

# Simulation Report - Week 1

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## 1. Introduction

This week I simulated an inverter circuit and a differential amplifier circuit that both use an opamp as the main component. As we are looking at introductory circuits from [1] this week, I decided to choose these two circuits as they perform some fundamental operations on signal and hence find wide applications in many electronic devices.

## 2. Simulation Details

- Environment: LTspiceXVII
- Important component(s): LM741 Opamp IC
- Reference Book: Gayakwad[1]

### 2.1 Opamp Inverter circuit

#### A. Theory

This inverter circuit is simply a special case of the *inverting feedback amplifier* where the resistor  $R_1$  in series with the voltage source and the feedback resistor  $R_2$  (generally denoted in texts as  $R_F$ ) have equal resistance i.e.  $R_1 = R_2$ . Due to the feedback loop, if the output voltage of the opamp  $V_{out}$  increases, the same voltage is also applied to the inverting terminal  $v^-$  so this in turns decreases the output voltage.

The output of this circuit is equal in amplitude to the input signal  $V_1$  but inverted.

$$\begin{aligned}\text{Gain of the feedback circuit, } B &= \frac{R_1}{R_1 + R_2} \\ &= \frac{1}{2}\end{aligned}$$

#### B. Schematic and Waveform

See Fig. 1

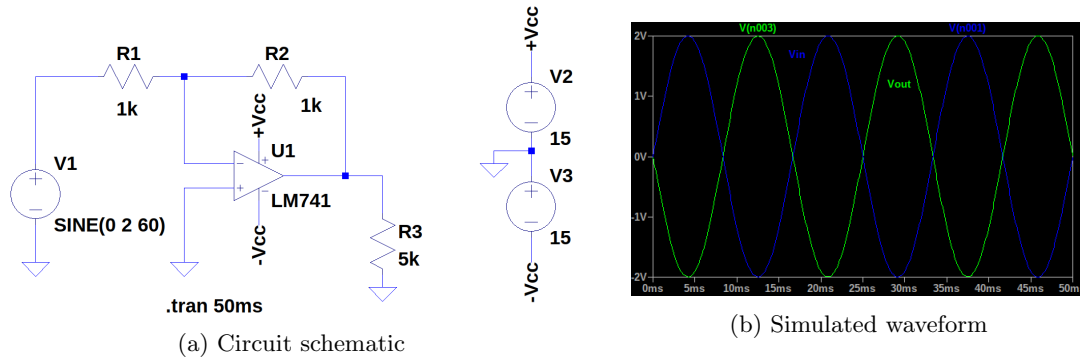


Figure 1: Inverter circuit

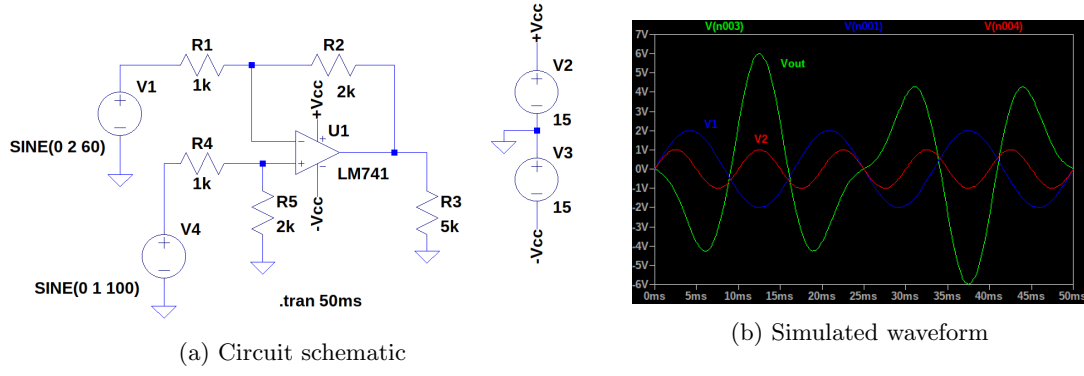


Figure 2: Differential amplifier circuit

## 2.2 Opamp Differential Amplifier

### A. Theory

The opamp differential amplifier is the combination of a *non-inverting amplifier* and an *inverting amplifier*. If we remove  $V_1$ , the inverting input is grounded and the resulting circuit is a non-inverting amplifier. Similarly, we can reduce the circuit to an inverting amplifier by removing the voltage source  $V_4$ .

$$\text{Output voltage, } V_{out} = -\frac{R_2}{R_1}(V_1 - V_4)$$

$$\text{Voltage gain, } A_D = -\frac{R_2}{R_1}$$

### B. Schematic and Waveform

See Fig. 2

## References

- [1] Ramakant A. Gayakwad. *Op-Amps and Linear Integrated Circuits*. PHI Learning Pvt. Ltd., New Delhi-110001, fourth edition, 2010.