California State University, Fresno
Department of Electrical and Computer Engineering

ECE 90L Principles of Electronic Circuits Laboratory

Experiment No. 2: Equipment and Electrical Measurement Techniques

Objective

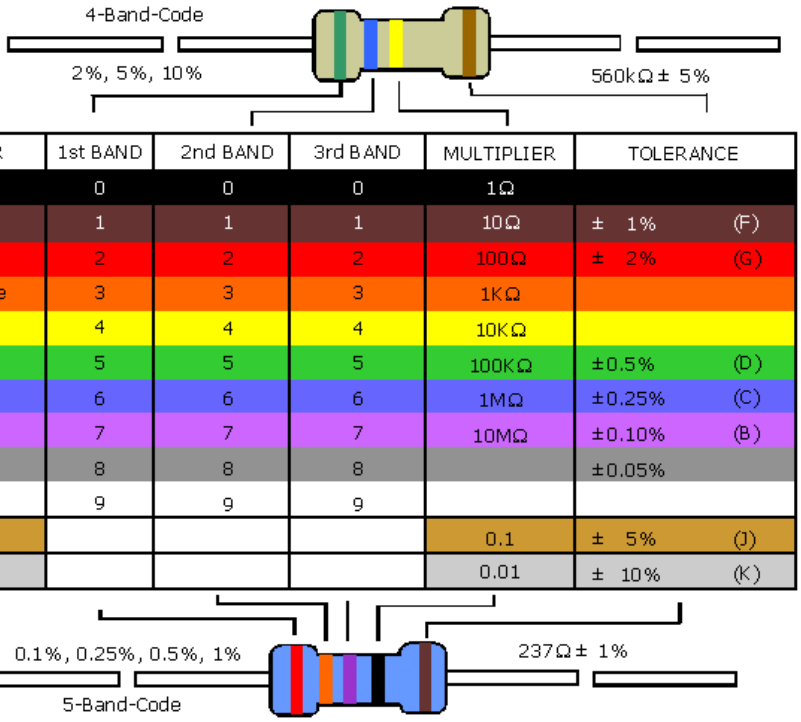
The objective of this laboratory is to become more familiar with laboratory equipment and to learn basic electrical measurement techniques for resistance, voltage, and current.

Prelab

Determine the theoretical values of the voltage and current for all labeled elements in Figures 2 and 3.

Procedure

1.) Observe and record the color coding, nominal resistance, and tolerance of the three 1/4 W resistors on your laboratory bench. The color code is as follows:



COLOR	1st BAND	2nd BAND	3rd BAND	MULTIPLIER	TOLERANCE	
Black	0	0	0	1Ω		
Brown	1	1	1	10Ω	± 1%	(F)
Red	2	2	2	100Ω	± 2%	(G)
Orange	3	3	3	1KΩ		
Yellow	4	4	4	10KΩ		
Green	5	5	5	100KΩ	±0.5%	(D)
Blue	6	6	6	1MΩ	±0.25%	(C)
Violet	7	7	7	10MΩ	±0.10%	(B)
Grey	8	8	8		±0.05%	
White	9	9	9			
Gold				0.1	± 5%	(J)
Silver				0.01	± 10%	(K)

Figure 1: Resistor Color Code Table

2.) Use the GW Instek GDM-8245 Digital Multi-Meter (DMM) to measure the resistance of:

a) The resistors from Part 1. Note the tolerances.
b) Three settings of a resistor decade box. Again, note the tolerances.
c) Your own body.

3.) Connect up the circuit as shown in Figure 2, but first measure the resistance of the two 500 kΩ resistors. Use the constant 5 V output from the Mastech DC Power Supply HY3005D-3, the breadboard on the lab bench, and 1/4 W resistors from the cabinet to construct your circuit. Single-core, 22 Gauge wire and wire strippers are available for you to use as well.

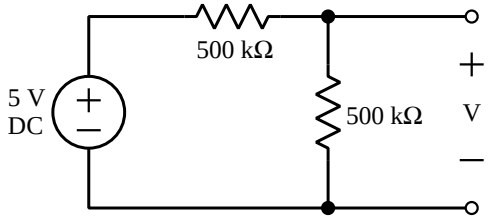


Figure 2: A Voltage Divider

Take an analog measurement of the 5 V power supply and the voltage V using the Senior Volt Ohmyst WV-98C (or WV-97A). Likewise, take a digital measurement of the same voltages using the GDM-8245. Compare your results. According to your calculations, which is more accurate, and why? When you are finished with your resistors, place them back in the appropriate bins in the cabinet.

4.) Replace the 5 V DC source in Figure 2 with a 5 V_p (5 V peak = 10 V peak-to-peak), 80 Hz sinewave. (Adjust the 10 V_{pp} AC source using the variable voltage control on the SFG-1013 Function Generator.) Take two analog measurements of the voltage V using the Senior Volt Ohmyst WV-98C and the Tektronix 210 or 1002 oscilloscope. Again, compare your results. Which is more accurate, and why?

5.) Before you connect up the circuit in Figure 3, carefully measure the resistances R_1, R_2, and R_3 using the appropriate 1/4 W resistors from the cabinet. Then construct your circuit using the breadboard and the Mastech DC Power Supply.

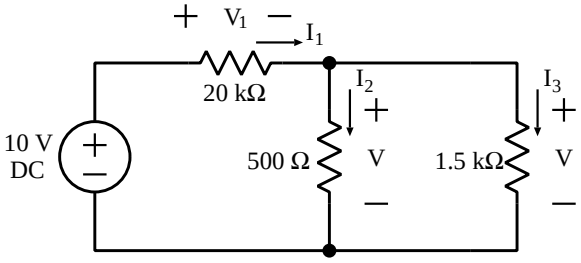


Figure 3: Series and Parallel Resistance

Carefully measure the voltage and current across and through each element using the GDM-8245 DMM.

6.) Change your input voltage from a 10 V DC Voltage Source to a 10 V_{pp} sinusoid at 1 kHz using the SFG-1013 Function Generator. Carefully observe the voltage waveform across each element using the Oscilloscope. Does Kirchoff's Voltage Law still hold? Why?

When you are finished, place the resistors in their appropriate bins in the cabinet.

Conclusion

Briefly discuss your conclusions about resistor tolerances, percentage error, and theoretical calculations versus experimental measurements. What conclusions can you draw about Kirchoff's Current and Voltage Laws? Do they provide an accurate model for determining voltage and current in a circuit?

Group Report

1.) Tabulate the nominal resistances, tolerances, and measured resistances from Parts 1 and 2.

2.) Tabulate and compare the results in Parts 3 and 4 to theory, showing percent error. Then calculate and explain analytically the results you would expect, taking into account the internal resistances of the Volt Meter.

3.) Tabulate and compare the results of Part 5 to theory, showing the percent difference. Explain your results.