Complex Engineering Problem

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OBJECTIVE:

(1) Design and implement an audio amplifier circuit with microphone (Input) and speaker (load) on Vero board/PCB. The audio amplifier can be an IC based or discrete transistor based design. Breadboard design are not acceptable

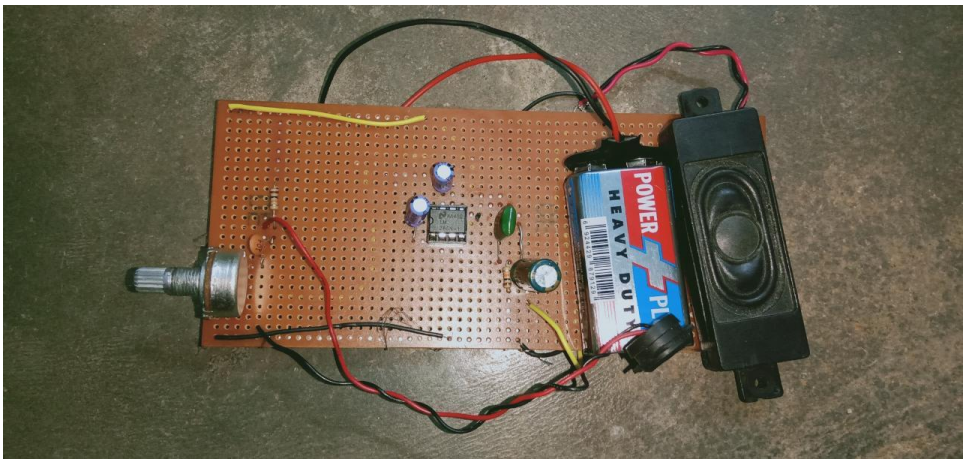
(2) Give an audio tone1 as input signal. a. Analyze the output of the circuit and take screenshots of output waveform from oscilloscope in jpg format through the interface port of oscilloscope. Taking photos of the oscilloscope screen is not recommended. Oscilloscope such as R&S®HMO1002 is recommended. b. Obtain the trace file of output waveform in csv format from the oscilloscope.

(3) Process the csv file in a simulation software to remove noise on output waveform of your amplifier circuit with the help of any simulation software (Multisim, Proteus, Matlab, Simulink etc.) and save the output wave forms in jpg format.

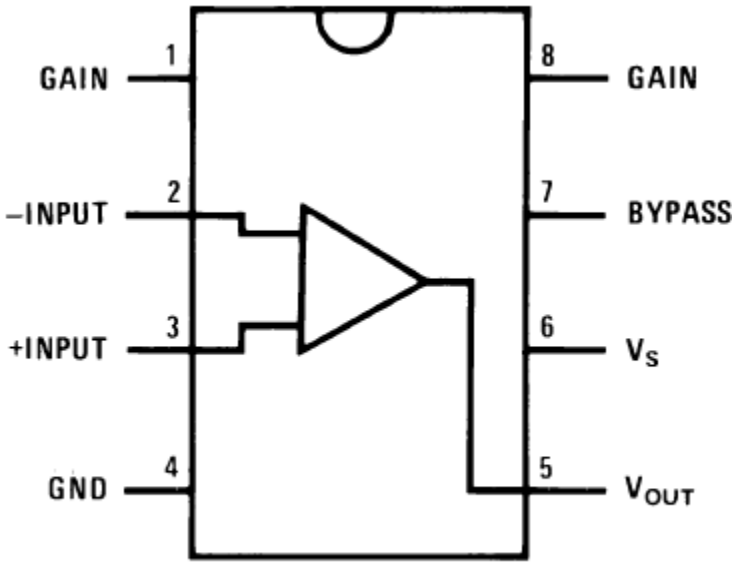
COMPONENTS:

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

1A. PICTURE OF THE IMPLEMENTED CIRCUIT AND DESCRIPTION



In audio amplifier I useLM386, LM386 is a low voltage audio amplifier and frequently used in battery powered music devices like radios, guitars, toys etc. **The gain range is 20 to 200**, gain is internally set to 20 (without using external component) but can be increased to 200 by using resistor and capacitor between PIN 1 and 8, or just with a capacitor. Voltage gain simply means that Voltage out is 200 times the Voltage IN.



LM386 Pin Diagram

- **PIN 1 and 8:** These are the gain control PINs, internally the gain is set to 20 but it can be increased up to 200 by using a capacitor between PIN 1 and 8. We have used 10uF **capacitor C1** to get the highest gain i.e. 200. Gain can be adjusted to any value between 20 to 200 by using proper capacitor.

- **Pin 2 and 3:** These are the input PINs for sound signals. Pin 2 is the negative input terminal, connected to the ground. Pin 3 is the positive input terminal, in which sound signal is fed to be amplified. In our circuit it is connected to the positive terminal of the condenser mic with a **100k potentiometer RV1**. Potentiometer acts as volume control knob.

- A **capacitor C5** of 0.1uF has also been used along with potentiometer, to remove the DC component of input signal and only allow audio (AC component) to be fed into LM386.
- **Pin 4 and 6:** These are the power supply Pins of IC, Pin 6 for is +Vcc and Pin 4 is Ground. The circuit can be powered with voltage between 9v.

- **Pin 5:** This is the output PIN, from which we get the amplified sound signal.

- The output signal has both AC and DC component, and DC component is undesirable and can't be fed to Speaker. So to remove this DC component, a **capacitor C2** of 220uF has been used. This has the same function as Capacitor C5 (0.1uF) at input side.

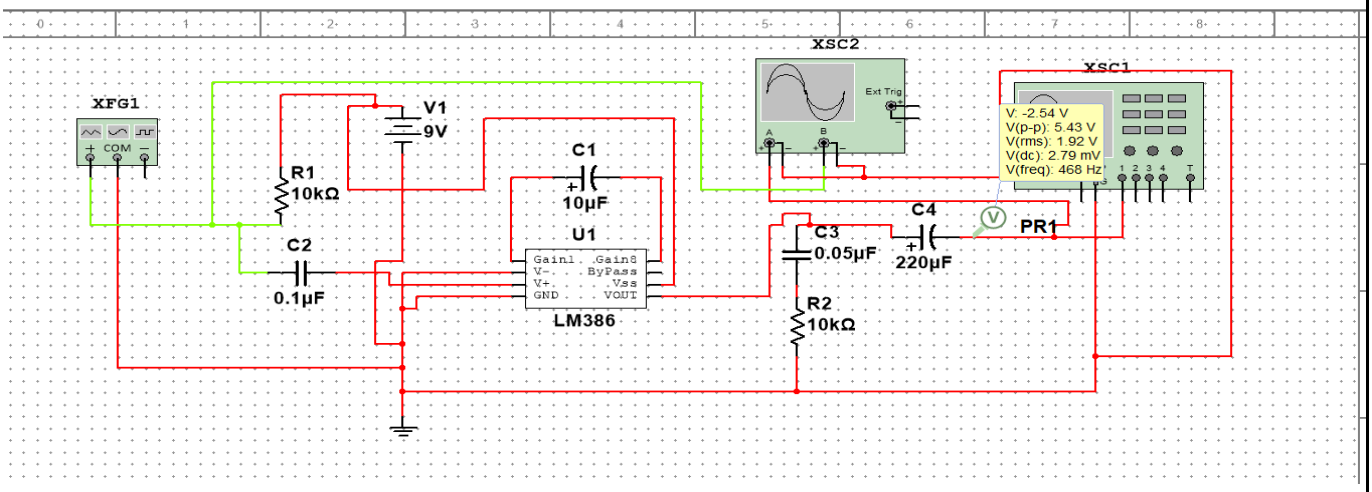
- Along with this capacitor, a **filter circuit** of **Capacitor C3** (.05uF) and **resistor R1** (10k) has been used at the output PIN 5. This filter also called the **"Zobel network"**, this electronic filter is used to remove the sudden High frequency oscillations or noise.

- **Pin 7:** This is the bypass terminal. It can be left open or can be grounded using a capacitor for stability

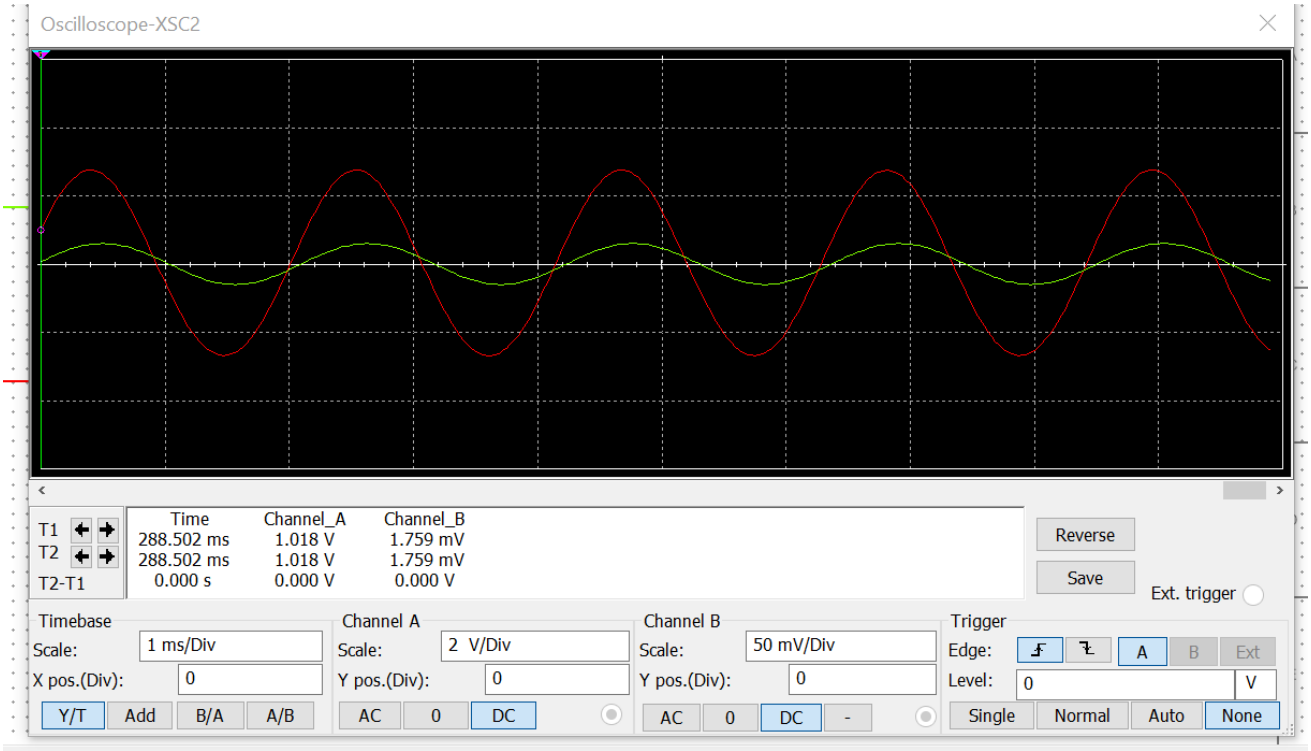
- **Resistor R2** (10k) has been used as a Pull up resistor to connect Condenser mic to the positive supply voltage, to provide the power to the mic. A suitable resistor should be used for proper working of mic, you can look up to datasheet for the value or use a variable resistor and set the proper value.

- This **LM386 audio amplifier circuit** can be also used **to record any sound**. We just need a 3.5 mm audio plug and a computer with sound recording software. We only need to connect computer's 3.5mm jack in place of Speaker, using 3.5mm audio plug, and we can easily record our voice or any sound into computer like a professional microphone.

1B. JPG OF THE SCREENSHOT

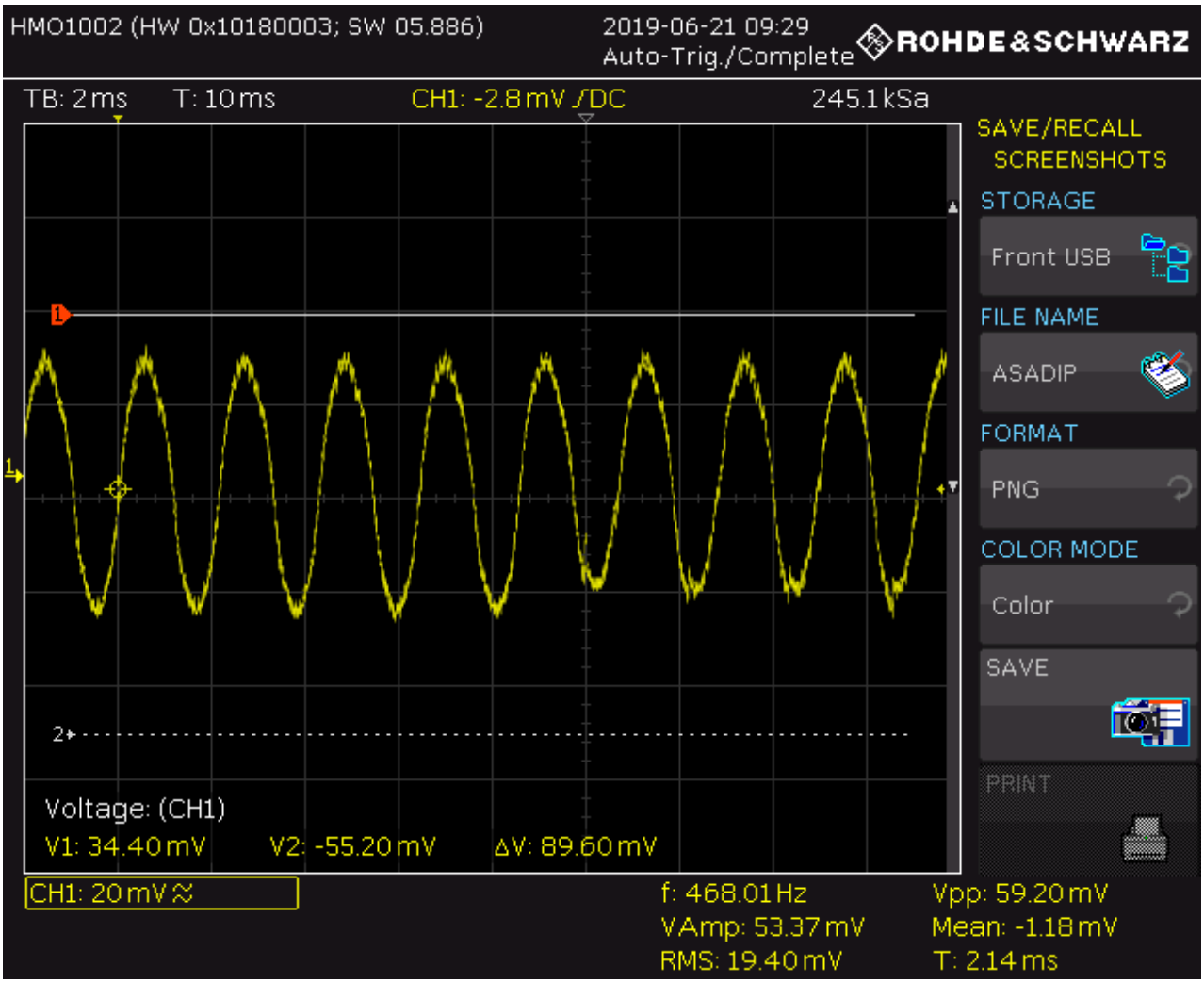


This is scamatic of circuit here the **V=2.54** amplified voltage, when I applied **468Hz and 15mV** as an input. The graph of this circuit given blow.



Here Green is my input voltage which is connected with channel B where as the red is output voltage which is connected with channel A.

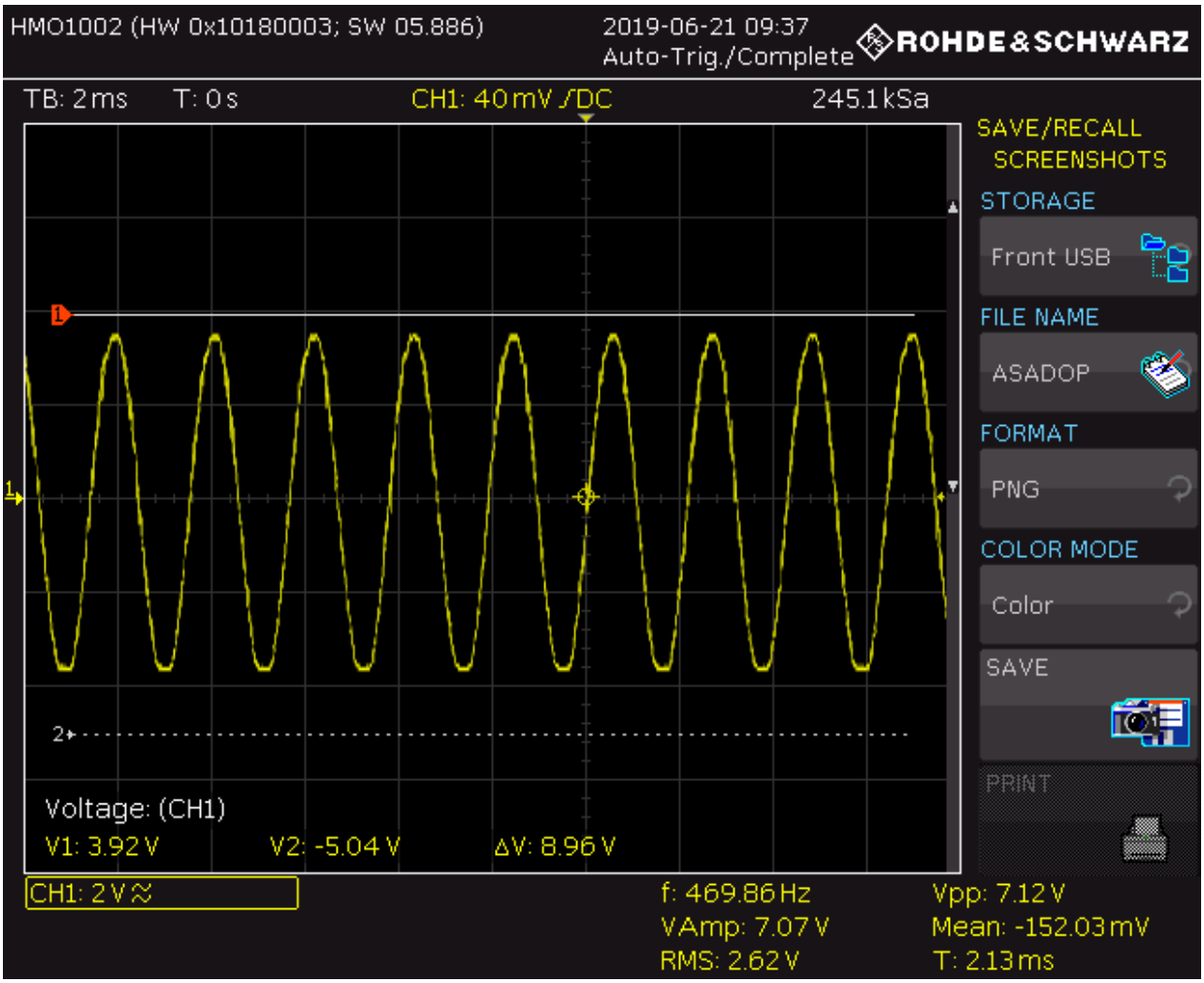
REAL WORLD SIMILATION:



This is **input wave form** of real world simulation of my circuit here we can see that there is a lot of noises here.

Here,

- Vpp: 59.20mV
- f: 468.01Hz
- RMS: 19.40mV

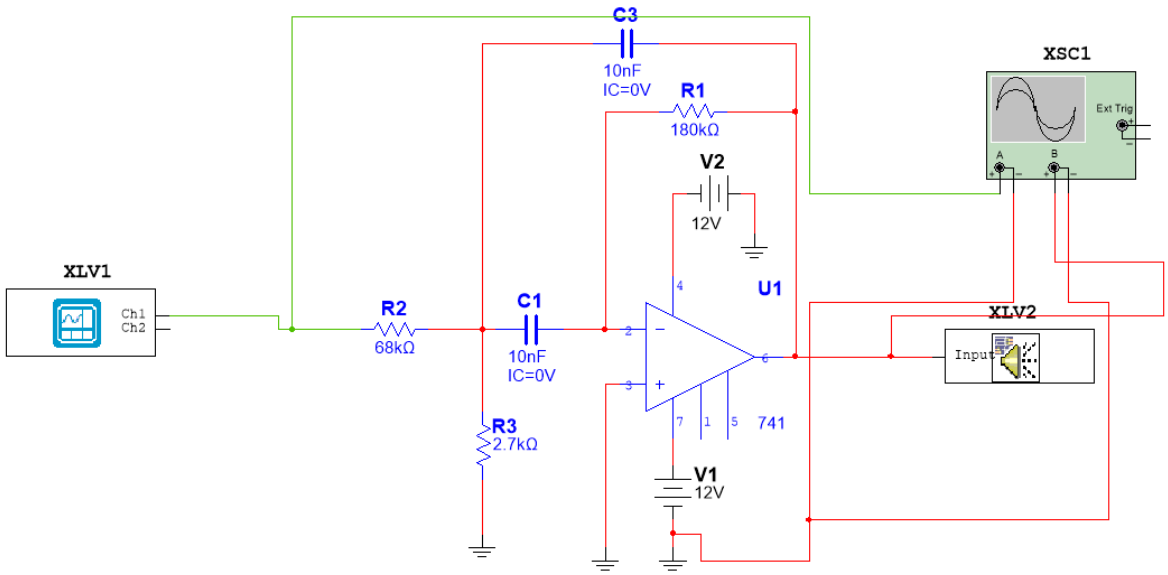


This is **output wave form** of real world simulation of my circuit here we can see that there is a lot of noises here.

Here,

- Vpp: 7.12V
- f: 469..861Hz
- RMS: 2.62V

1C. PICTURE OF THE NOISE FILTER SCHEMATIC:

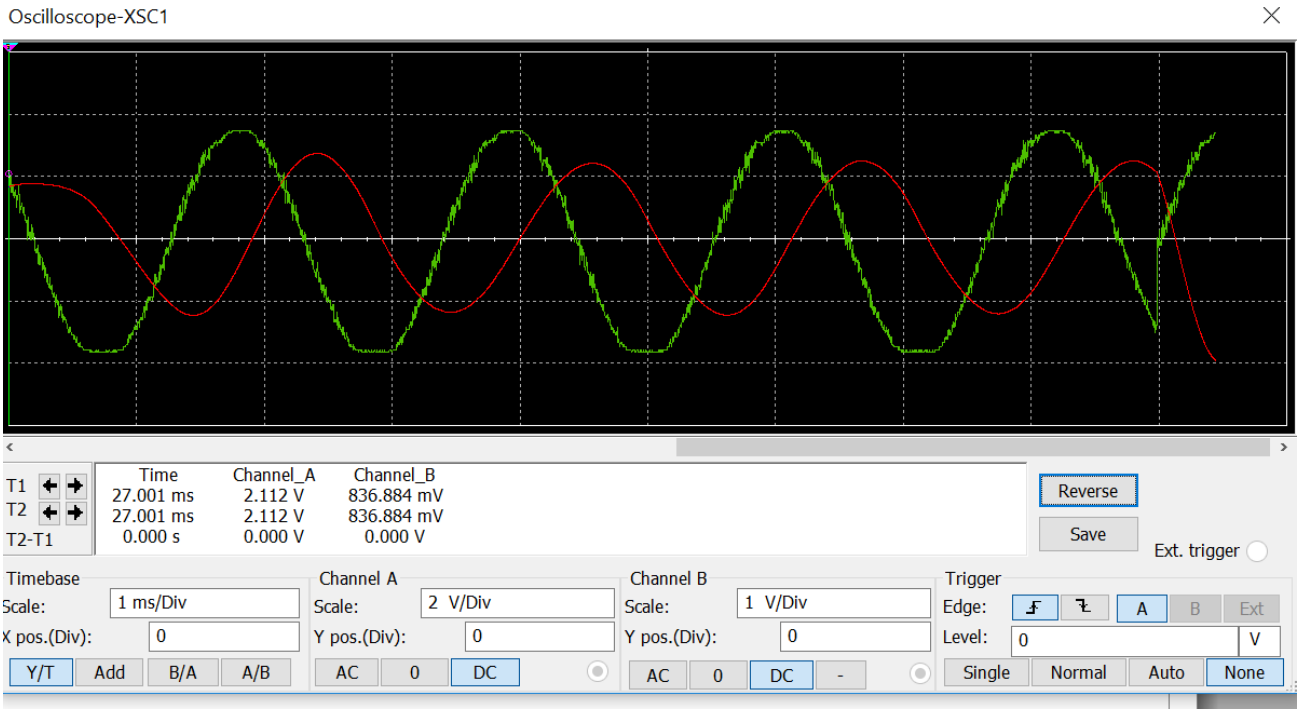


This ia a Picture of the noise filter schematic from the simulation software, for noise filtering I used Bandpass Filter Circuit.

Bandpass Filter Circuit:

Bandpass filter to filter an input signal coming from VirtualBench which take input in CSV file, I upload CSV file in it which I take from real world simulation. Signals that pass through the filter are played using a LabVIEW Speaker instrument, but on the same wire I used Oscilloscope for visualize the out put.

1D. WAVEFORM PICTURES OF THE INPUT AND OUTPUT WAVEFORM TO THE CIRCUIT:



This is my Waveform pictures of the input and output waveform to the circuit.

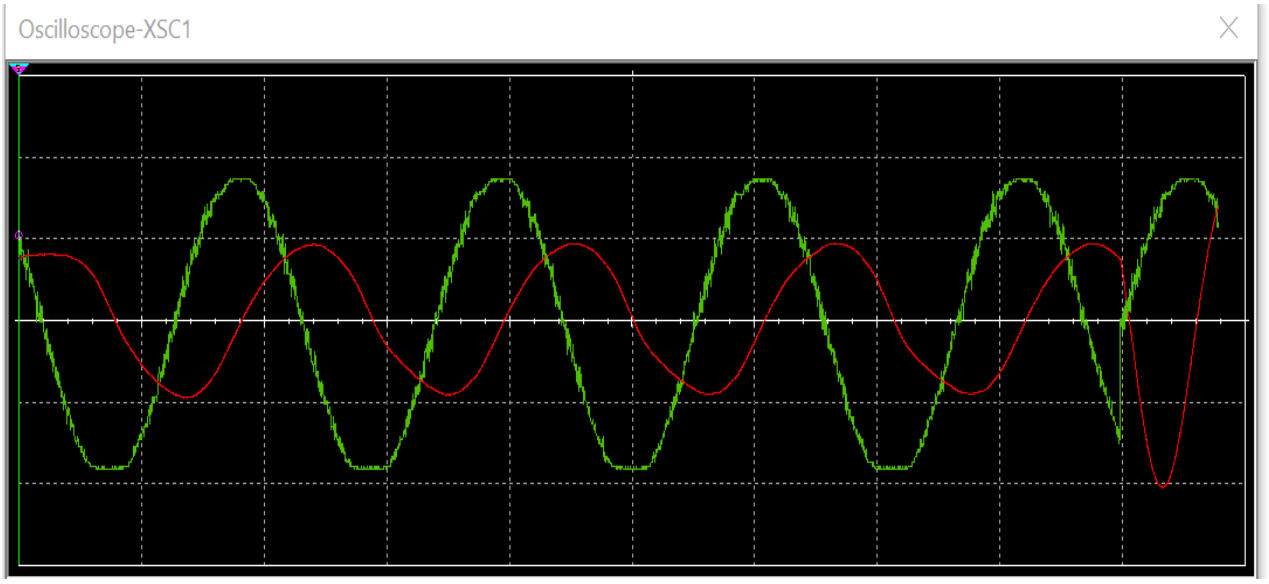
Here green is input wave form, and red is output or filtered wave form.

1E. ANALYSIS OF THE ALGORITHM/CIRCUIT.

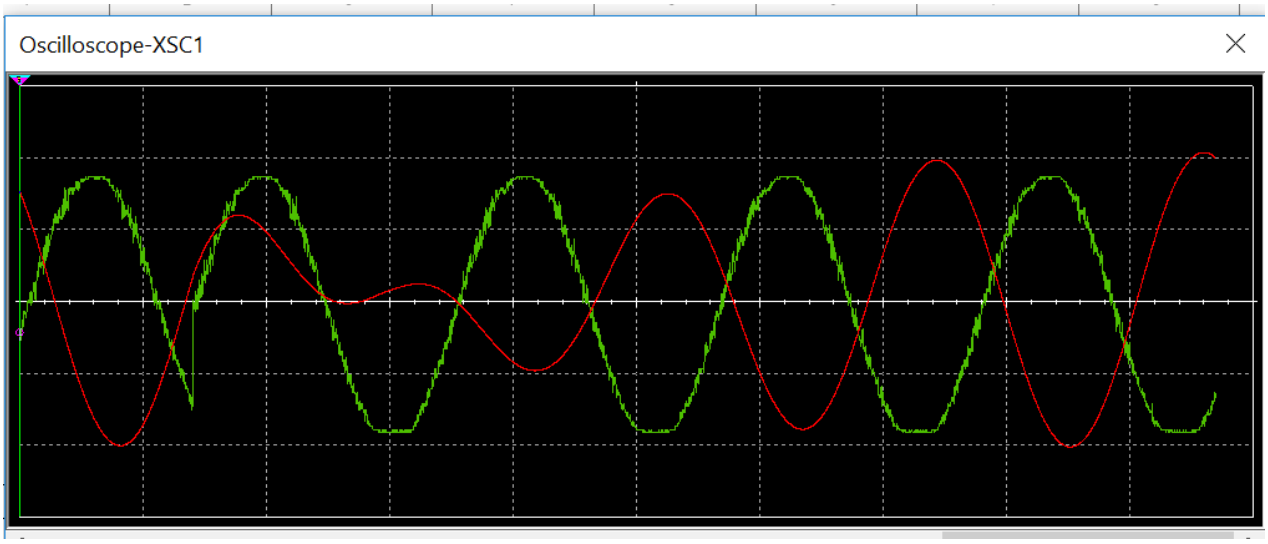
Bandpass Filter Circuit:

Bandpass filter to filter an input signal coming from VirtualBench which take input in CSV file, I upload CSV file in it which I take from real world simulation. Signals that pass through the filter are played using a LabVIEW Speaker instrument, but on the same wire I used Oscilloscope for visualize the out put.

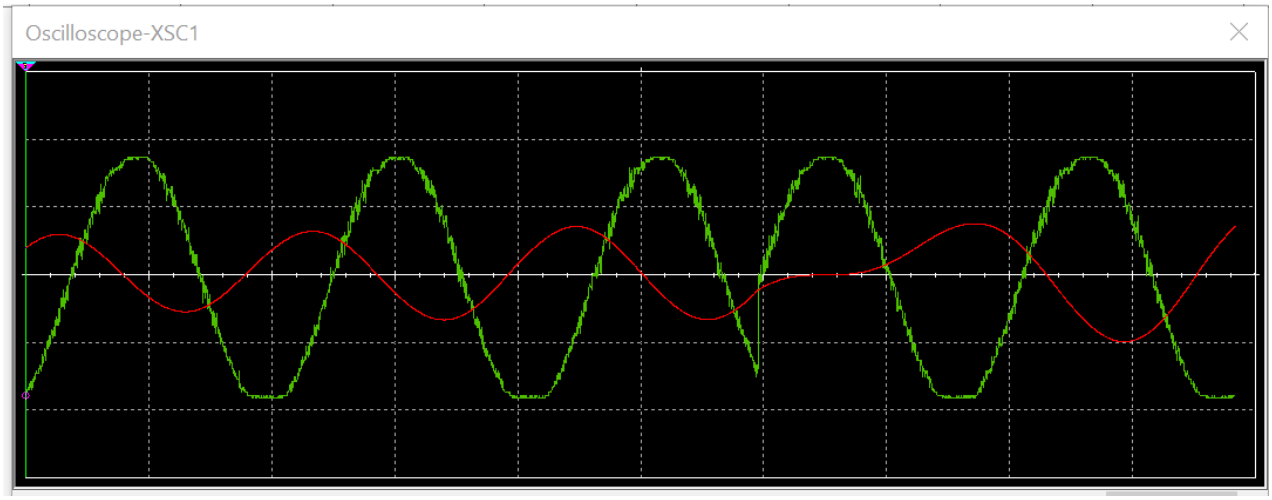
Lets analysis by changing the C3 capacitance value from10uF to 5uF and the result shows below.



When I change capacitor (C3) value from 5uF to 30uF then the result shown below:



When I change capacitor (C3) value from 30uF to 50uF then the result shown below:


Oscilloscope-XSC1