**LAB NOTE**

**Subject: Electronic Design Principles**

**Topic: Basic Op Amp**

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# Objectives

* Building an A) inverting amplifier B) Non-inverting amplifier C) Voltage follower.
* Design a circuit using one of the quad Op-amps in your first semester ESD kit.

**Requirement:**

1. Decide the power to be applied to the IC based on your datasheet. State your reason. (hint: +/- 3 up to +/- 10).
2. Prepare circuits in advance and prepare the tables with predicted/calculated outcomes to compare with the actual values (minimum 10 entries).
3. The amplification should be approximately 2 for both amplifiers.
4. Use a potentiometer (variable resister) to vary the input voltage.

# Theory and Calculation

## Theory

* A noninverting amplifier is a configuration in which the signal is on the noninverting input and a portion of the output is returned to the inverting input.
* An inverting amplifier is a configuration in which the noninverting input is grounded and the signal is applied through a resistor to the inverting input.
* A special case of the inverting amplifier is when Rf =0 and Ri = ∞. This forms a voltage follower or unity gain buffer with a gain of 1

## Design and Calculation

A diagram of a circuit

Description automatically generated

Figure 2‑1: Non-inverting amplifier’s design

A diagram of a circuit

Description automatically generated

Figure 2‑2: Inverting amplifier’s design

A diagram of a circuit

Description automatically generated

Figure 2‑3: Voltage follower's design

For this design the following equipment are use:

* 3 Resistors and 1 Resistor
* IC LM348N
* Function Generator
* Power Supply

Non-inverting amplifier formula to calculate gain:

Inverting amplifier formula to calculate gain:

Voltage follower formula’s gain will be a constant 1:

Formula to calculate Vout:

Because the requirement is to build a circuit with gain approximately 2, so:

* **Non-inverting amplifier:**

Assuming Ri = , so:

So for non-inverting amplifier, 2 resistor will be used.

* **Inverting amplifier:**

Assuming Ri = , so:

Because the kit does not have a resistor with value so instead will use resistor.

So for inverting amplifier resistor and resistor will be used.

* **Power supply:**

**A black and white line

Description automatically generated with medium confidence**

Figure 2‑4: LM348N's datasheet

From the datasheet, it said that it recommended that the power supply of Vcc+ should be in range from 4V to 18V, and for Vcc- should be from -4 to -18.

# Design and Result

For this assignment, 10 cases will be tested, 4 will be with DC power and 6 will be from AC power.

## Multisim’s design for all 3 circuits.

A diagram of a circuit

Description automatically generated

Figure 3‑1: Multisim's design

## Breadboard’s design

A close up of a circuit board

Description automatically generated

Figure 3‑2: Breadboard’s design

## Result

### DC power

* Inverting

|  |  |  |  |
| --- | --- | --- | --- |
| Input | Output | | |
| Theory | Multisim (CH2) | Breadboard |
| 1.36 | -2.72 |  |  |
| -1.84 | 3.68 |  |  |
| -1.2 | 2.4 |  |  |
| -2.6 | 5.2 |  |  |

Table 3‑1: DC power for Inverting Amplifier

* Non -Inverting

|  |  |  |  |
| --- | --- | --- | --- |
| Input | Output | | |
| Theory | Multisim (CH3) | Breadboard |
| -1.28 | -2.56 |  |  |
| -1.92 | -3.84 |  |  |
| -1.04 | -2.08 |  |  |
| -0.8V | -1.6 |  |  |

Table 3‑2: DC power for Non-Inverting Amplifier

* Voltage follower:

|  |  |  |  |
| --- | --- | --- | --- |
| Input | Output | | |
| Theory | Multisim (CH4) | Breadboard |
| -0.8 | -0.8 |  |  |
| -1.04 | -1.04 |  |  |
| -1.92 | -1.92 |  |  |
| -1.2 | -1.2 |  |  |

Table 3‑3: DC power for Voltage Follower

### AC power

* Inverting

|  |  |  |  |
| --- | --- | --- | --- |
| Input (Vpp) | Output | | |
| Theory | Multisim (CH2) | Breadboard |
| 1.28 | 2.56 |  |  |
| 1.04 | 2.08 |  |  |

Table 3‑4: AC power for Inverting Amplifier

* Non-inverting

|  |  |  |  |
| --- | --- | --- | --- |
| Input (Vpp) | Output | | |
| Theory | Multisim (CH3) | Breadboard |
| 1.28 | 2.56 |  |  |
| 1.04 | 2.08 |  |  |

Table 3‑5: AC power for Inverting Amplifier

* Voltage Follower

|  |  |  |  |
| --- | --- | --- | --- |
| Input (Vpp) | Output | | |
| Theory | Multisim (CH4) | Breadboard |
| 1.28 | 1.28 |  |  |
| 1.04 | 1.04 |  |  |

Table 3‑6: AC power for Voltage Follower

# CONCLUSION

From the result of all cases:

* All cases have Theory’s result, Multisim’s result and Breadboard’s result nearly the same.

**REFERENCES**