Department of Electrical & Computer Engineering
ENEE2103 - Circuits and Electronics Laboratory

Experiment #10
Operational Amplifier

Prepared by:
Mohammad Abu-Shelbaia 1200198
Instructor: Dr. Mahran Quran
Assistant: Eng. Rafah Rahhal
Section: 4

Date: August 20, 2023

Contents

List of Figures

List of Tables

1 Simulation and Data Analysis

1.1 Inverted Adding Amplifier

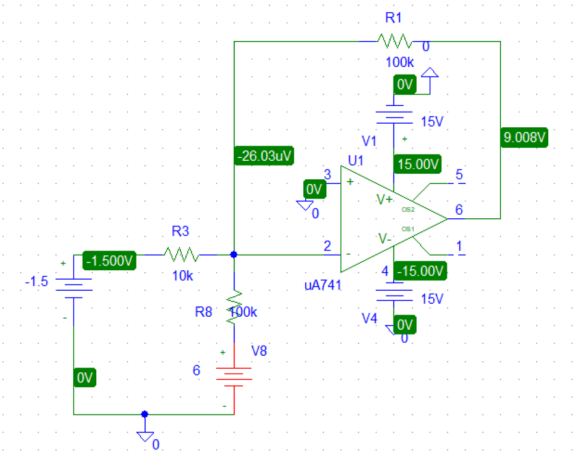

Figure 1: Inverted Adder Operational Amplifier

Input Voltage		Outoput Voltage
V_1	V_2	V_o
0.5	2	-6.991
0.3	4	-6.991
-0.9	2	7.008
-1.5	6	9.008

Table 1: Adding Amplifier Voltage Reads

$$V_o \approx -9.987V_1 - 0.998V_2 \tag{1}$$

1.2 Voltage Follower Operational Amplifier

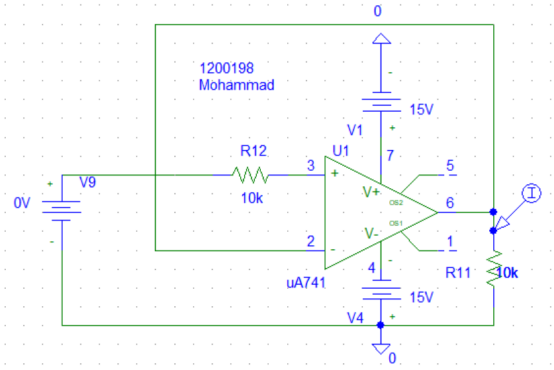

Figure 2: Voltage Follower Operational Amplifier Circuit

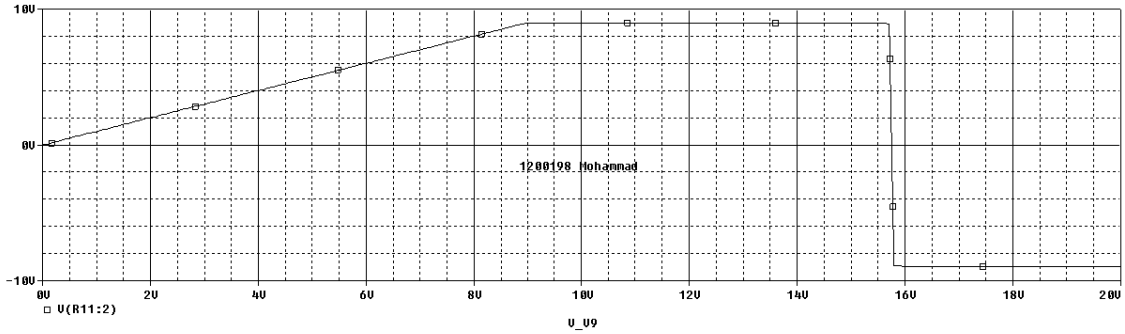

Figure 3: V_o over V_i for Voltage Follower

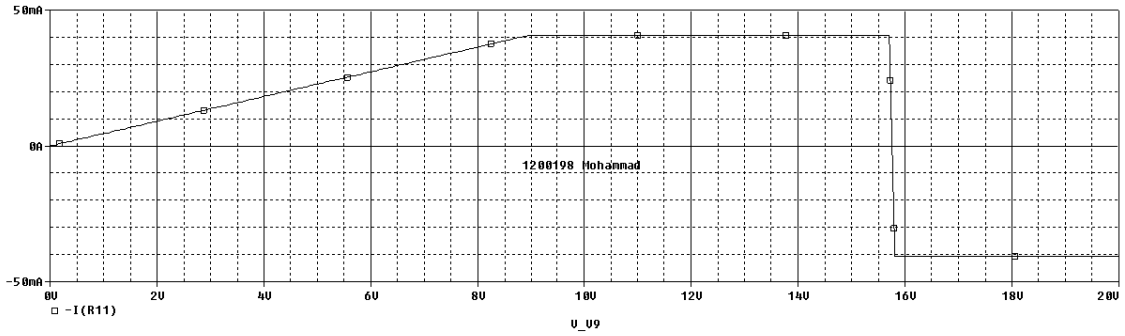

Figure 4: I_o [220Ω] for Voltage Follower Operational Amplifier

We can see that the current is liniearly increasing with the voltage, which is expected since the resistance is constant. But at $I_o = 40mA$ the current is constant disregarding the voltage, and after $V_i \approx 15.5V$ the current is constant at $I_o = -40mA$.

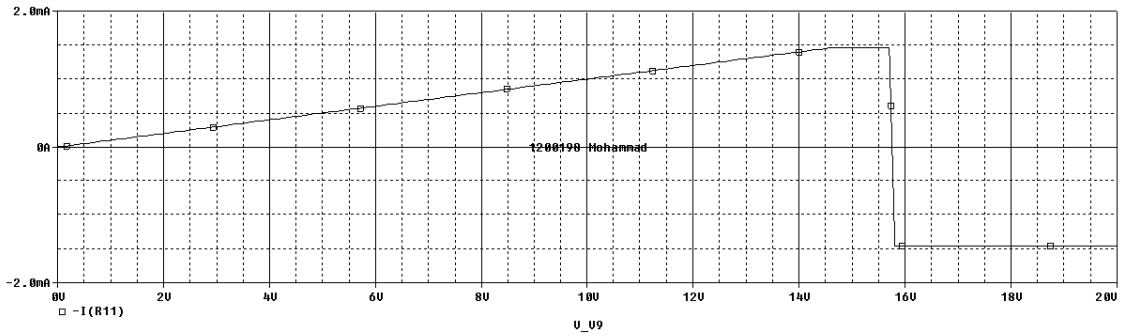

Figure 5: I_o [10KΩ] for Voltage Follower Operational Amplifier

We notice the same behavior as the previous circuit, but the current is constant at $I_o = 1.5mA$ and $I_o = -1.5mA$ when voltage crosses $V_i \approx 15.5V$.

1.3 Comparator Operational Amplifier

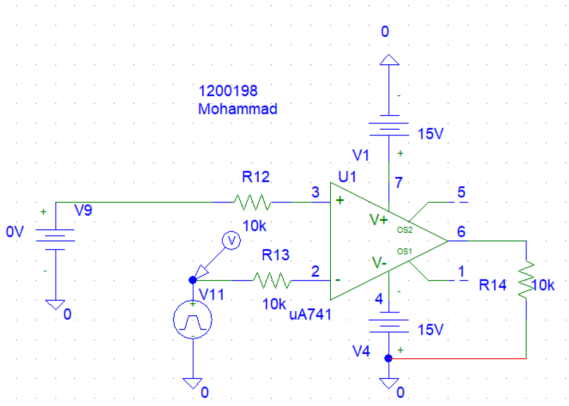

Figure 6: Comparator Operational Amplifier Circuit

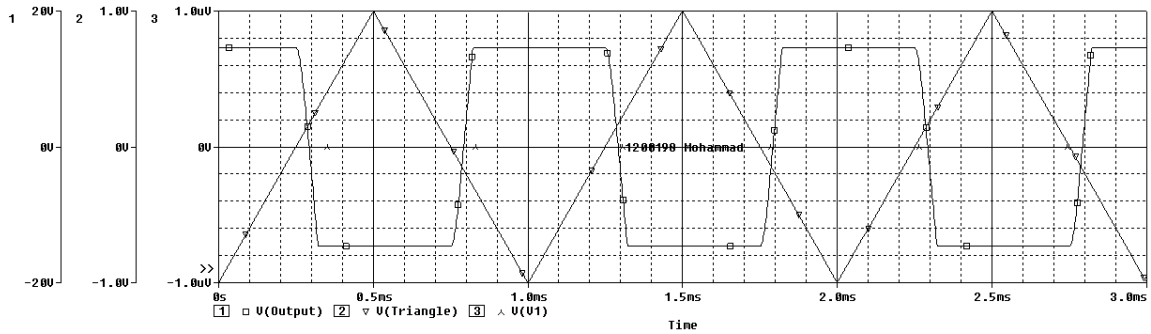

Figure 7: Comparator Operational Amplifier Output

We notice that whenever $V_1 > V_2$ the output is $V_o = 15V$, and whenever $V_1 < V_2$ the output is $V_o = -15V$.

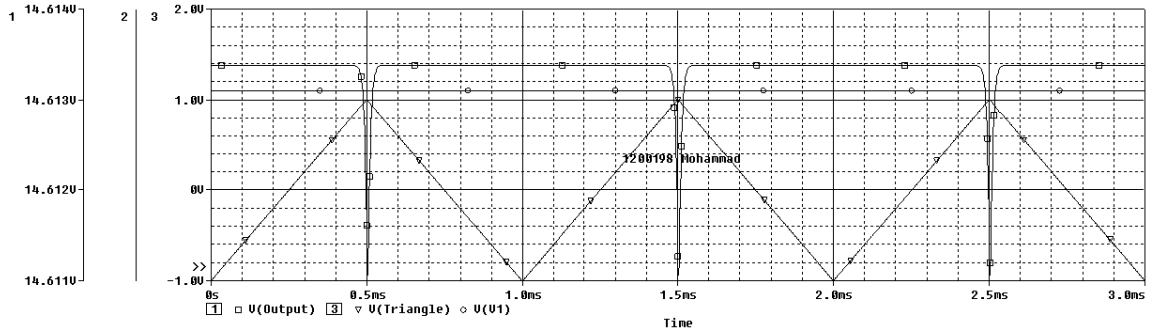

Figure 8: Comparator Operational Amplifier Output [$V_1 = 1.1V$]

From the previous graph, we can see that the output is always $V_o \approx 15V$ since $V_1 > V_2$.

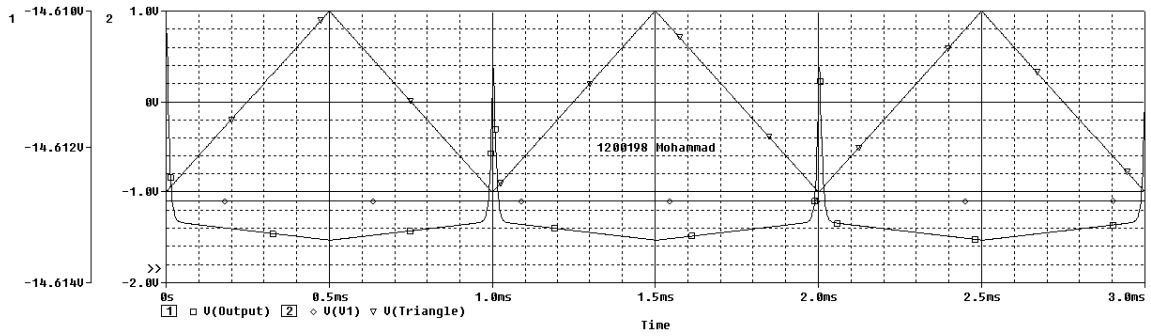

Figure 9: Comparator Operational Amplifier Output [$V_1 = 1.1V$]

From the previous graph, we can see that the output is always $V_o \approx -15V$ since $V_1 < V_2$.

1.4 Comparator with Hysteresis Operational Amplifier

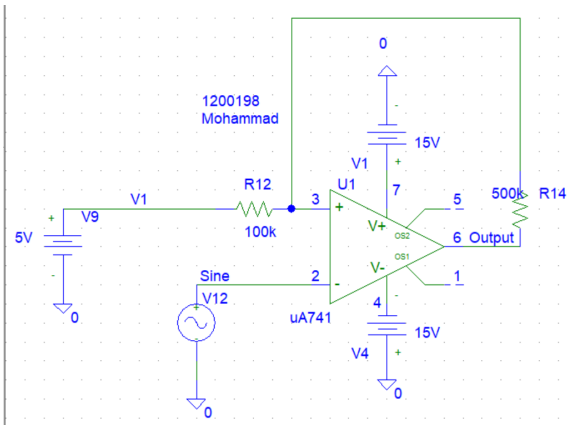

Figure 10: Comparator with Hysteresis Operational Amplifier Circuit

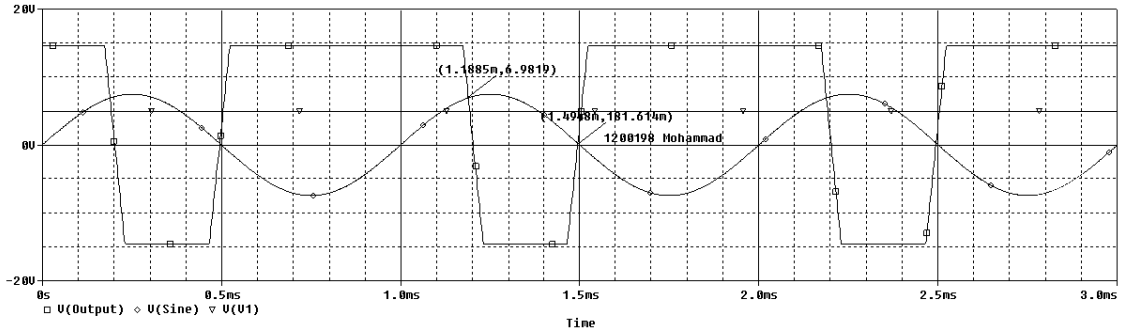

Figure 11: Comparator with Hysteresis Operational Amplifier Output

At around $V_i = 6.98V$ the output switches from $V_o = 15V$ to $V_o = -15V$, and at around $V_i = 0V$ the output switches from $V_o = -15V$ to $V_o = 15V$.