1.4.3: Input Resistance

Overview:

An extremely important circuit characteristic – the circuit's input resistance – will be determined using Kirchoff's laws. The input resistance of a circuit can be a significant design parameter; if the circuit is later incorporated in part of a larger overall system, the circuit's input resistance can have a significant effect on the behavior of the overall system.

Before beginning this lab, you should be able to:

- State Ohm's law from memory
- Use a digital mulitmeter to measure resistance, voltage, and current (Lab 1.1, 1.2.1)
- Use the Analog Discovery's arbitrary waveform generator (AWG) to apply constant voltages to a circuit (Lab 1.2.2)
- Use the Analog Discovery voltmeter to measure a constant voltage (Lab 1.2.1)
- Use color codes on resistors to determine the resistor's nominal resistance
- Use KVL and KCL for circuit analysis

After completing this lab, you should be able to:

- Estimate the input resistance of a resistor network from measured voltage-current characteristics

This lab exercise requires:

- Analog Discovery
- Digilent Analog Parts Kit
- Digital multimeter

Symbol Key:

DEMO — Demonstrate circuit operation to teaching assistant; teaching assistant should initial lab notebook and grade sheet, indicating that circuit operation is acceptable.

ANALYSIS — Analysis; include principle results of analysis in laboratory report.

SIM — Numerical simulation (using PSPICE or MATLAB as indicated); include results of MATLAB numerical analysis and/or simulation in laboratory report.

DATA — Record data in your lab notebook.

General Discussion:

The *input resistance* of a circuit is the effective resistance that a source (or another stage of an overall system) will see when it is connected to the circuit. This value can be an extremely important design parameter for a circuit. In this part of the lab assignment, we will determine the input resistance of the circuit shown in Figure 1.

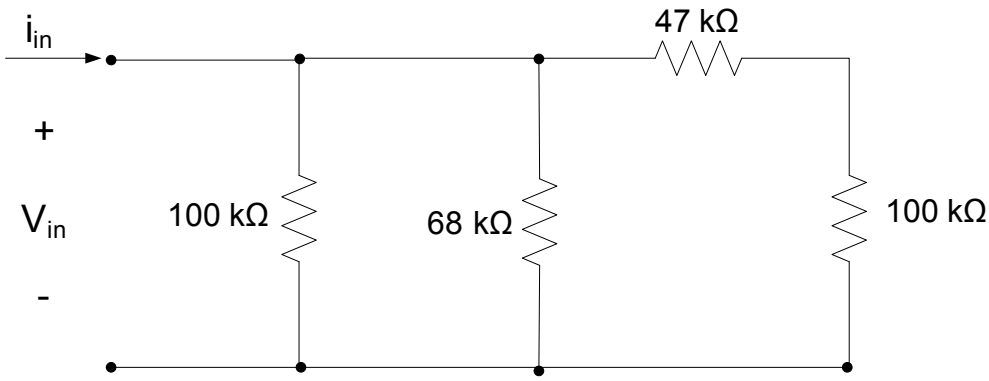

Figure 1. Circuit schematic.

Pre-lab:

ANALYSIS

Determine the relationship between V_{in} and i_{in} for the circuit shown in Figure 1. Defining the input resistance according to Ohm's law as $R_{in} = \frac{V_{in}}{i_{in}}$, determine the input resistance of the circuit of Figure 1.

Lab Procedures:

DATA

1. Construct the circuit of Figure 1. Measure and record the actual resistance of all resistors used in your circuit. Use a variable voltage supply (the arbitrary waveform generator of the Analog Discovery will work) to apply V_{in} and i_{in} to the circuit. For <u>at least</u> five different values of V_{in} between 0V and 5V, measure V_{in} and i_{in}.

ANALYSIS

2. Plot the voltage-current characteristic for the five points determined in part 1. Estimate the input resistance of the circuit from the slope of the voltage-current characteristic. (Feel free to draw your own best-fit line to the data points, without performing a least-squares best fit.)

ANALYSIS

3. Calculate the input resistance for each combination of V_{in} and i_{in} measured in part 1. Determine the average input resistance over the five measurements and the standard deviation of the measurements. Compare this value of input resistance to the one determined in part 2.

DEMO

4. Demonstrate operation of your circuits to the Teaching Assistant Have the TA initial the appropriate page(s) of your lab notebook and the lab checklist.