Assignment 1

Design Exercises

DE 1 (6 points)

Use only 10 kΩ resistors to create a network with an equivalent resistance of 6.67 kΩ. What is the minimum number of required resistors? Show your circuit.

DE 2 (8 points)

Use network analysis and Ohm's Law to derive a formula for V_{OUT} for a loaded voltage divider, make sure that you arrive to the equation

$$V_{\text{OUT,LOADED}} = V_{\text{UNLOADED}} \frac{R_{\text{L}}}{R_{1//2} + R_{\text{L}}}$$

DE 3 (6 points)

Assuming that R_1, R_2 and R_L are 10 kΩ resistors and V_{IN} is 10V, compute V_{OUT} for both a loaded voltage divider and an unloaded voltage divider. How much does the output voltage change when it is loaded?

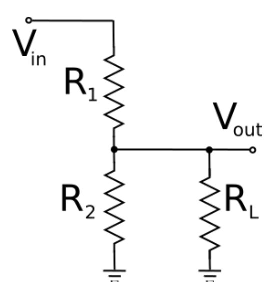

Figure 1: Loaded voltage divider

Lab 1: Voltage, Current, Resistance and Power

Your notebooks must be complete, understandable, and address all activities, design exercises, observations, and questions noted in the laboratory's procedures. Remember to use your notebook as a laboratory journal and record your data, design calculations, notes and scratch work. *Make sure to write a conclusion for each exercise and each week.*

Task 1

Construct the resistor network you designed in exercise 1-1. Check to see that the total resistance agrees with your calculation. Put 10V into your device and use an ammeter to see if it draws the expected current. How much power is being consumed, and how would one measure it?

Task 2

Make an unloaded voltage divider from 1 kΩ to 100 kΩ resistors and apply input voltages in the range from 2 V to 15 V. Measure the input voltages and the current of this device. Be sure to sketch your experimental setup in your lab notebook! Plot your measurements with the voltage on the vertical axis and the current on the horizontal axis. The *equivalent* or *input resistance* of your voltage divider is the slope of the curve. Relate this to the resistors you used to construct the voltage divider.

Task 3

Attach a load resistor R_L which is factor of 10 larger than R_1 or R_2. Remeasure your loaded voltage divider input resistance. Did it change significantly?

Task 4

Attach a load resistor R_L which is factor of 10 smaller than R_1 or R_2. Remeasure your loaded voltage divider input resistance. Did it change significantly?

Task 5

Make your voltage divider from Exercise 1-3. Apply constant input voltage equal to 10V and measure the output voltage and output current for a variety of load resistances in the range from 100 Ω to 100kΩ (use at least 10 different load resistors). Note how the output voltage changes and compare your results to your calculations. Do the results make sense?

Task 6

Measure the maximum current your voltage divider from previous task can supply (use different load resistors). Relate it to V_{in}, R_1, and R_2.