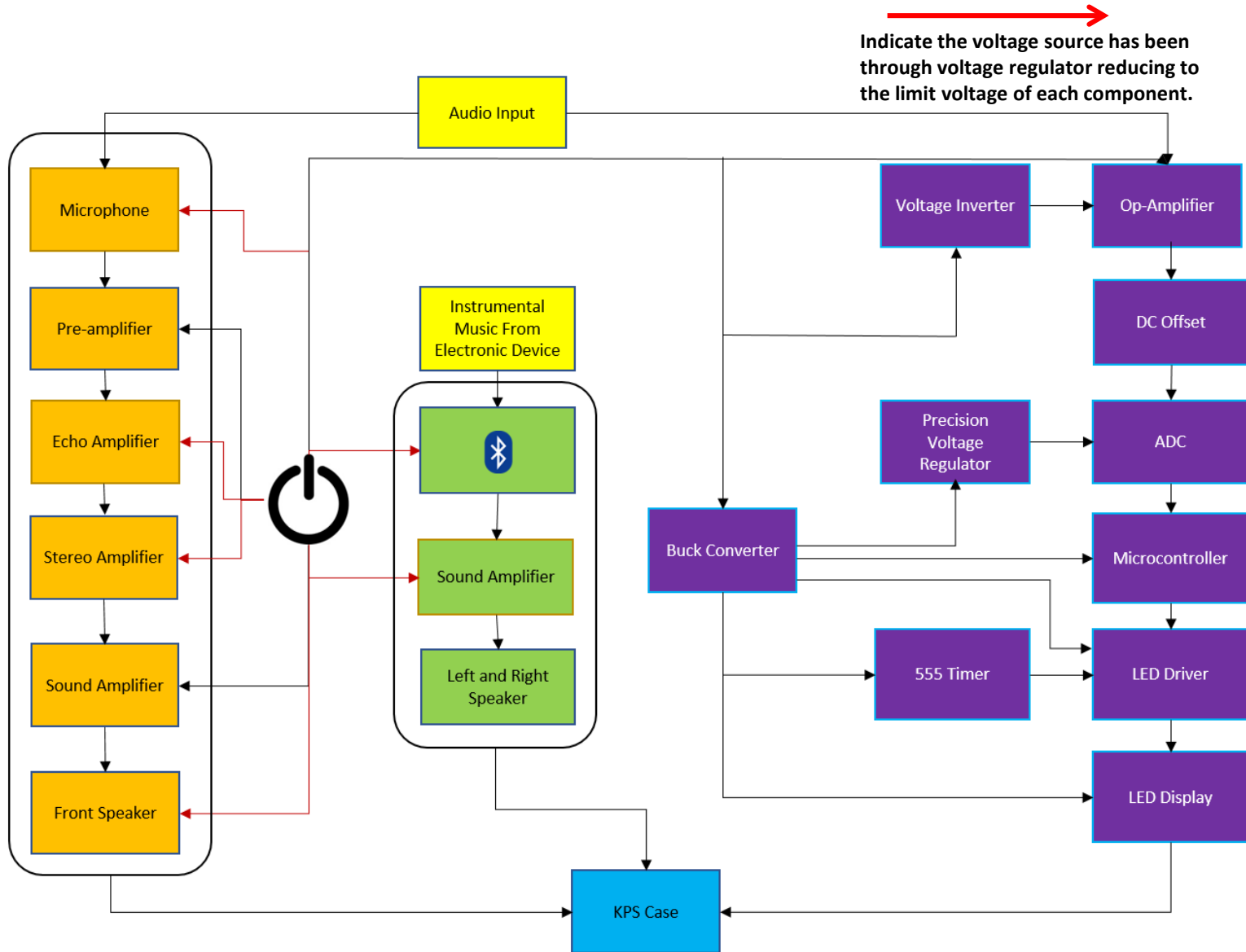
- Have a karaoke system that is portable
  - Provide performers the ability to sing to their favorite songs in front of an audience and access the songs on any device wirelessly.
    - KPS will bring the technology of Bluetooth to karaoke allowing for Karaoke to exist in any moment, and at any time.
    - Will connect to any cell phone (Apple or Android platform)
  - Three built in speakers
  - Audio and Voice effects
  - Lighting effects
  - Have a karaoke system that combines portable audio, voice and lighting into one device for karaoke, so that any one can put on an impressing show
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# Specifications

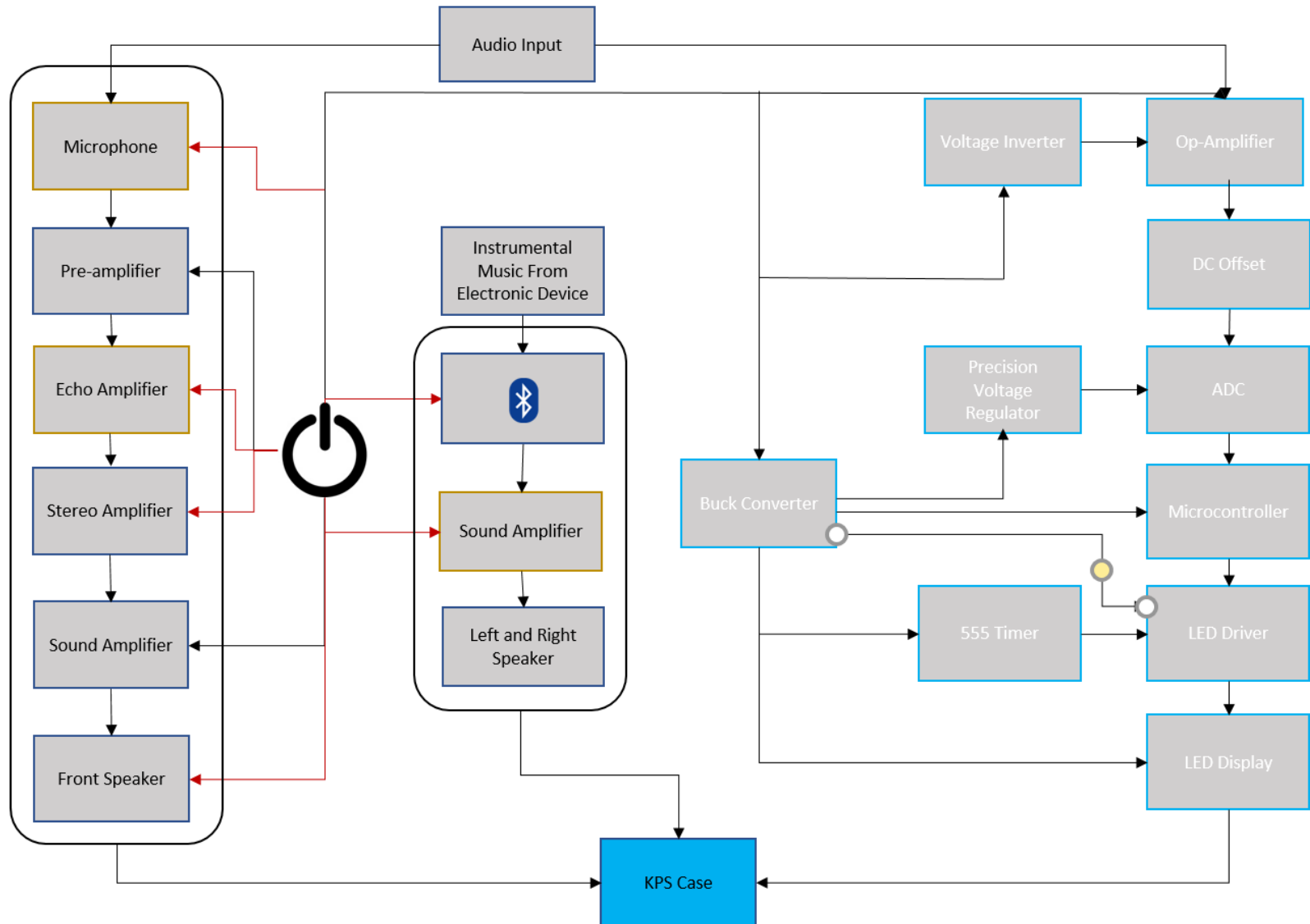
Weight	Less than 2lbs
Volume	1 dBA – 25 dBA
Frequency	100 Hz – 10 KHz
Battery	12V 9800mAh Lithium-Ion Rechargeable
Speakers	3 Speakers: 4 Ohms and 5 Watts
Supporting System	All Electronic Devices with Bluetooth
Bluetooth Range	Up to 10 Meters
Microphone	Condenser Microphone (2V-10Vdc)
LEDs	Display an Array of Colors
Costs	Around 300 USD



# Overall Block Diagram

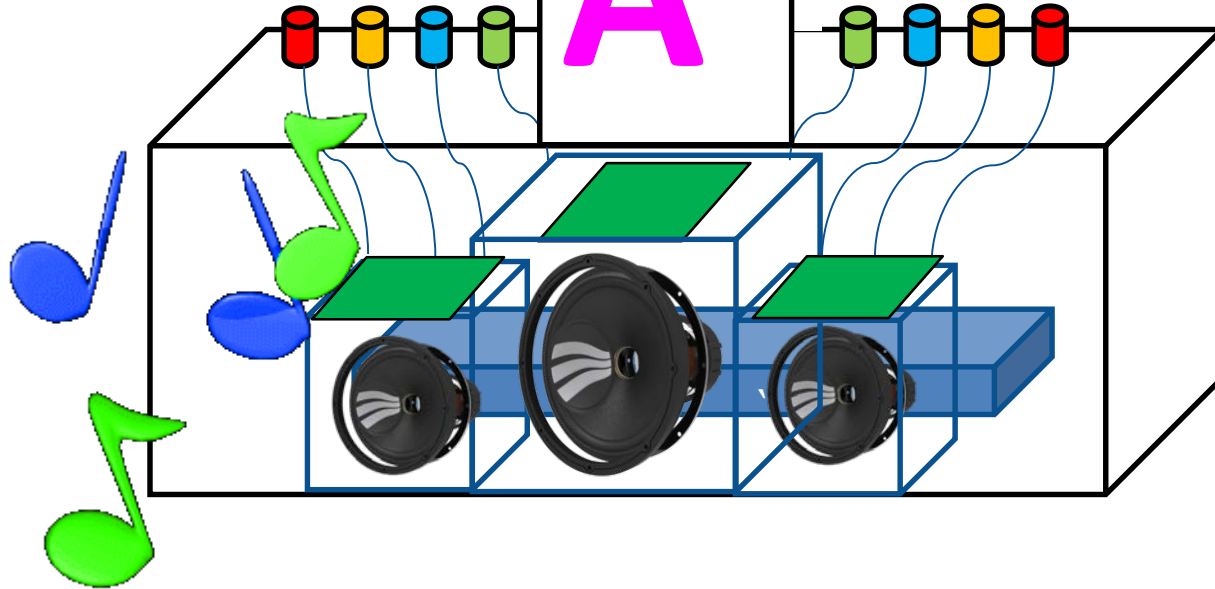


# KPS Case

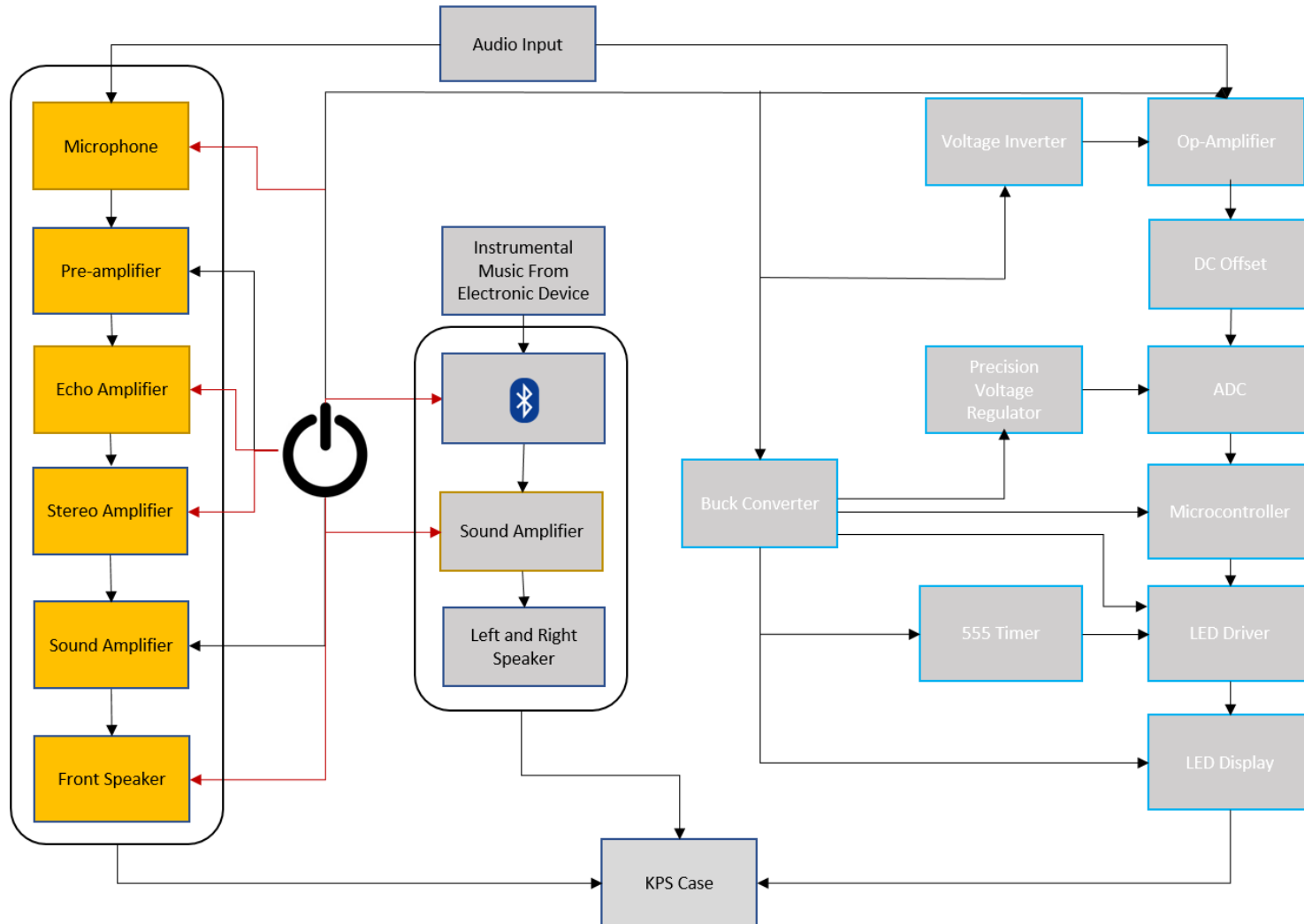




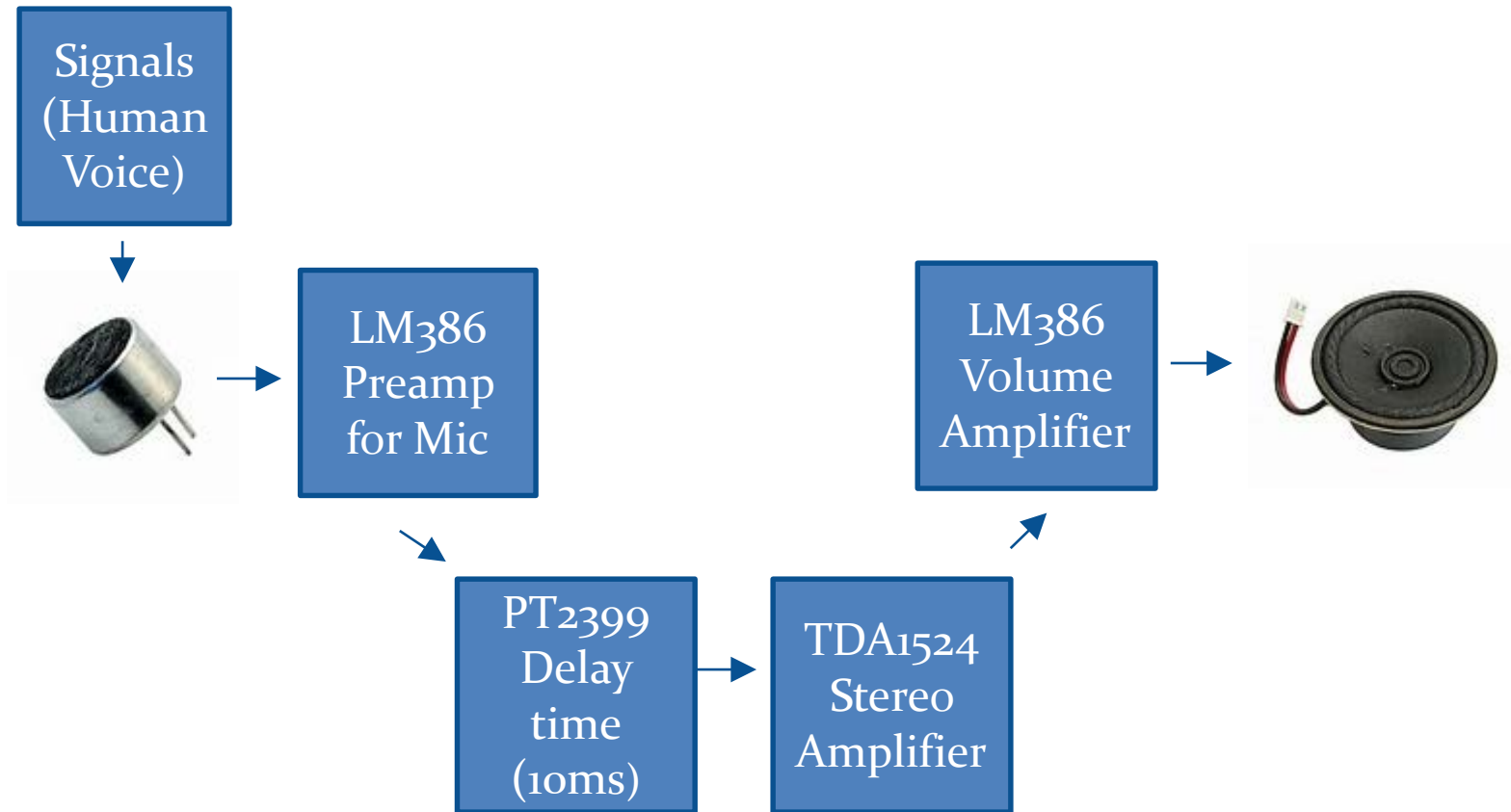
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# Microphone System

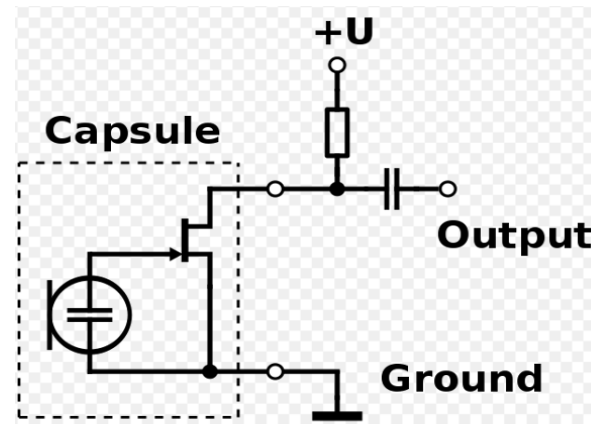


# Echo and Stereo Block Diagram



# Condenser Microphone

- Voltage Range: 2V – 10V
- Current Supply: 500uA
- Frequency Range: 30Hz ~ 15kHz
- Sensitivity: -42dB  $\pm$ 3dB
- S/N Ratio: 60dB
- Output type: Analog
- Direction: Omnidirectional
- Impedance: 2.2K
- Voltage – Rated: 2V

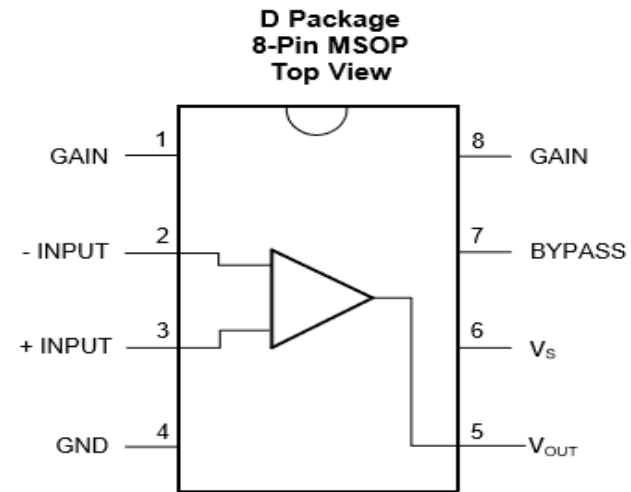




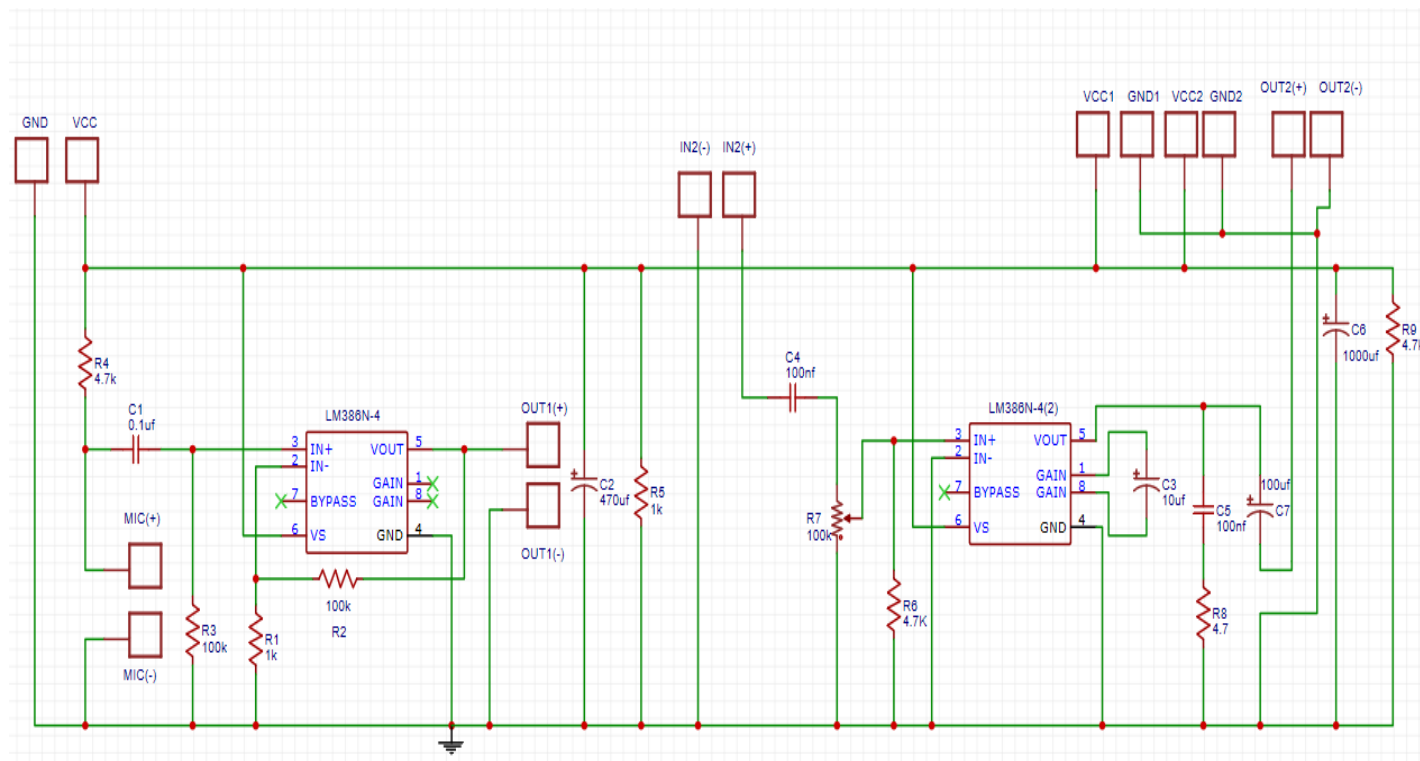
# Pre-Amp for Mic and Volume Amplifier(LM386)

- Packages: LM386N-1, LM386N-3, LM386N-4, LM386M-1, LM386MX-1, LM386MMX-1

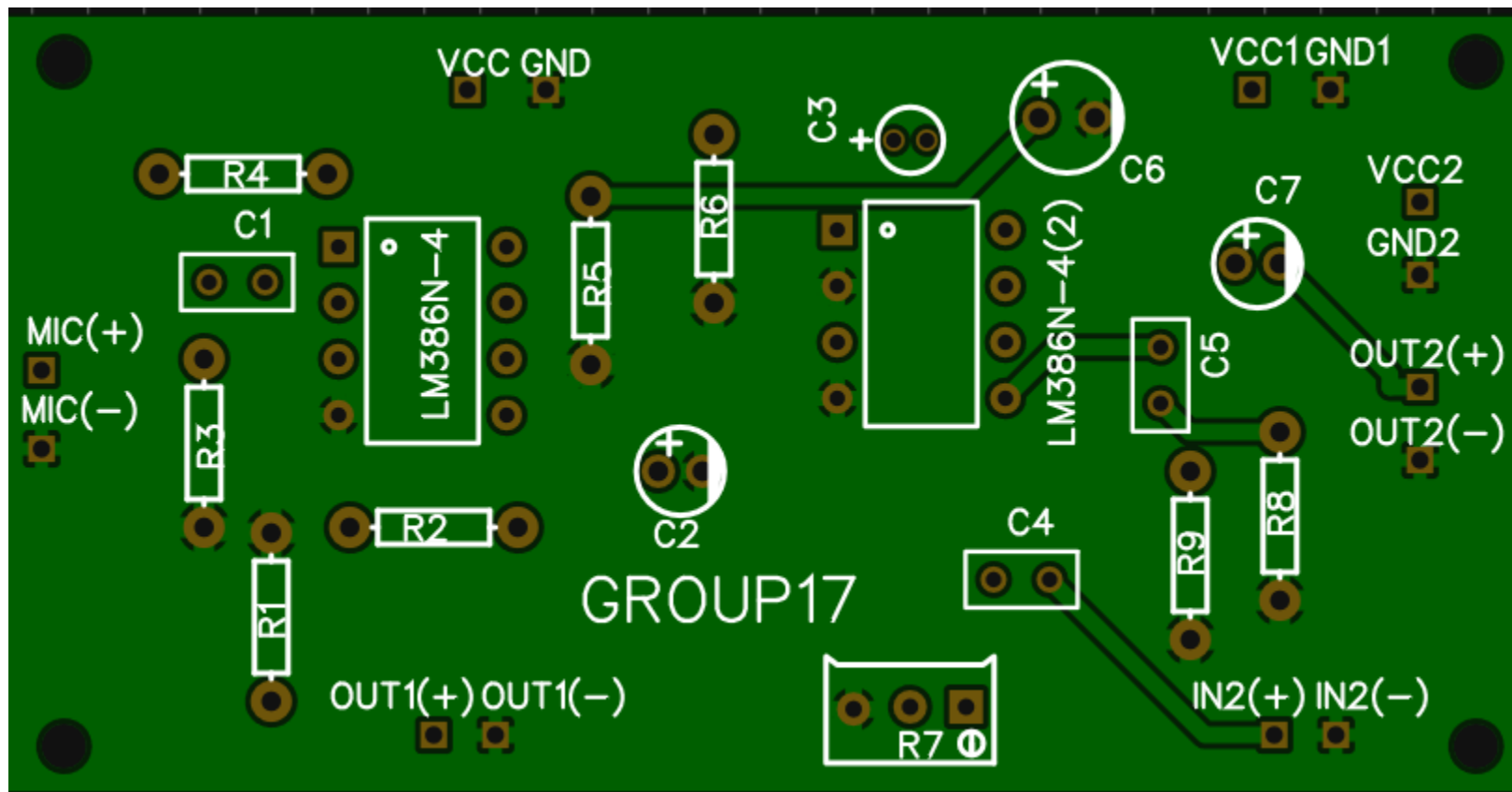
- LM386N-4 Specifications:
- Supply Voltage: 5V - 18V
- Analog input voltage:  $-0.4V - 0.4V$
- Operating free-air temperature:  $0 - 70^{\circ}C$
- Storage Temperature:  $-65^{\circ}C - 150^{\circ}C$
- Output Power: 0.7W - 1.3W
- Voltage Gain: **typical:** 26 dB  
**special:** 46 dB (put 10uF between pin 1 and pin 8)



# Preamp and Volume Amplifier Diagram(LM386N-4)

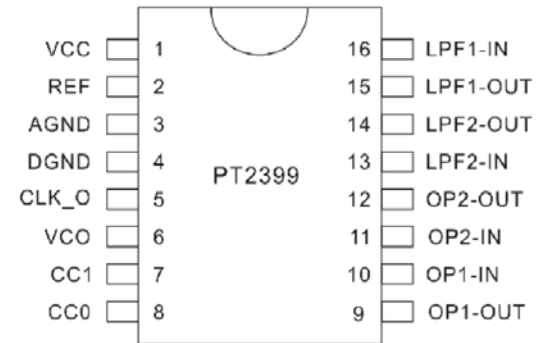


# Preamp and Volume Amplifier PCB

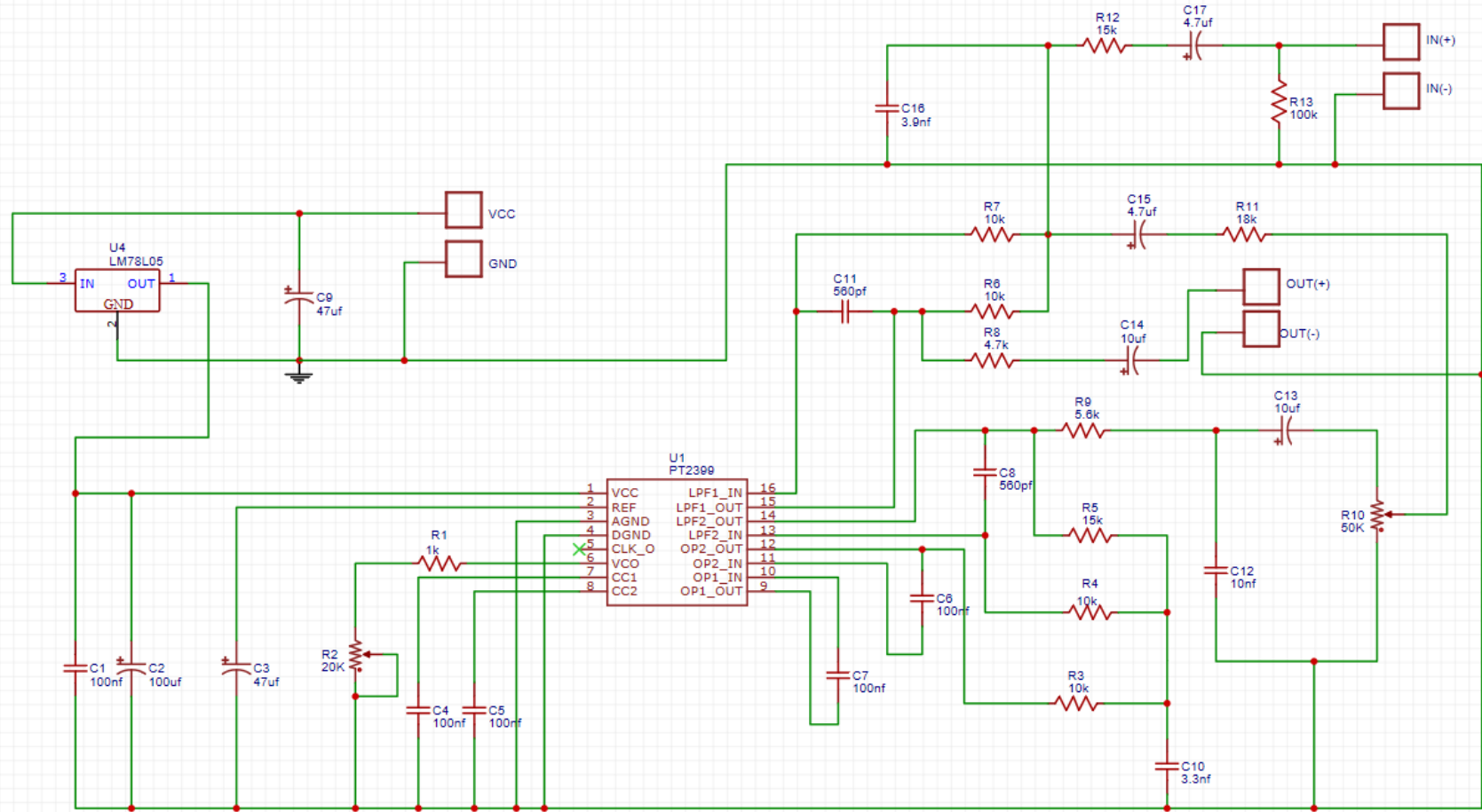


# PT2399 Delay Chip

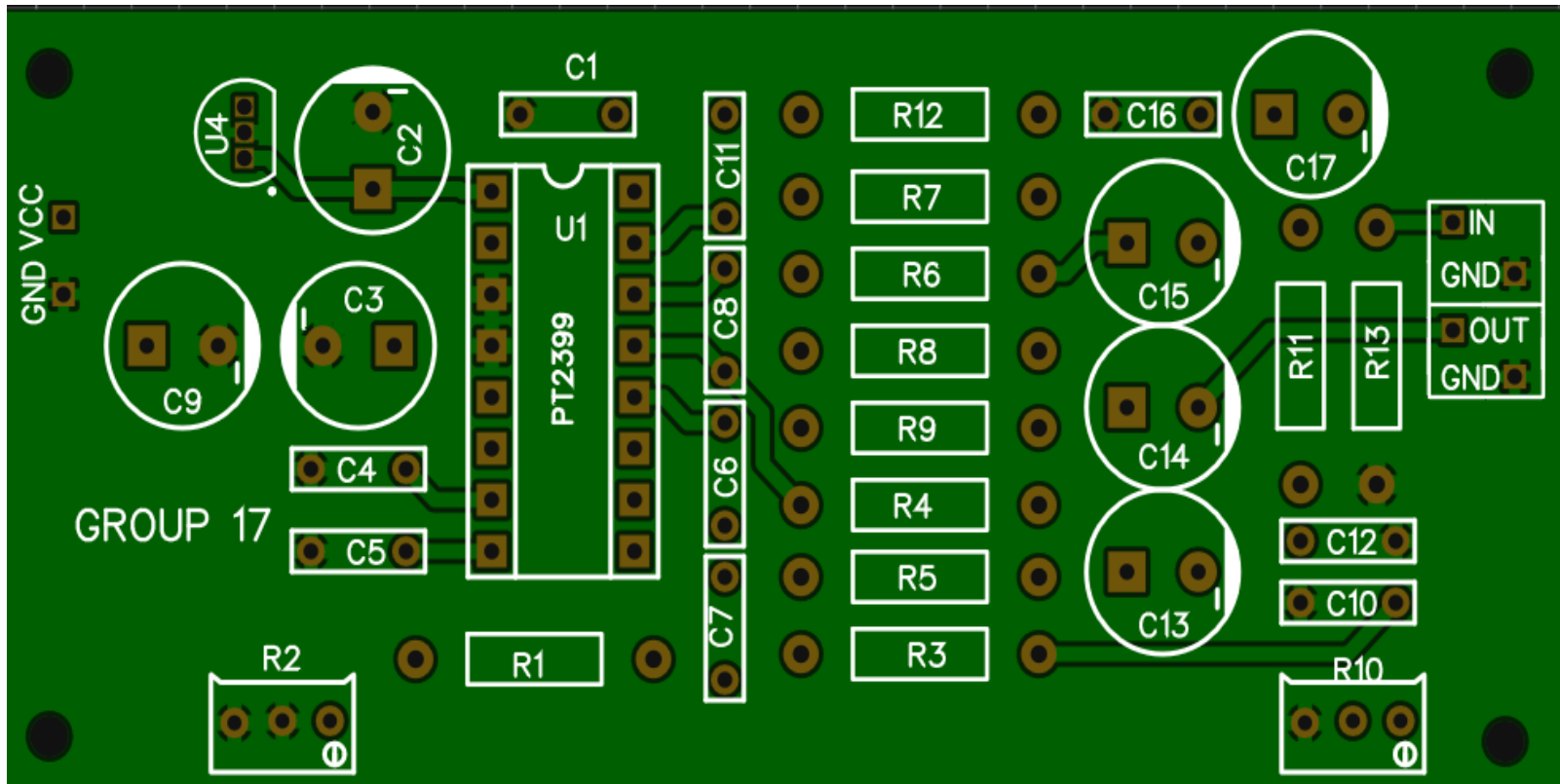
- Echo Digital Chip (ADC and DAC)
- Memory Storage: 44Kbit RAM
- Voltage Supply: 4.5V – 5.5V
- Voltage Gain: 0.5dB - 2.5dB
- Output Noise Voltage: -95 dBV - -80 dBV
- Pin 6: VCO uses to change the delay time by put a potentiometer



# PT2399 Circuit Diagram

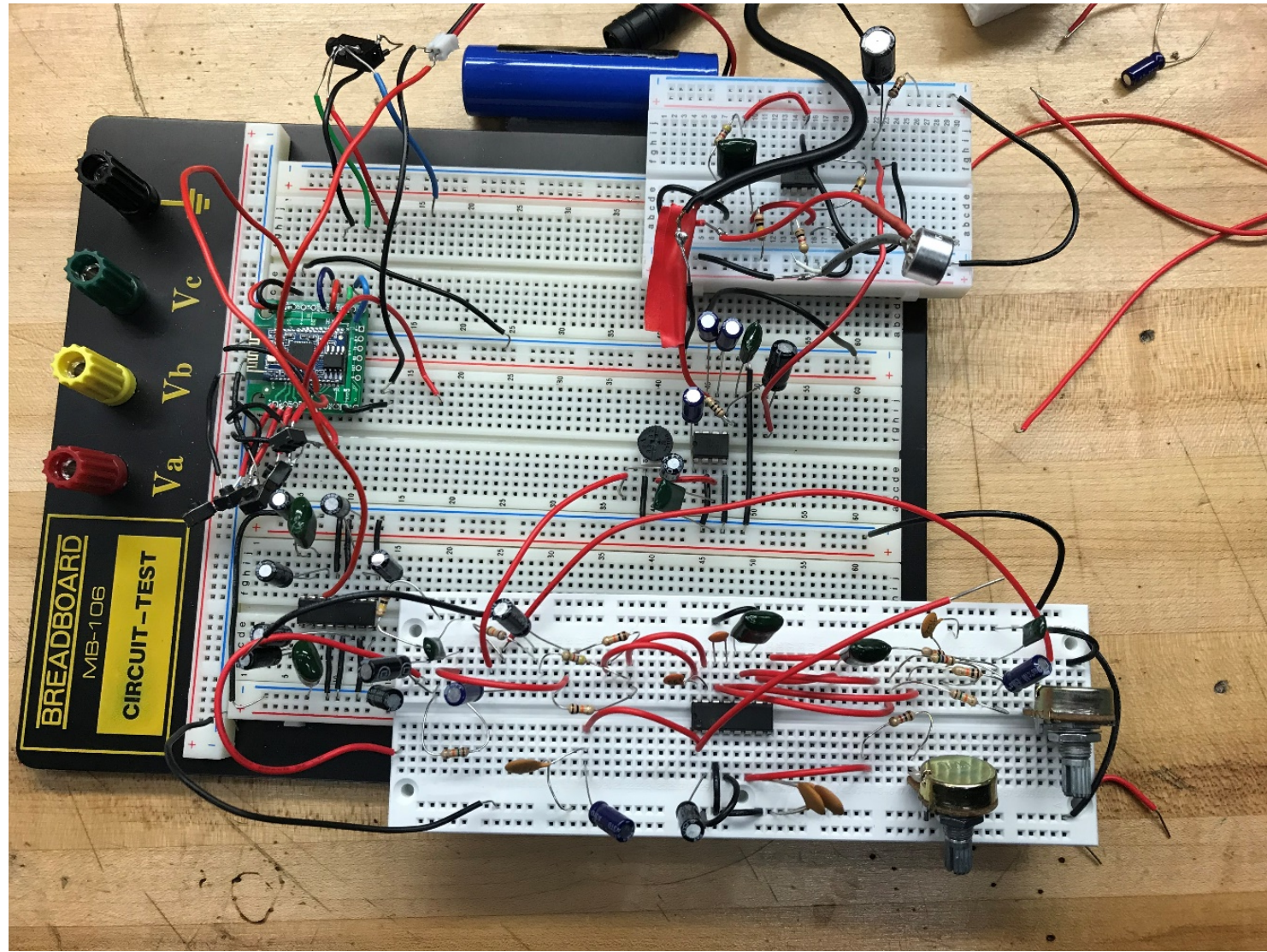



# PT2399 Delay PCB Board






# Echo Amplifier Prototype

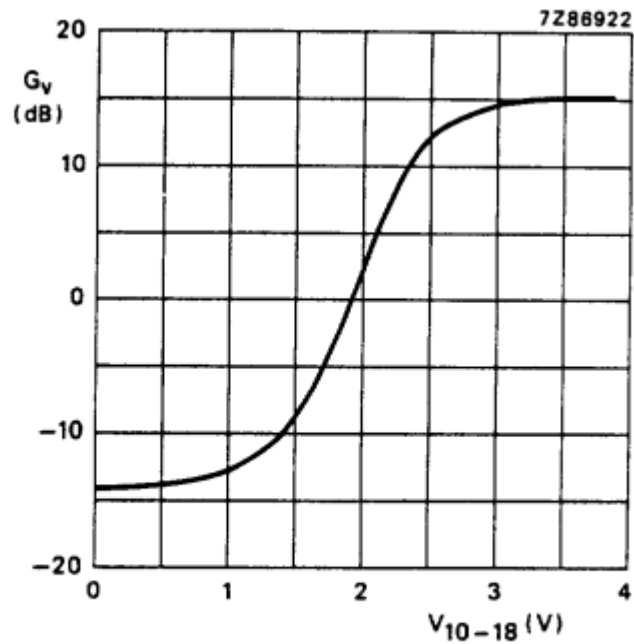




# Stereo Amplifier - Bass and Treble Amplifier (TDA1524A)

- To tone control the sound
  - Volume control, Balance, Bass and Treble tone controls.
  - 20 dB of voltage gain, +/-15 dB of bass and treble control
  - 12 Vdc Voltage Supply
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# Test Curves

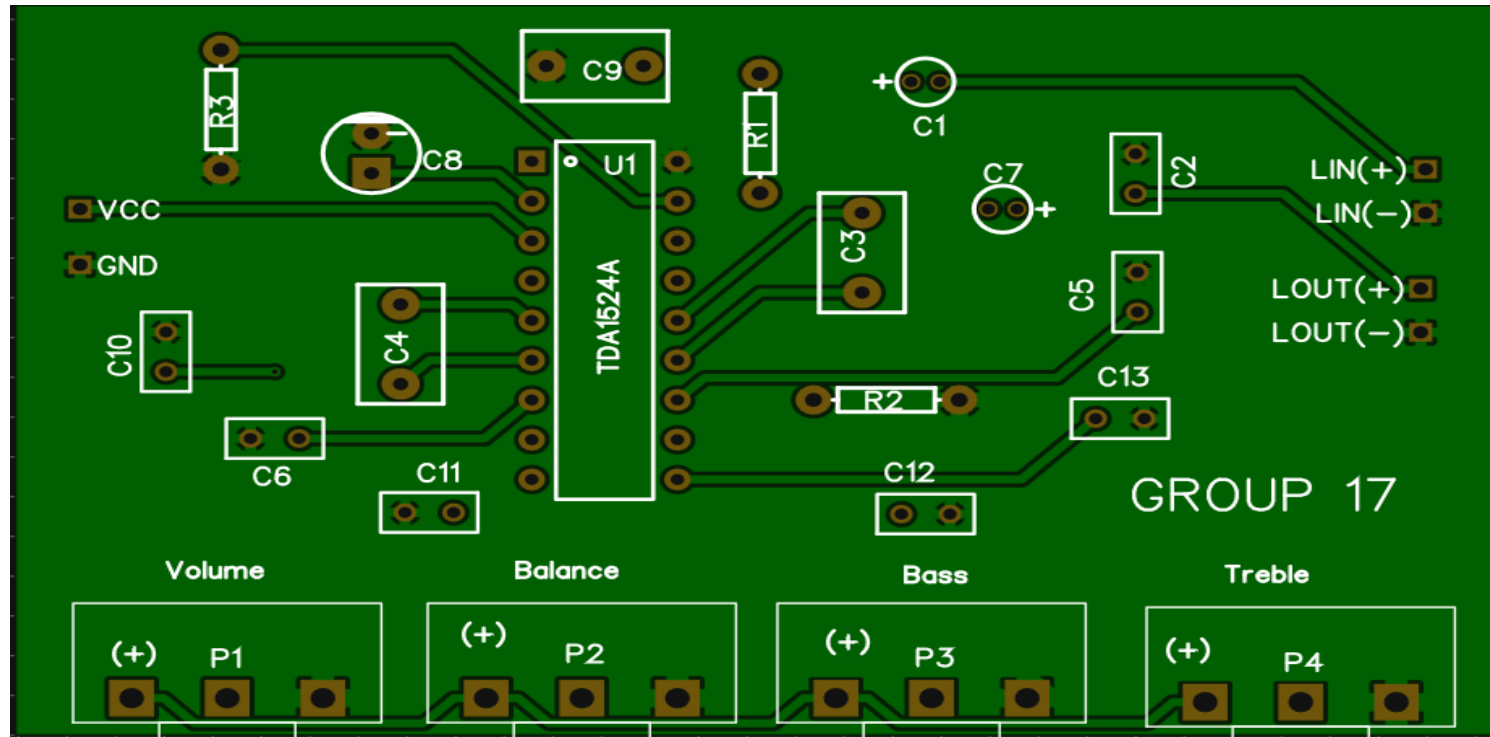


Treble control curve; voltage gain ( $G_v$ ) as a function of control voltage ( $V_{10-18}$ ).

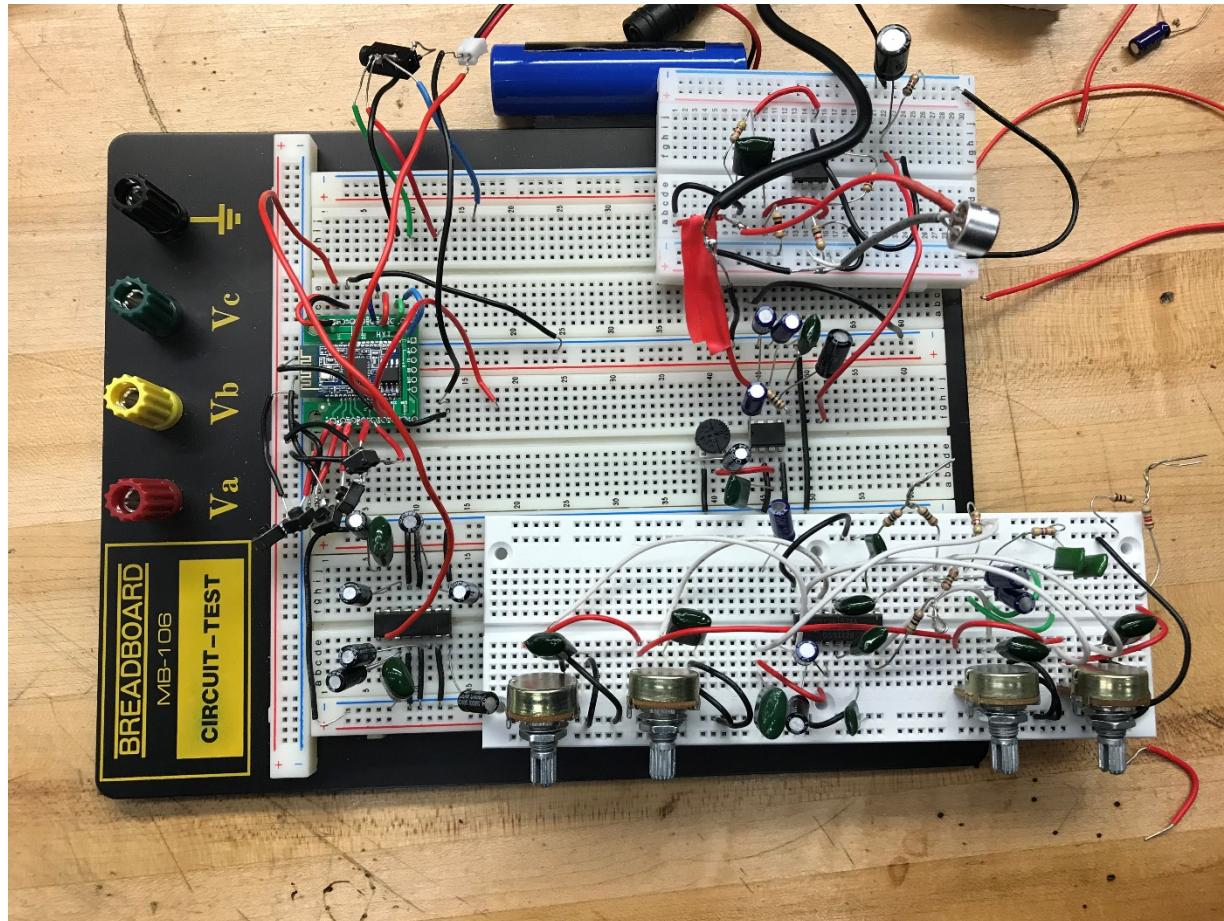




# Tone Control PCB board

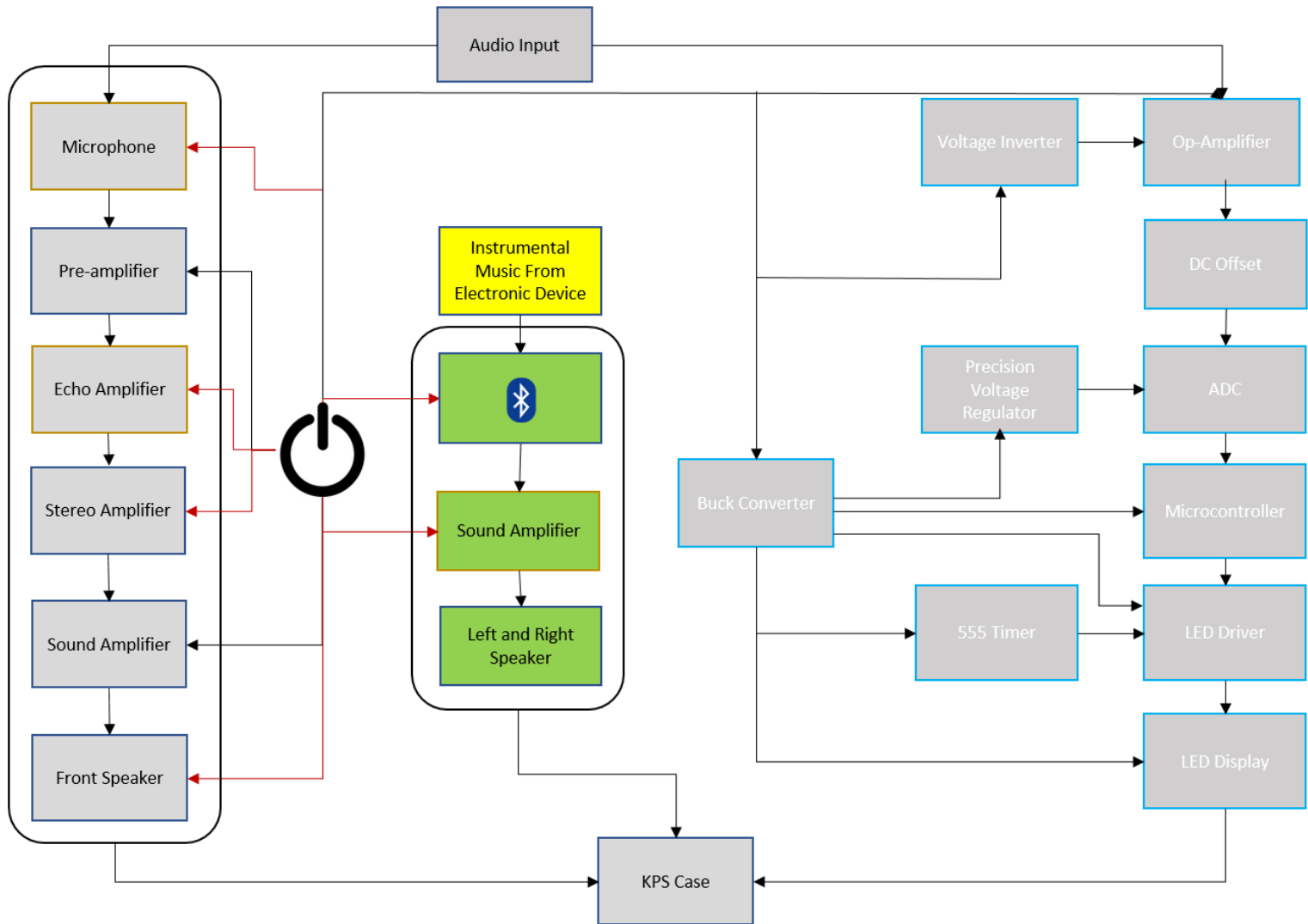


# Stereo Amplifier Prototype






# Instrumental (Beat) Music





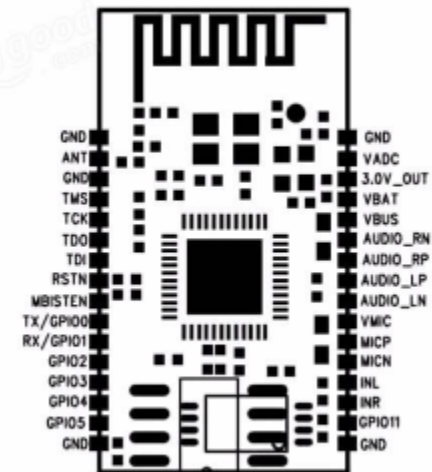
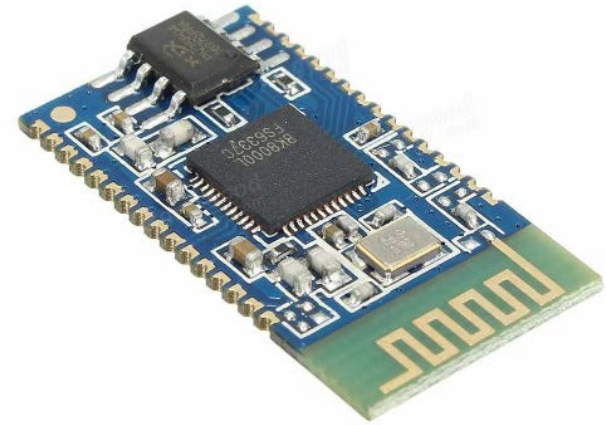
# Wireless Technology

- Wireless connection from electronic device (phone, laptop, tablet ,etc.)
  - Bluetooth technology with short range consumes less energy, fit for portable device.
  - BK8000L Bluetooth Module is chosen for this project
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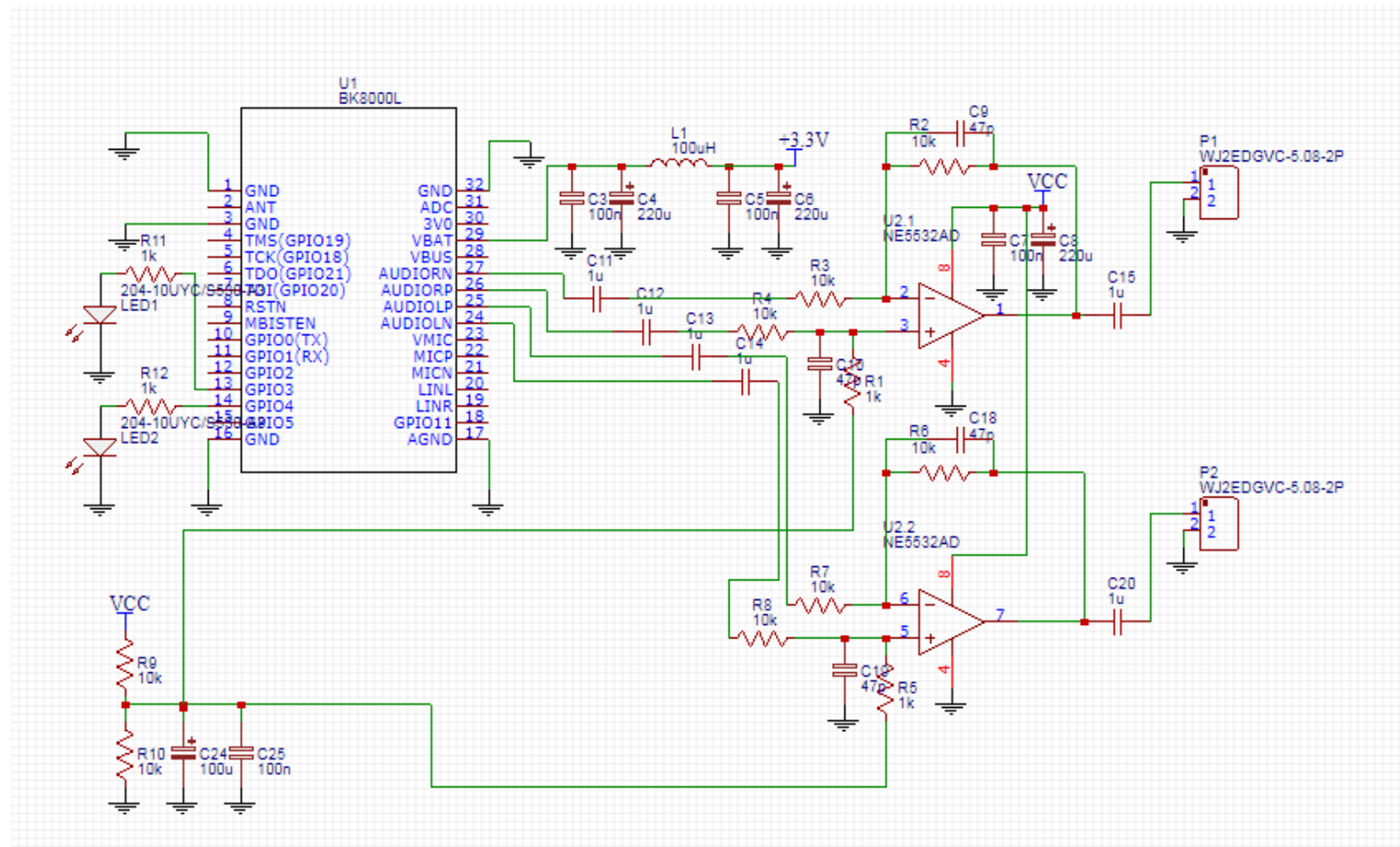
# BK8000L Stereo Bluetooth Module

## Specification:

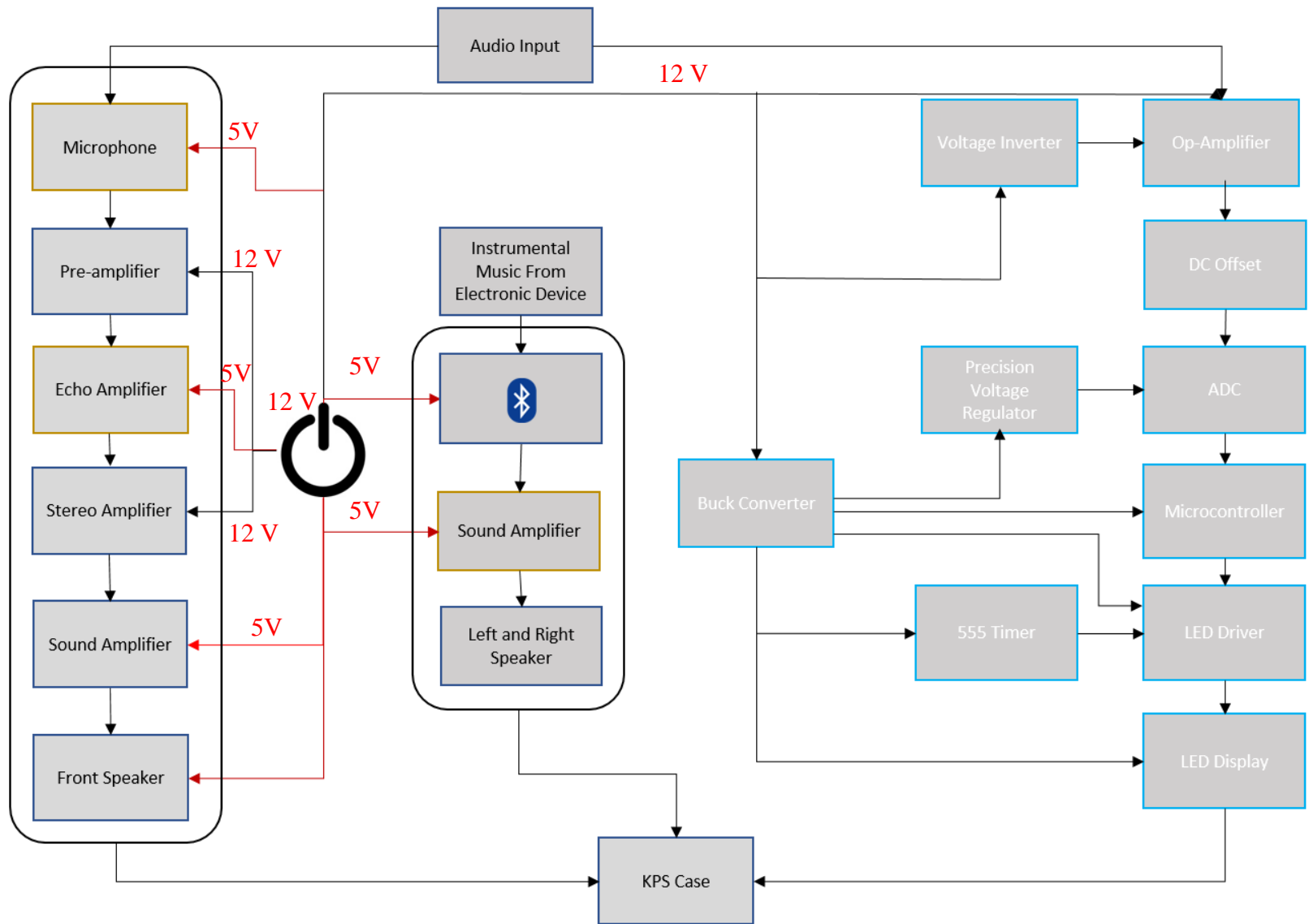
Manufacturer	Details
Power Supply	2.8-5V
Brand	Sparkfun
Interface	I2C & UART
Frequency Range	2.4GHz ~ 2.480GHz
Price	\$4
Wireless Transmission Range	<10 meters
Bluetooth Type	V2.1+EDR
Dimension	13.5 mm x 25 mm x 1.5 mm



# BK8000L Schematic




# Power System





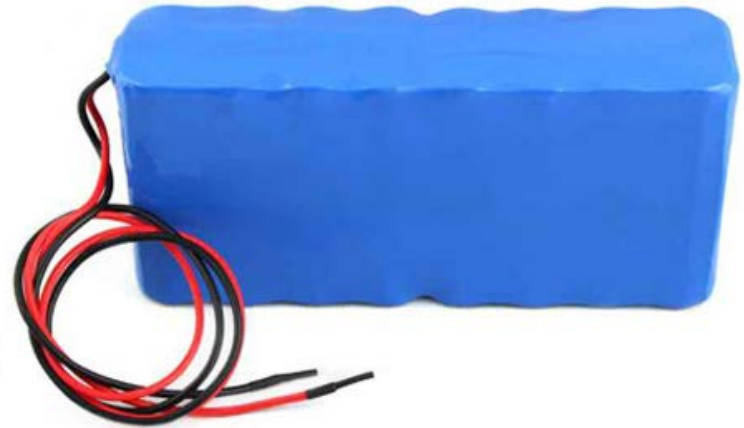
# Power

- We have multiple boards.
  - Extra board for power distribution does not fit into the project box
  - Voltage regulator for each board.
  - Using battery with 12V voltage supply.
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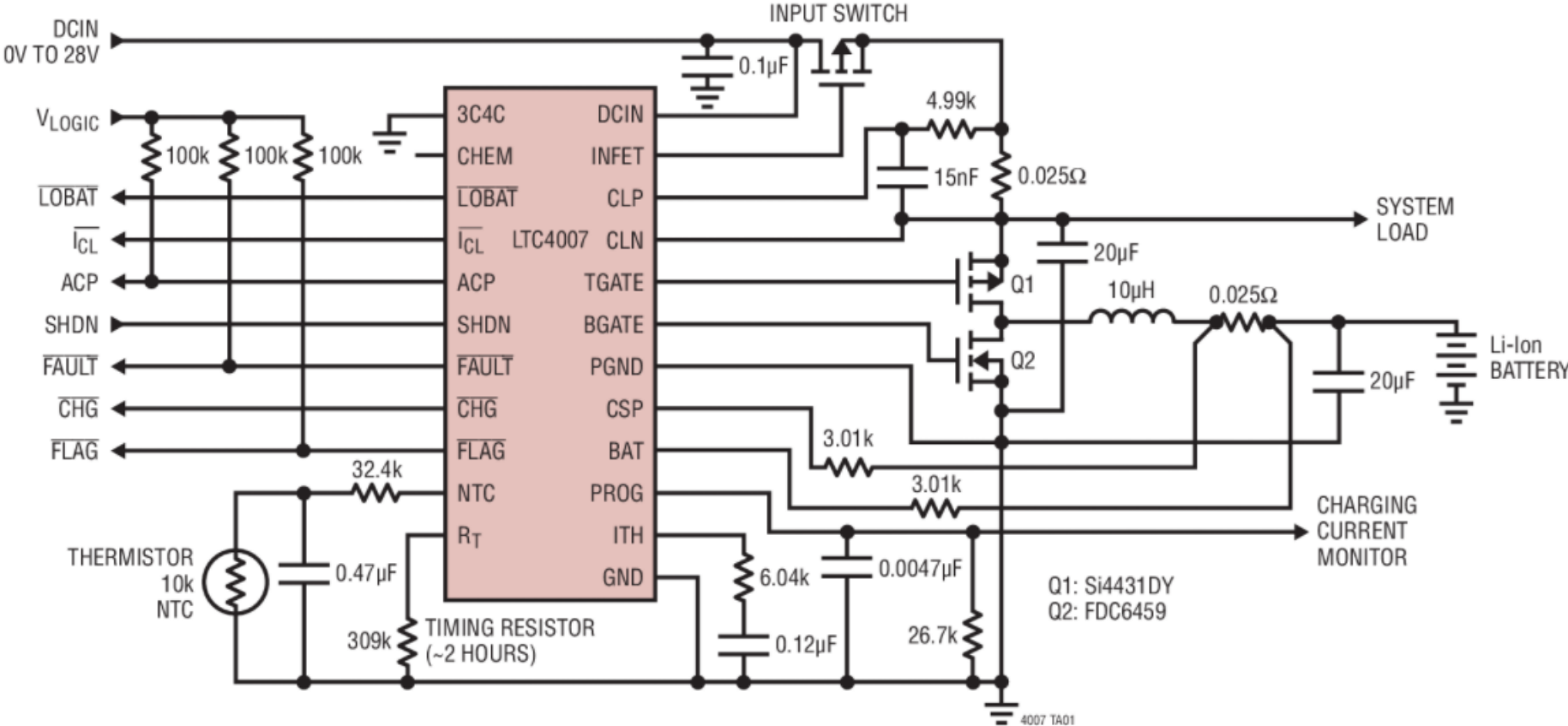
# Lithium-Ion Battery

- Rechargeable
- High energy density
- High capacity 9800mAh
- Low self-discharge
- Durable
- 10.8 – 12.6 V

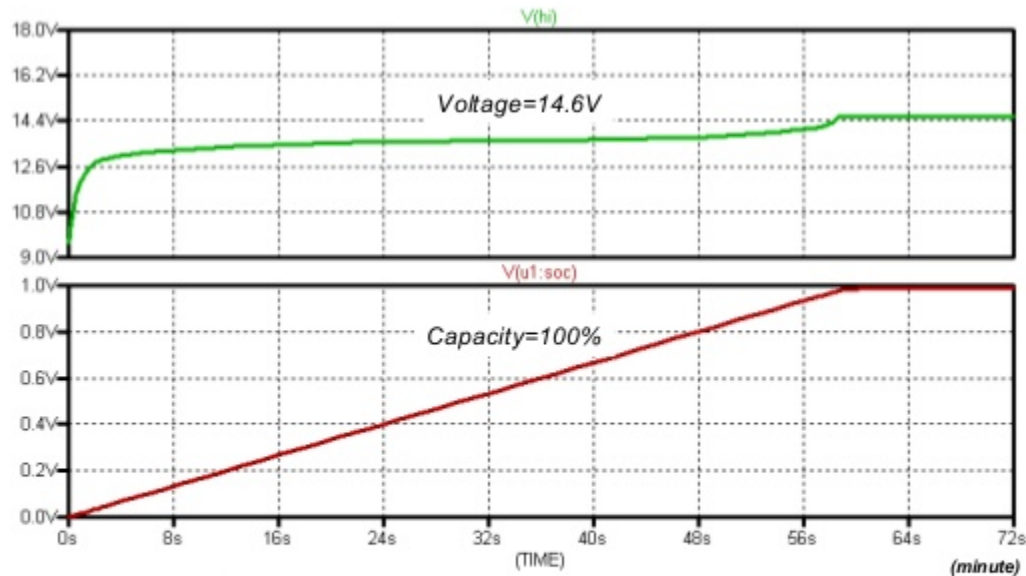


# LM3622 Battery Charger Circuit

## 12.6V, 4A Li-Ion Battery Charger



# Charging Characteristic

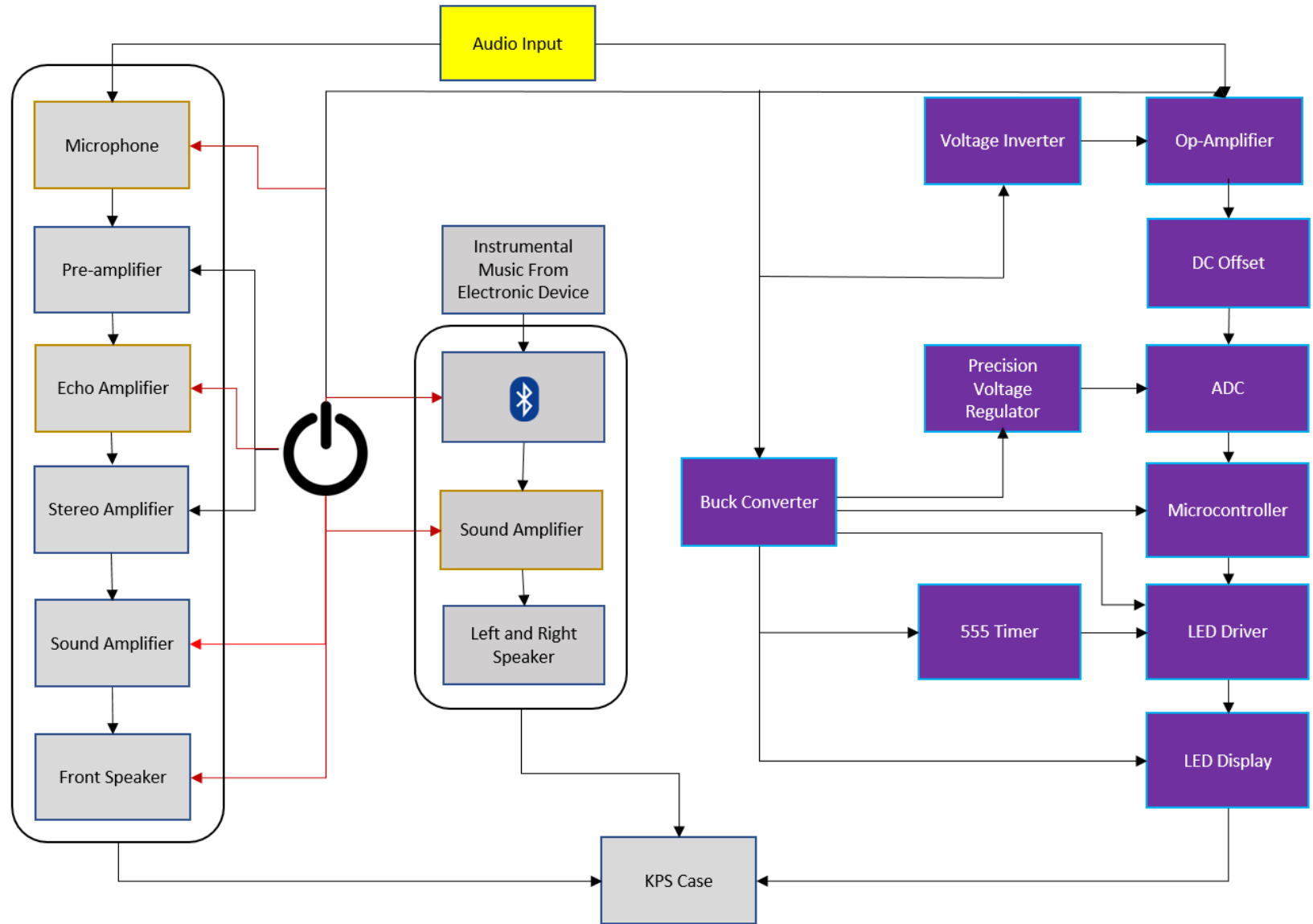


- Input Voltage: 20V
- Charging Voltage: 14.6V
- Charging Current: 10000mA (1 Charge)

# Power Consumption Calculation


Qty.	Devices	Working Current (mA)	Total Consumption (mA)
2	Pre-Amplifier (LM386)	4	8
2	Amplifier (LM386)	4	8
1	Tone Control (TDA1524)	50	50
1	Speakers 4 Ohms 5W	312	624
1	Speakers 4 Ohms 10W	625	625
1	Echo (PT2399)	100	100
1	Bluetooth Module	45	45
TOTAL			1460
	Battery = 9800 mAh	<b>≈ 7 hours</b>	

# LED DISPLAY

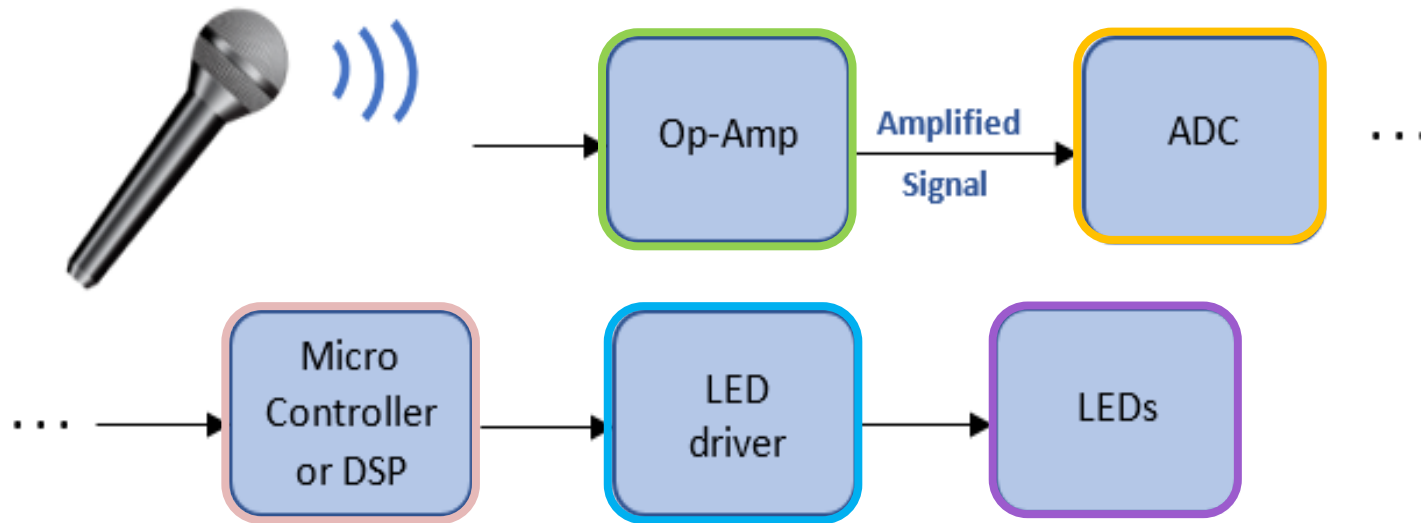


# LED Display Goals



- Map frequency to an LED
  - Multiple modes and color
    - Simple light show with configurable tempo
    - Random pattern and random color
  - No noticeable delay in light
  - Light changing speed, that can be changed to either slow or fast
  - Provide an effective lighting show, that could also aid in instruction and guidance for aspiring singers.
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# LED Display Block Diagram



# EMBEDDED TECHNOLOGIES

DSP



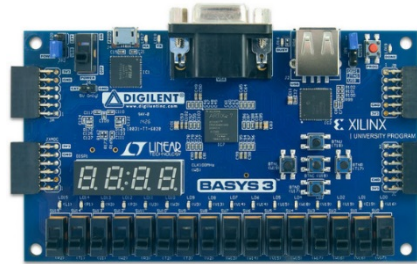
## PROS

- optimized for fast operational needs
- Can process data in real time
- Ideal for audio signal processing

## CONS

- Proprietary software
- Configuration of DSP chips can be complex
- Expensive break out boards

FPGA



## PROS

- Reprogrammable chips
- Provide hardware-timed speed and reliability
- Parallel in nature

## CONS

- Volatile memory
- Power consumption
- Requires more components

MCU



## PROS

- Familiarity
- Endless resource because of the open source nature.
- Onboard Memory

**ATMEGA328**

**ATMEGA2560**



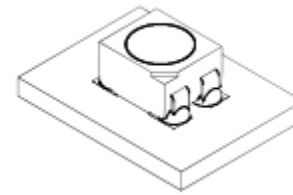
# ADC121S01: Analog to Digital Converter

Manufacturer	Series	Architecture	Resolution (bits)	Sampling Rate(Hz)	Cost
Maximum Integrated	MAX1243	SAR	10	73K	\$5.51
Texas Instruments	TLV2541	SAR	12	200K	\$4.55
	ADC121S101	SAR	12	1M	\$3.93
Analog Devices	AD7478	SAR	8	1M	\$3.90

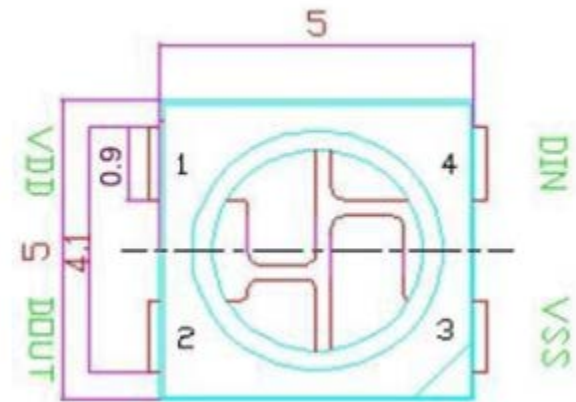
Reason for chip selection:

- Highest resolutions, highest speeds
- Relatively cheap, only falling second by three cents to the Analog Devices AD7478

# RGB LED - Worldsemi



- Part: WS2812B
- Addressable RGB LED
- LEDs are configured to work well with the WS2811 driver.
- Input voltage: 5
- 20 mA of current draw
- Small in size

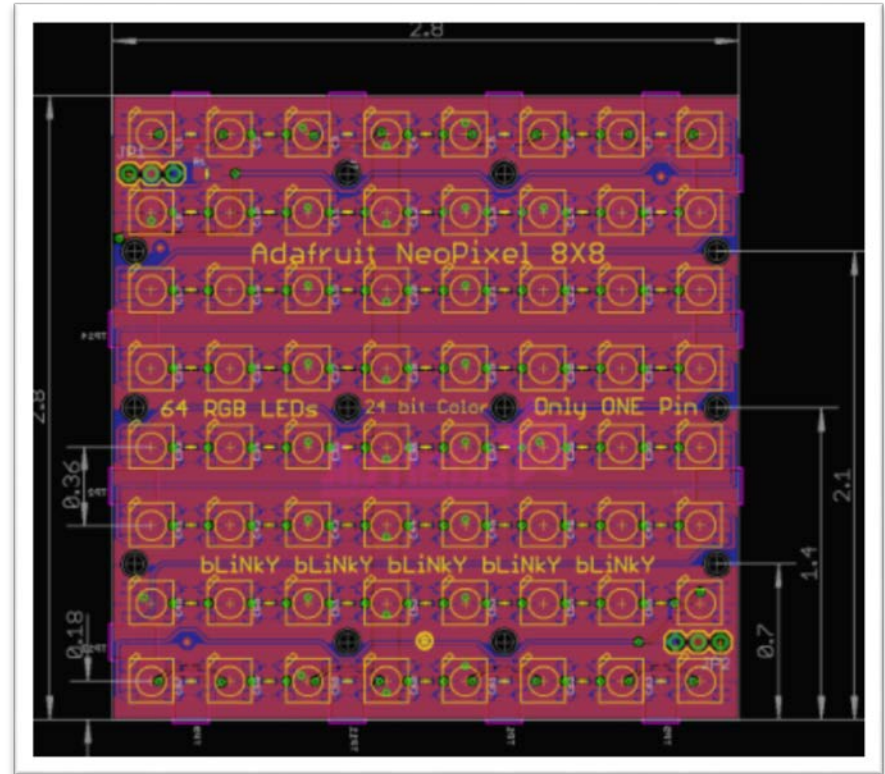


Common Anode (+)



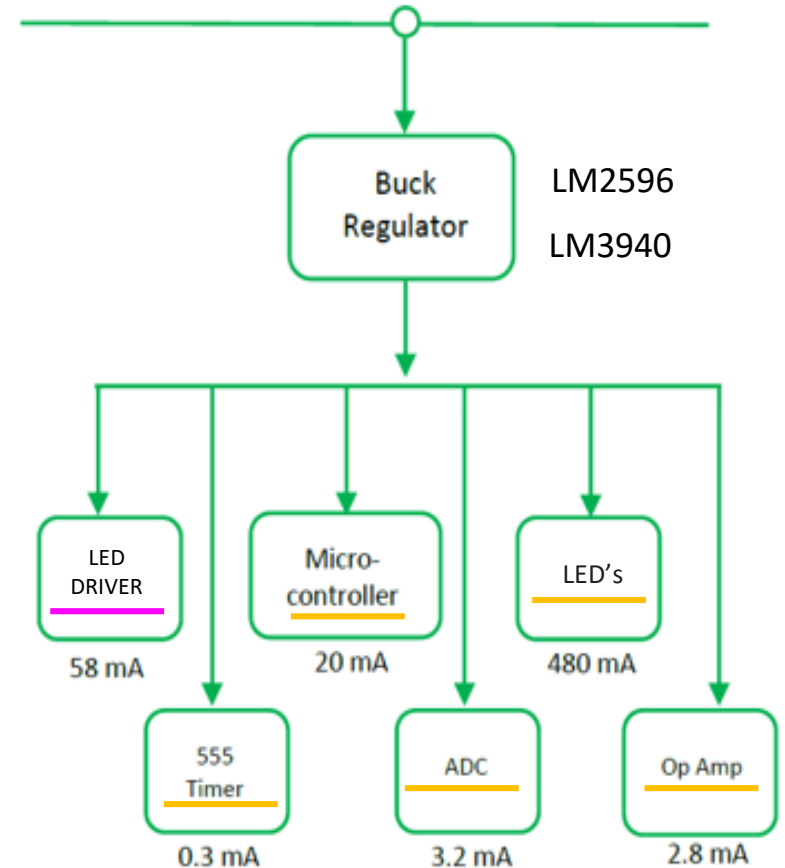
# NeoPixel: 64 RGB LED Pixel Matrix

- 64 LEDs each with three outputs (R, G, B). An integrated driver is used to configure the LEDs.
- WS2811 driver: 3 channel constant current LED drive IC
- LED power supply voltage up to 10V
- Scan frequency not less than 400Hz/s

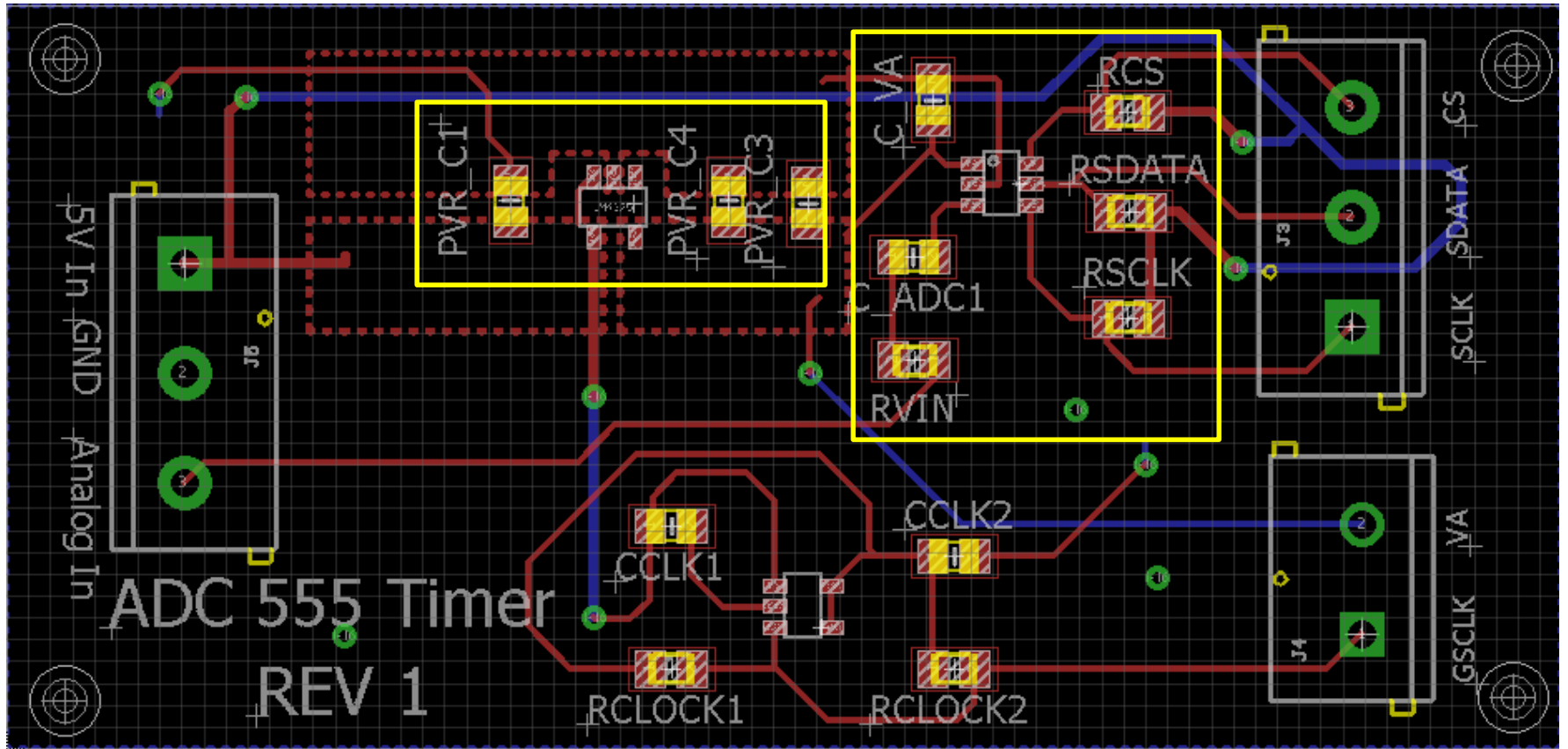


# Powering the LED Display

	PER UNIT			TOTAL
	Min Voltage	Max Voltage	Max Amperage	
<b>TLC5955</b>	-3V	+5.5V	29mA	60mA
<b>ADC121S101</b>	+2.7V	5.25V	3.2mA	
<b>MIC 1555</b>	+2.7V	+18V	300μA	
<b>ATMEGA 2560</b>	4.5V	5.5V	2.0mA	
<b>OPA376</b>	2.2V	5.5V	1mA	
<b>LEDs</b>			20mA	480mA



# LED Display PCB -ADC

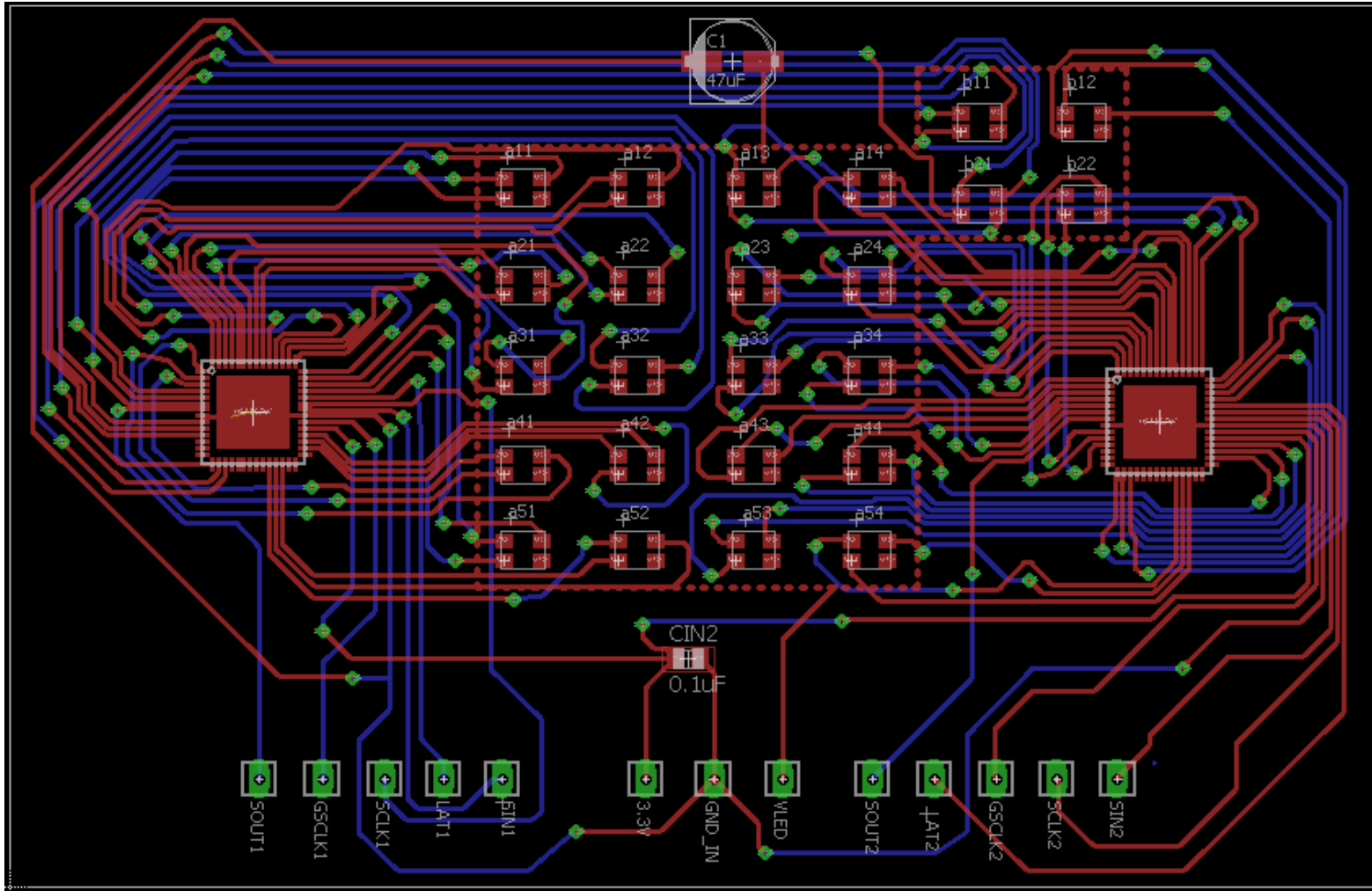






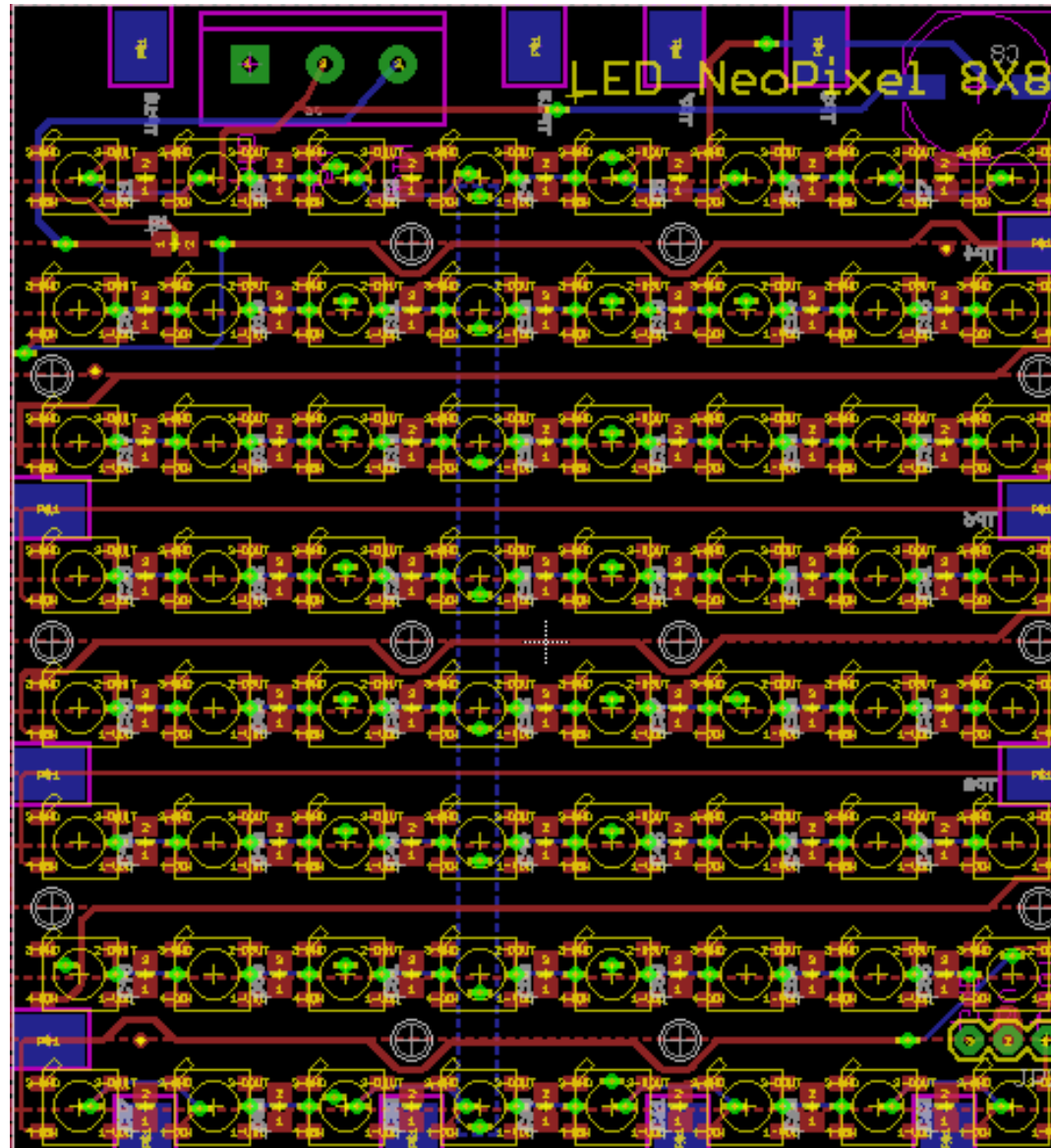


# LED Display PCB

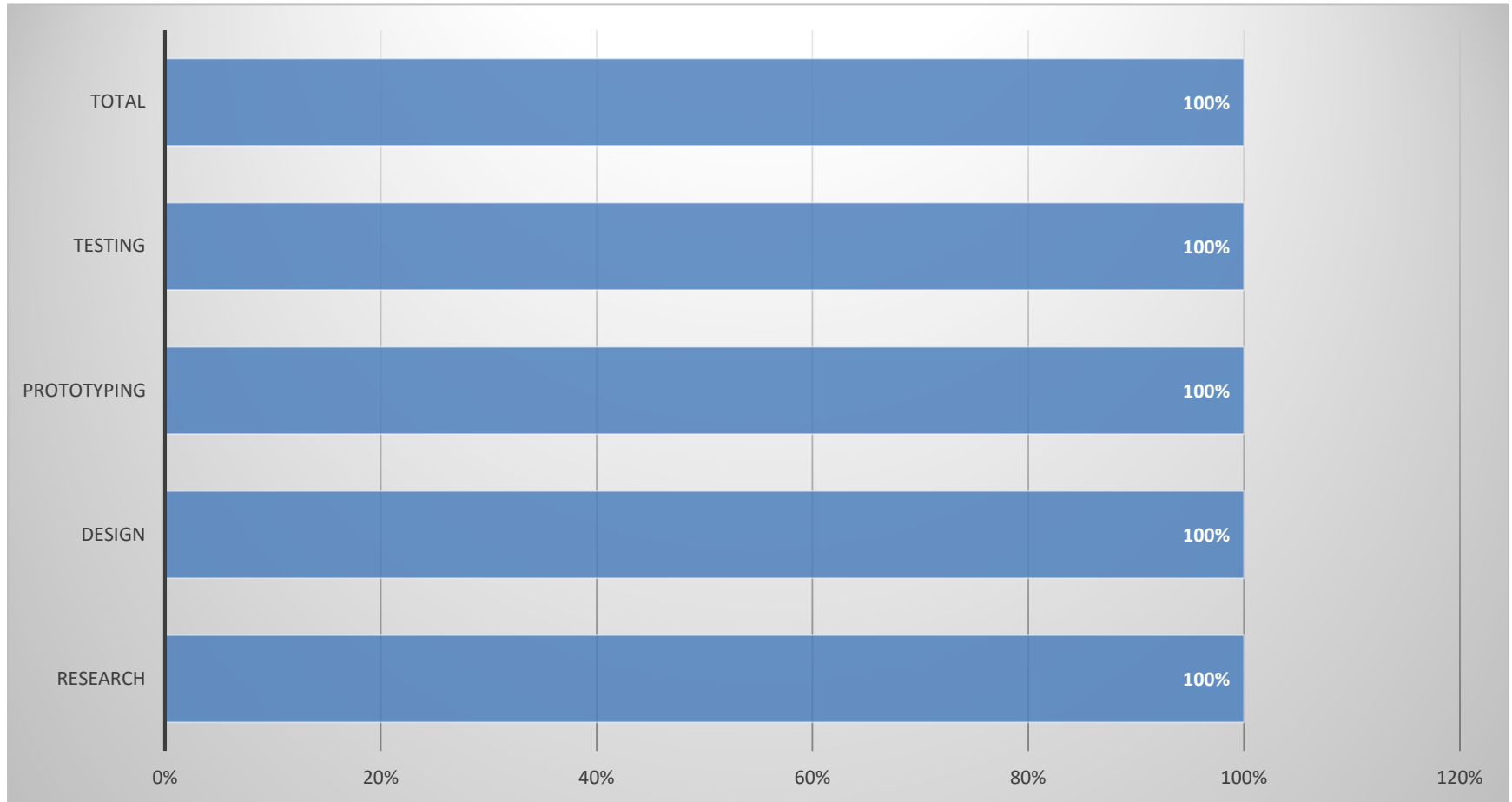




# LED Display PCB



# Progress



# Budget


## KPM Parts List

Description	Price per Unit	Developing Amount	Developing Total	Project Amount	Project Total
Charging Cable	Donate	1	\$0	1	\$0
TDA1524A	\$2	10	\$20	1	\$2
PT2399	\$2	10	\$20	1	\$2
LM386	\$3	10	\$30	2	\$6
Audio/Recording Cable	Donate	1	\$0	1	\$0
PCB Boards	\$20	10	\$200	6	\$120
Electret Microphone	\$2	10	\$20	2	\$4
Cover (Fiber Glass)	\$100	0	0	1	\$100
Speakers	\$8	5	\$40	3	\$24
Rechargeable Battery	\$20	2	\$40	1	\$20
Bluetooth Module	\$15	3	\$45	1	\$15
Microcontroller	\$15	1	\$15	1	\$15
LEDs	\$0.75	30	\$40	30	\$40
Misc.	\$30	2	\$60	1	\$30
<b>TOTAL</b>			<b>\$530</b>		<b>\$378</b>



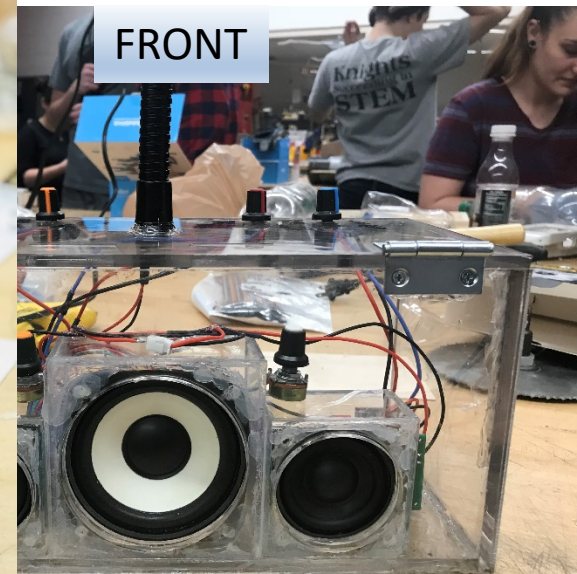
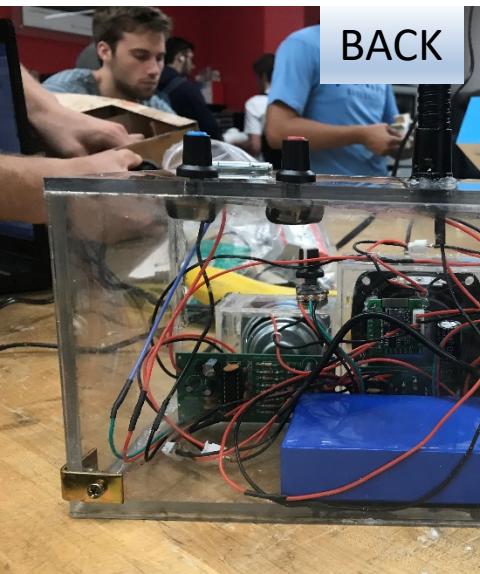
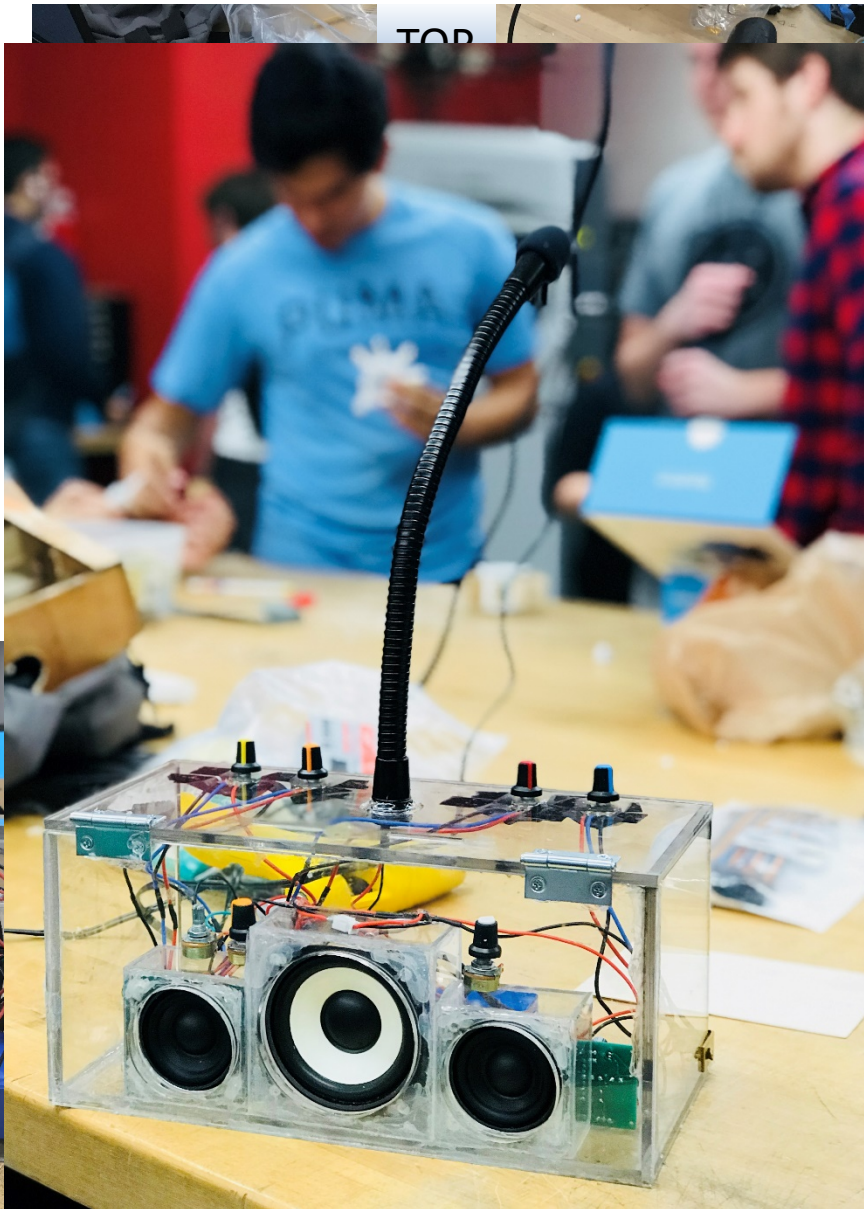
# Challenges vs. Solutions

<b>Challenges</b>	<b>Solutions</b>
Noise + Distortion	- Research and build filter to the amplifiers
Many circuits -> Errors	- The case can be opened to repair PCBs.
Huge PCB board + Small and Portable Device	- Separate the circuits into 4 PCB boards and mount them on the case. -Easy to find error.





# Picture

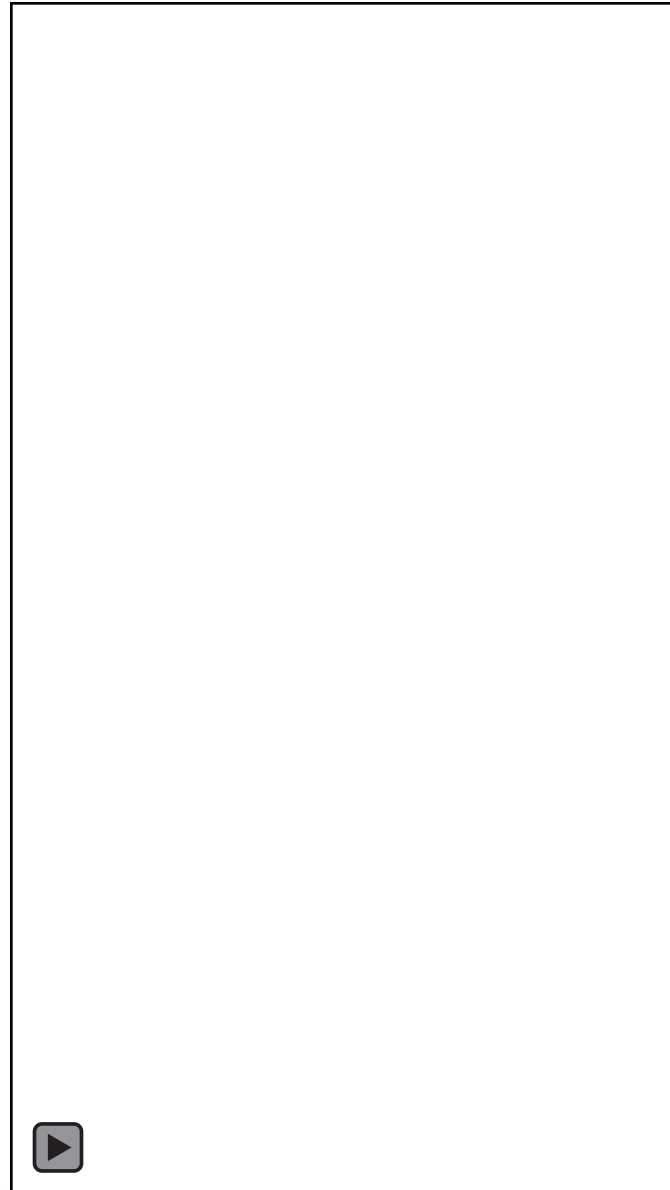




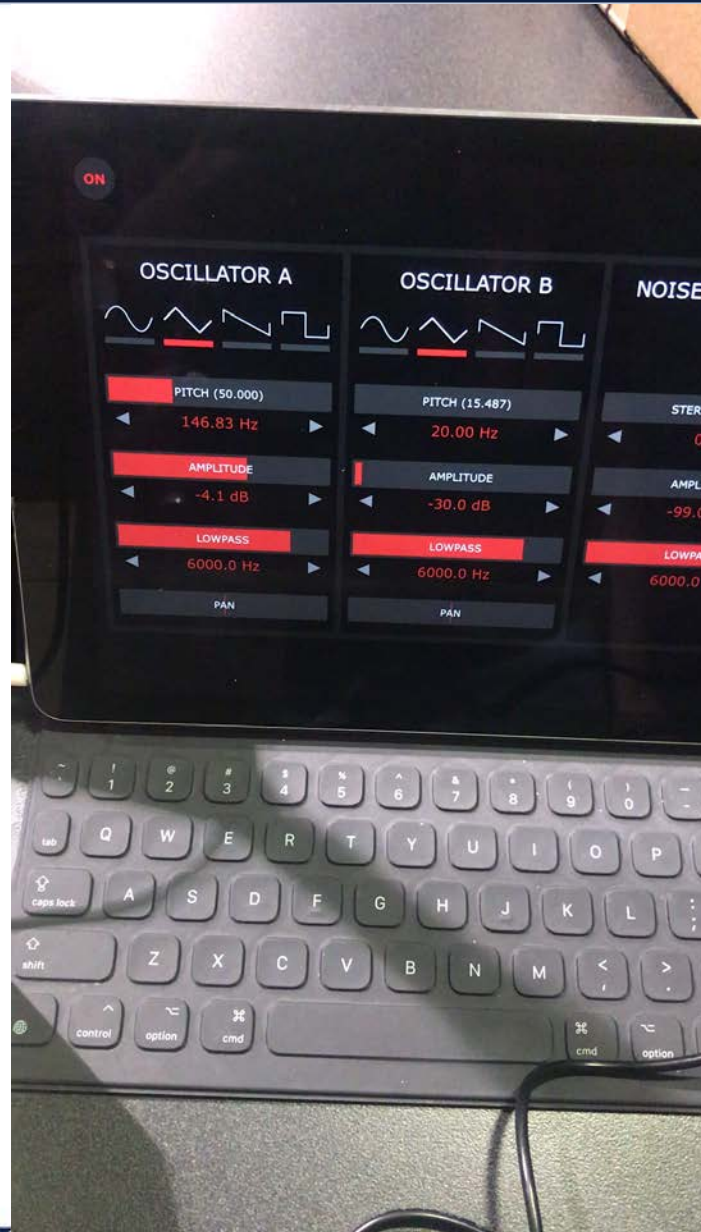
# Picture



# Video



# Video





# What's next?

- Create Website
- Complete paper
- Graduate

# QUESTIONS?

