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**Project:**  
**LM386 Based Audio Amplifier Circuit**

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# TABLE OF CONTENTS

<b>ABSTRACT.....</b>	<b>2</b>
<b>CHAPTER 1:.....</b>	<b>3</b>
<b>INTRODUCTION TO AUDIO AMPLIFIER.....</b>	<b>3</b>
1.1 Definition and Varieties of Amplifiers.....	3
1.2 Electronic Amplifier Types and Applications .....	3
1.3 Role of Microphone-Based Amplifiers in Audio Systems.....	3
1.4 Purpose and Working Principle of Microphone-Based Amplifiers .....	3
1.5 Significance of Microphone Amplification .....	3
1.6 Block diagram .....	4
1.7 Block diagram description .....	4
<b>CHAPTER 2:.....</b>	<b>5</b>
<b>Background .....</b>	<b>5</b>
2.1 What is amplifier? .....	5
2.2 About ic LM386 .....	5
<b>CHAPTER 3:.....</b>	<b>7</b>
<b>CIRCUIT DESIGNER.....</b>	<b>7</b>
3.1 Schematic Diagram of LM386 Audio Amplifier.....	7
3.2 Components Required for LM386 Audio Amplifier Circuit.....	7
3.3 Stimulation .....	8
3.4 Breadboard circuit .....	11
3.5 Sound test.....	11
<b>CONCLUSION .....</b>	<b>12</b>
<b>REFERENCE .....</b>	<b>13</b>

## **ABSTRACT**

This project centers on the development of an audio amplifier employing the LM386 low voltage audio power amplifier to amplify frequencies spanning 15 Hz to 20 kHz. The amplifier design adopts a single-stage configuration, utilizing a solitary transistor to augment weak input signals. By applying the input signal to the transistor's base, a minute base current initiates within the input circuit. Through the inherent action of the transistor, this small current undergoes amplification, resulting in a substantially larger alternating current (AC) output signal, effectively achieving the desired amplification.

The focus of this report encompasses the comprehensive design process, encompassing meticulous component selection, circuit setup, and construction. Rigorous experimental testing was carried out to verify the amplifier's functionality within the specified frequency range. Rigorous assessments, including evaluations of voltage gain, frequency response, and distortion levels, were conducted to gauge the amplifier's performance within the targeted frequency spectrum. Special attention was given to assessing the LM386's effectiveness as a low voltage audio power amplifier, ensuring its compatibility and efficiency for the intended audio amplification application.

# **CHAPTER 1:**

## **INTRODUCTION TO AUDIO AMPLIFIER**

### ***1.1 Definition and Varieties of Amplifiers***

Amplifiers constitute an essential electronic component that magnifies the amplitude of an input signal. These devices are diverse and categorized based on their circuit configurations and operational modes. Small signal amplifiers, specifically, play a crucial role in amplifying minute input signals, often derived from sensors like microphones, to a level suitable for driving various output devices such as speakers or transducers.

### ***1.2 Electronic Amplifier Types and Applications***

The domain of electronic amplifiers encompasses a wide array of circuitry, ranging from Operational Amplifiers (Op-Amps) and Small Signal Amplifiers to the more robust Large Signal and Power Amplifiers. The classification of amplifiers revolves around numerous factors, including signal magnitude (small or large), physical configuration, and the processing of input signals, which defines the relationship between the input signal and the current flow within the load.

### ***1.3 Role of Microphone-Based Amplifiers in Audio Systems***

Amplifiers serve as fundamental elements in various audio systems available in the market. The application of microphones as input devices in amplification circuits is particularly noteworthy. Microphone-based amplifier projects, similar to Mini Audio Amplifiers, are designed to amplify low-level signals captured by microphones to render them audible through speakers or other output devices.

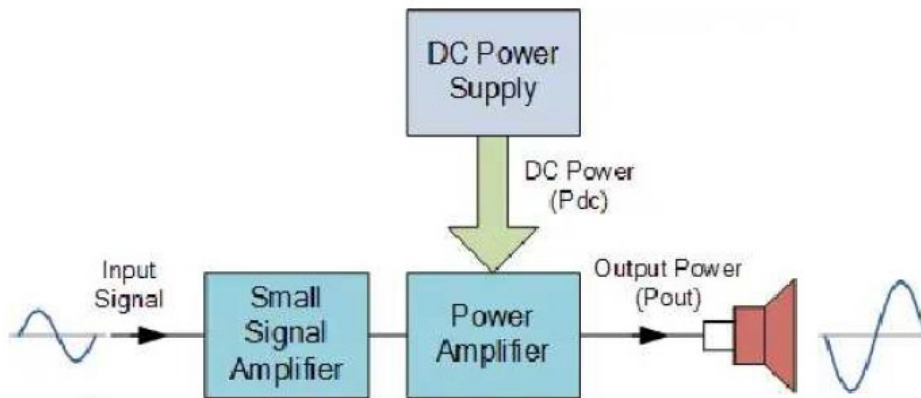
### ***1.4 Purpose and Working Principle of Microphone-Based Amplifiers***

In projects utilizing microphones instead of audio jacks, the input signals received from the microphone often exhibit low amplitude. Directly transmitting such signals to speakers would produce outputs that might not be perceptible even within close proximity. Thus, these signals are channeled through specialized amplifier circuitry tailored for microphone inputs.

### ***1.5 Significance of Microphone Amplification***

The primary function of the amplifier circuitry lies in enhancing the microphone-derived audio signal. Amplification allows the strengthened audio signal to be directed to speakers or transducers, converting it into audible sound output. With the audio frequency range typically spanning from 20Hz to 20KHz, the amplifier circuit is meticulously configured to amplify signals within this range while minimizing interference and noise.

## 1.6 Block diagram



## 1.7 Block diagram description

Block diagrams provide a systemic approach to understanding and designing circuits by breaking them down into distinct blocks or sections, each serving a specific function. They illustrate the connections between these blocks, showcasing the inputs and outputs without detailing the internal components. This approach, known as the systems approach, facilitates a clear comprehension of circuit functionality.

The microphone acts as a transducer, converting sound into voltage. A pre-amplifier is employed to amplify the small audio signal (voltage) received from the microphone. Further signal adjustments are made through tone and volume controls. The tone control manipulates the balance between high and low frequencies, while the volume control manages the signal strength. Subsequently, the power amplifier steps up the strength or power of the audio signal. Finally, the loudspeaker, another type of transducer, converts the enhanced audio signal back into audible sound. This systematic breakdown of the circuit's components and their interconnections allows for a holistic understanding of the signal flow and processing within the system.

## CHAPTER 2:

### Background

#### *2.1 What is amplifier?*

An amplifier is an electronic device that increases the voltage, current, or power of a signal. Amplifiers are used in wireless communications and broadcasting, and in audio equipment of all kinds. They can be categorized as either weak-signal amplifiers or power amplifiers. Weak-signal amplifiers are used primarily in wireless receivers. They are also employed in acoustic pickups, audio tape players, and compact disc players. A weak-signal amplifier is designed to deal with exceedingly small input signals, in some cases measuring only a few nano volts (units of  $10^{-9}$  volt). Such amplifiers must generate minimal internal noise while increasing the signal voltage by a large factor. The most effective device for this application is the field-effect transistor. The specification that denotes the effectiveness of a weak-signal amplifier is sensitivity, defined as the number of micro volts (units of  $10^{-6}$  volt) of signal input that produce a certain ratio of signal output to noise output (usually 10 to 1). Power amplifiers are used in wireless transmitters, broadcast transmitters, and hi-fi audio equipment. The most frequently-used device for power amplification is the bipolar transistor. However, vacuum tubes, once considered obsolete, are becoming increasingly popular, especially among musicians. Many professional musicians believe that the vacuum tube (known as a "valve" in England) provides superior fidelity. Two important considerations in power amplification are power output and efficiency. Power output is measured in watts or kilowatts. Efficiency is the ratio of signal power output to total power input (wattage demanded of the power supply or battery). This value is always less than 1. It is typically expressed as a percentage. In audio applications, power amplifiers are 30 to 50 percent efficient. In wireless communications and broadcasting transmitters, efficiency ranges from about 50 to 70 percent. In hi-fi audio power amplifiers, distortion is also an important factor. This is a measure of the extent to which the output waveform is a faithful replication of the input waveform. The lower the distortion, in general, the better the fidelity of the output sound.

#### *2.2 About ic LM386*

##### **Specifications of LM386:**

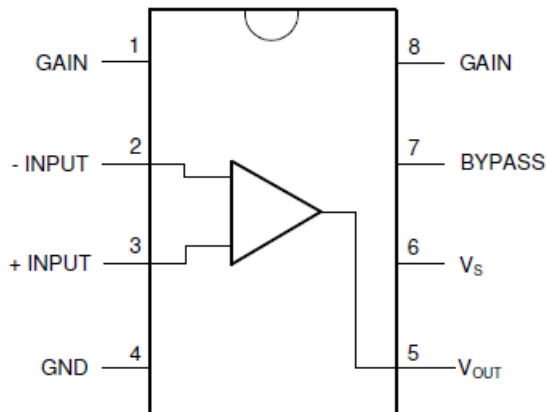
The LM386, an integrated low-voltage audio power amplifier, embodies a host of specifications that render it an invaluable asset in audio circuitry. Operating within a voltage range of 4V to 12V, this amplifier is adept at handling low power supplies, making it particularly suitable for battery-powered devices. With a nominal input impedance of approximately 50 k $\Omega$ , it seamlessly interfaces with various audio sources, ensuring compatibility across diverse setups. Its wide frequency response spanning from 40 Hz to 100 kHz facilitates amplification across the audible spectrum, delivering faithful audio reproduction. Delivering an output power ranging between 0.25W to 1W, contingent on the power supply voltage and load impedance, the LM386 offers versatility in output capabilities. Furthermore, it maintains low distortion levels, typically below 0.2% at nominal output power, preserving audio fidelity for

discerning applications. Operating within a temperature range of  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ , this amplifier proves resilient across varied environmental conditions, adding to its reliability and adaptability.

### Features of LM386:

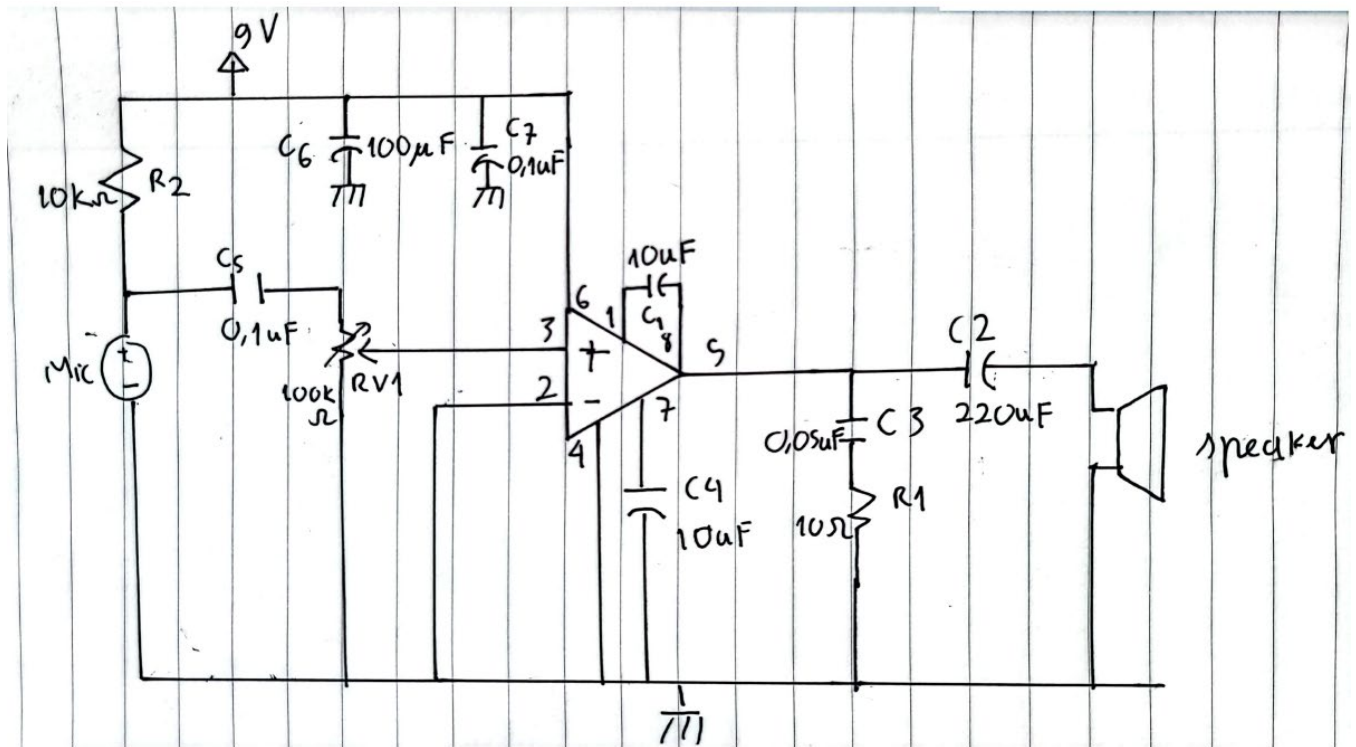
The LM386 audio power amplifier boasts an array of features that underscore its significance in the realm of audio electronics. Its efficient operation within a low voltage range, coupled with minimal quiescent current, makes it an optimal choice for portable, battery-driven applications, ensuring prolonged battery life. The LM386's hallmark simplicity is evident in its minimal external component requirement, simplifying circuit design and implementation. The amplifier's gain range, adjustable from 20 to 200, provides users with a broad spectrum of amplification options, allowing for fine-tuning based on specific needs. Equipped with internal gain setting resistors that can be externally modified, it offers a customizable approach to gain adjustments. With a high signal-to-noise ratio (SNR) and integrated thermal shutdown protection, the LM386 delivers clear, low-noise audio output while safeguarding against potential damage due to overheating. Its versatility in package types like DIP and SOIC amplifies its appeal, offering adaptability in various circuit board designs and applications.

### Pin Configuration:



## CHAPTER 3: CIRCUIT DESIGNER

### 3.1 Schematic Diagram of LM386 Audio Amplifier



### 3.2 Components Required for LM386 Audio Amplifier Circuit

- IC LM386
- Condensor Mic
- Speaker 8ohm,0.5watt
- Capacitors- 220uF/16v, 100uF/16v,10uF (two) /16v, 0.1uF(two) /16v, 0.05uF/16v
- Resistor- 10k, 10ohm
- Potentiometer- 100k
- Battery 9V

The LM386 integrated circuit contains several critical pins and components, each playing a distinct role in the functionality of the audio amplifier circuit. Pins 1 and 8 primarily serve as gain control pins, originally set to a gain of 20 but adjustable to a maximum of 200 by incorporating a capacitor between them. In this specific circuit setup, a 10uF capacitor (C1) has been employed to achieve the highest possible gain of 200. However, users can fine-tune the gain between 20 and 200 by selecting an appropriate capacitor value.

For handling sound signals, Pins 2 and 3 act as input pins. Pin 2, the negative input terminal, is grounded, while Pin 3, the positive input terminal, receives the sound signal for amplification. In this



configuration, Pin 3 is linked to the positive terminal of the condenser microphone via a 100k potentiometer (RV1), operating as a volume control knob.

To prepare the signal for amplification, a 0.1uF capacitor (C5) in conjunction with the potentiometer eliminates the DC component of the input signal, permitting only the audio (AC component) to enter the LM386.

Managing the power supply, Pins 4 and 6 respectively represent the ground and +Vcc terminals. The IC operates within a voltage range of 5-12V. Capacitors C6 and C7, in parallel with the power supply, filter out low-frequency noise, ensuring sufficient power for robust bass notes.

Pin 5 constitutes the output terminal, delivering the amplified sound signal. To eliminate the undesirable DC component from the output signal, a 220uF capacitor (C2) functions similarly to C5 at the input end.

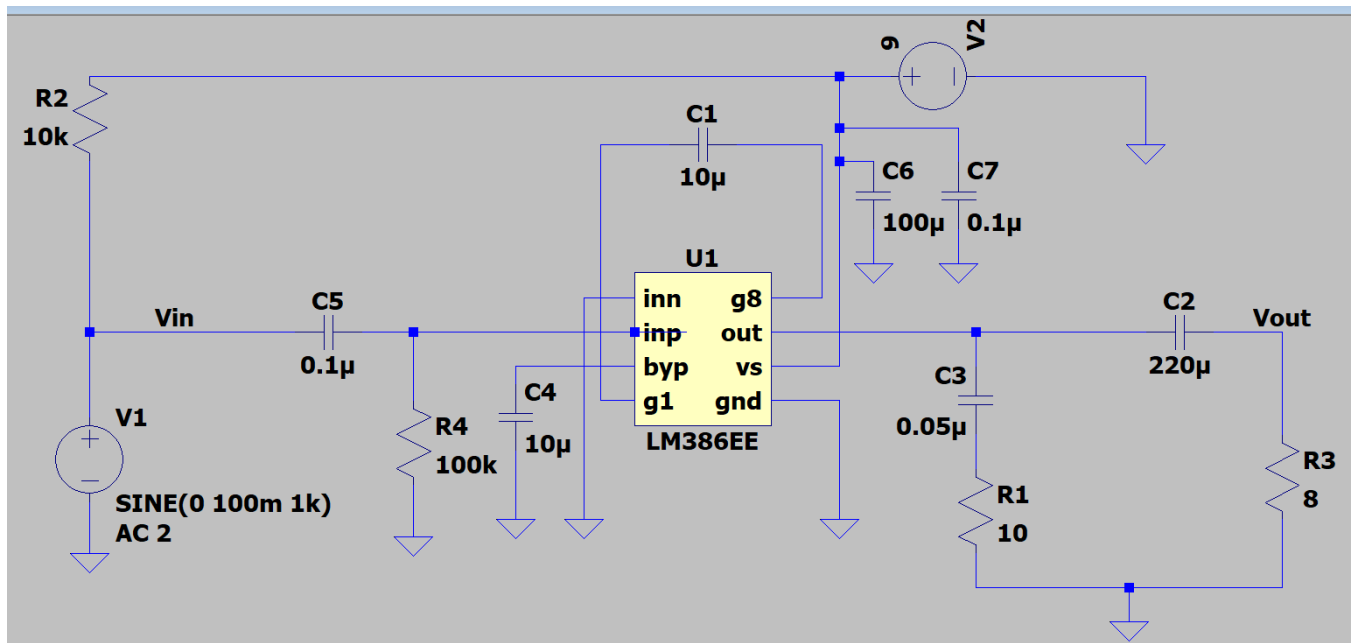
In addition to C2, a filter circuit comprising Capacitor C3 (0.05uF) and Resistor R1 (10ohm) to make filter to make clear noise without high frequency sound, it will sent high frequency to ground.

Pin 7, the bypass terminal, can either be left open or grounded using a capacitor for stability.

To power the condenser microphone adequately, Resistor R2 (10k) serves as a pull-up resistor, linking the microphone to the positive supply voltage. It's crucial to select an appropriate resistor value for the microphone's proper operation, which can be obtained from the datasheet or by utilizing a variable resistor to determine the suitable value.

### 3.3 Stimulation

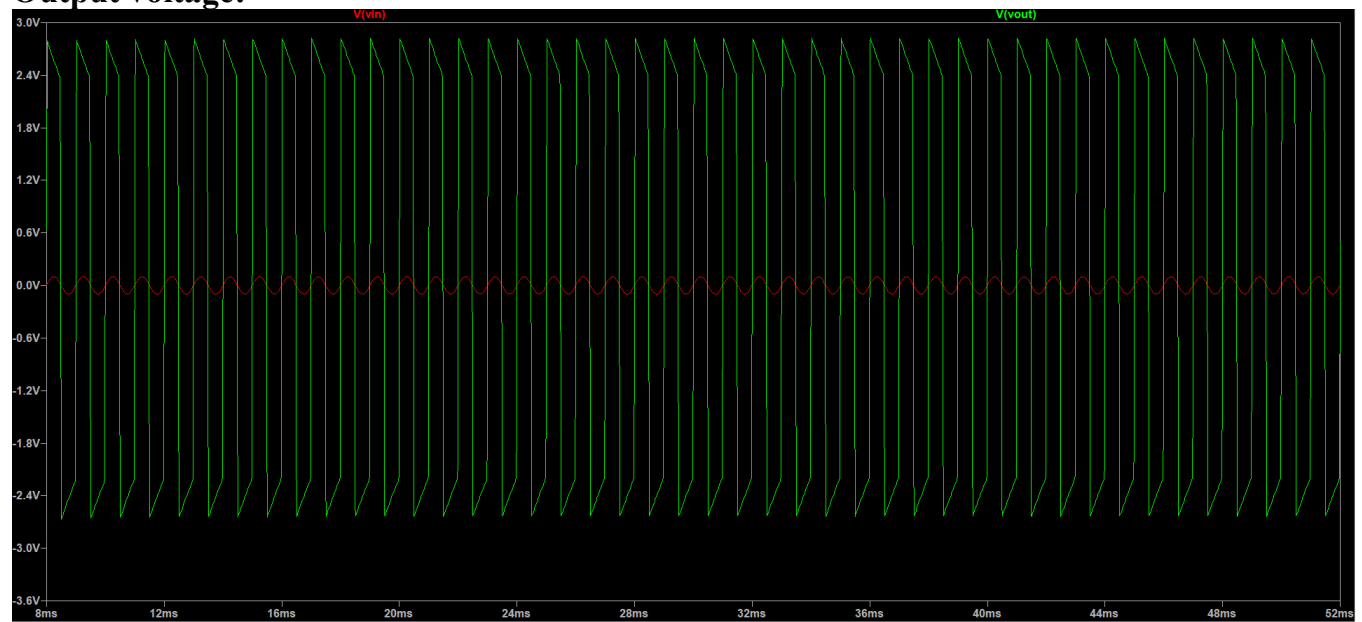
#### Circuit:



## DC Analysis:

--- Operating Point ---		
V(n004) :	0.00763106	voltage
V(n002) :	1.18363	voltage
V(n003) :	1.17704	voltage
V(n005) :	4.65376	voltage
V(n006) :	4.51844	voltage
V(n001) :	9	voltage
V(vin) :	0	voltage
V(vout) :	8.19061e-015	voltage
V(n007) :	2.32688e-018	voltage
I(C3) :	-2.32688e-019	device_current
I(C2) :	-1.02383e-015	device_current
I(C7) :	9e-019	device_current
I(C6) :	9e-016	device_current
I(C4) :	4.51844e-017	device_current
I(C1) :	-6.59032e-020	device_current
I(C5) :	7.63106e-022	device_current
I(R1) :	2.32688e-019	device_current
I(R4) :	7.63106e-008	device_current
I(R3) :	1.02383e-015	device_current
I(R2) :	-0.0009	device_current
I(V2) :	-0.00515594	device_current
I(V1) :	0.0009	device_current
Ix(u1:INN) :	-2.29133e-007	subckt_current
Ix(u1:INP) :	-7.63106e-008	subckt_current
Ix(u1:BYP) :	-4.52112e-017	subckt_current
Ix(u1:G1) :	-6.50521e-019	subckt_current
Ix(u1:G8) :	-1.80842e-018	subckt_current
Ix(u1:OUT) :	-9.32414e-016	subckt_current
Ix(u1:VS) :	0.00425594	subckt_current

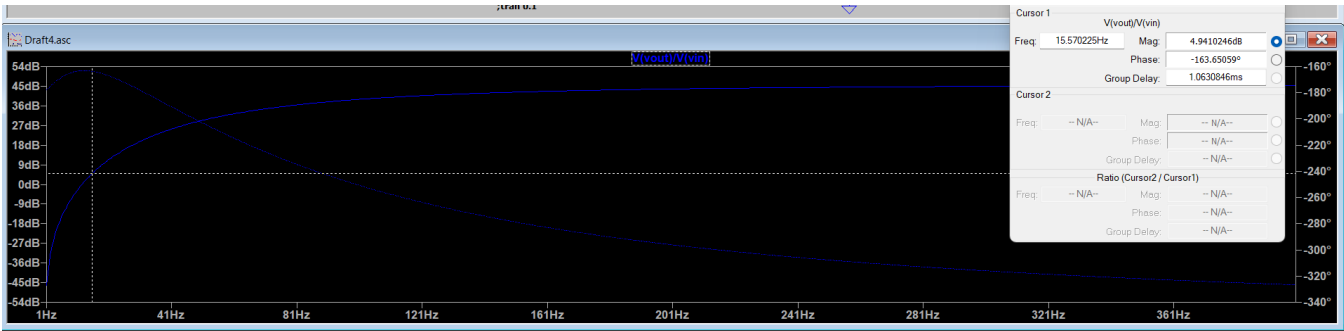
## Output voltage:



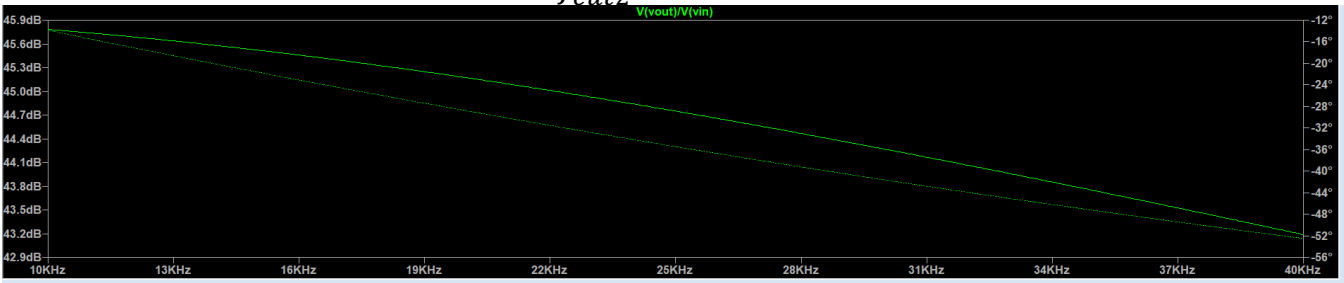
Because of the gain is 200 so the output will nearly 2.8V to have bigger sound for speaker

Frequency Bandwidth:

$$f_{cut1} = 16\text{hz}$$

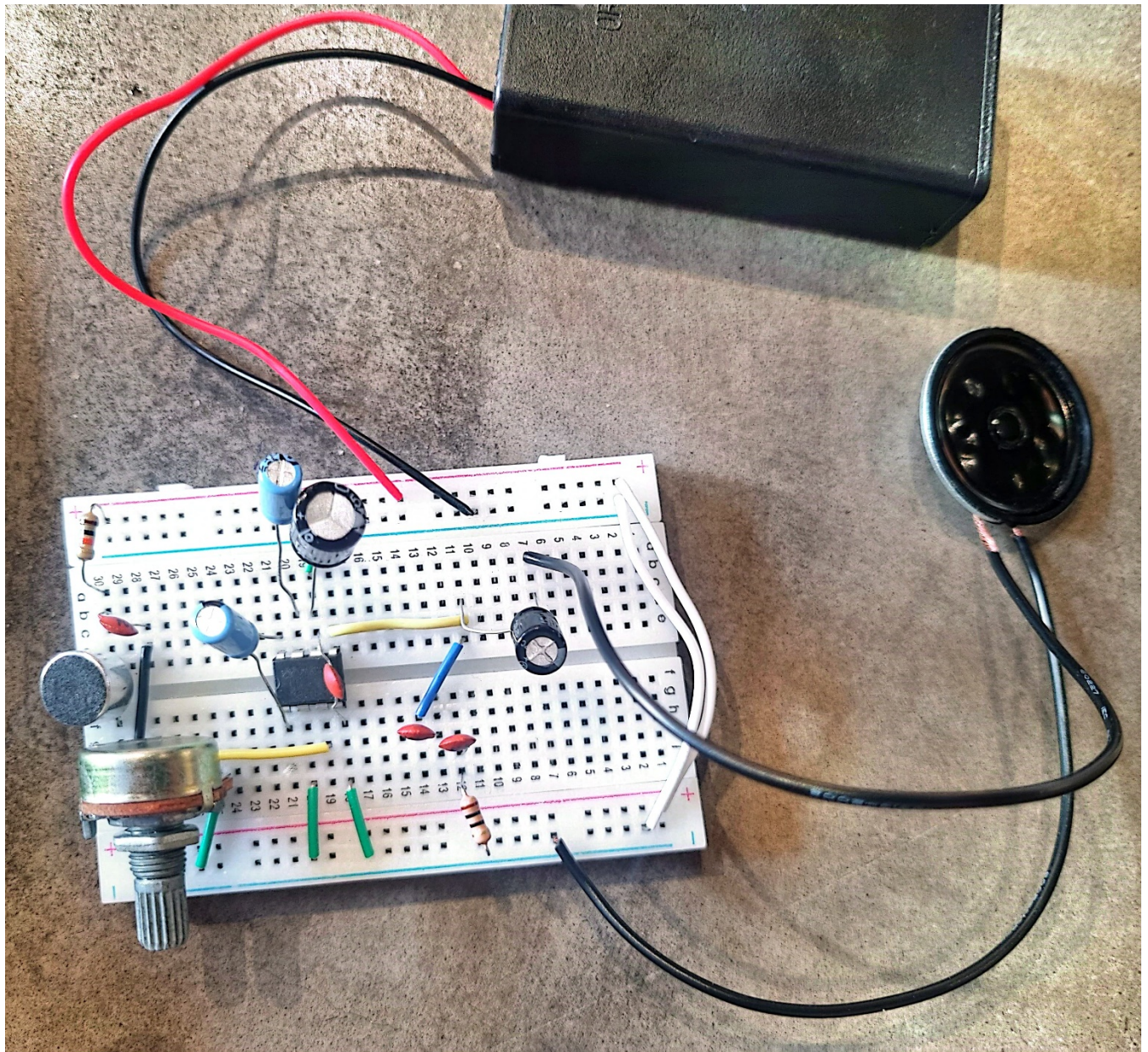


$$f_{cut2} = 16\text{khz}$$





### 3.4 Breadboard circuit



### 3.5 Sound test

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## CONCLUSION

The LM386 audio amplifier, a cornerstone in audio electronics, encapsulates a fusion of simplicity and functionality, proving its indispensability across diverse applications. Its compact design and ability to operate efficiently on low voltage with minimal external components make it a go-to choice for numerous audio devices, especially those reliant on battery power. This amplifier's adjustable gain settings and intelligently designed input and output circuitry ensure the seamless processing of signals, offering amplified sound of exceptional clarity while mitigating undesirable distortions and noise. Its adaptability to various audio sources and its capacity to manage input and output signals distinctively showcase its versatility, catering to a broad spectrum of audio setups. As an enduring technological solution, the LM386 persists as an integral tool sought after by audio enthusiasts, engineers, and hobbyists alike due to its enduring technical prowess, simplicity, and adaptability, solidifying its place as an enduring staple in the realm of audio amplification.

In the ever-evolving landscape of audio technology, the LM386 audio amplifier remains a vital asset, embodying a perfect amalgamation of reliability and functionality. Its compact form factor and ability to function optimally within low voltage parameters while demanding minimal external components signify its versatility and suitability across diverse applications, particularly in portable devices reliant on limited power sources. This amplifier's ability to modulate gain settings and streamline signal processing endows it with the capability to deliver amplified sound with pristine clarity while effectively minimizing undesirable distortions and noise. Its versatility extends to its compatibility with an array of audio sources, ensuring a tailored approach for various audio setups. As a timeless innovation, the LM386 persists as a fundamental tool cherished by audio enthusiasts, engineers, and hobbyists alike, owing to its unwavering technical prowess, ease of use, and adaptability, cementing its status as an indispensable component in the domain of audio amplification.

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