Overview of the Audio Mixer

I. Introduction

Audio mixer, also called mixing console, is an electronic device for combining (also called "mixing") and modifying audio signals. Audio mixers can be analog or digital type. Digital audio mixer use digital signal processing and analog mixers are usually based on operational amplifiers (opamps) electronic circuits.

In this course, we are going to learn and build a three-channel analog audio mixer with opamps, resistance and capacitance. The input audio signals can be anything from microphones, cell phones and computers. The mixer will be able to combine audio signals from different signal sources, change the volumes of each input channel, as well as the overall volume of the mixer output. Then, we are going to add more circuits for audio equalizer, which boost or attenuate a range of frequencies, e.g. bass, midrange, and treble, and perform general equalization control at the output.

II. Circuit Diagram

This supplemental material will go over the whole system and show you a general landscape of the mixer you are going to build. The mixer is going to be built part-by-part in labs, so you can well plan an arrangement of the circuit on the breadboard, keep what you have done in each lab and combine them together in the last lab. It will help if you could let your TA check whether the circuit performs well in each lab.

1. System Block Diagram

The system is shown in Figure 1, which contains three input signals, preamplifier, summing amplifier, equalizer and a speaker.

- The three signal sources, which are three channels, provide signals to the system. The source can be from any electronic devices, such as cell phones and computers. The microphone is used to convert acoustic signal to electric signals.
- The preamplifier is only implemented to the microphone source because other audio signals, like those from cell phones or computers, have already been pre-amplified before come into the circuit, while the signal from microphone are not amplified yet.
- The summing amplifier is utilized to combine the three channels and control volumes of each channel. For example, if source 1 is expected to be boosted and source 2 is to be attenuated, the summing amplifier is the circuit to perform this function.
- The equalizer is the core to boost or attenuate signals in a range of frequencies.
- The speaker is the device to covert electric analog signal to acoustic signals.

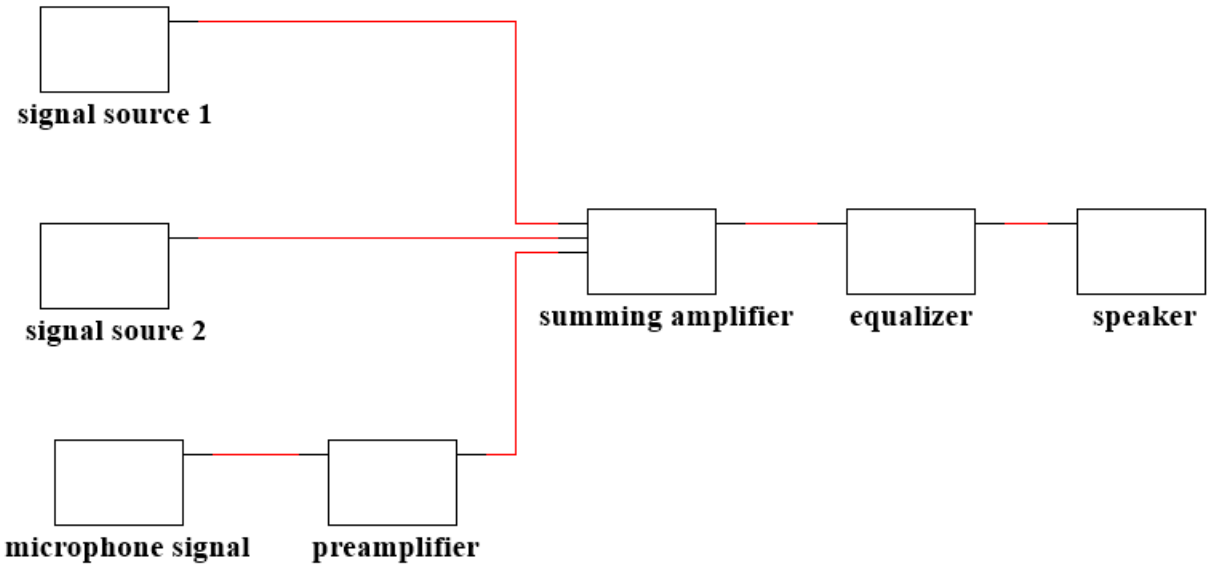

Figure 1 System Block Diagram

2. Microphone

To make the microphone work, it should be DC biased as Figure 2. However, the output signal will have a DC offset because of the DC bias voltage, which is not desirable. Thus, microphone circuit is always followed by a mic preamplifier to balance the input signal, which means to remove the DC voltage offset. To simplify the circuit we are going to make, you are expected to design a simple circuit that simultaneously activate the FET impedance converter and remove the DC offset with only resistance and capacitance. Although it will not work as well as the mic preamplifier, it will be good enough to remove the DC bias and improve the quality of output sound.

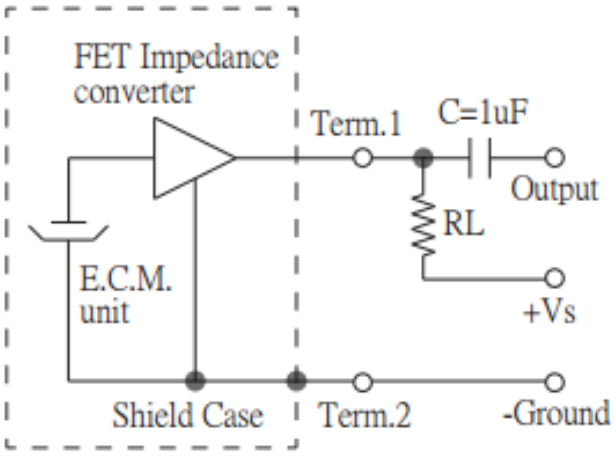

Figure 2 Microphone Circuit

3. Preamplifier

The preamplifier circuit is shown in Figure 3. The potentiometer is used to change the gain of the circuit and the capacitor is added to remove the white noise at high frequency range.

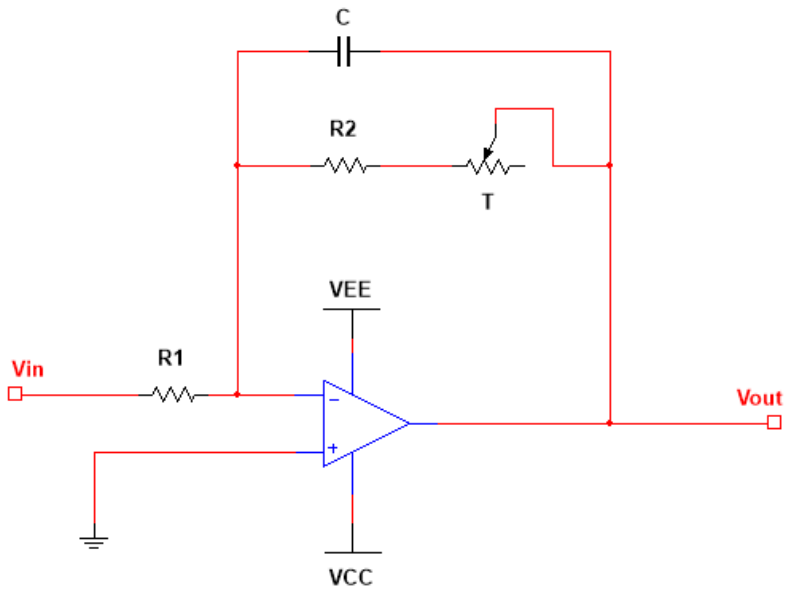

Figure 3 Preamplifier Circuit

4. Summing Amplifier

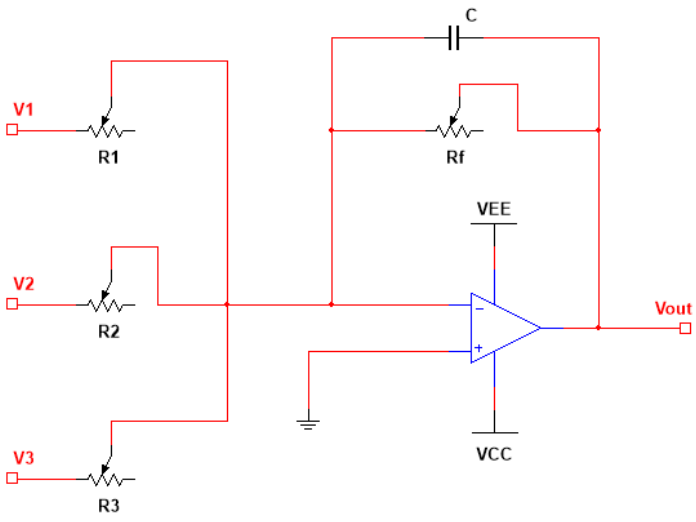

Figure 4 Summing Amplifier

The summing amplifier is to mix signals of three channels, while the three potentiometers are used to change volumes. The R_1, R_2 and R_3 are to change volume of each channel while the R_f are used to change the whole volume.

5. Equalizer

The equalizer contains more blocks, buffer, filters and another summing amplifier. The buffer, also called voltage follower, is implemented before all filters. Filters are in parallel and each of them controls different range of frequencies. Filter1 controls low frequencies, filter2 controls midrange frequency and filter3 will boost or attenuate high frequencies. The summing amplifier will combine the three processed channels and deliver the signal to the speaker.

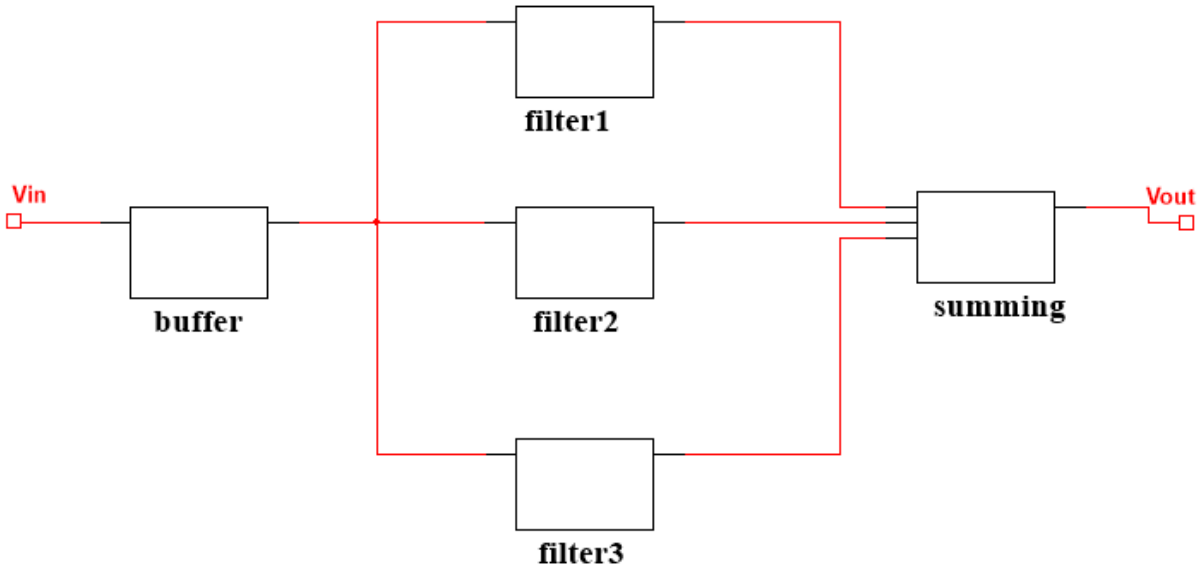

Figure 5 Equalizer

The circuits of each block are shown in the following figures. The structures of all filters are the same while the parameters of capacitance or resistance are different. To control different range of frequencies, you are expected to design those parameters by yourselves and make it work. The potentiometer in each filter control the maximum gain of the circuit and decide whether it is a band pass or band reject filter.

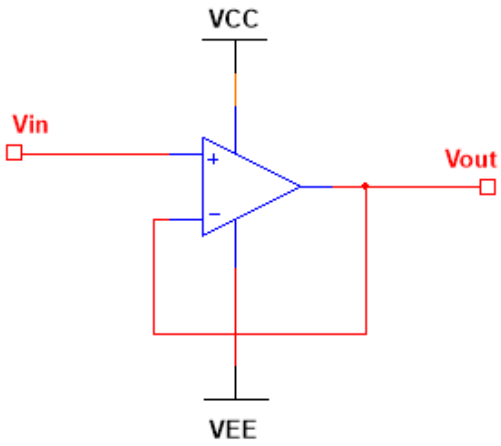

Figure 6 (a) Buffer Circuit

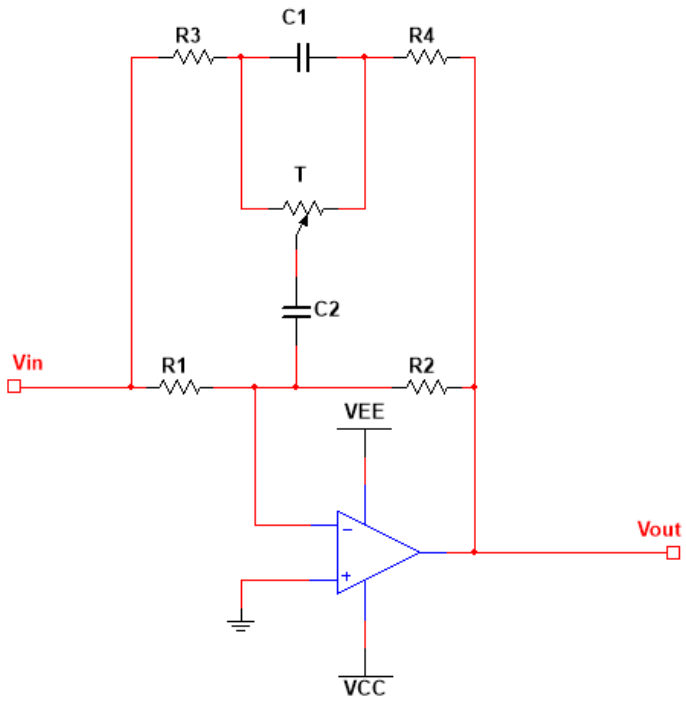

Figure 6 (b) Filter Circuit

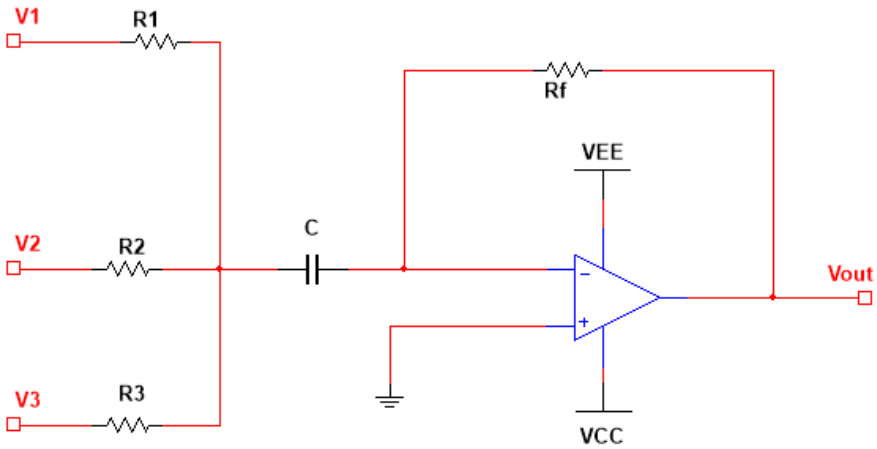

Figure 6 (c) Summing Amplifier in Equalizer

6. Speaker

The speaker is the electronic device that convert electronic signal to acoustic signal so that people can hear the processed sounds. It can be borrowed from EE Store in EEB137.

III. Build the Circuit

Here is an example of the circuit built on the breadboard. The circuit is going to be built part-by-part during the lab. You need to arrange your breadboard, keep each part on the board and combine them in the last lab. Then you can enjoy and play with what you have built!

To play with the circuit, you can use any music or video as inputs to your circuit, change volumes and tuning frequencies by filters. It is like a studio engineer and there is a lot of fun. Work on it and enjoy it.