West Virginia University LCSEE

EE 355L

Spring 2023

Section: 001

Date: 9/18/23

Lab 4: Integrator and Differentiator

Submitted by:
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Objective

The objective of this lab is to build two fundamental amplifier circuits. They are the integrator and differentiator circuit. IC 741 is the "ideal" op amp component used for the circuits.

Procedure

Circuit 1(Integrator): Simulate integrator in LTSpice and implement on breadboard. The following parameters were used: Vdd+ = 5v , Vdd- = -5v, R_1= 5k Ω, C= 10nF. The following inputs are simulated and tested on breadboard:

a) V_{in} = v Input from diagram 1
b) V_{in} = 0.2sin(2π100t) v
c) V_{in} = 0.2sin(2π500t) v (same as part b but increase frequency)

Circuit 2(Differentiator): Simulate integrator in LTSpice and implement on breadboard. The following parameters were used: Vdd+ = 5v , Vdd- = -5v, R_1= 5k Ω, C= 100nF. The following inputs are simulated and tested on breadboard:

d) V_{in} = v Input from diagram 2
e) V_{in} = 0.2sin(2π100t) v
f) V_{in} = 0.2sin(2π500t) v (same as part b but increase frequency)

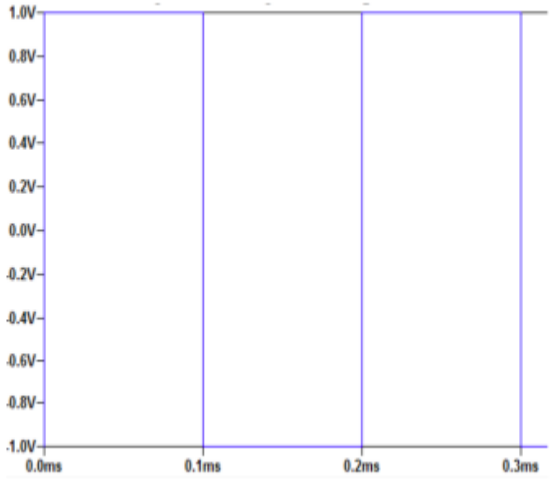


Diagram 1: Input signal Integrator

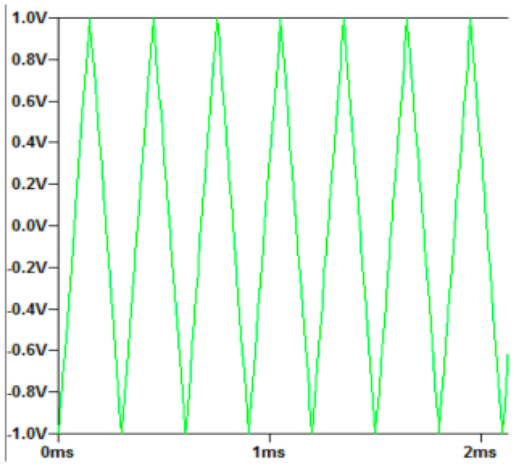


Diagram 2: Input signal Differentiator

Calculation

No Calculations for this lab

Circuit Diagram(s)and Breadboard Implementation

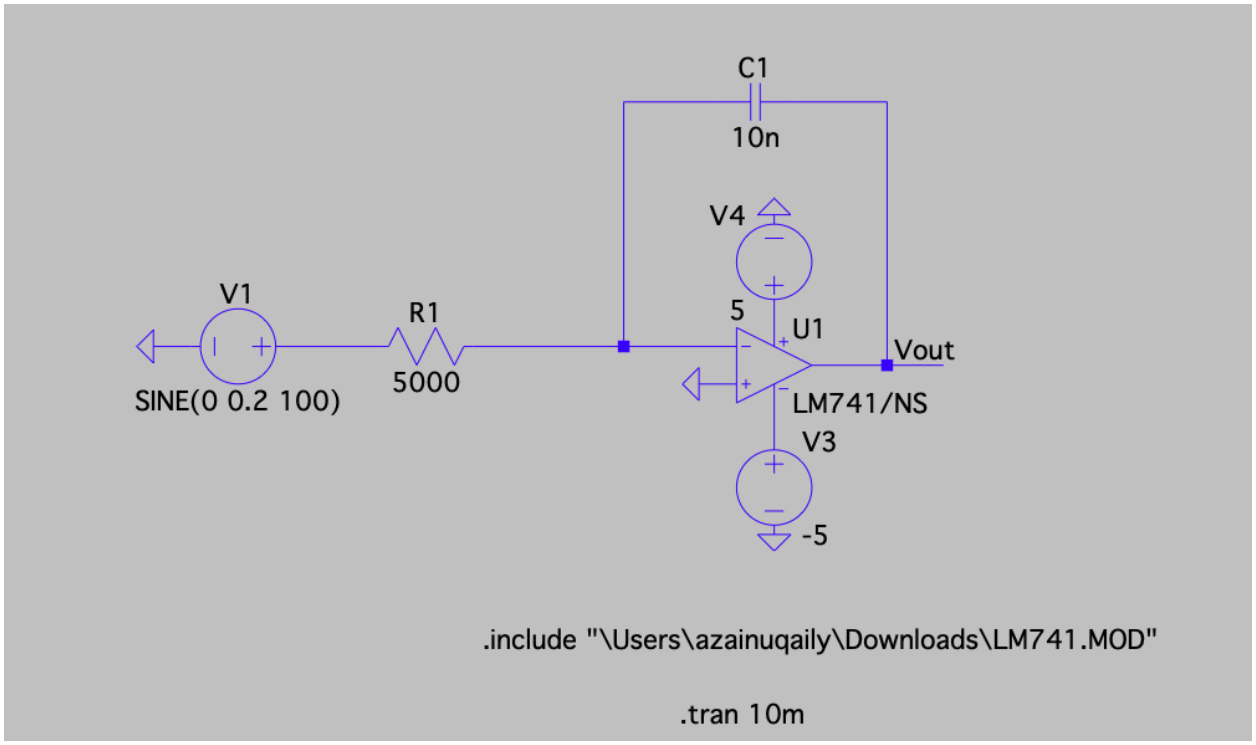
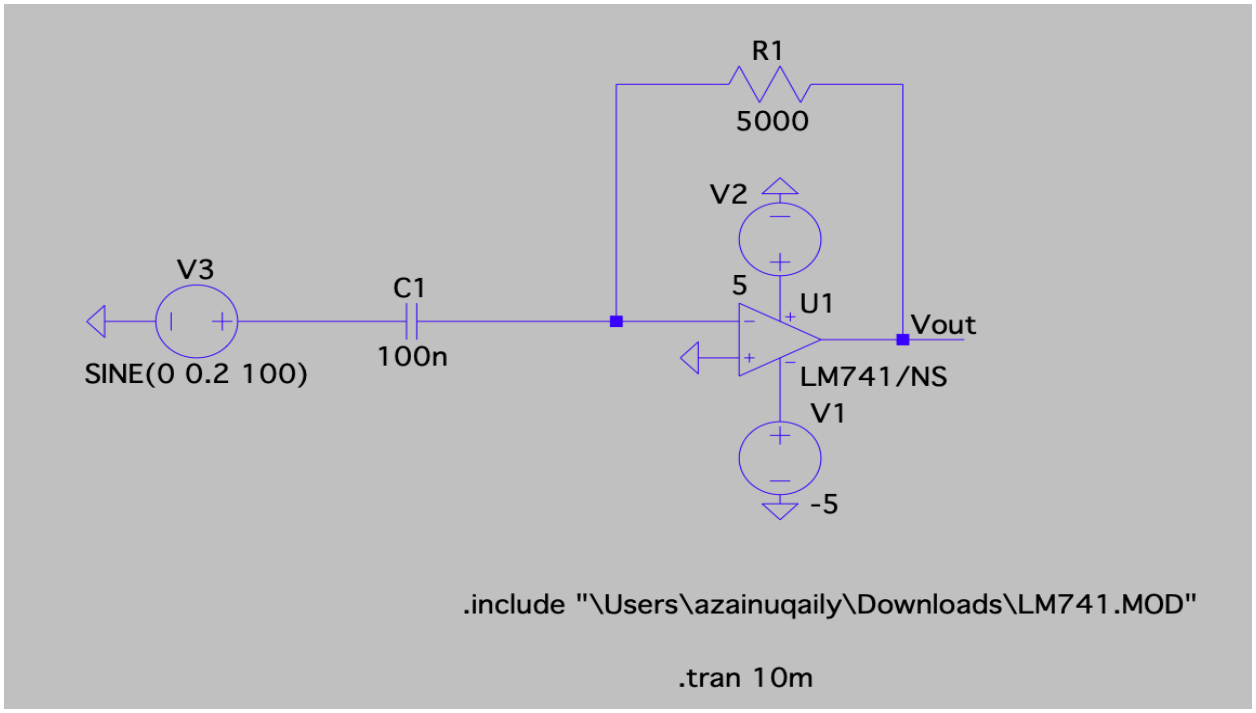


Figure 1: Integrator (circuit 1)



Figures 2: Differentiator (circuit 2)

Results & Discussion (LT Spice Simulation and Oscilloscope)

INTEGRATOR FIGURES

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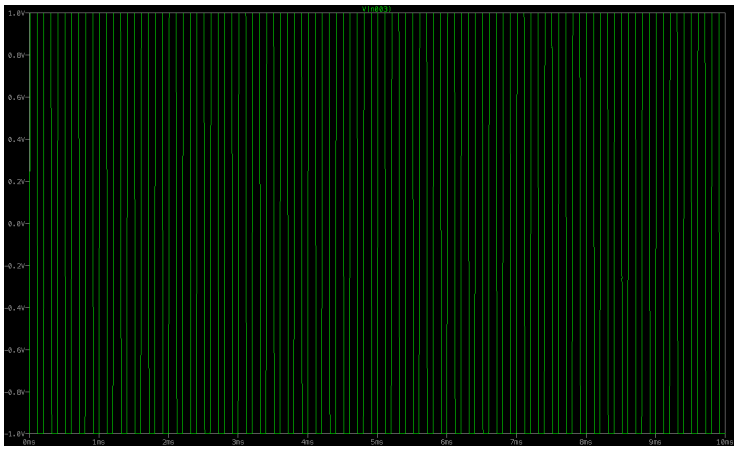
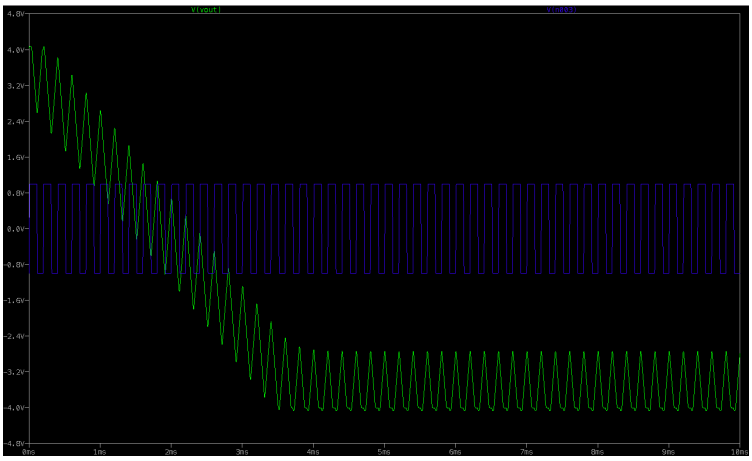
<td>  </td>
<td>  </td>
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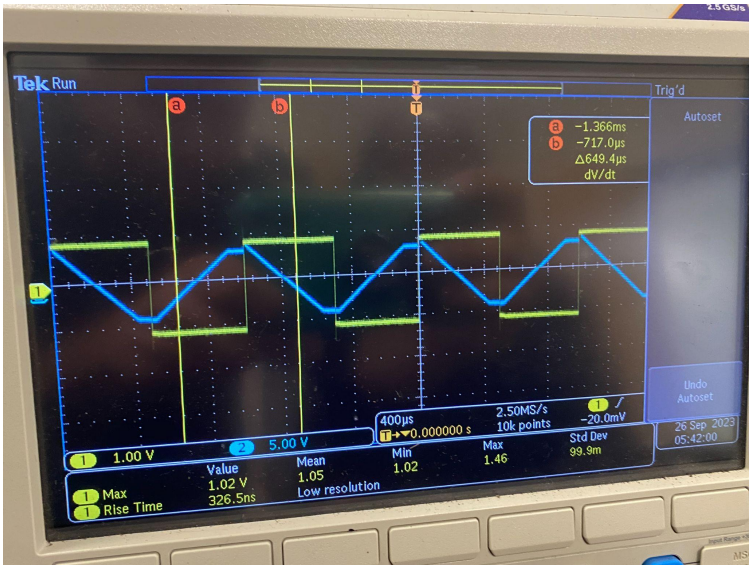
<td> 
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<td>Input from Diagram 1</td>
<td>Output</td>
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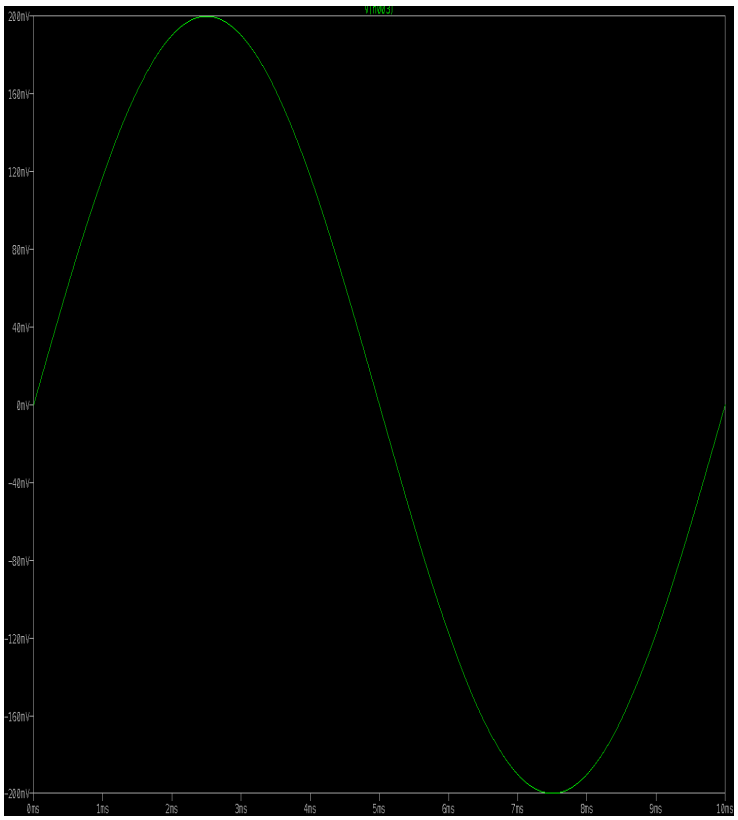
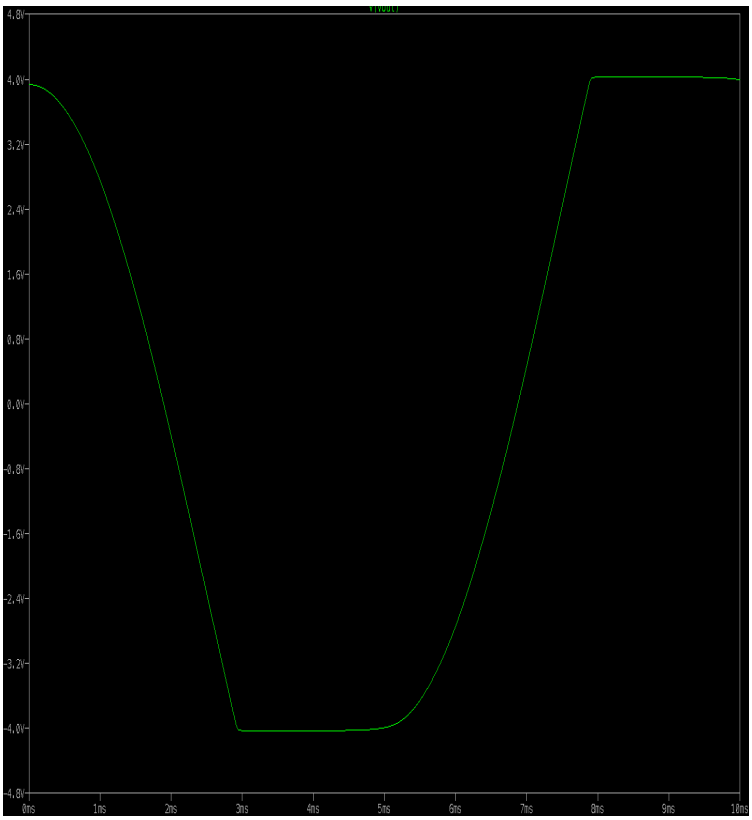
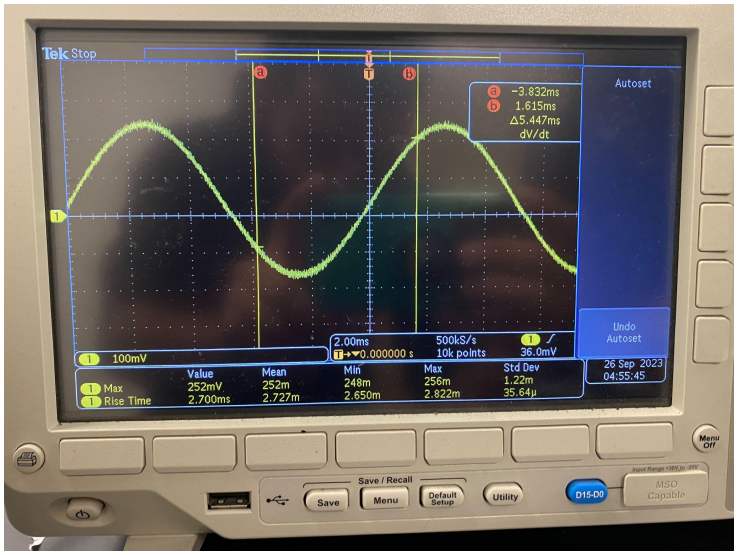
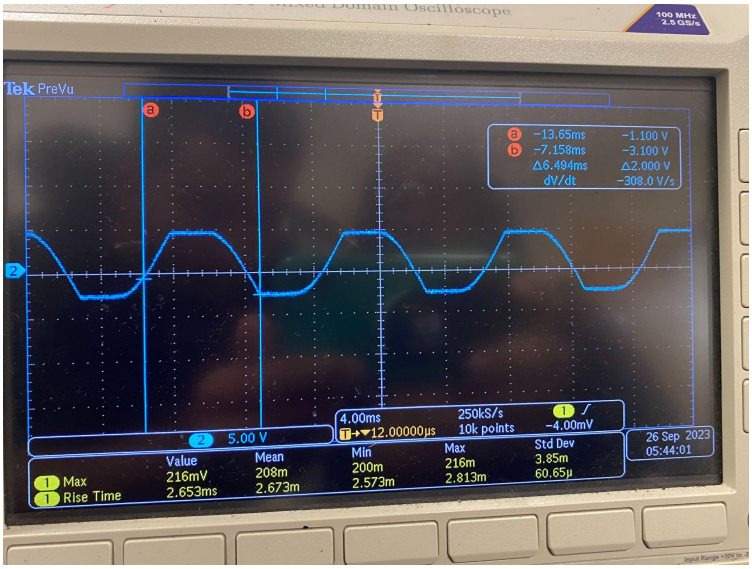


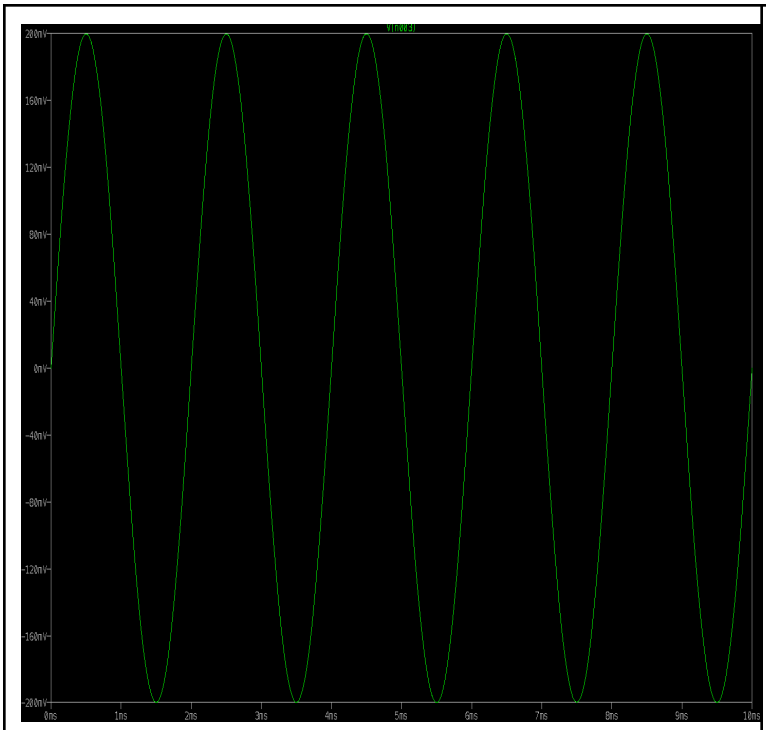


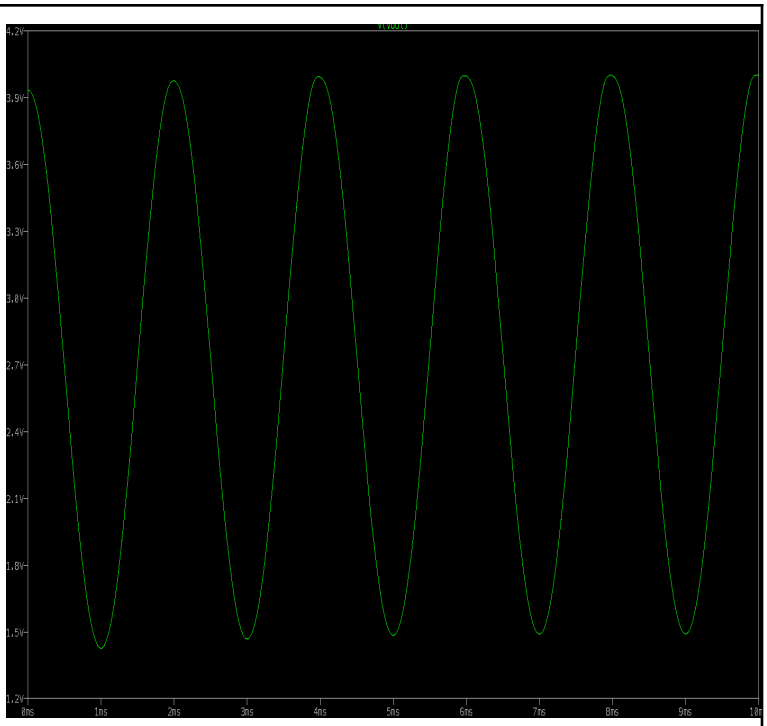


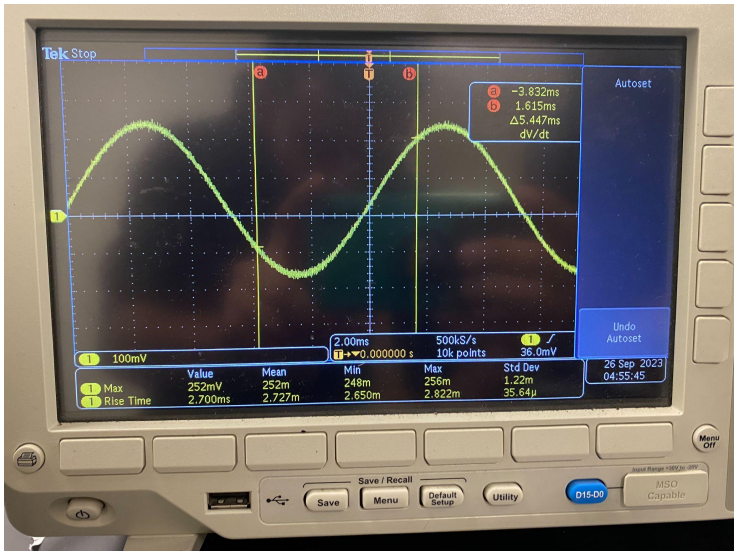


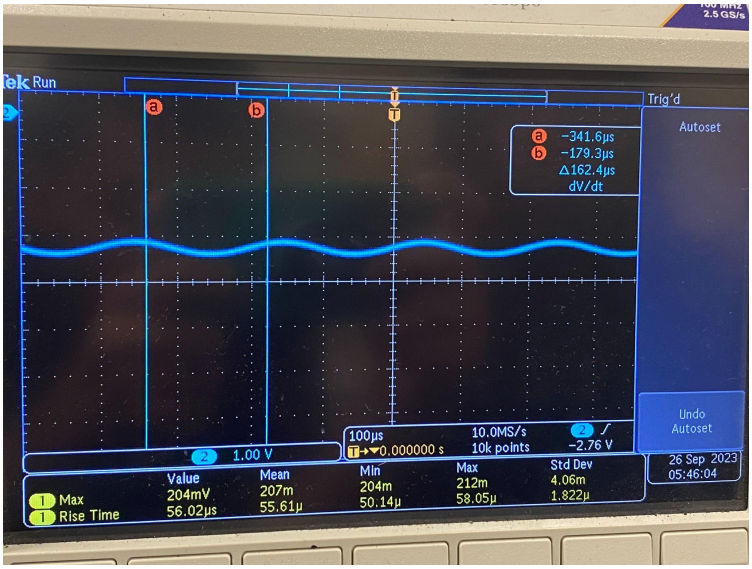
Input (V_{in} = 0.2sin(2π100t) v)

Output





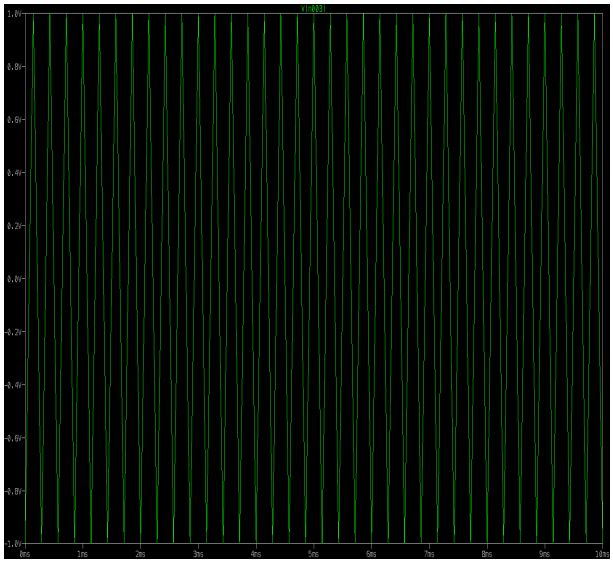


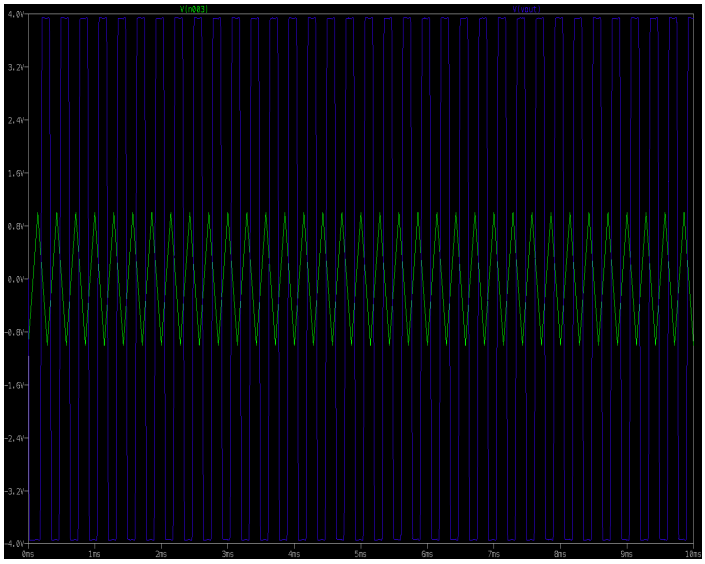


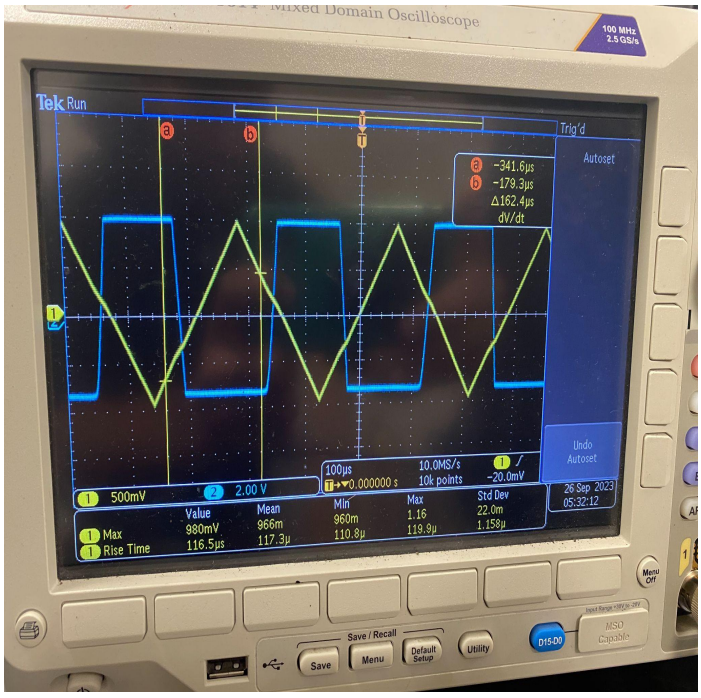
Input (V_{in} = 0.2sin(2π500t) v)

Output

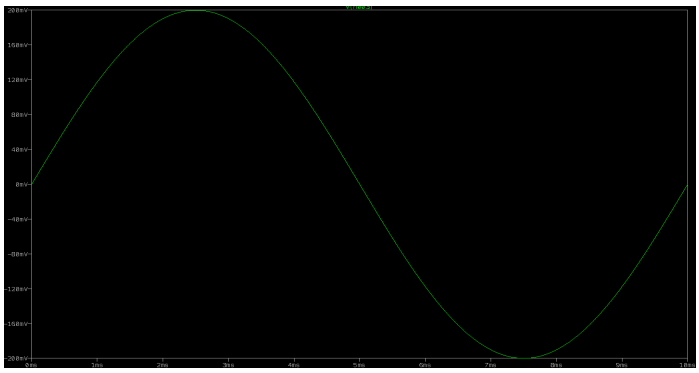
DIFFERENTIATOR FIGURES

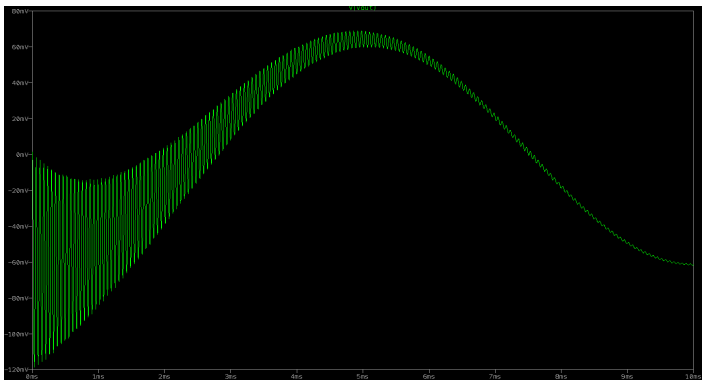






Input from Diagram 2	Output





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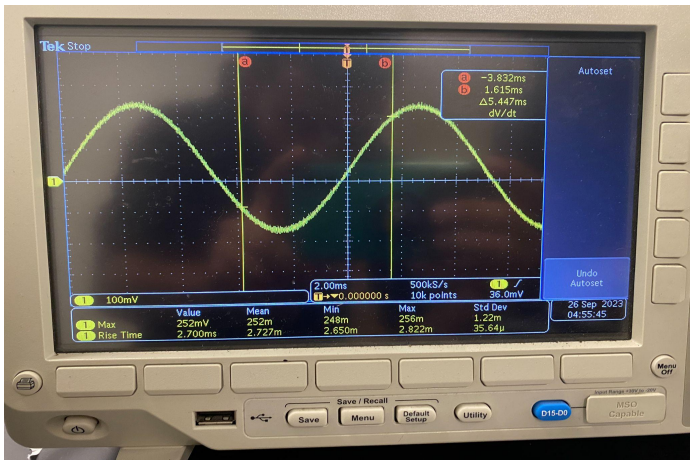
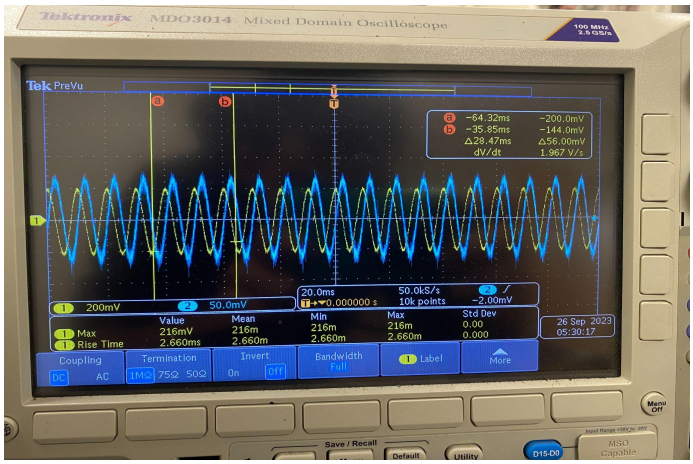
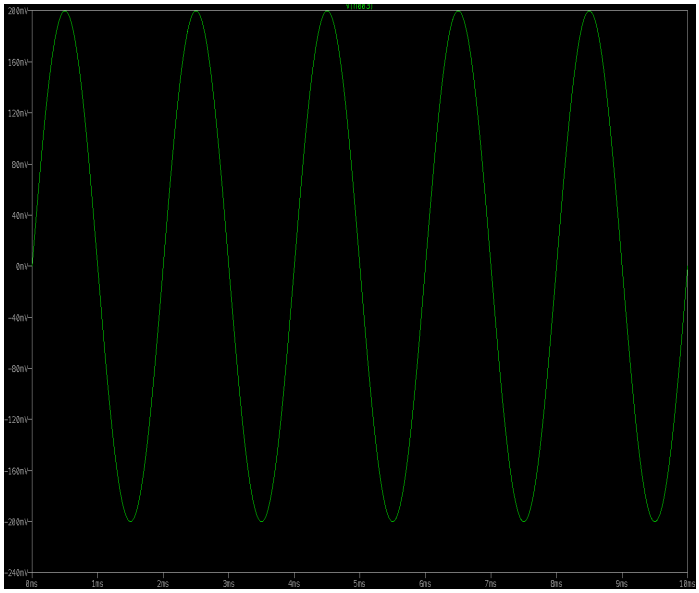
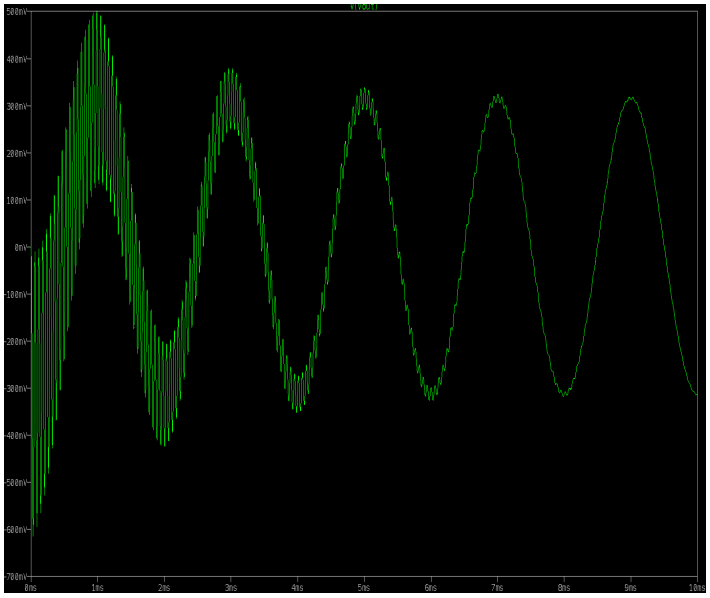


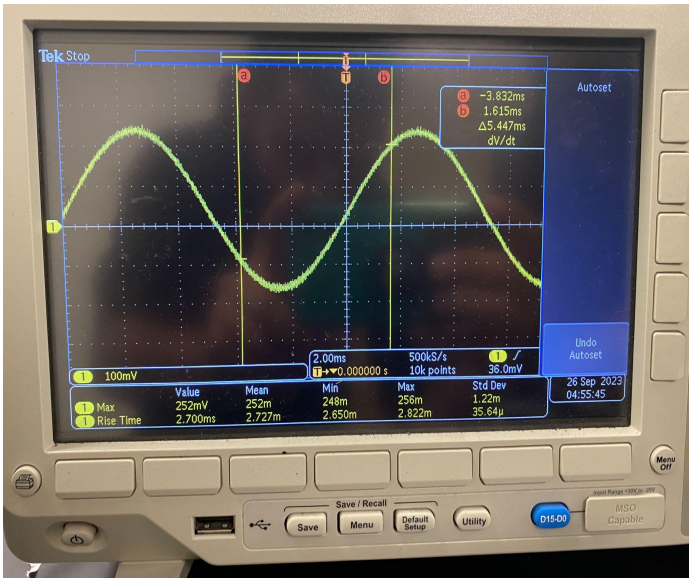
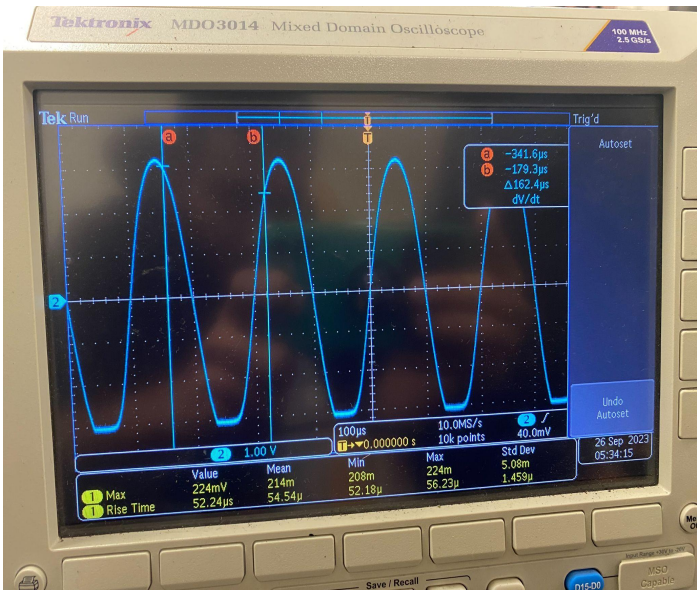


Input (V_{in} = 0.2sin(2π100t) v)

Output





	
Input (V_{in} = 0.2sin(2π5000t) v)	Output

Conclusion

What happens to the output when the frequency is increased?

Integrator: As the frequency is increased the amplitude of the output voltage increases. The output voltage also sees a phase shift of -90 degrees. Higher frequencies may also cause the performance of the integrator to become worse.

Differentiator: As the frequency is increased the amplitude of the output voltage decreases. There is less net change in voltage over a fixed window of time. The output voltage has a phase shift of +90 degrees. Higher frequencies may cause the performance of the differentiator to become worse.

Overall, this lab did a good job illustrating how the integrator and differentiator work. It also highlighted the frequency dependance of the capacitor in the integrator and differentiator circuits.