

California State University, Fresno

Department of Electrical and Computer Engineering

ECE 90L Principles of Electronic Circuits Laboratory
Experiment No. 10: Op-Amp Integrator and Differentiator

Objective

The objective of this laboratory is to study the behavior of an op-amp integrator and an op-amp differentiator.

Prelab

For both of the circuits in the lab, predict mathematically and graphically the output for the following inputs.

1. Constant (DC) Voltage
2. Square Wave
3. Triangular Wave
4. Sine Wave

Use the voltages and frequencies mentioned in Parts 1 and 2 of the Procedure.

Procedure

1.) Build the Op-Amp Integrator circuit in Figure 1. Use +15 V and -15 V the op-amp power. For the input resistor, use a 1/4-W $R_i = 620\text{ k}\Omega$ resistor. For the capacitor, use a $C = 0.047\text{ }\mu\text{F}$. Be sure to include a $50\text{ }\Omega$ resistor to ground at V_{in} .

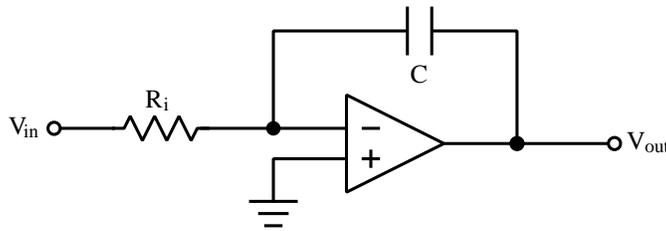


Figure 1: Op-Amp Integrator

Apply a DC voltage of 1 V and sketch the output, by measuring V_{in} on Channel 1 of the oscilloscope and V_{out} on Channel 2 of the oscilloscope. You will need to use the single sweep feature of the scope to capture the waveform. Also, set the trigger threshold to just under 0 V, since the op-amp integrator is inverting.

Next, set the signal generator to produce a 5 V_{pp} , 50 kHz square wave. Apply the input to the circuit, and measure V_{in} and V_{out} with the oscilloscope.

2.) Build the Op-Amp Differentiator circuit in Figure 2. For the feedback resistor, use a 1/4-W $R_f = 6.2\text{ k}\Omega$ resistor. For the capacitor, use $C = 12\text{ pF}$. Be sure to include a $50\text{ }\Omega$ resistor to ground at V_{in} . Apply a 5 V, DC signal and capture the output. Then apply a 5 V_{pp} 100 Hz square wave, and a triangular wave and sine wave of the same peak-to-peak amplitude and frequency. Capture all input and output waveforms.

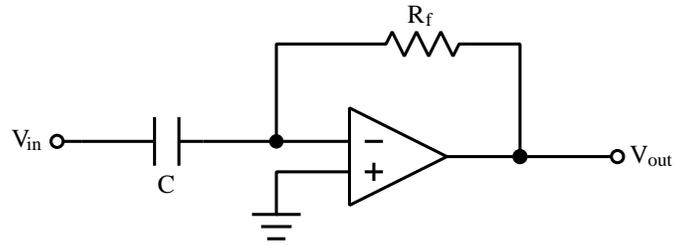


Figure 2: Op-Amp Differentiator

Conclusion

How do the outputs of the two circuits compare to the predictions in prelab?

Group Report

- 1.) Compare your prelab to the waveforms captured by the oscilloscope for each of the inputs. Explain your results qualitatively, as well as quantitatively.
- 2.) Explain why the $50\ \Omega$ resistor is necessary, especially for the integrator circuit.