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School of Engineering Technology

Department of Electrical Engineering

**Electronic Circuits and Devices Lab**

**Lab Experiment # 1**

Negative Feedback Circuits

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| **Issue** | **Date** | **Contributors** | **Authorized by** | **List of Modifications** |
| 1 |  | Eng. Nadia AlSa’d |  |  |
| 2 | Mar. 2021 | Eng. Rasha Shaheen | Dr. Muhannad Al Traifi |  |
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**Lab Experiment # 1**

Negative Feedback Circuits

**Purpose:**

* To demonstrate the operation of both inverting and non-inverting amplifier circuits using a 741 operational amplifier.
* To demonstrate the operation of the Buffer circuit using a 741 operational amplifier.

**Background:**

Inverting, and non- inverting op amp circuits operate in the negative feedback closed-loop mode. The inverting amplifier's closed-loop voltage gain can be less than, equal to, or greater than 1. As its name implies, its output signal is always inverted with respect to its input signal. On the other hand, the non-inverting amplifier's closed-loop voltage gain is al-ways greater than 1, while the input and output signals are alwa`ys in-phase.

**Required Mathematical Formulas:**

* *Inverting amplifier closed-loop voltage gain*

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* *Non- inverting amplifier closed-loop voltage gain*



A **voltage buffer**, also known as a **voltage follower**, or a **unity gain amplifier**, is an amplifier with a gain of 1. It’s one of the simplest possible op-amp circuits with closed-loop feedback.

Even though a gain of 1 doesn’t give any voltage amplification, a buffer is extremely useful because it prevents one stage’s input impedance from loading the prior stage’s output impedance, which causes undesirable loss of signal transfer

**Preliminary:**

Three circuits will be implemented and analyzed. Inverting operational amplifier, the AC input and output will be measured and sketched using the oscilloscope, the voltage gain will be measured at different values of Rf. Non-Inverting Op-Amp, the AC input and output will be measured and sketched using the oscilloscope, the voltage gain will be measured at different values of Rf. The third circuit will be buffer Op-Amp, AC input and output will be measured and sketched using the oscilloscope, the voltage gain will be measured.

MultisimTM will be applied during all examinations.

As a preliminary, circuit should be analyzed analytically to calculate the voltage gain.

**In the lab:**

*Part 1: Inverting Op-Amp:*

Circuit 1

Diagram, schematic

Description automatically generated

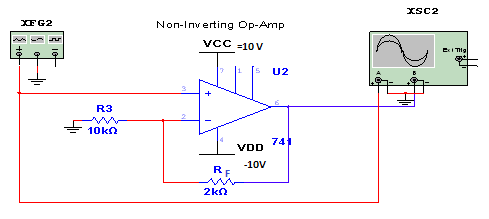
1. Start a new file in Multisim, name it “inverting amplifier”.
2. Build *Circuit 1* and assign proper source and impedance values. With Vin=1Vp-p, 500 Hz, use Vcc=10V and VDD=-10V.
3. Connect all elements properly and place a ground node at the bottom.
4. Assign voltage probes for the input and output voltages.
5. Connect the signal generator to the circuit as shown above, then Connect Channel 1 & Channel 2 of your oscilloscope as shown in the figure, and sketch both the input and output waveforms.
6. Run the simulation and record probe readings. And draw the oscilloscope results. Are they similar to the values expected from your analytical calculations? Compare your results with that obtained in the lab.
7. Calculate the voltage gain (output voltage divided by the input voltage).
8. Fill your results in the following table

|  |  |  |  |
| --- | --- | --- | --- |
| **Rf** | **Measured V0** | **Measured Gain** | **Expected Gain** |
| **2 kΩ** | 198mv | 0.19 | 0.2 |
| **10 kΩ** | 973mv | 1 | 1 |
| **20 kΩ** | 2.01v | 2.19 | 2 |
| **310 kΩ** | 9.2v | 9.2 | 31(maybe cause highest gain possible is 10 ?) |

Build *Circuit 1* on a breadboard and validate results.

*Part 2: Non-Inverting Op-Amp:*

Circuit 2



1. Start a new file in Multisim, name it “inverting amplifier”.
2. Build Circuit 2 and assign proper source and impedance values. With Vin=1Vp-p, 500 Hz, use Vcc=10V and VDD=-10V.
3. Connect all elements properly and place a ground node at the bottom.
4. Assign voltage probes for the input and output voltages.
5. Connect the signal generator to the circuit as shown above, then Connect Channel 1 & Channel 2 of your oscilloscope as shown in the figure, and sketch both the input and output waveforms.
6. Run the simulation and record probe readings. And draw the oscilloscope results. Are they similar to the values expected from your analytical calculations? Compare your results with that obtained in the lab.
7. Calculate the voltage gain (output voltage divided by the input voltage).
8. Fill your results the following table

|  |  |  |  |
| --- | --- | --- | --- |
| **Rf** | **Measured V0** | **Measured Gain** | **Expected Gain** |
| **2 kΩ** | 1.167 | 1.17 | 1.2 |
| **10 kΩ** | 1.987 | 1.99 | 2 |
| **20 kΩ** | 2.97 | 2.98 | 3 |
| **310 kΩ** | 8.397 | 8.54 | 32 |

Build *Circuit 2* on a breadboard and validate results.

*Part 3: Buffer:*

Circuit 3

Diagram, schematic

Description automatically generated

1. Start a new file in Multisim, name it “inverting amplifier”.
2. Build Circuit 3 and assign proper source and impedance values, with Vin=1Vp-p, 500Hz, use Vcc=10V and VDD=-10V.
3. Connect all elements properly and place a ground node at the bottom.
4. Assign voltage probes for the input and output voltages.
5. Connect the signal generator to the circuit as shown above, then Connect Channel 1 & Channel 2 of your oscilloscope as shown in the figure, and sketch both the input and output waveforms.
6. Run the simulation and record probe readings. And draw the oscilloscope results. Are they similar to the values expected from your analytical calculations? Compare your results with that obtained in the lab.
7. Add a feedback resistor Rf = 600kΩ. And draw the oscilloscope results
8. Calculate the voltage gain with and without the feedback resistor.

*Breadboard:*

Build *Circuit 3* on a breadboard and validate results.