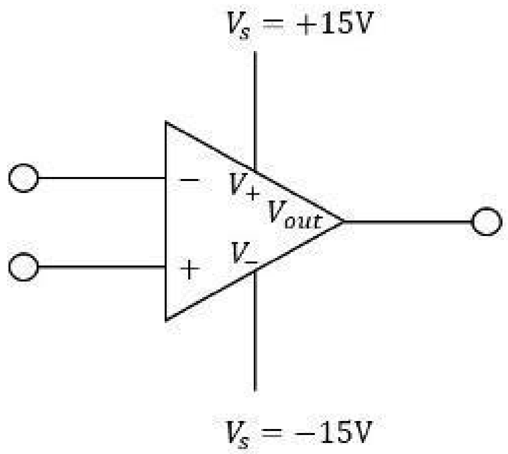
Experiment 8: Op-Amps II

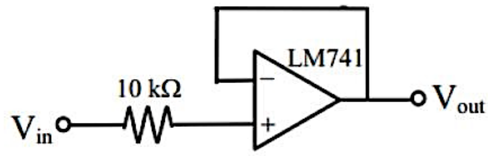
Materials

1. 1 kΩ, 3.3 kΩ, 10 kΩ resistors
2. 0.01 μF, 100 pF capacitors
3. LM741 and LF411 Op-Amp

Note: For this activity, op-amps need to be biased at both its V_+ and V_- pins. If the activity states that V_s = ±15V, set up the op-amp's V_+ and V_- pins as in figure on the right:

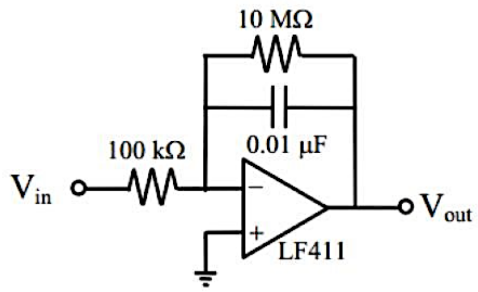


A. Limitation: Slew Rate



1. Construct the following circuit. Use a square wave input (V_{pp} = 5V, *f* = 1kHz, no DC offset) and opamp V_s = ±15V.
2. Sketch the input and output waveforms. Indicate the important voltage values and points on the plot.
3. Determine the slew rate of the op-amp (both the slewing up and slewing down rates). Hint: It is related to a slope.
4. Compare the experimental slew rate with the typical slew rate of LM741 (i.e. 0.5 *V/μs*).
5. Change the input to a sine wave (V_{pp} = 5V, no DC offset). Vary the frequency until the output amplitude begins to drop. Take note of this frequency and relate it with the slew rate.
6. What is the significance of the slew rate of an op-amp?

B. Application 6: Op-Amp Integrator (Active Low-Pass Filter)

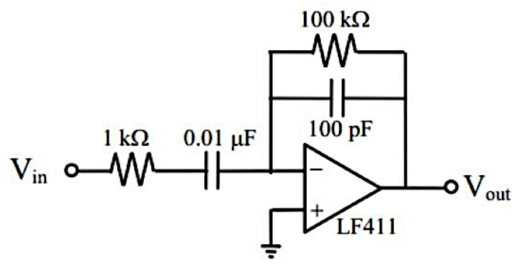


1. Construct the following circuit. Use a square wave input (V_{pp} = 5V, *f* = 1kHz, no DC offset) and op-amp V_s = ±15V.
2. Sketch the input and output waveforms. Indicate the important voltage values/points on the plot.
3. Calculate the theoretical peak-to-peak amplitude of the expected wave output. (Hint: Perform an integration). Compare with the experimental result in B2.
4. Remove the 10MΩ resistor and vary the DC output of the input. Describe and explain what happens. What is the function of the 10MΩ resistor? Warning: The oscilloscope must be in DC coupling.
5. Repeat steps B1 to B3 using sine wave and triangle wave inputs. Explain the output.

Experiment 8: Op-Amps II

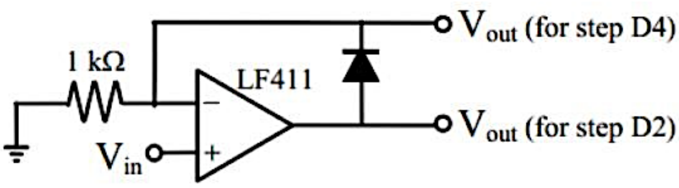
C. Application 7: Op-Amp Differentiator (Active High-Pass Filter)

1. Construct the following circuit. Use a square wave input (V_{pp} = 5V, f = 1kHz, no DC offset) and opamp V_s = ±15V.
2. Sketch the input and output waveforms. Indicate the important voltage values/points on the plot.
3. Repeat steps C1 to C2 using sine wave and triangle wave inputs. Explain the output.



D. Application 8: Active Rectifier

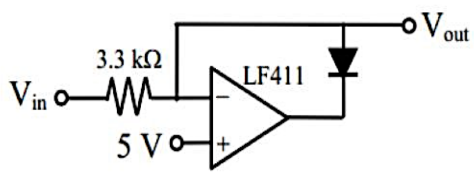
1. Construct the following circuit. Use a square wave input (V_{pp} = 10V, f = 100Hz, no DC offset) and op-amp V_s = ±15V.



2. Sketch the input and output waveforms (see circuit). Indicate the important voltage values and points on the plot.
3. What causes the glitch in the output waveform?
4. Sketch the input and output waveforms (see circuit). Indicate the important voltage values and points on the plot.
5. Explain the difference between the output waveforms in steps D2 and D4.

E. Application 9: Active Clamp

1. Construct the following circuit. Use a square wave input (V_{pp} = 20V, f = 1kHz, no DC offset) and op-amp V_s = ±15V.



2. Sketch the input and output waveforms. Indicate the important voltage values and points on the plot.
3. Vary the input amplitude to lower values. Describe and explain what happens to the output. Explain the output.
4. Repeat steps E1 to E2 with the diode reversed.