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MMI 401 2017
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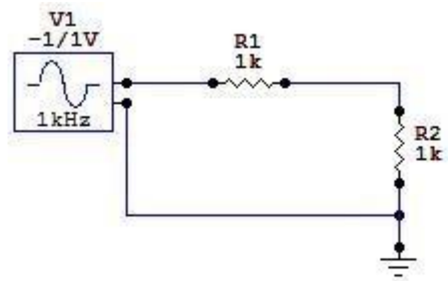
MMI 401 Lab 1

An Introduction to Electrons



Hopefully you know this is a simple AC voltage divider that will cut the 1V peak signal in half.

Part 1:

Design and simulate in Circuit Maker a voltage divider that cuts a 100V peak-to-peak AC signal to a 70V peak-to-peak AC signal.

Hint 1: Read that again!

Hint 2: There is more than one correct answer.

On your lab report present the following…

- The schematic
- The *transient analysis* plot showing the waveform at the input and output

Notes:

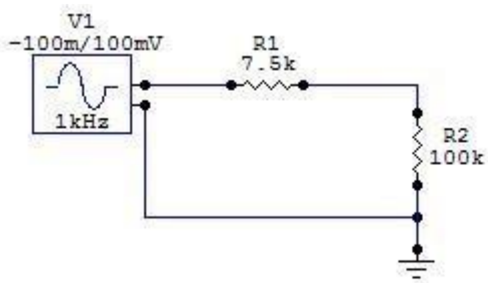
Holding shift while probing allows you to probe in multiple different spots. Use the “c” and “d” sliders to mark the peaks of both waveforms.

At the bottom of the wiki there are instructions on how to export graphics from Circuit Maker however using the Snipping Tool suffices as well.

Unfortunately, Circuit Maker defaults the background of all analysis graphs to black. While they look nice on your computer, it’s impossible to read on paper. To change the colors of your graphs, right click on one of them, click *Colors…*, select *Wave Bkgnd* from the scroll menu and change its color to white.

Part 2:

For part two we're going to simulate plugging a guitar into some piece of gear (amp, pedal, etc.). To model this, create the following circuit in Circuit Maker:



100mV is a pretty standard output signal coming from a guitar. The 7.5kΩ resistor simulates the *output impedance* of the guitar. The 100kΩ resistor simulates the *input impedance* of the amp or pedal.

Now, let's pretend the guitar has active pickups. This forces the 100mV output from the guitar to *ride on a 4.5V DC bias*. Double-click the signal generator to add this DC bias. Probe the output with the oscilloscope (transient analysis). What do you see?

What single component can make that DC offset go away? Insert that component into the schematic. Probe the output of the circuit again and show what happened.

One **very important consequence** of adding this SPOOKY component to the circuit is that it changes the circuit's *frequency response*. Probe the output with the AC Analysis (Bode Plot) to show the frequency response.

Using the "a" "c" and "d" sliders, mark the *cutoff frequency* or *-3dB point* and place this in your report.
What happens to the circuit's frequency response as you change the value of that component? Try experimenting with different values on the range of .001 F to 100 F.

*Note: For all frequency plots, you want the y-axis in dB. Click the sine wave in the top left corner of the Bode Plot window and change this if your y-axis is not in dB already***

To recap: For Part 2 of your lab report, I want to see the following…

- The Schematics
  - With the DC bias
  - With the mystery component added
- The Analysis Plots
  - Transient Analysis of both circuits.
  - Frequency Analysis of the circuit with the mystery component.
    - I want to see one Bode Plot with the mystery component added with its default value.
    - I want to see a second Bode Plot that *contains multiple waveforms* that helps illustrate what happens as you change the mystery components value.
- See any questions littered in the lab? Think of these as guided questions: supplement the pretty pictures in your report with their answers.

Lab Questions:

1. In the second circuit, what would happen to the output if you were to swap the 7.5kΩ and 100kΩ resistors? Explain why this happens and why this is bad in a way that some circuits noob, aka your Dad maybe, could understand.

2. What are a few reasons having a DC offset at the output (or the input to your pedal or amp) is bad?

3. Very briefly (one sentence, don't over think this) explain why adding the mystery component blocks DC voltage.

4. In the second circuit, after your modifications, describe the relationship between the mystery component's value and the circuit's cutoff frequency.

5. Based on that relationship, what is a potentially negative impact of using a mystery component with a very small value?

EXTRA CREDIT!!

Hypothesize what would happen if, instead of placing the mystery component in series with your load resistor, you placed it in parallel. Very briefly, similarly to how briefly you answered question 3, explain your reasoning behind this guess. It's okay if you don't really have a good reason just yet, this is simply a thought experiment.

Now check your hypothesis by simulating the described circuit and similarly probe the output using the AC Analysis (Bode plot) and measure the *cutoff frequency* using the sliders. What did we just create?

Due: Before Next class