Lab 10
Electronic Noise

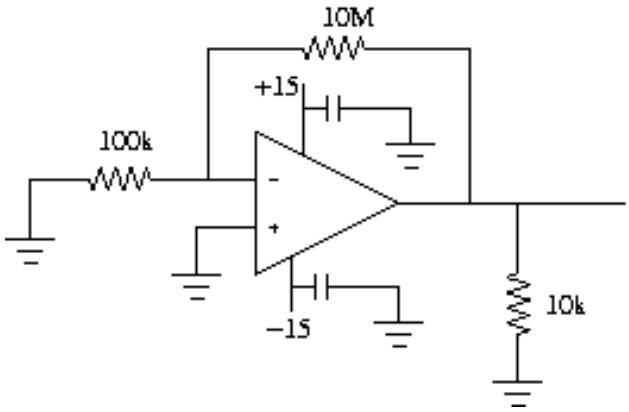
In this lab you will measure the noise due to resistors and other components.

Pre-lab

1. Estimate the expected RMS noise in the first circuit. It is difficult to guess at the bandwidth of the measurements, so you should write your answer in terms of bandwidth. Using the first measurement you can estimate the bandwidth and then verify that it is consistent in the other measurements.

Resistors and Op-Amp noise

Build the following circuit



1. Build an inverting amplifier with a gain of 100 using a LF411. Use a 10M resistor as the feedback resistor. Ground the input. Add a 10k resistor to the output as a load. Add 0.1 μF capacitors from each power connection to ground at the LF411.

2. If there is 60 Hz interference on any of these measurements, the effect on the measurement can be removed by triggering on the ac-line, setting the time resolution at 0.1 ms/div, and offsetting the time so that the resulting noise waveform is flat.

3. Build the circuits neatly to reduce the chance of oscillations. If there are oscillation make sure you have the power supply bypass capacitors, all grounds are connected in the same place, and the wires are short.

4. Look at the output with a 1X probe. At 1ms/div the output should be a random noise signal. Record the peak-peak signal level.

5. Change the input and feedback so that feedback resistor is 100k and the gain is sill 100. What is the new output noise voltage. By what factor did it change? What factor does the theory predict?

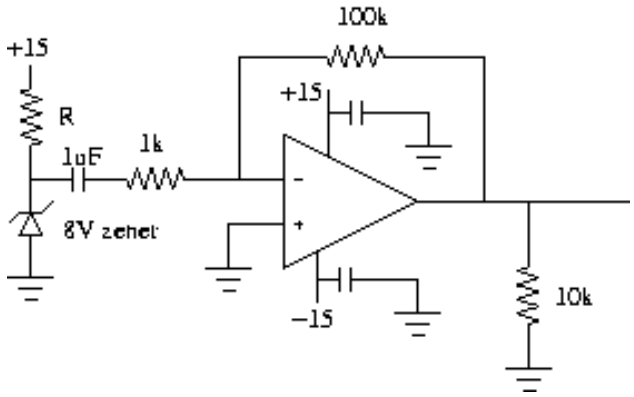
6. Instead of grounding the positive input of the op-amp connect it through a 1M to ground. Measure the peak-peak noise voltage.

7. Repeat this 3 more times changing the resistor from the positive to ground to 10k, 100k, and 10M.

8. Plot the measured and calculated noise values versus resistance.

Avalanche Noise

Use this circuit



9. Reconnect the positive terminal to ground. Connect the input through a 1.0 μF non-electrolytic capacitor to a reverse biased 8 V zener. The amount of noise will depend on the current through the zener. Measure the noise with the following resistors between the zener and 15 V: 1k, 10k, 100k, and 1M. Plot the measured noise versus zener current.