ELECTRONICS WORKSHOP-2, PROJECT-1

THE AUDIO AMPLIFIER

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ABSTRACT

The audio power amplifier is used to amplify low-power audio signals to a level that can be suitable for driving the loudspeakers. Thus the audio power amplifier becomes a kind of essential part in the electronics that could make sounds. In this project, a good performance audio power amplifier is designed. It consists of four parts: pre-amplifier unit, the gain cell unit, the active filter and the power amplifier unit. In the pre-amplifier unit, a BC547 and BC557 transistor is used to amplify the low signal.The results of simulation in Multisim show a good output waveform and different frequency response with the tonality control. Also the pure sound can be heard by ear clearly. The good simulation result offers the encouragement to build the circuit on the board and do the measurement. The measured results show a good output waveform, the output power 1W.

An audio amplifier is designed to amplify frequencies between 15 Hz and 5 kHz. Any amplifier that is designed for this entire band of frequencies or any band of frequencies contained in the audio range is considered to be an audio amplifier.

INTRODUCTION

The audio power amplifier, which is also known as the audio amplifier, is a kind of electronic amplifiers that amplify low-power audio signals (the frequencies of the low-power signals are always between 20Hz to 20KHz,which is the range of human hearing) to a level that can be suitable for driving the loudspeakers. Nowadays all types of electronics that could make sounds are widely using the audio power amplifier, such as mobile phones, MP4 players, laptops, television, audio equipment, etc. The audio power amplifier plays a quite important role in the sound reinforcement, and the speakers cannot play a good role in amplification without the audio power amplifiers.

Amplifiers are classified in two main ways: The first classification is by function and other is by frequency response. The functional op-amps are voltage amplifiers and power amplifiers. In these op-amps output voltage and power gets amplified respectively. Frequency response of an amplifier refers to the band of frequencies that the amplifier can be designed to amplify. The components of an amplifier respond differently at different frequencies hence selected components of the amplifier can amplify certain range or band of frequencies. An audio amplifier is one, which can amplify a band of frequencies.

PROCEDURE

Since human voice has a limit of amplitude so it is important that:

- External noise is sidelined and curbed as much as possible.
- Only the users' voices are amplified.

The first point is what a filter would do. So a filter is a must. The filter must also curb noise as much as possible. Also, to make sure users' voices are heard aloud, we need to raise it up a notch after taking it as an input. The initial stages of the audio amplifier will do that. The filter will take in the output of these initial cascaded stages and let pass only a certain range of frequencies, the ones that everybody wants to hear. The filtered output will then be passed to the power-amplifier, which increases the power of the signal so that the speaker, which is supposed to give out sound, can be driven. The audio amplifier stages have been shown in Figure 1.

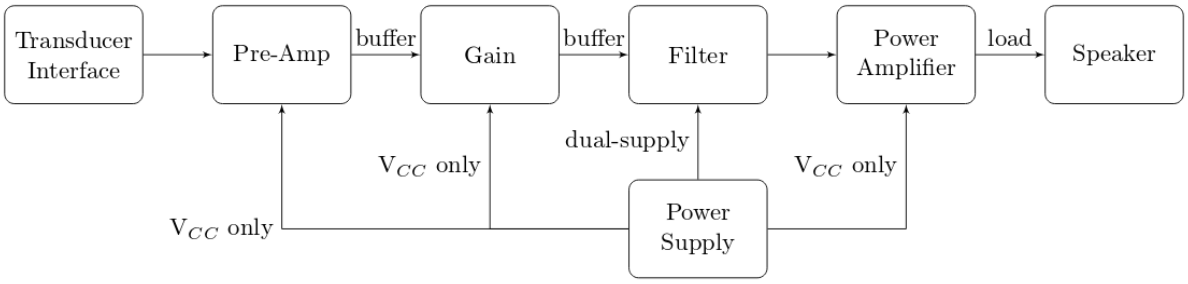

Figure 1: The stages of audio amplifier.

Now that the supposed process has been outlined, it is recommended to start with designing the pre-amplifier which is the first stage of amplification. The pre-amplifier, the gain and the buffer in between them for impedance matching, all of them are single-transistor systems. The pre-amplifier and the gain stages are voltage-divider-biased common-emitter-configuration amplifiers and the buffer in the middle is a common-collector-configuration circuit that does impedance matching.

After making these 3 stages, the pre-amplifier was tested on an input sinusoid with a 20mV peak-to-peak value and received an output of 600mV peak-to-peak output. When this output was fed to the cascade of buffer-stage and gain-stage, it was seen that the overall output was about 4.5 V to 5 V peak-to-peak.

The next step in the process was the power-amplifier. It's the last stage (refer to Figure 1) of the audio amplifier. The power amplifier is supposed to amplify the input power and

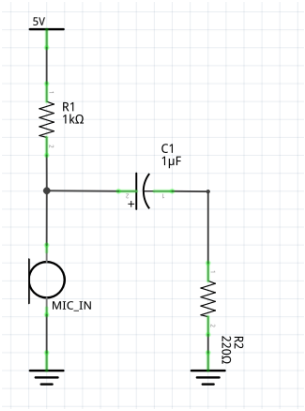

Figure 2: The Mic Coupler interface

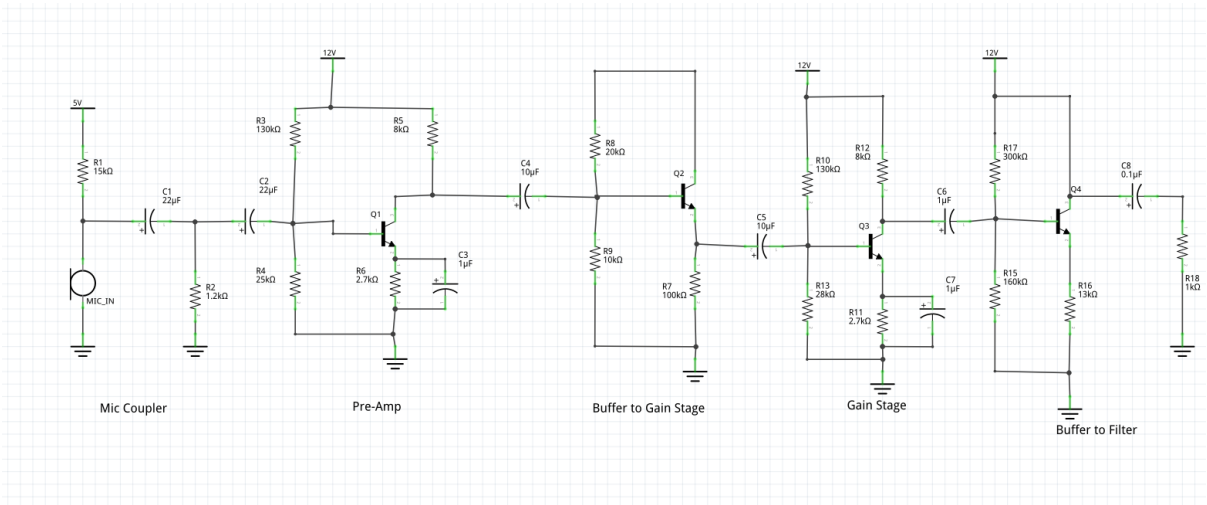

Figure 3: Part-1 of the process.

give some output power greater than the input power. The power amplifier was tested on a sinusoid of 10 V peak-to-peak value and the result was that while the input current was amplified, the input and output voltages were more or less the same.

The next stage was the filter. Since the desired frequency is 50Hz to 5kHz, we decided to make a low pass filter for letting pass frequencies below 5kHz. We used the op-amp IC uA741 to make the filter using non-inverting configuration.

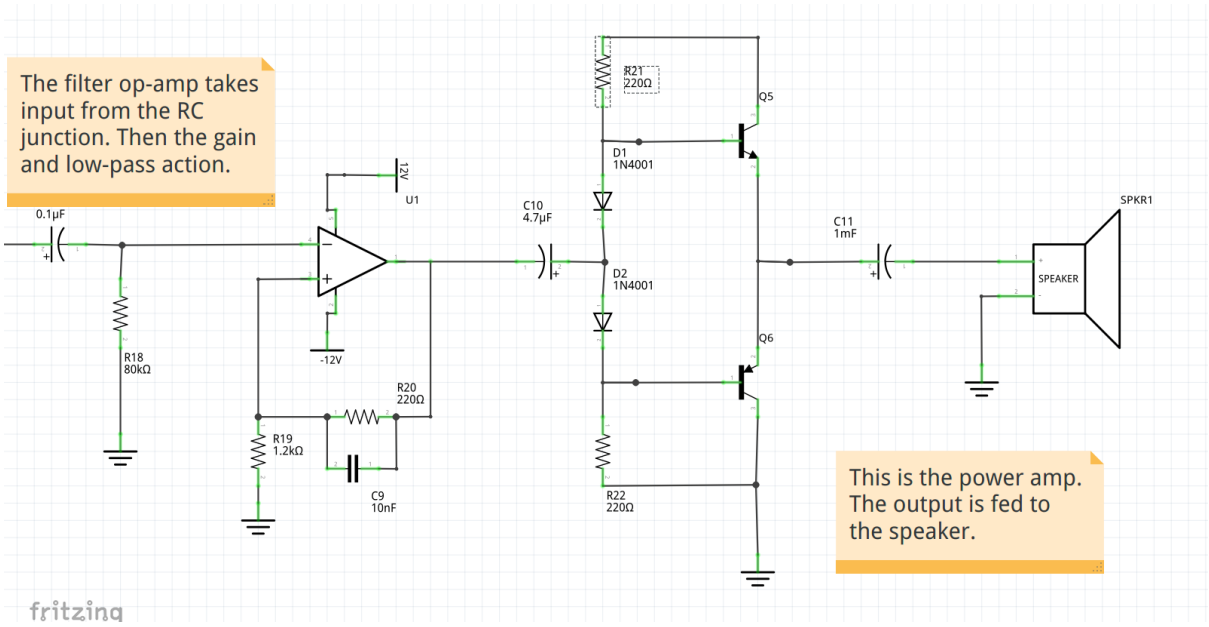

Figure 4: Part-2 of the process

RESULTS

Input Voltage : 20mV peak to peak
Voltage after at Pre-Amp Stage : 793mV peak to peak
Voltage after at Gain Cell : 4.35V (rms)
Voltage after Filter (Op-amp) Stage : 3.15V (rms)
Frequency response : 20Hz to 5000Hz

Voltage after Power Amp. : 2.9 V (rms)
Current in Speaker : 360 mA (rms)

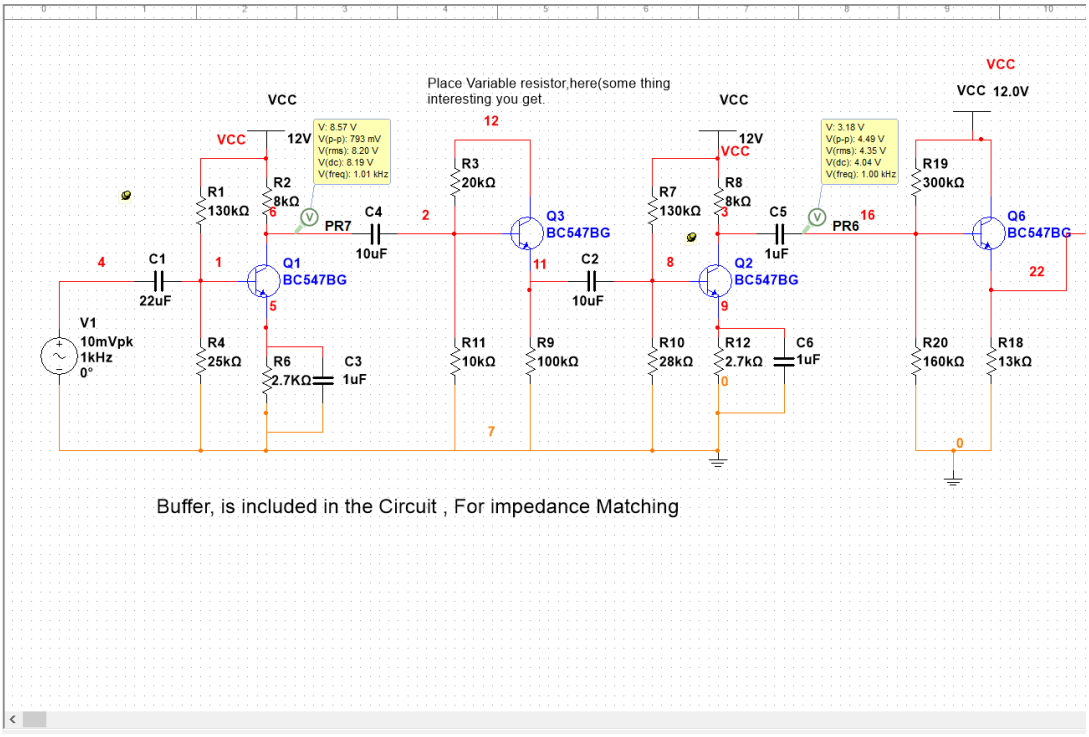

Figure 5: Look at the observation bubble

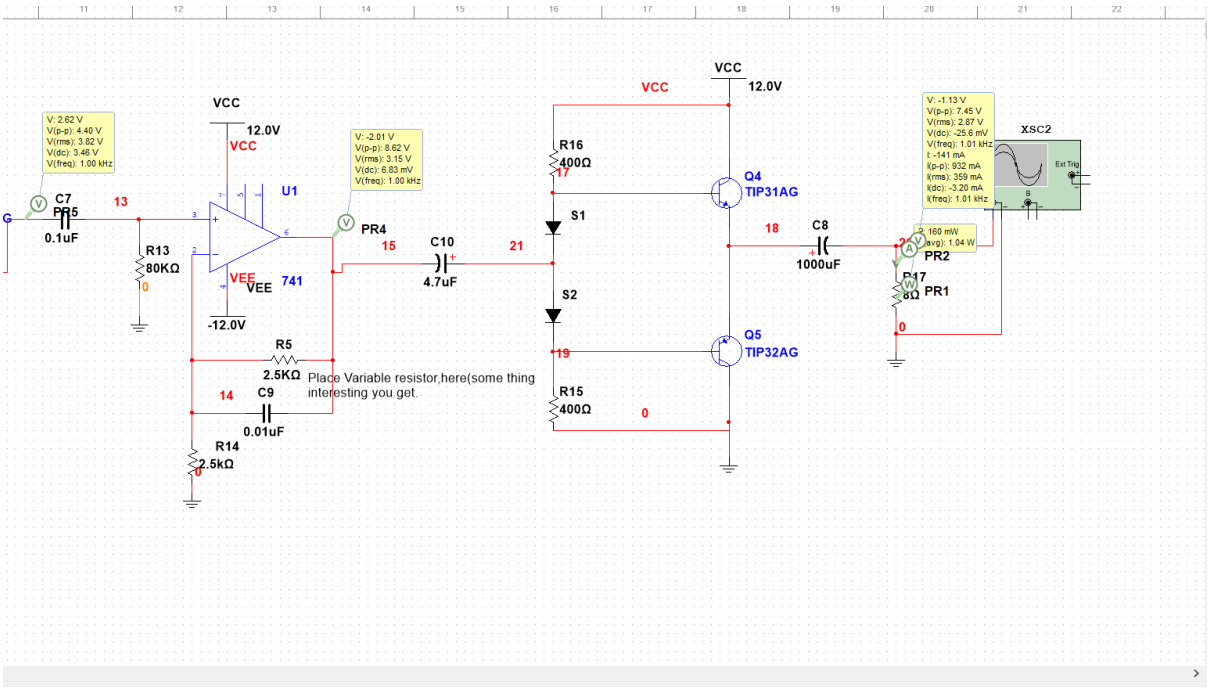

Figure 6: Look at the observation bubble(s).

CONCLUSION

The audio power amplifier is designed in four stages: pre-amplification unit, gain cell unit, active filter unit and power amplification unit. For the pre-amplification unit, BC547, NPN transistor is used to achieve the gain; gain cell is designed to to get a voltage gain; active filter is designed to achieve amplification for band of voices only; for the power amplifier unit, TIP31 and TIP32 transistors are used. In addition, the measured results show the output power is 1W, 350-400mA current and voltage of around 3V at output. Judging from all kinds of results, this designed audio power amplifier can meet the aim of the project topic.

FUTURE SCOPE

Two of the most prolific recent advances in audio technology, at least from a hardware point of view, are noise-cancellation and wireless connectivity in professional and consumer headphones and earphones.

These technologies have become commonplace over the past five years or so in the way people listen to music or use audio devices to communicate. Bluetooth has only recently reached a level where it is considered by OEMs(original equipment manufacturer) as good enough to carry quality audio and replace wires completely.

We are now also starting to see noise-cancellation features in these wireless devices to offer the best of both worlds, allowing users to block out external, unwanted sounds and concentrate solely on the music without being tied to a device

Without doubt, cable-free cans will become the standard in the next couple of years or so. But other forms of wire-free music listening are also likely to become the norm.

WiFi speaker systems are already popular with music enthusiasts. Championed by the likes of Sonos, Bose and Raumfeld, WiFi systems offer seamless integration of stereo, home cinema system and other amplified audio devices with no rewiring or complex programming. Sonos Bridge, for example, lets you connect your wireless router and link all your Sonos players with one touch. The music can then be played from any mobile device in the house through as many players as you want simultaneously.

Sound quality: When you measure normal speakers, even those made for studio recordings, when they produce sound pressure levels of 100db, they are in the range of one percent distortion. Our transducer, when it produces sound pressure levels of 100db, has 0.1 percent distortion, that's 100 times less than studio speakers.

The lower the level of distortion, the more details in the music are audible, so this is the reason why we made Orpheus: to bring distortion to such a low level so when you listen to music you can hear all the details.

REFERENCES

For theory:

- Electronics Tutorials `https://www.electronics-tutorials.ws/`
- Wikipedia : `https://en.wikipedia.org/wiki/Audio_power_amplifier`
- YouTube : `https://www.youtube.com`
- Learn About Electronics : `https://www.learnabout-electronics.org/`

CAD and simulation Credits: "Fritzing" and "Multisim"