Lab Report (Example file)

EXPERIMENT 1:

REAL EXPERIMENT:

Implementation:

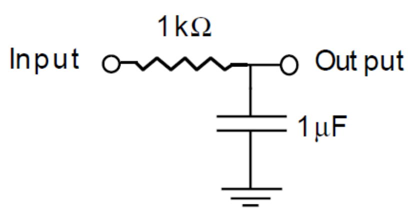

Fig 2

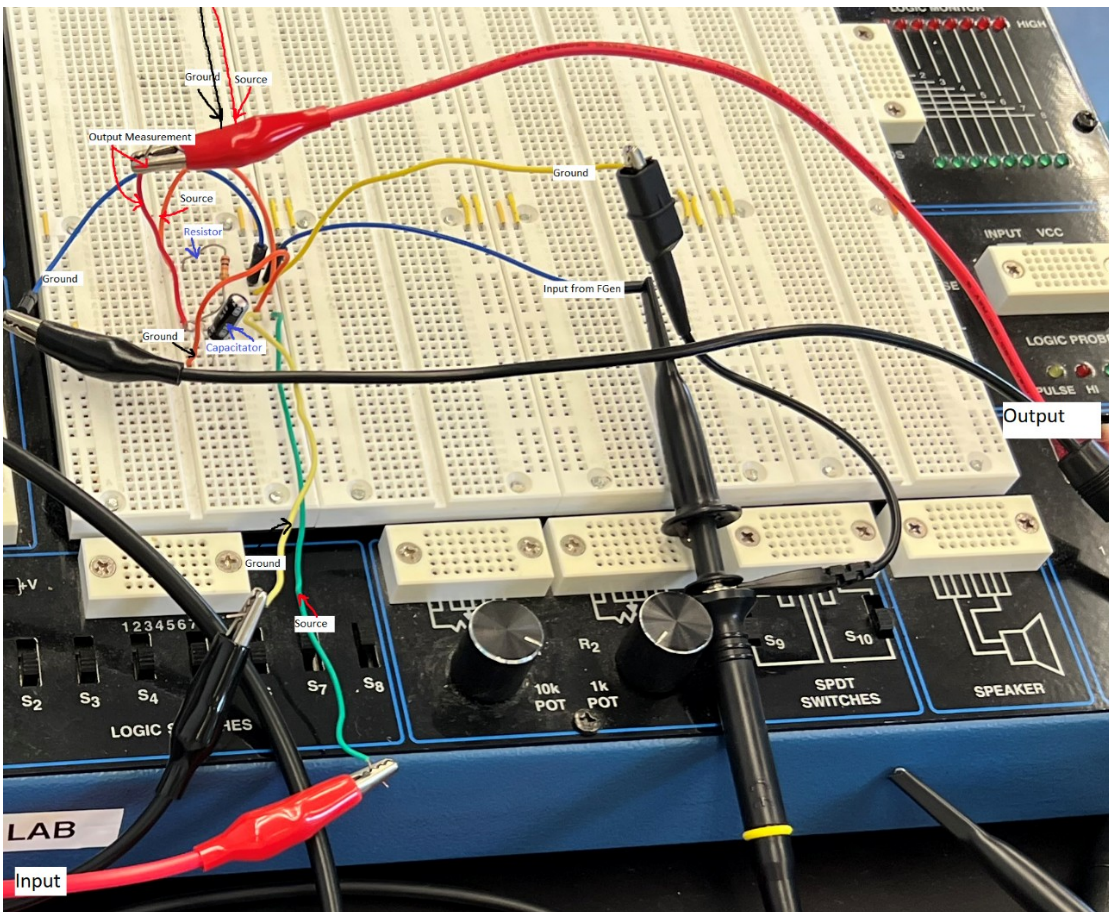

Figure 1 (Zoom in to see labels)

Description: In the circuit above the bottom green and yellow wires are connected to the clips labeled "Input" which is the oscilloscope that measures Vin. At "input", the black clip connects to ground and the red clip connects to the source. The "Output" clips connect to the ground (black clip) and the output point (in between the capacitator and the inductor) at the red clip. The "output" measures Vout at the output point demonstrated in the original drawing of the circuit. The capacitator is connected to the ground by its shorter (negative) side and to the resistor by its longer (positive) side. The resistor then connects to the input voltage provided by the Function generator. The function generator also connects to ground.

Results Display:

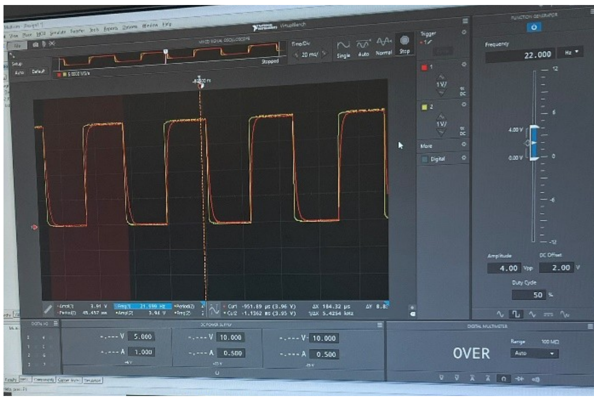

Figure 2

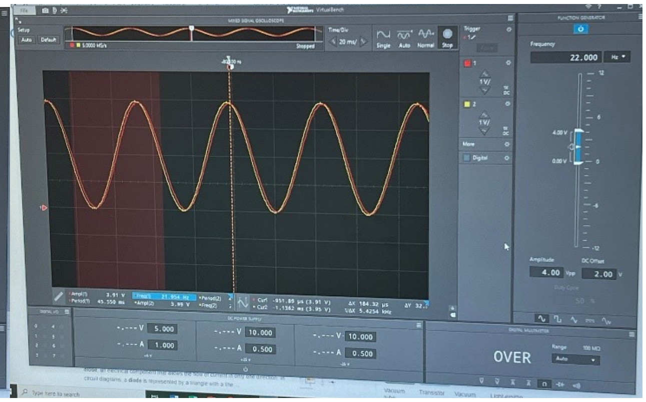

Figure 3

Comments: The oscilloscope display of the circuit in Figure 1 shows that at a frequency of 22 Hz, the measured Vin (yellow line) and Vout (Red line) are the same. Both the square and sign waves coincide and have the same amplitudes.

MULTISIM:

Implementation:

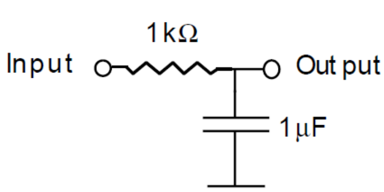

Fig 2

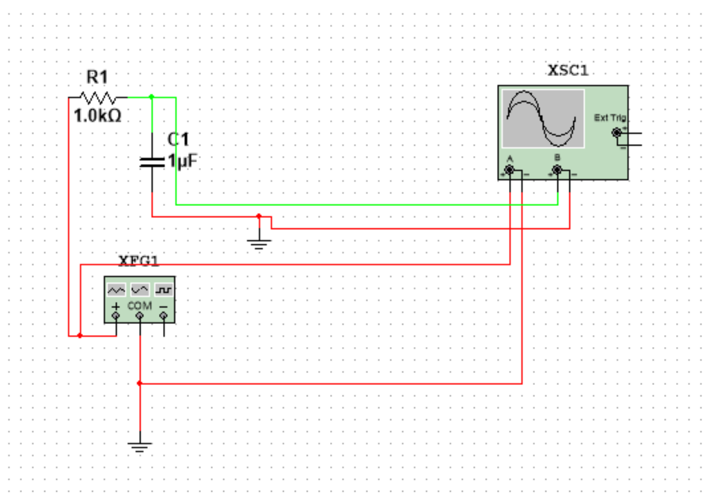

Figure 4

Description: In Figure 4, the same circuit is connected as in Figure 1, but in Multisim. The resistor, R1, connects to the positive side of the Function Generator, XFG1, and to the positive side of the

Capacitator, C1. The negative end of C1 connects to the ground. COM of XFG1 also connects to ground. The oscilloscope, XSC1, has two channels – A and B. Positive Channel A connects to the wire from the positive side of XFG1 to the resistor (input) and Negative Channel A connects to ground. Positive Channel B connects in between the capacitator and resistor to measure Vout (green wire), Negative Channel B connects to ground.

Results:

<table>
<tr>
<td>50 Hz</td>
<td>

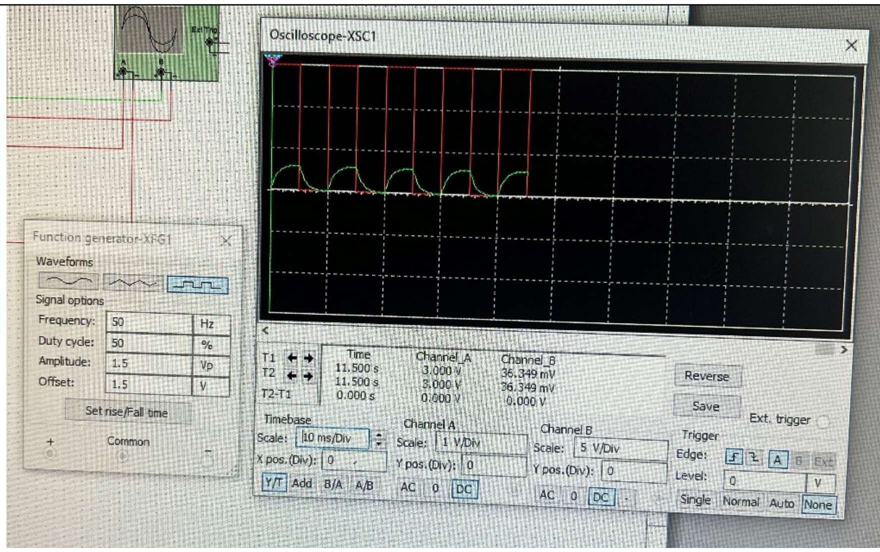

Figure 5

Comments:
Explain how this frequency affects the output signal – at 50 Hz, the output signal is lowe than at the other frequencies. The ratio of input to output signals starts at close to zero and increases with higher frequencies.
</td>
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<tr>
<td>100 Hz</td>
<td>

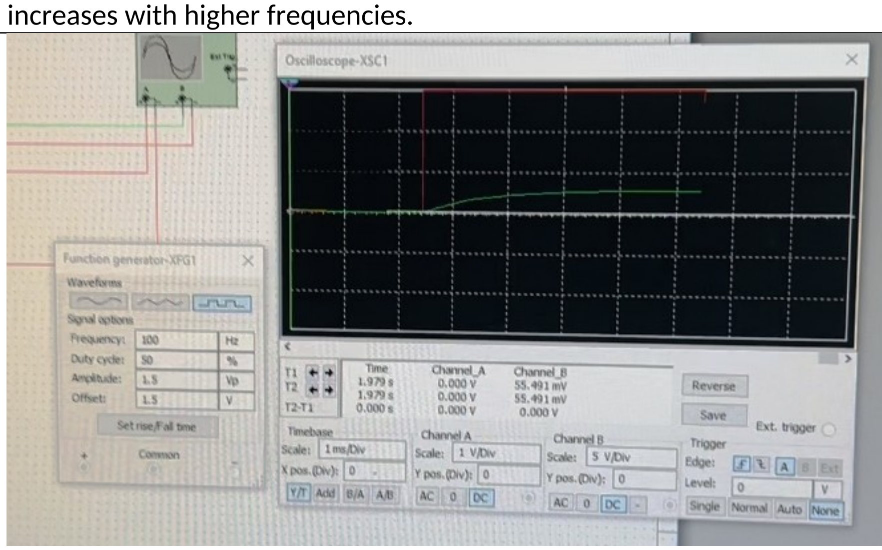

Figure 6

Comments:
Explain how this frequency affects the output signal – At 100 Hz, the output signal looks more like a sine curve and is still only a fraction of the input signal, having an amplitude of just a little
</td>
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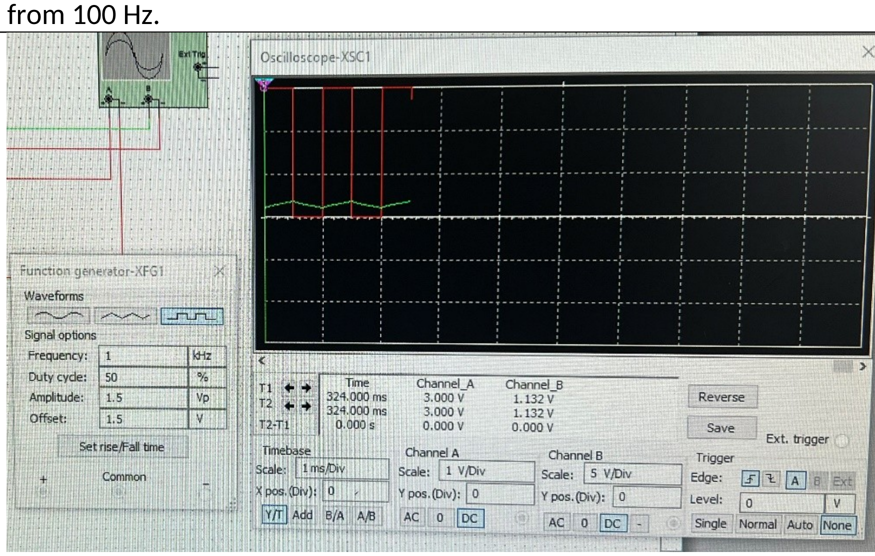
</table>

	over ½ of a grid block. The amplitude of the signal at channel B has increased since 50 Hz.
500 Hz	 *Figure 7* **Comments:** Explain how this frequency affects the output signal – at 500 Hz, the output signal varies in almost a sin curve but with linear lines. The amplitude of the output signal increases again from 100 Hz.
1 kHz	 *Figure 8* **Comments:** Explain how this frequency affects the output signal – The amplitude of the output has increased to over a volt and is coming closer from a ratio of zero to a ratio of 1.

Experiment 1 Questions: Which frequencies does the circuit act as a differentiator circuit, Explain?

Differentiator circuits only allow high voltages at output and attenuate low voltages. Only high frequencies will pass, and low frequencies will create an output amplitude of nearly 0. You can see that

50Hz and 100Hz, amplitude of Vout is close to 0 meaning that the low frequencies did not pass and the circuit is a differentiator circuit.

EXPERIMENT 2:

Implementation:

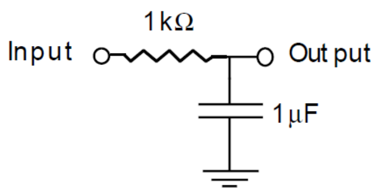


Fig 2

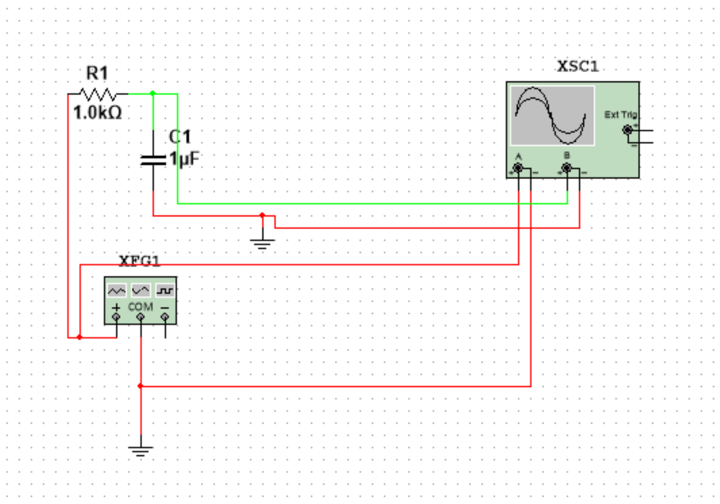


Figure 9 (Same as Multisim in Figure 4)

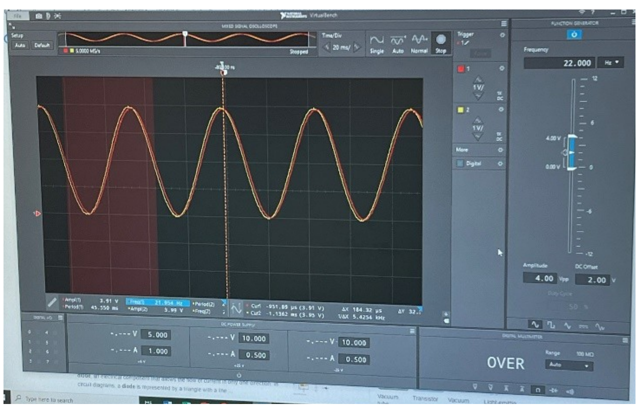


Figure 10 (For same circuit as Figure 1)

Description: The circuit implemented in Experiment 2 and shown in figure 9 is the same as in experiment 1. Figure 10 shows the sine wave signals on the oscilloscope in the real experiment. The resistor and capacitor in figure 9 connect in a circuit with the Function Generator and Oscilloscope in the same way as in the previous experiment.

Results:

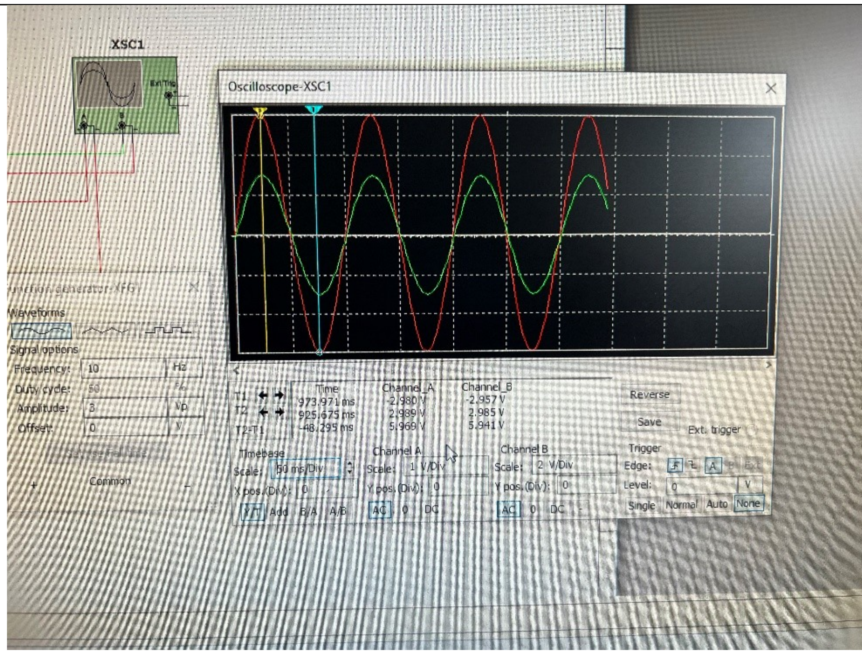
<table>
<tr>
<td>10 Hz</td>
<td>

Figure 11

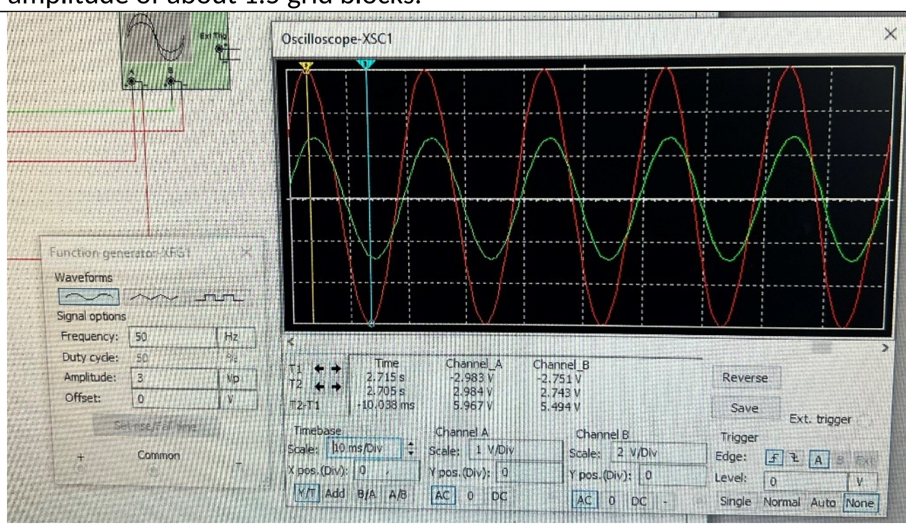
Comments: The input signal has a maximum amplitude (distance from horizontal axis to top of graph) of 3 grid blocks. The output signal, shown in green has a maximum amplitude of about 1.5 grid blocks.</td>
</tr>
<tr>
<td>50 Hz</td>
<td>

Figure 12

Comments: At 50 Hz, the maximum amplitude of the input signal is about 3 grid blocks. The maximum amplitude of the output signal is about 1.5 blocks again.</td>
</tr>
</table>

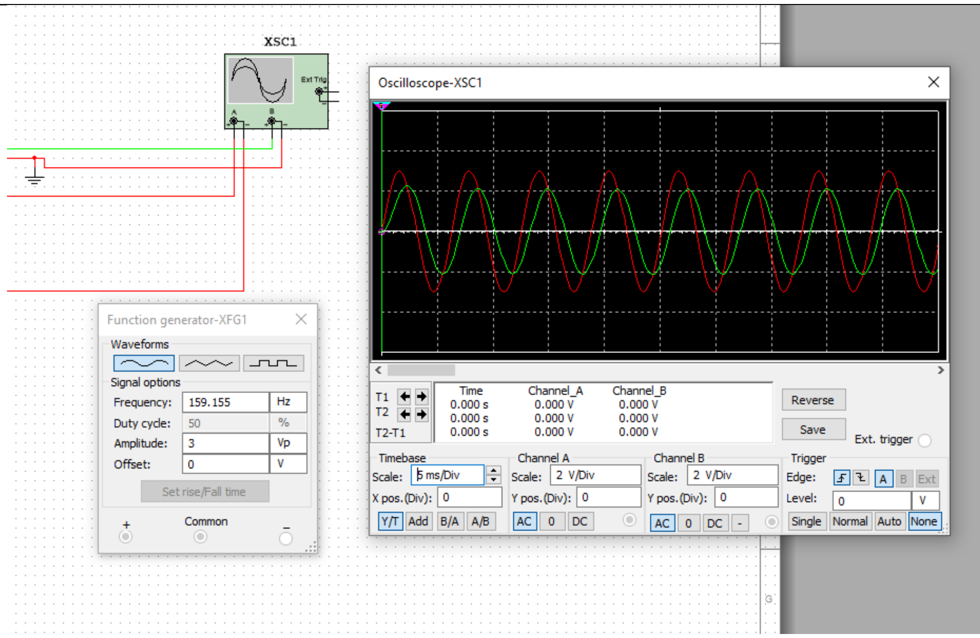
<table>
<tr>
<td>$\frac{1}{2\pi RC}$ Hz</td>
<td>


Figure 13

Comments: at the cutoff frequency, the amplitudes of the output signal is about 1 block and the amplitude of the input signal is about 1.5 blocks. The ratio of the signals is less than 1 but still not very close to 0
</td>
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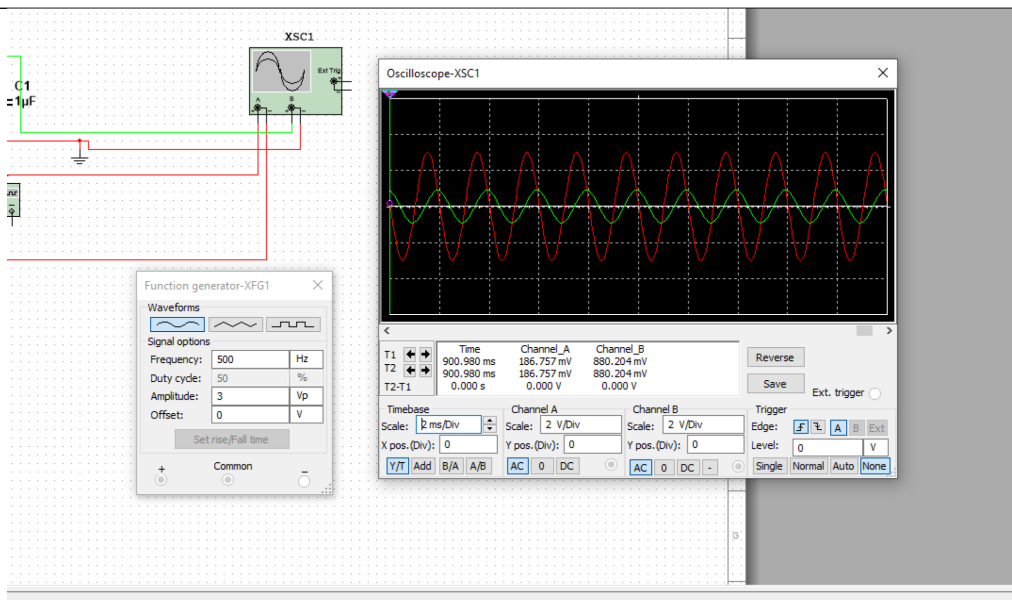
<tr>
<td>500 Hz</td>
<td>


Figure 14

Comments: At 500 Hz, the output signal is significantly less than the input signal. On the image, the input has an amplitude of about 1.5 blocks while the output has an amplitude of about .5 blocks.
</td>
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</table>

5 kHz

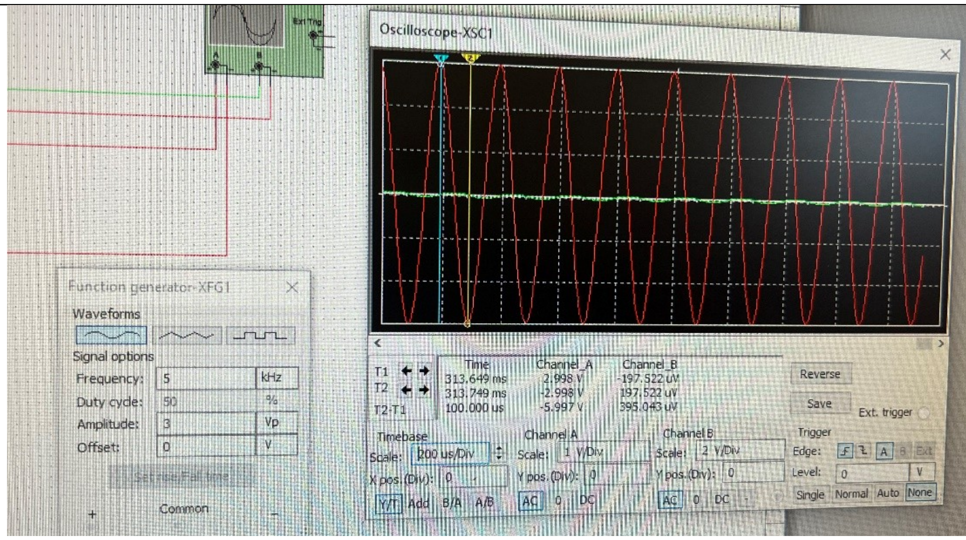


Figure 15

Comments: At 5 kHz, the output signal barely has a noticeable amplitude compared to the input signal.

Measured Data:

Measured Amplitudes

Table 1:

Frequency (Hz)	Amplitude Vout (V)	Amplitude Vin (V)
10	5.971	5.978
50	5.69	5.967
159.15	4.236	6
500	1.812	5.992
5000	190.276*10^-3	5.997

Amplitude Ratios:

Table 2:

Frequency (Hz)	Amplitude Ratio (Vout/Vin)
10	0.9988290398
50	0.9535780124
159.15	0.706
500	0.3024032043
5000	0

Plot:

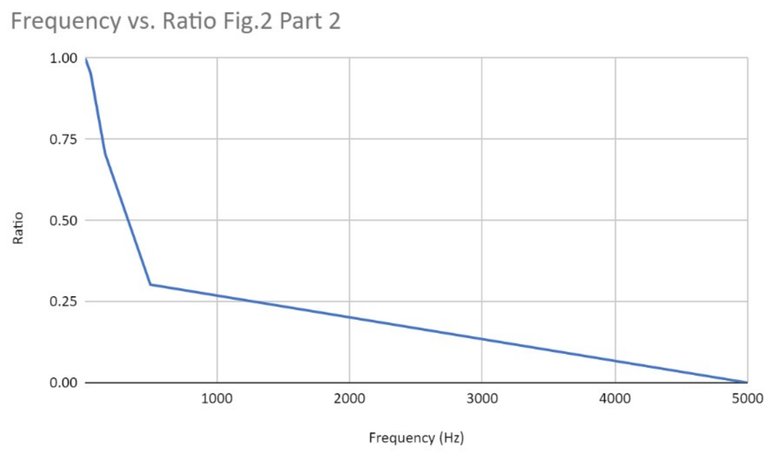


Figure 16

Comments: The plot in Figure 16 shows an exponential decay in Amplitude ratio value with increase in frequency. At 10 Hz, the ratio of amplitudes is about 1, meaning Vout = Vin. At 500 Hz, you can see the graph beginning to rapidly tend to 0 which is reaches at 5000 Hz, meaning Vout is tending to 0.

Experiment 2 Questions:

In the second experiment: Which frequencies does the circuit act as a high pass filter, Explain?

Your answer:

Which frequencies does the circuit act as a differentiator circuit, Explain?

Your answer:

Which frequency (should be cutoff frequency) the ratio of the amplitude between the output signal and input signal is be approximate $\frac{1}{\sqrt{2}}$, then convert this ratio to db (should be approximate -3)?

Your answer:

EXPERIMENT 3:

Implementation:

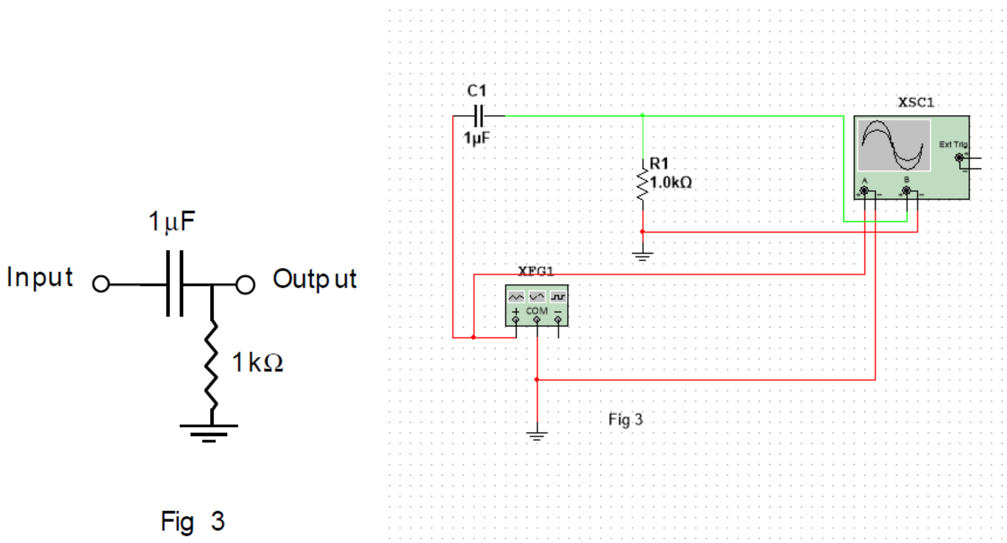
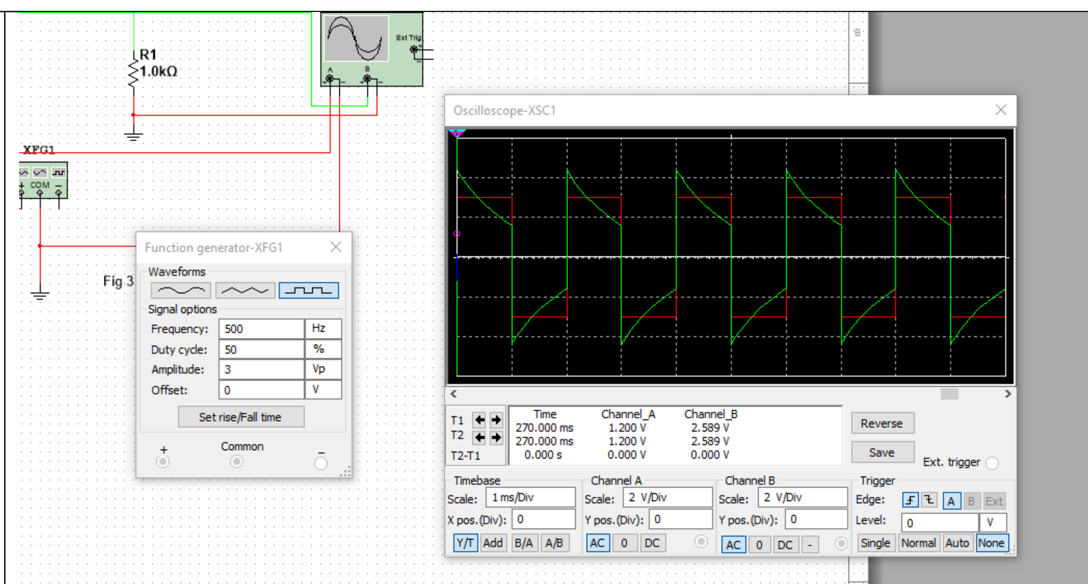


Figure 17

Description: In figure 17, the capacitor C1, connects to the positive side of the function generator, XFG1, generating an input voltage and the resistor R1. R1 also connects to ground. The function generator connects to ground at COM. XSC1 is an oscilloscope with channel A connecting to the input between XFG1 and C1 and to ground and Channel B connecting to the output between C1 and R1 (green wire) and to ground.

Results:

500 Hz	 *Figure 18*

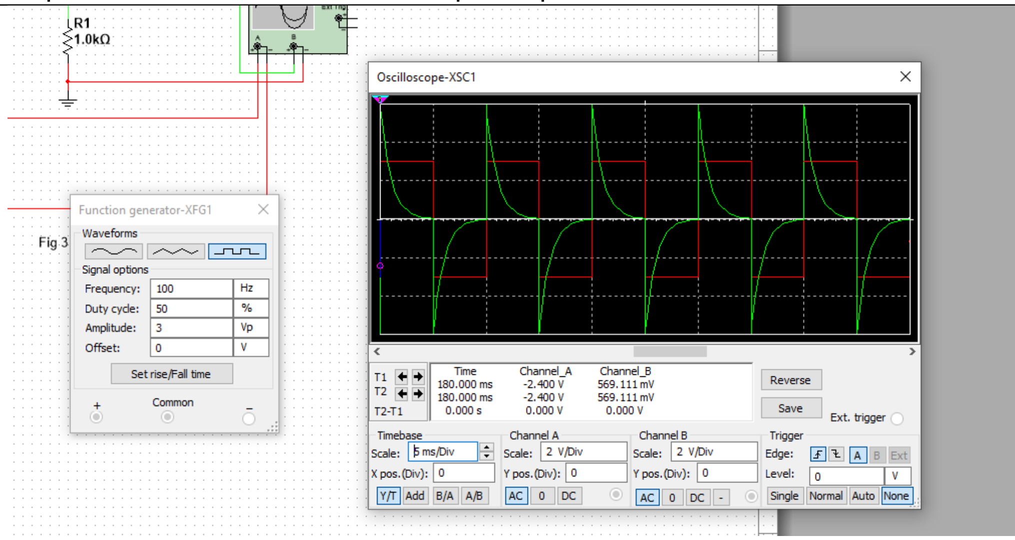
<table>
<tr><td></td><td>Comments: Explain how this frequency affects the output signal – at 500 Hz, the output signal, green line, has an amplitude slightly higher than the input signal. The input amplitude is about 1.5 blocks and output amplitude is about 2 blocks</td></tr>
<tr><td>100 Hz</td><td>

Figure 19

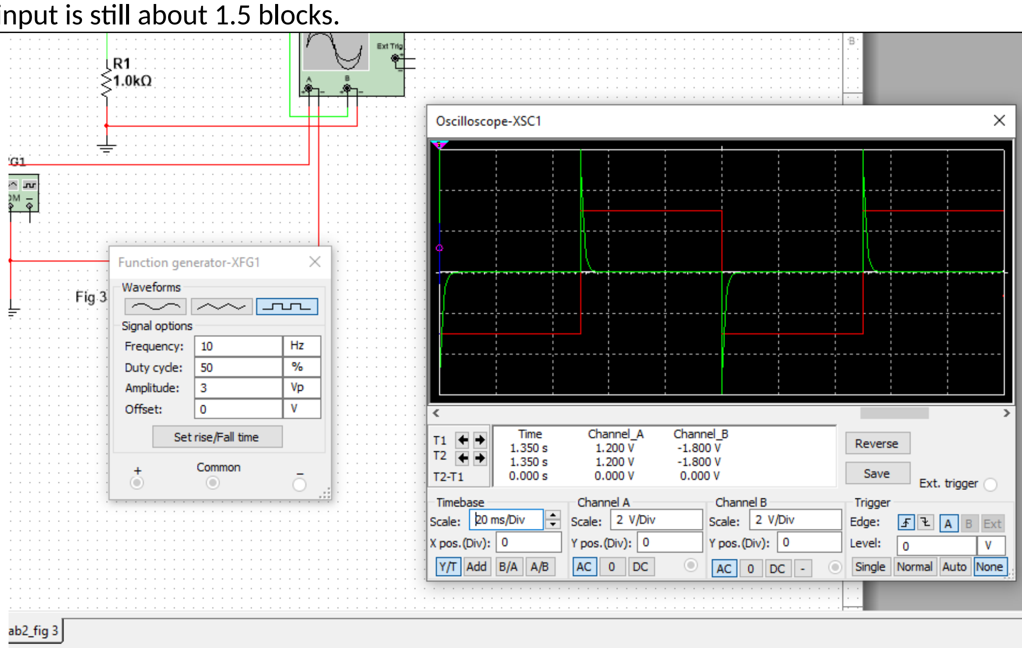
Comments: Explain how this frequency affects the output signal – The decrease of frequency to 100 Hz causes an increase in output signal amplitude to about 3 blocks while input is still about 1.5 blocks.</td></tr>
<tr><td>10 Hz</td><td>

Figure 20

Comments: Explain how this frequency affects the output signal – at 10 Hz, the output signal seems to be about at the same relative amplitude as at 100 Hz, maybe with slight further increase in amplitude</td></tr>
</table>

Experiment 3 Questions:

Which frequencies does the circuit act as an integrator circuit, Explain?

Your answer:

EXPERIMENT 4:

Implementation:

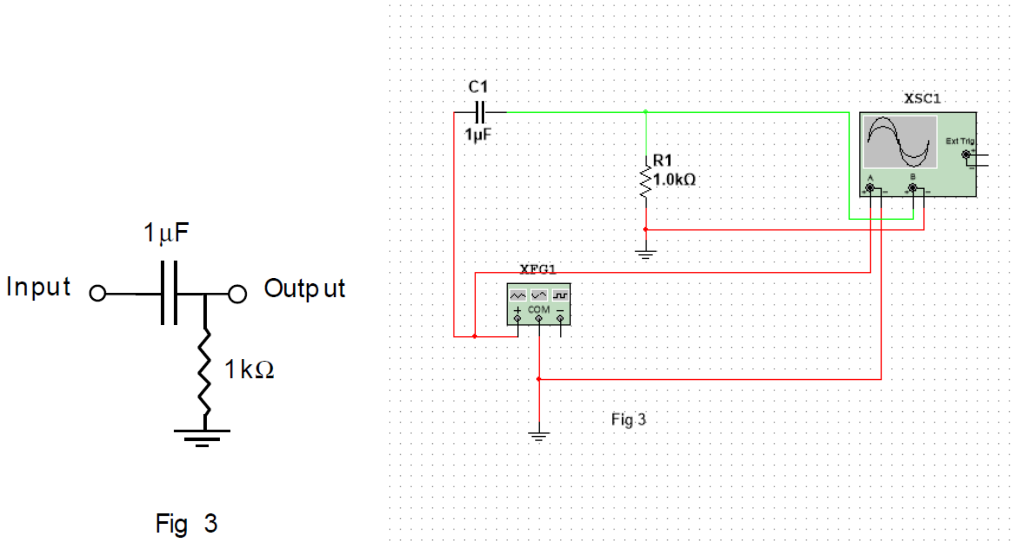
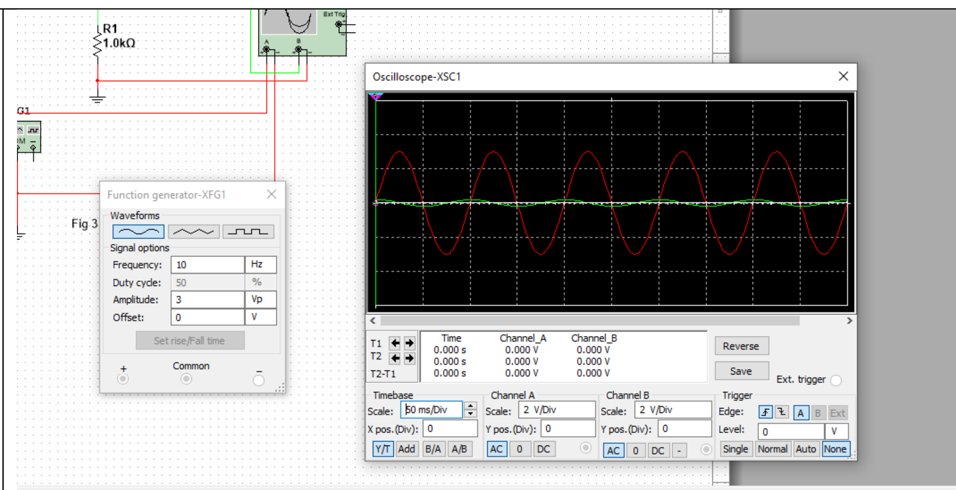


Figure 21

Description: Figure 21 shows the same circuit, connected in the same way as in Figure 17 of experiment 3.

Results:

10 Hz	 *Figure 22* **Comments:** at 10 Hz, the output signal has a very low amplitude compared to the input signal.

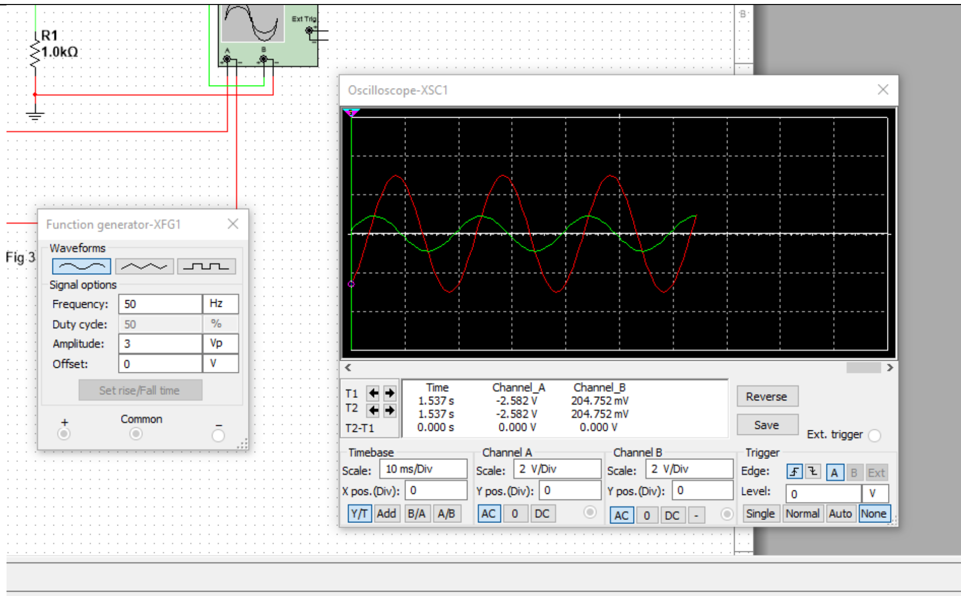
<table>
<tr>
<td>50 Hz</td>
<td>


Figure 23

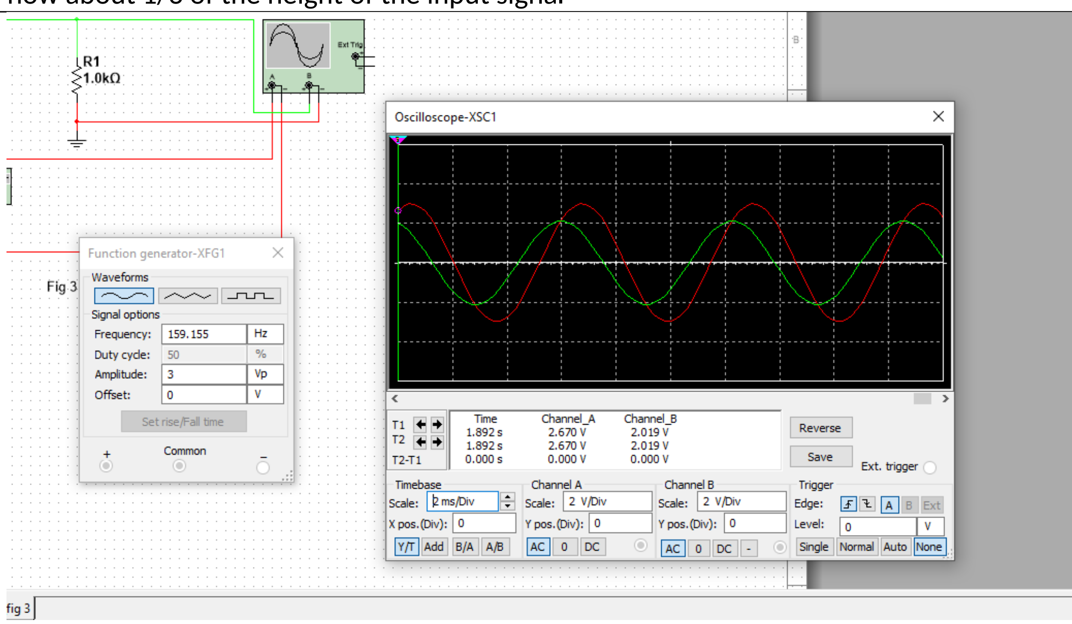
Comments: at 50 Hz, the amplitude of the green output wave increases from 10 Hz and is now about 1/3 of the height of the input signal
</td>
</tr>
<tr>
<td>$\frac{1}{2\pi RC}$
Hz</td>
<td>


Figure 24

Comments: at the cutoff frequency, the amplitude of the output wave increases to only be about ½ of a block lower than the amplitude of the input wave.
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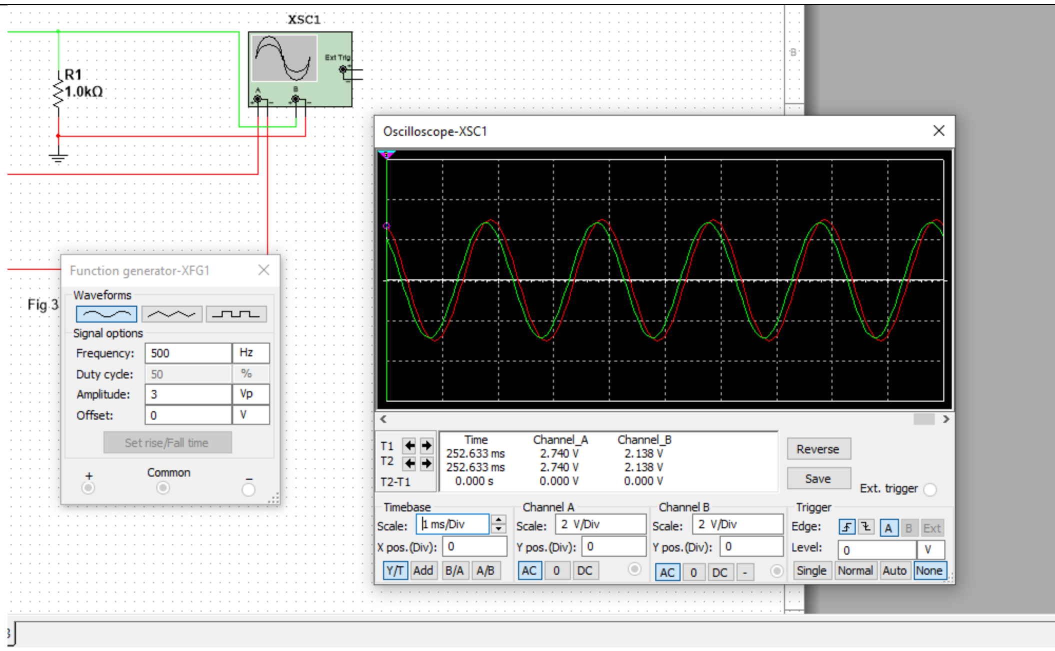
<table>
<tr>
<td>500 Hz</td>
<td>


Figure 25

Comments: at 500 Hz, the amplitude of the output wave is only a little lower than that of the input wave, there is barely a discernable difference in height.
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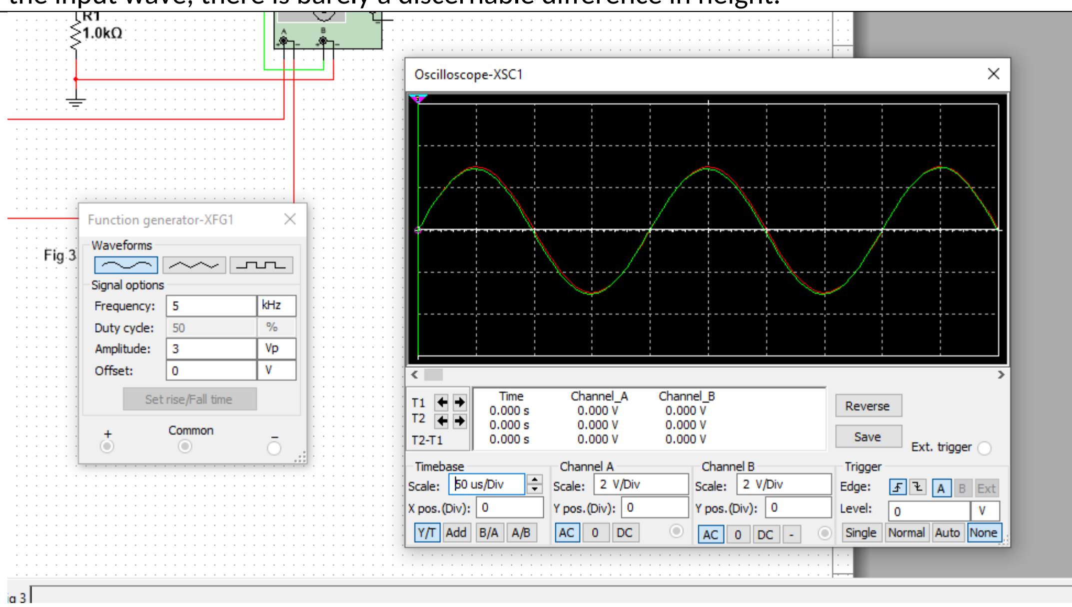
<tr>
<td>5 kHz</td>
<td>


Figure 26

Comments: at 5 kHz, the input and output amplitudes are exactly the same, meaning their amplitude ratio is 1.
</td>
</tr>
</table>

Measured Data:

Measured Amplitudes

Table 3:

Frequency (Hz)	Amplitude Vout (V)	Amplitude Vin (V)
10	376.492*10^-3	5.982
50	1.797	6
159.15	4.231	5.974
500	5.71	5.997
5000	5.991	5.985

Amplitude Ratios

Table 4:

Freqency (Hz)	Amplitude Ratio (Vout/Vin)
10	0
50	0.2995
159.15	0.708235688
500	0.952142738
5000	1.001002506

Plot:

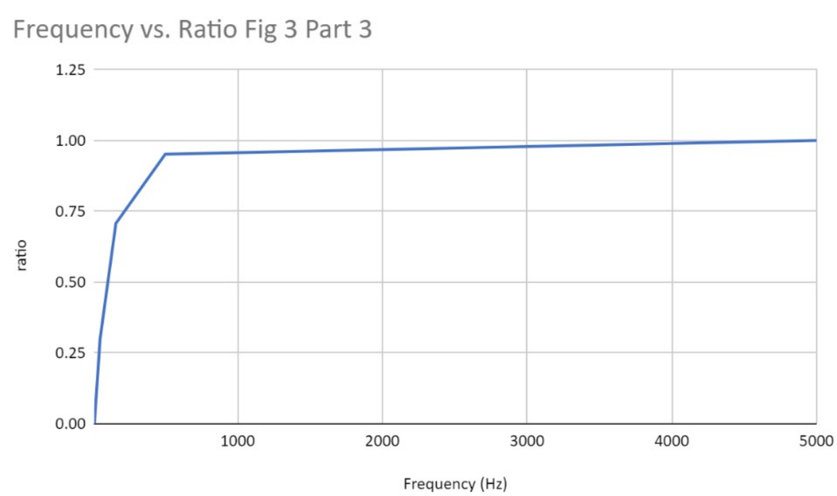


Figure 27

Comments: the plot in Figure 27 demonstrates a logarithmic growth of Amplitude ratio plateauing at 1. The amplitude ratio begins to tend towards 1 at about 500 Hz. At 10 Hz, the amplitude ratio begins at about 0.

Experiment 4 Questions:

Which frequencies does the circuit act as a low pass filter, Explain?

Your answer:

Which frequencies does the circuit act as an integrator circuit, Explain?

Your answer:

Which frequency (should be cutoff frequency) the ratio of the amplitude between the output signal and input signal is be approximate $\frac{1}{\sqrt{2}}$, then convert this ratio to db (should be approximate -3)?

Your answer:

Summary: I learned about different filters and types of circuits that use resistors and capacitators. I understand how High and low pass filters block certain frequencies from passing and stop a voltage change from Vin to Vout. I am still confused and find it difficult to understand integrator and differentiator circuits. It seems that they change whether the output voltage is varying or stable at a varying or stable input voltage but I also read that integrators act like low pass filters and differentiators act like high pass filters, how does the change in variation of voltage determine which frequencies can pass through the circuit?