# Lab notebook EECT 111

Spring 2019

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# 2 Labs

# Lab 1: Resistor Variability

# Lab 1



– The purpose of Lab One was to learn the how resistors vary even when they have the same color code.

– This lab allowed us to test the resistance of multiple resistors with the same specified resistance. This gave us three things

1. Opportunity to familiarize ourselves with basic lab equipment
2. Showed us that not all parts are truly made to spec
3. Taught us to take all of the parts in a lab under consideration as there can be variances.

# 5 Lab 1

- After collecting twenty resistors, we measured each one and recorded the resistance in ohms. After we measured all twenty, we made an Excel worksheets and found the smallest, largest, and average resistance as well as the standard deviation.
- Observations: All resistors fell within the acceptable tolerance levels, however, very few where actually close to 1k Ohms

# 6 Lab 1

EECT111

Lab 1 –Resistor Variability

Names: Joseph Forti, Andrew Erickson, Brian Yang
Date: 01/23/2019

The purpose of this lab is to:
Learn the how resistors vary using 20 resistors with the same color code.

Select a set of 20, 1 kohm resistors.
Measure and record the resistance of each resistor.

Equipment needed:

1 – Digital Multimeter
1 – 20 resistors with the same color code.

Resistor color code = brown, black, red
Resistor value = 1k Ohms
Resistor tolerance = +- 5

Using Microsoft Excel plot the resistor values and determine:

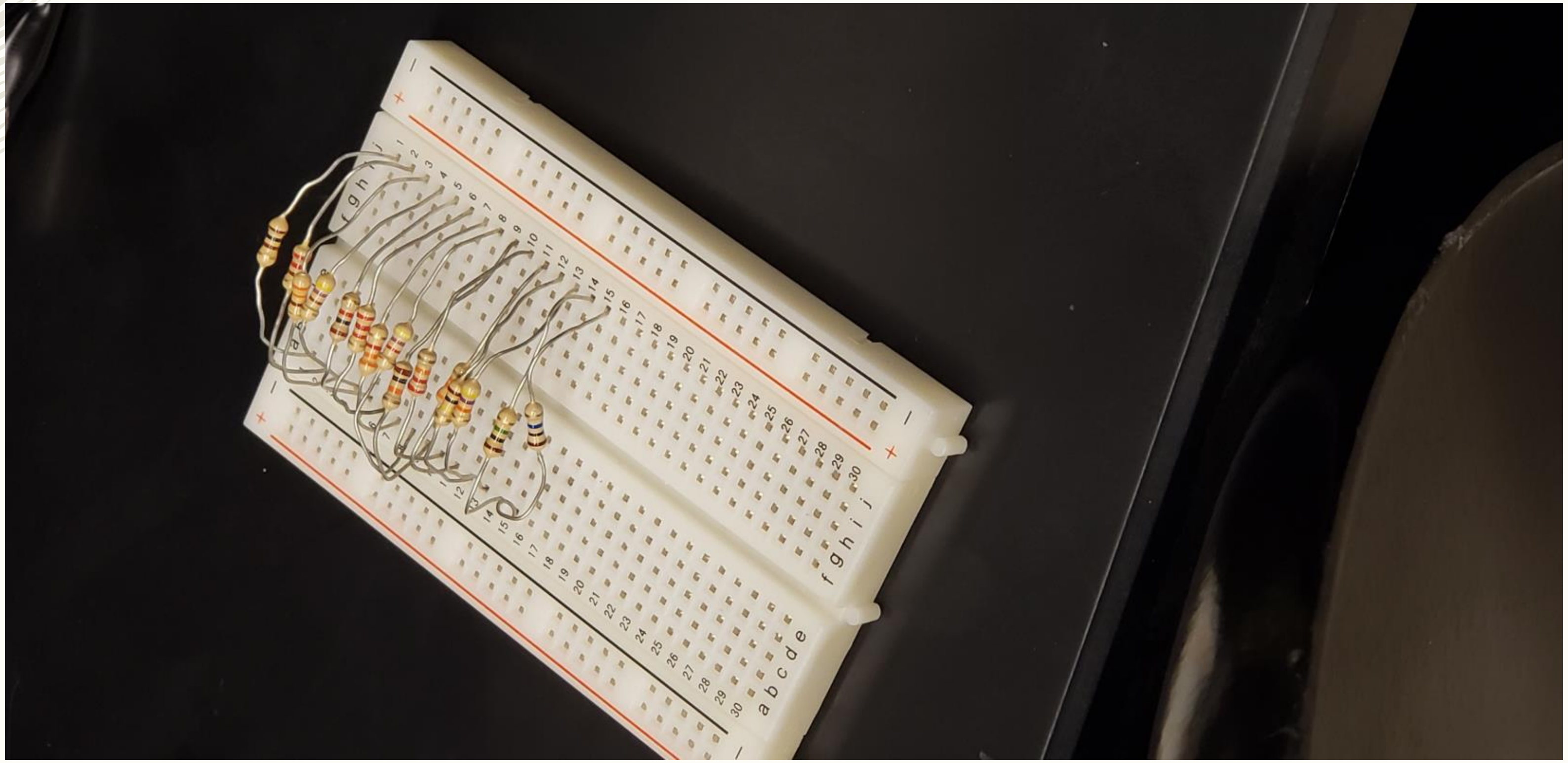
Smallest resistance = .9733 k
Largest resistance = 1.020 k
Average resistance = .9921 k
Standard Deviation = 0.0034

Do any of your resistor values exceed the part tolerance? _no___

| Sample | Measured Value |
|---|---|
| 1 | .9733 k |
| 2 | .9937 k |
| 3 | .9882 k |
| 4 | .9915 k |
| 5 | 1.034 k |
| 6 | .9852 k |
| 7 | 1.022 k |
| 8 | .9956 k |
| 9 | 1.006 k |
| 10 | 1.002 k |
| 11 | .9883 k |
| 12 | 1.001 k |
| 13 | .9923 k |
| 14 | .9986 k |
| 15 | .9953 k |
| 16 | .9886 k |
| 17 | .9913 k |
| 18 | 1.003 k |
| 19 | 1.003 k |
| 20 | 1.020 k |

| Lab 1 | | | |
|---|---|---|---|
| Resisotor # | Measured Resistance (KOhms) | Smallest Resistance | 0.9733 |
| 1 | 0.9733 | Largest Resitance | 1.034 |
| 2 | 0 .9937 | Average | 0.992189 |
| 3 | 0.9882 | Standard deviation | 0.003458 |
| 4 | 0.9915 | | |
| 5 | 1.034 | | |
| 6 | 0.9852 | | |
| 7 | 1.022 | | |
| 8 | 0.9956 | | |
| 9 | 1.006 | | |
| 10 | 1.002 | | |
| 11 | 0.9883 | | |
| 12 | 1.001 | | |
| 13 | 0.9923 | | |
| 14 | 0.9986 | | |
| 15 | 0.9953 | | |
| 16 | 0.9886 | | |
| 17 | 0.9913 | | |
| 18 | 1.003 | | |
| 19 | 1.003 | | |
| 20 | 1.020 | | |

# Lab 2: Reading and Sorting Resistors



# 8 Lab 2

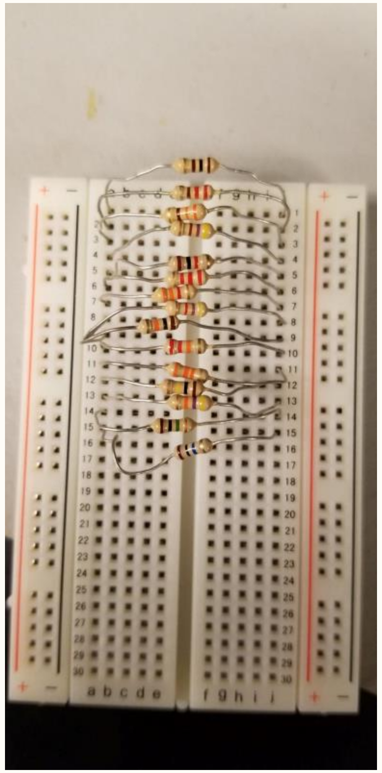
- The purpose of this lab was to: Learn the resistor c olor code using 15 resistors which must be sorted from smallest to largest value.
- This Lab called for us to measure the resistance of 15 different resistors based on their color code.
- Using an assortment of resistors, a breadboard, and a digital multimeter, we measured and recorded the resistance of each resistor in ohms.

# 9 Lab 2

## Resistor Values and color codes

| | Color Code | Measured Value |
|---|---|---|
| 100 = | Brown black, brown, Gold | 98.66 oh |
| 220 = | Red, Red, Brown Gold, | 217.57 |
| 330 = | Orange orange, brown gold | 324.31 |
| 470 = | Yellow, Violet, Brown, Gold | 458 ohm |
| 1K = | Brown, Black, Red, Gold | 1.00k |
| 2.2K = | Red, Red, Red, Gold | 2.19k oh |
| 3.3K = | Orange, Orange, Red, Gold | 3.23K oh |
| 4.7K = | Yellow, Violet, Red, Gold | 4.59k |
| 10K = | Brown, Black, Orange, Gold | 9.83k |
| 22K = | Red, Red, Orange, Gold | 21.98k |
| 33K = | Orange, Orange, Orange,Gold | 32.75k |
| 47K = | Yellow, Violet, Orange, Gold | 46.46k |
| 100K = | Brown, Black, Yellow, Gold | 99.20k |
| 1M = | Brown, Black, Green, Gold | 1.009M |
| 10M = | Brown, Black, Blue, Gold | 10.24M |

## Resistors on the breadboard

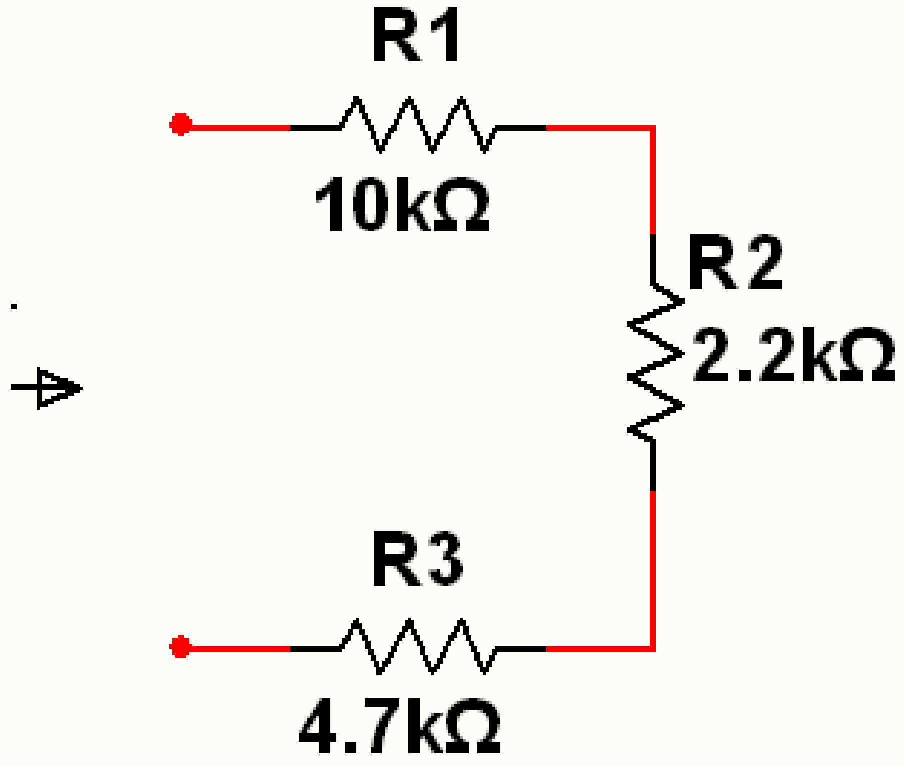


# Lab 2



- Observations: All resistors besides the two largest resistors were under their prescribed resistance. The to resistors with M resistance were over their prescribed resistance. All measurements were agreeable and fell within the given tolerance.

# Lab 3: series circuit analysis



Lab 3



# Objective: verify that analysis results agree with test results.

- Equipment used
- Resistors (10k,2.2k,4.7k) ohm
- Power : elvis ll (9 volts)
- digital multimeter

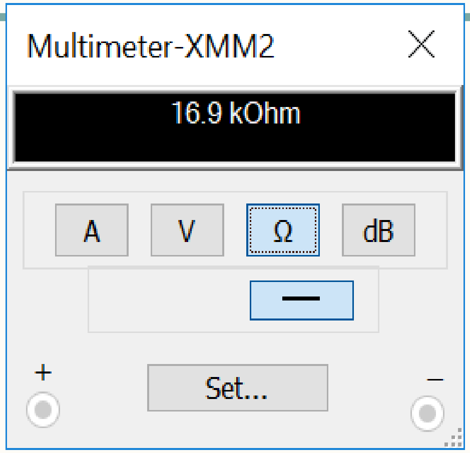
Calculate results using Excel, multisim, and measuring in lab.

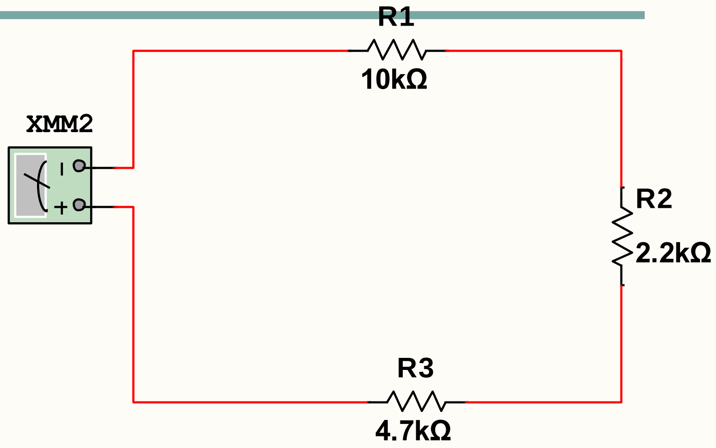
# Measured resistance results:

| | | |
|---|---|---|
| $R_1$ | = | 10.0E+3 |
| $R_2$ | = | 2.2E+3 |
| $R_3$ | = | 4.7E+3 |
| $R_T$ | = | 16.9E+3 |

| | Measured | Calculated | Simulated |
|---|---|---|---|
| R1= | 9.796 | 10k | 10kOhm |
| R2 = | 2.2 kOhm | 2.2k | 2.2kOhm |
| R3 = | 4.7kOhm | 4.7k | 4.7kOhm |
| RT = | 16.9 kOhm | 16.9 | 16.9kOhm |

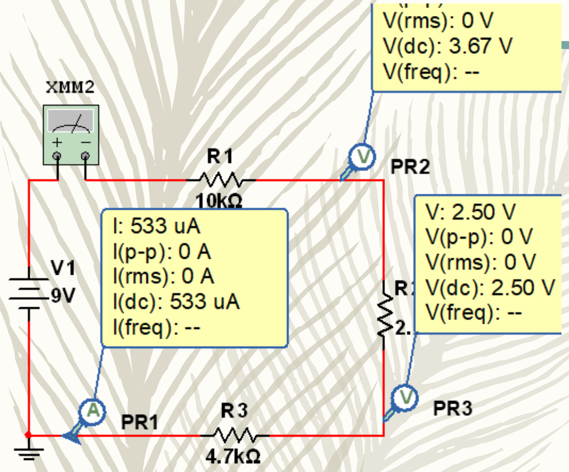
Measured = using Digital Multimeter
Calculated = based on color code and Excel values
Simulated = Multisim simulation

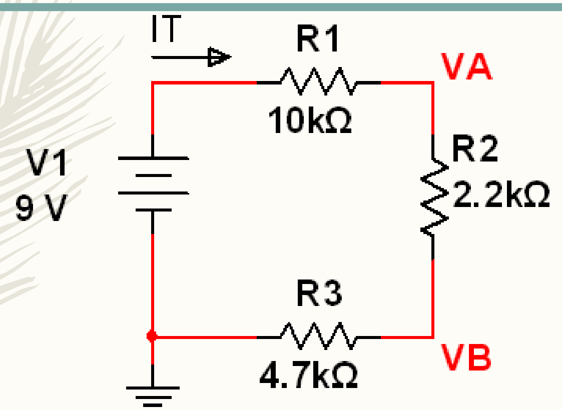


# Lab 3






| | | |
|---|---|---|
| $I_T$ | = | 532.54E-6 |
| $V_1$ | = | 9 |
| $V_A$ | = | 3.6746 |
| $V_B$ | = | 2.5030 |

| | Measured | Calculated | Simulated |
|---|---|---|---|
| IT = | 5372.2 uA | 532.5 uA | 532.54 uA |
| V1 = | 9v | 9v | 9 V |
| VA = | 3.6432 | 3.674556 | 3.675V |
| VB = | 2.5617 | 2.502959 | 2.503V |

Measured = using Digital Multimeter
Calculated = based on color code and Excel values
Simulated = Multisim simulation

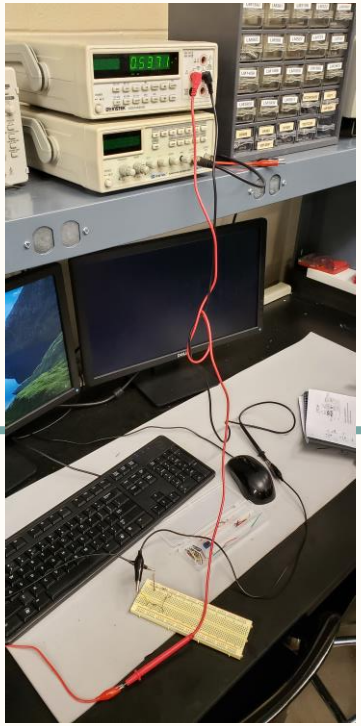
# Voltage and currant results:

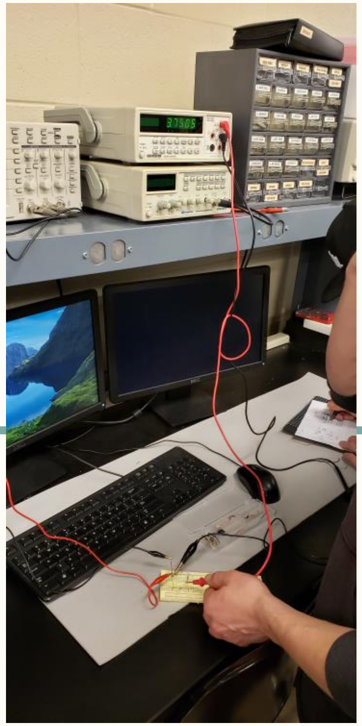
# Lab 3

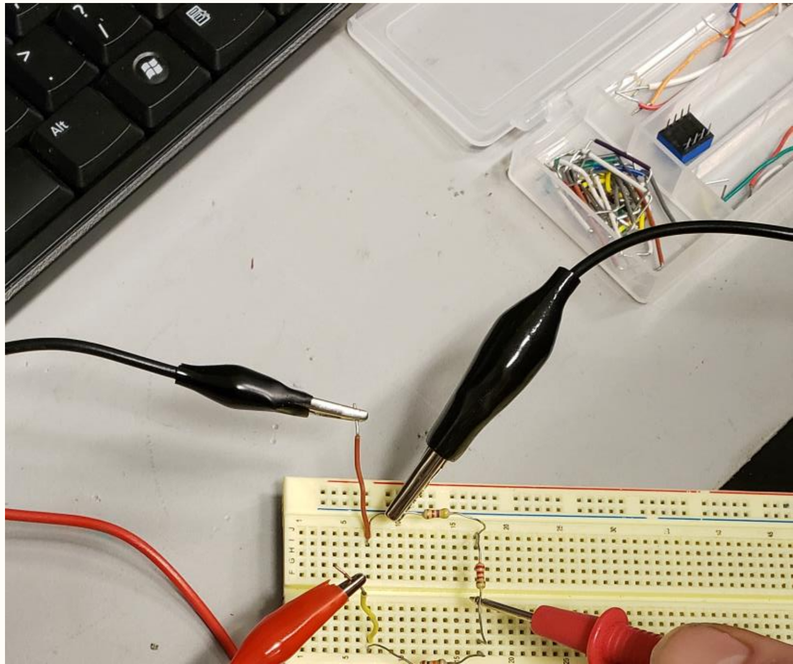


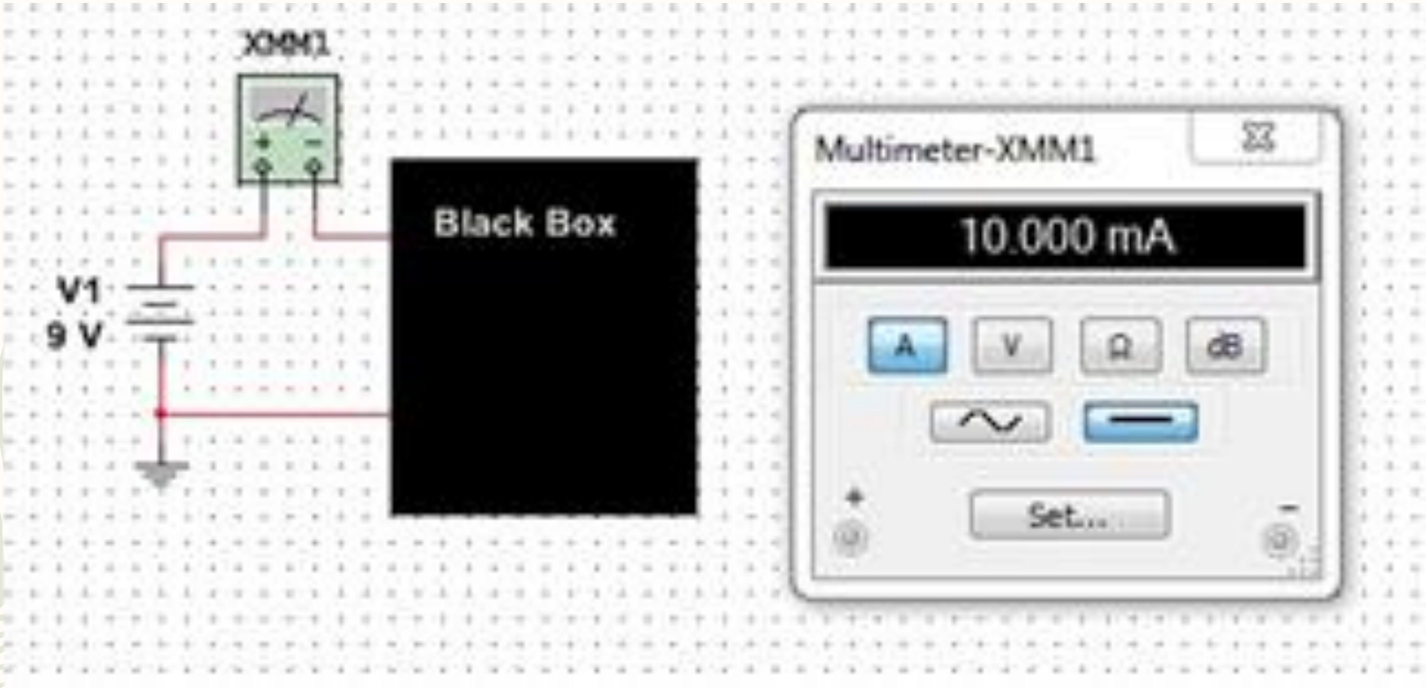
## Observations:

- As long as we made sure everything was set up properly the measurements in the lab were agreeable with the multisim and excel calculations. Also make sure the board is set up properly or measurements wont be right.










# Lab 4: Blackbox Challenge

# Lab 4



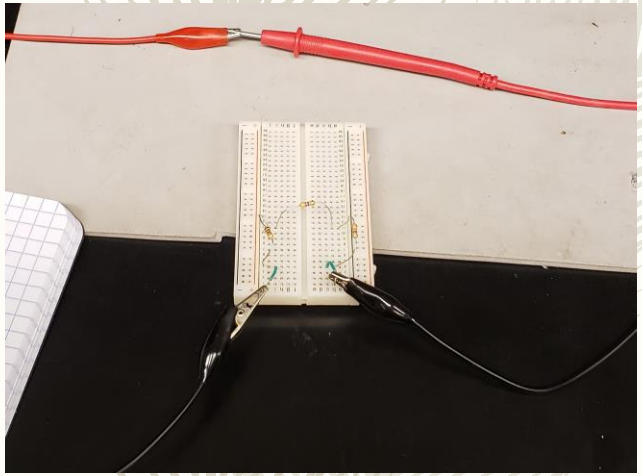
## Objective: there is a 9V power supply and a 10mA current draw, design a 3 resistor series circuit using standard resistors that meet those requirements.

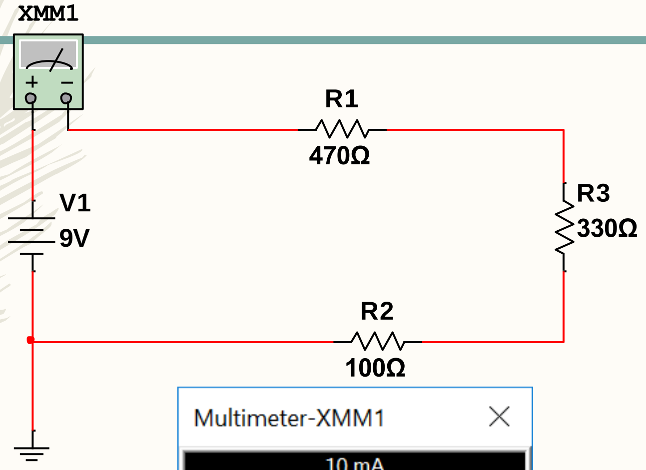
Equipment used:

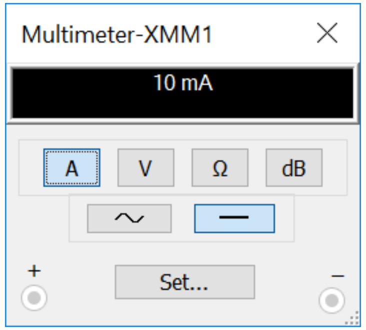
- Elvis II (9v)
- Digital Multimeter
- Standard resistors

# Lab 4








| | Design | Measured | Calculated | Simulated |
|---|---|---|---|---|
| V1 = | 9V | 9V | 9V | 9V |
| IT = | 10E-3 mA | 9.98E-3 mA | 10.E-3 mA | 10mA |
| RT = | 900 ohm | 895 ohm | 900 ohm | 900 ohm |
| R1 = | 470 ohm | 469.2 ohm | 470 ohm | 470 ohm |
| R2 = | 330 ohm | 327.32 ohm | 330 ohm | 330 ohm |
| R3 = | 100 ohm | 97.97 ohm | 100 ohm | 100 ohm |

## Resistance and currant results: excel, multisim, measured

# Lab 4

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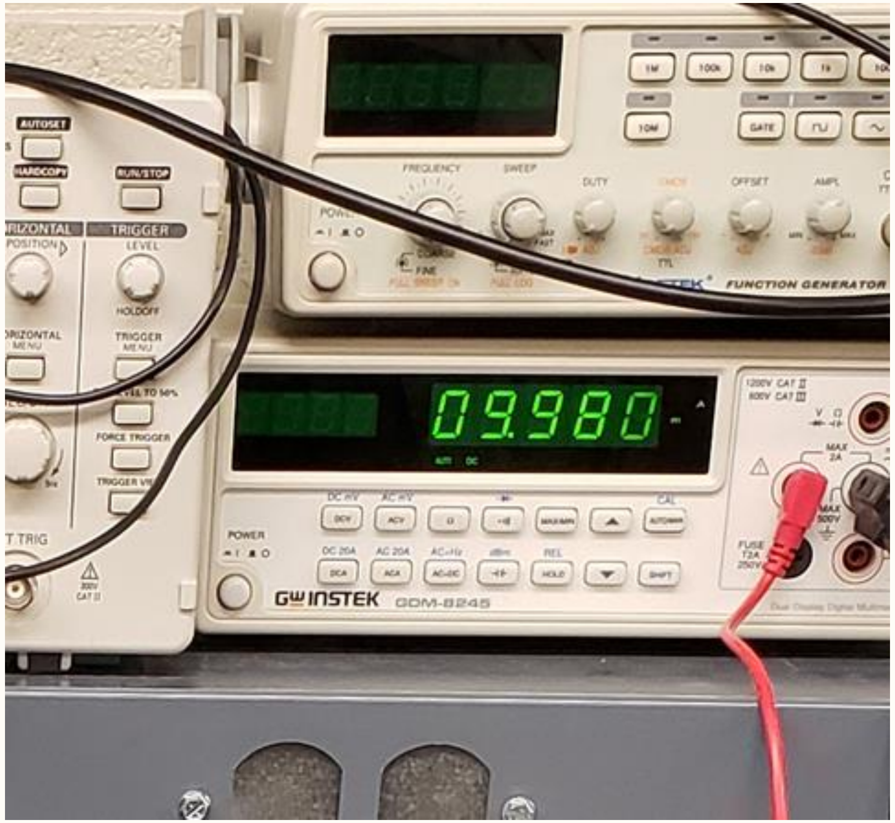
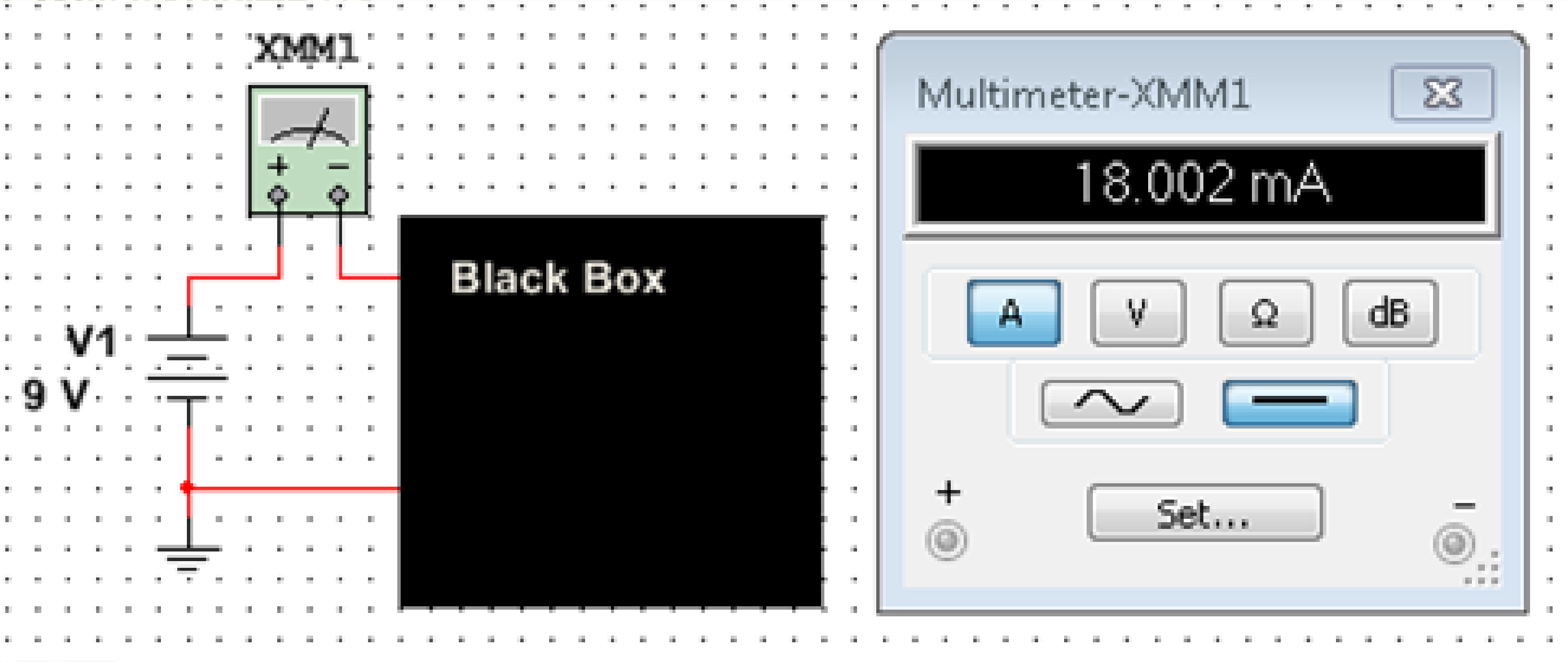
Observations: everything was agreeable as far as calculations being close to measurement, we did notice a slight drop in current when measuring in the lab.



# Lab 6: Black Box 2 Design



# Lab 6



Parallel Resistor Circuits

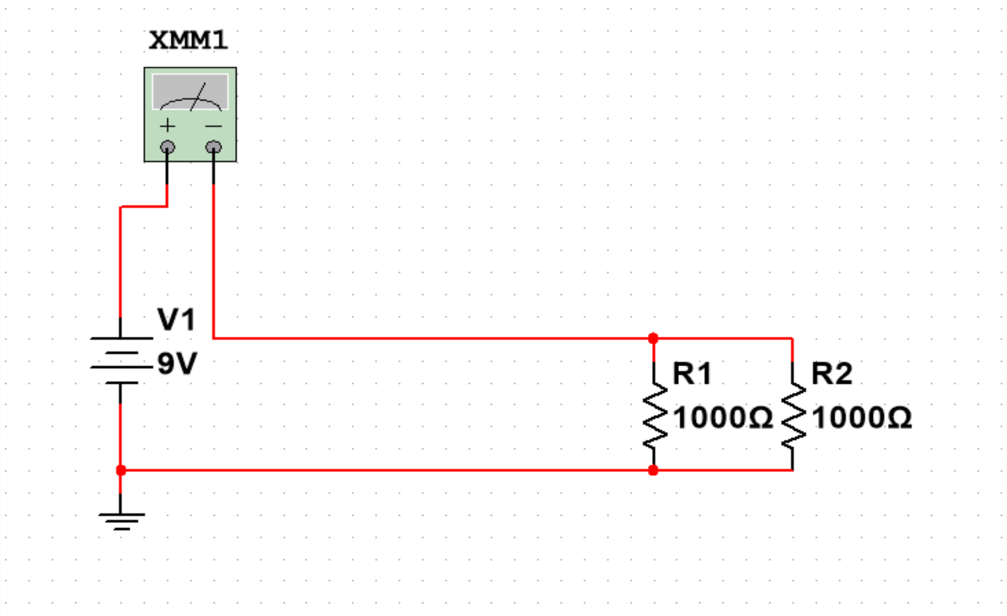
– The purpose of lab 6 was to experiment with resistor circuits in series. In this instance we were tasked with building a circuit that would provided 18mA of power from a 9V source.

# Lab 6



Using ohms law (R=V/I), we created an excel sheet to find the required resistance to create 18mA. After finding that it was 500 Ohms, we used basic algebra to find that we need to use to 1000 ohm resistors in parallel to make 500 ohms.

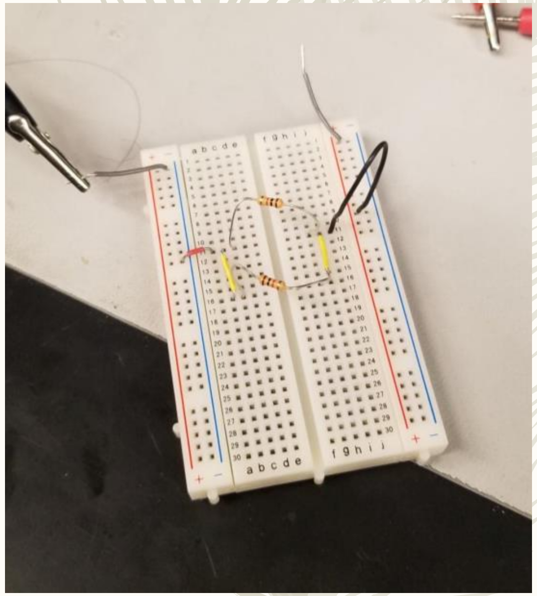
| | A | B | C |
|---|---|---|---|
| 1 | Lab 6 | | |
| 2 | V | 9 | |
| 3 | I | 0.018 | |
| 4 | R(required Ohms | 500 | |
| 5 | R1 (ohms) | 1000 | |
| 6 | R2 (ohms) | 1000 | |
| 7 | RT | 500 | |
| 8 | | | |
| 9 | | | |
| 0 | | | |
| 1 | | | |



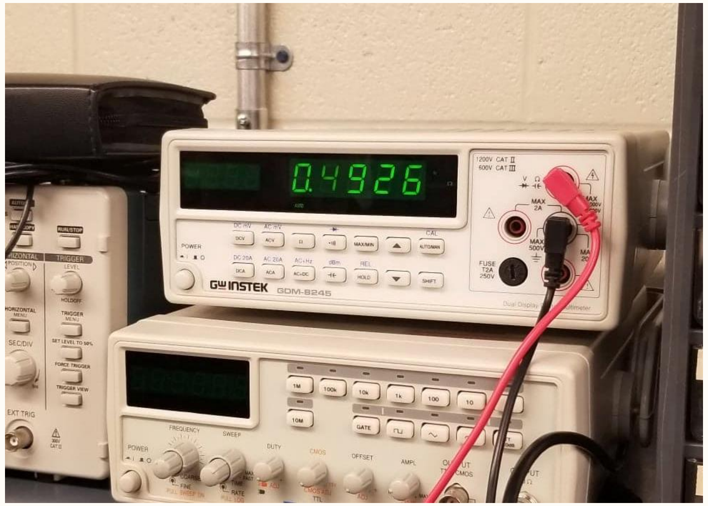
# Lab 6



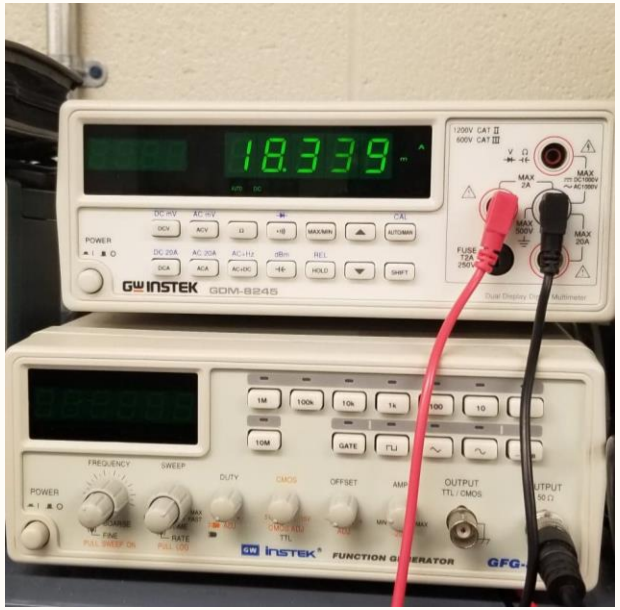
In the lab, we built a circuit with two 1000 ohm resistors and measured the resistance and amperage with a digital multimeter.



Resistance kOhm




Current mA



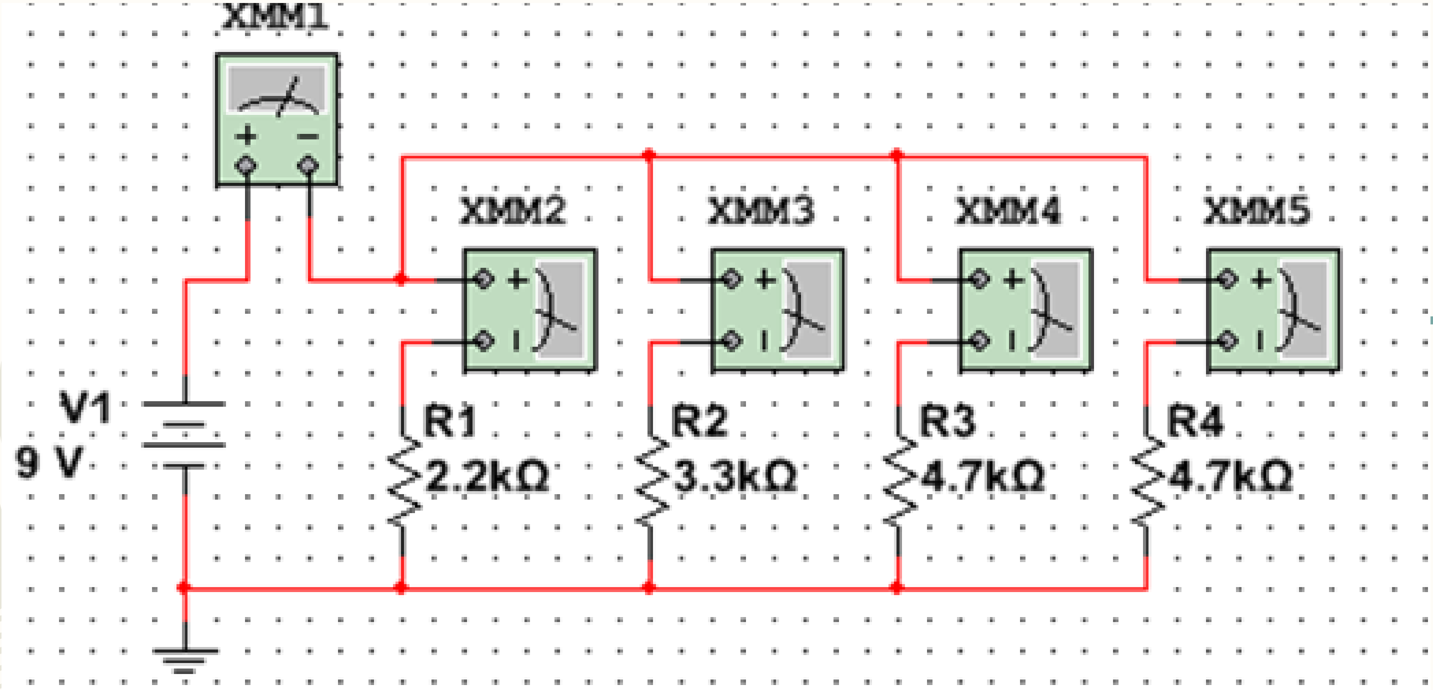
# Lab 6



– Results and Observations

| | Design | Measured | Calculated | Simulated |
|---|---|---|---|---|
| V1 = | 9.00 | 9.0E+0 | 9 | 9 |
| IT = | .018 A | 18.3E-3 A | .018 A | .018 A |
| RT = | 500Ohm | 492.8E+0 | 500 Ohm | 500 Ohm |
| R1 = | 1k Ohm | 989.0E+0 | 1k Ohm | 1k Ohm |
| R2 = | 1k Ohm | 981.0E+0 | 1k Ohm | 1k Ohm |

The measured amperage was a bit higher than calculated. This was probably due to the resistors being slightly under their stated resistance.




# Lab 7: 4 resistor parallel circuit

# Lab 7

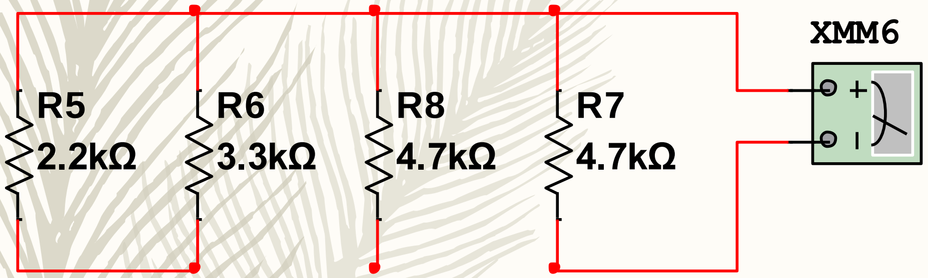


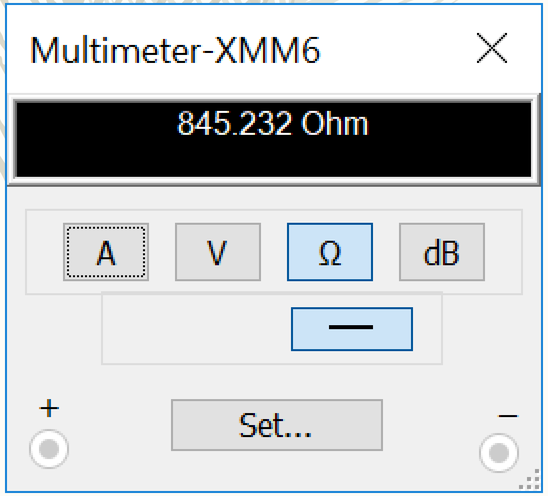
Objective: 9V is applied to 4 parallel resistors, measure resistor values, total current, and all branch currents.

Equipment used:

- Elvis II (9v)
- Digital Multimeter
- Standard resistors

# Resistance total: calculated, multisim, measured




Excel
RT= 1/((1/2.2k)+(1/3.3k)+(1/4.7k)+(1/4.7k))

R1 = 2.2E+3
R2 = 3.3E+3
R3 = 4.7E+3
R4 = 4.7E+3
Rt = 845.2316076

| | Design | Measured |
|---|---|---|
| R1 = | 2.2k | 2.194k |
| R2 = | 3.3k | 3.243k |
| R3 = | 4.7k | 4.619k |
| R4 = | 4.7k | 4.633k |

# Lab 7

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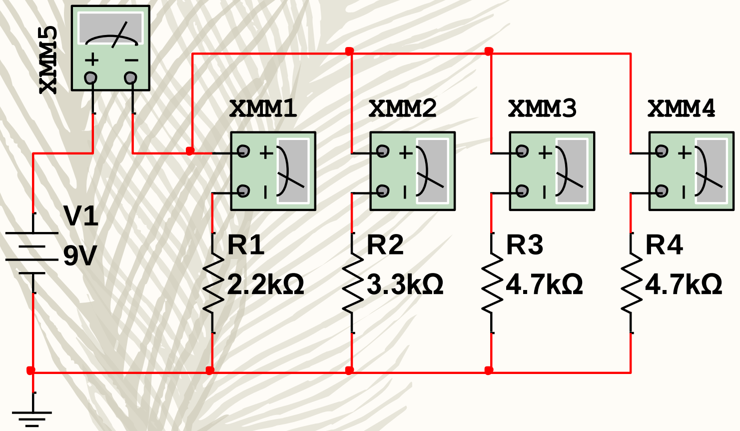
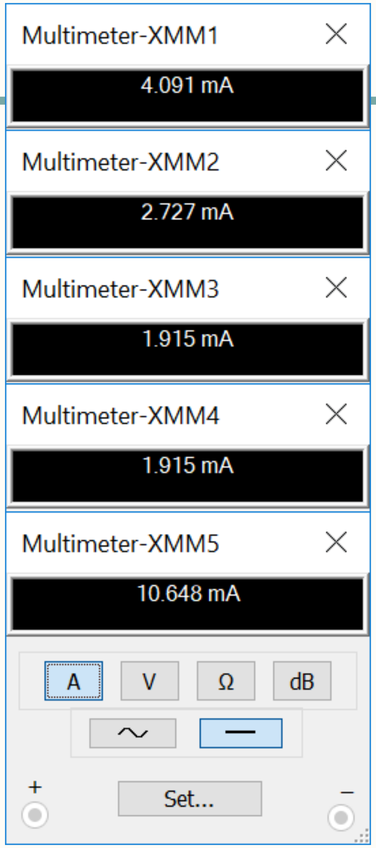
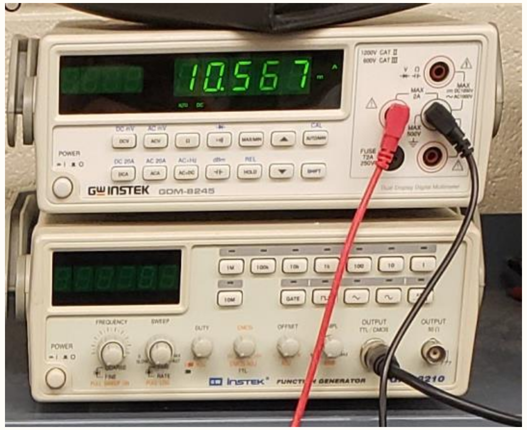
## Branch and total current results: excel, multisim, lab

| | Measured | Calculated | Simulated |
|---|---|---|---|
| V1 = | 9 | 9 | 9 |
| RT = | 1.021K | 845.232 | 845.232 |
| I1 = | 3.903E-3 | 4.091E-3 | 4.091E-3 |
| I2 = | 2.680E-3 | 2.727E-3 | 2.727E-3 |
| I3 = | 1.896E-3 | 1.915E-3 | 1.915E-3 |
| I4 = | 1.898E-3 | 1.915E-3 | 1.915E-3 |
| IT = | 10.566E-3 | 10.648E-3 | 10.648E-3 |




EXCEL:

I1=V/R1, I2=V/R2, I3=V/R3, I4=V/R4

IT= I1+I2+I3+I4

| | | |
|---|---|---|
| V | = | 9 |
| $R_1$ | = | 2.2E+3 |
| $R_2$ | = | 3.3E+3 |
| $R_3$ | = | 4.7E+3 |
| $R_4$ | = | 4.7E+3 |
| $I_1$ | = | 4.091E-3 |
| $I_2$ | = | 2.727E-3 |
| $I_3$ | = | 1.915E-3 |
| $I_4$ | = | 1.915E-3 |
| $I_T$ | = | 10.648E-3 |
| Rt | = | 845.23161 |

# Lab 7

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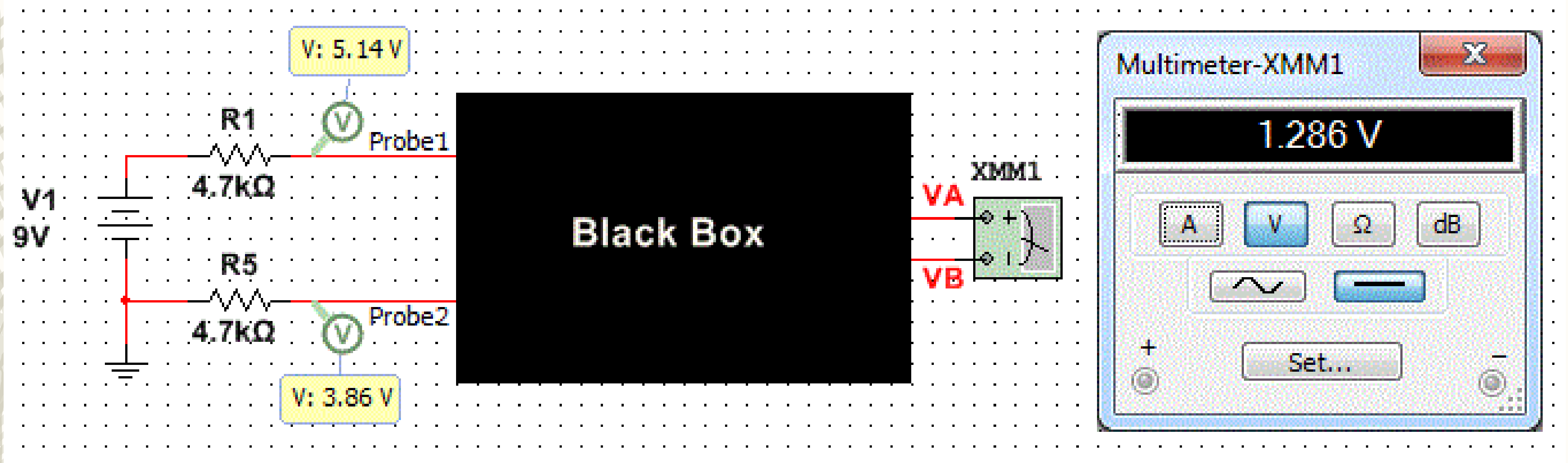
Observations: after we figured out that we did not set up the breadboard properly for a parallel circuit we fixed it and all calculations were within acceptable range compared to the simulation and calculations.

# Lab 8: Blackbox 3 design



Lab 8



# Objective: learn about building a circuit that produces exactly 1.3V

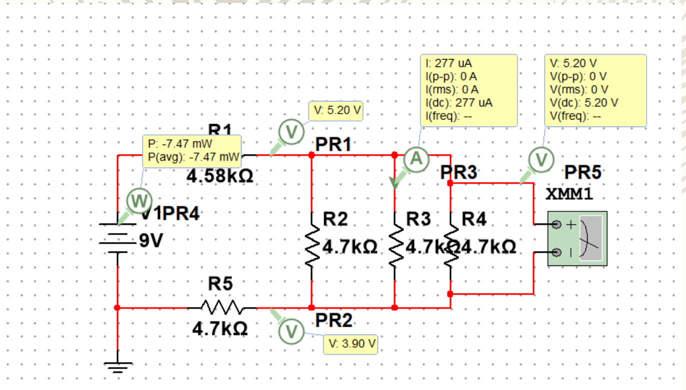
Equipment used:

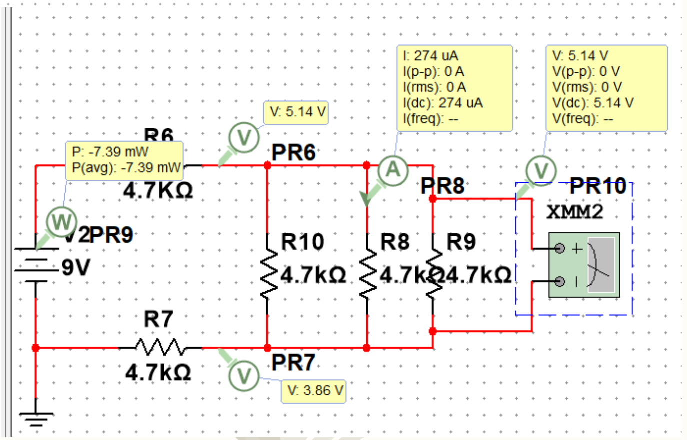
- Elvis II (9v)
- Digital Multimeter
- 5-Standard resistors
- 1-5kOhm pot

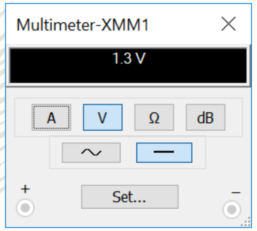
Lab 8

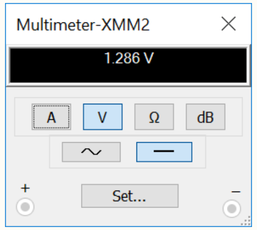


# Results: excel, multisim, lab




VA= V-(IT*R1), VB=V-(IT*(R(BB)+R1)), VA-VB-1.2857V

| | Measured | Calculated | Simulated |
|---|---|---|---|
| V1 = | 9V | 9V | 9V |
| VA = | 5.147 V | 5.14V | 5.14V |
| VB = | 3.87V | 3.86V | 3.86V |
| VA - VB = | 1.2964 | 1.286V | 1.286V |
| (VA - VB) adj = | (5.236-3.917) | (5.2-3.9)V | (5.2-3.9)V |

| | Design | Measured |
|---|---|---|
| R1 = | 4.7k | 4.62k |
| R2 = | 4.7k | 4.629k |
| R3 = | 4.7k | 4.642k |
| R4 = | 4.7k | 4.616k |
| R5 = | 4.7k | 4.588lk |
| R(Black Box) = | 1566.66 | 1.5233k |
| R1adj = | 4.58K | 4.4367k |

| | |
|---|---|
| V1 = | 9 |
| R1 = | 4.7E+3 |
| R2 = | 4.7E+3 |
| R3 = | 4.7E+3 |
| R4 = | 4.7E+3 |
| R5 = | 4.7E+3 |
| RT = | 10.967E+3 |
| RT(ADJ) = | 10.847E+3 |
| IT = | 820.7E-6 |
| IT(ADJ) = | 829.7E-6 |
| R(BB) = | 1.567E+3 |
| R1(ADJ) = | 4.58E+3 |
| VA = | 5.14E+0 |
| VB = | 3.857E+0 |
| VA-VB = | 1.285714286 |
| VA-VB(ADJ) = | (5.2-3.9) |
| | |
| IT = | 821.3E-6 |
| | |
| PIN = | 7.4E-3 |

# Lab 8

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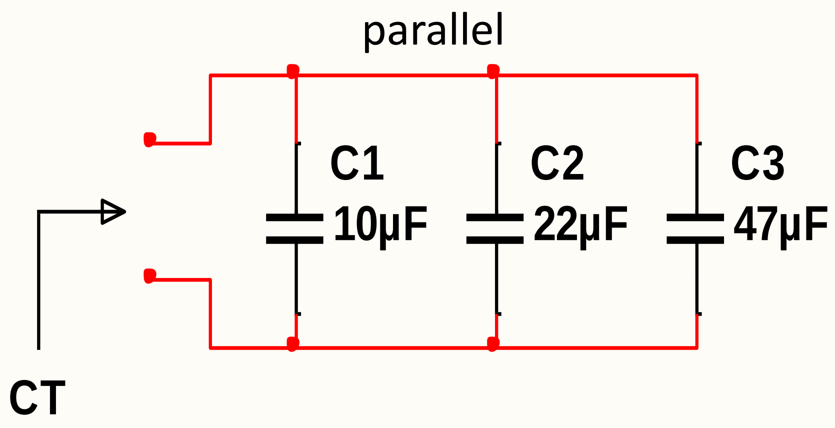
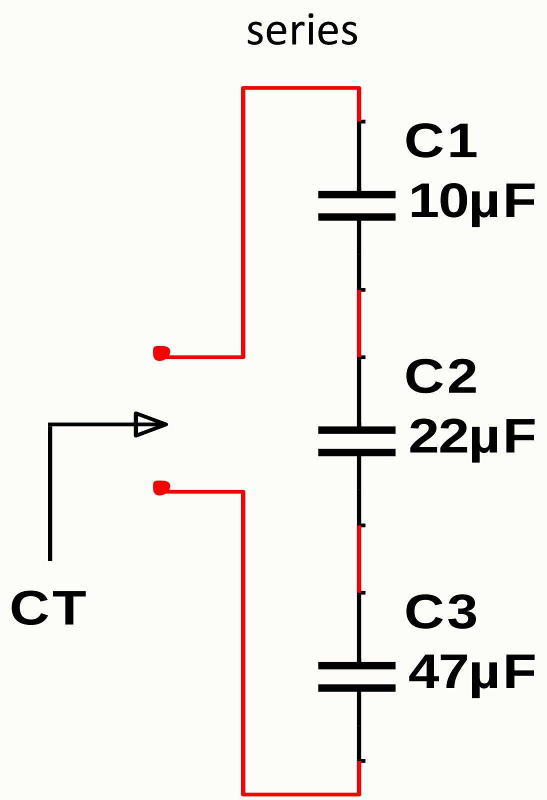
Observations: We used two different resistors to create a resistance that was close to 4.58k Ohm (3.3k+1.2k).Resistors tended to be on the low side of resistance. We also found that we needed to pay close attention to make sure that our wires and resistors didn’t touch. Note to self: if it equals zero, CHECK THE POWER and make sure its on!

# Lab 10: Series/Parallel Capacitors



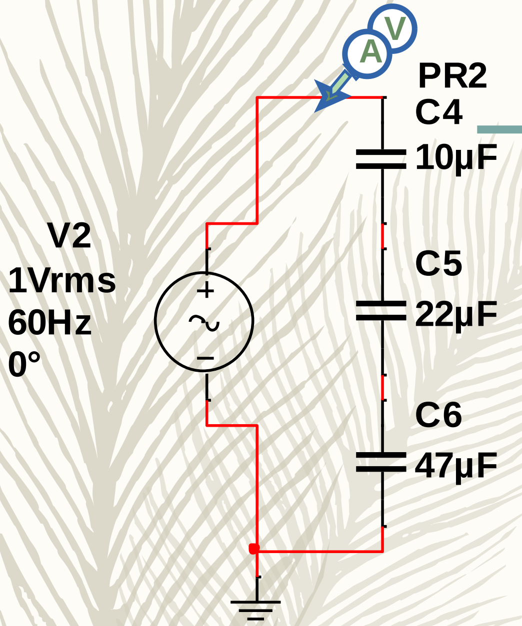
# Lab 10



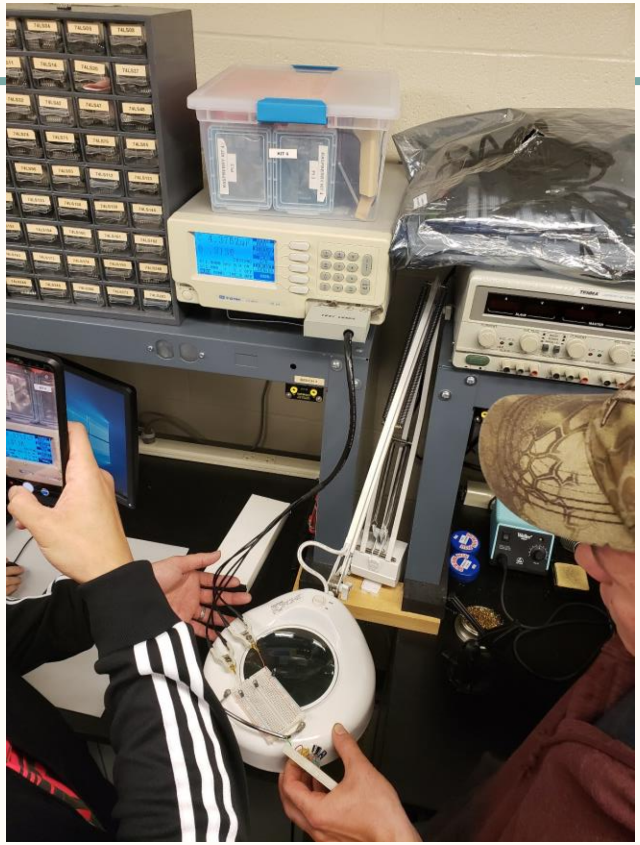
- The purpose of this lab is to:
- Experiment with series circuits and parallel combinations of capacitors.
- The following capacitors are needed (1 each of the following): 10uF, 22uF and 47uF
- Measure and record the capacitance of each capacitor using the LCR meter. Connect the capacitors as shown in Figure 1 and measure and record the total capacitance, CT. Then connect the capacitors as shown in Figure 2 and measure and record the total capacitance, CT.

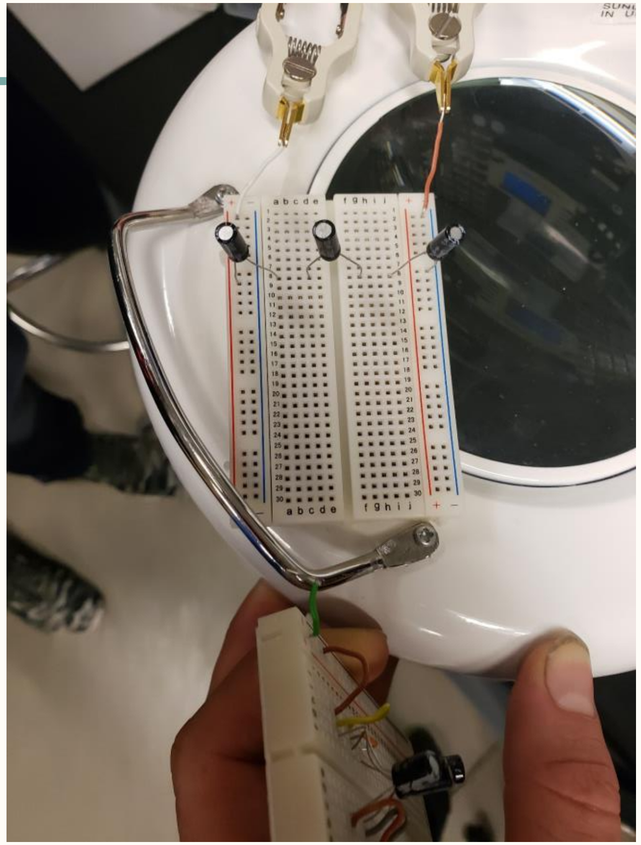
# Lab 10 – Series Capacitor





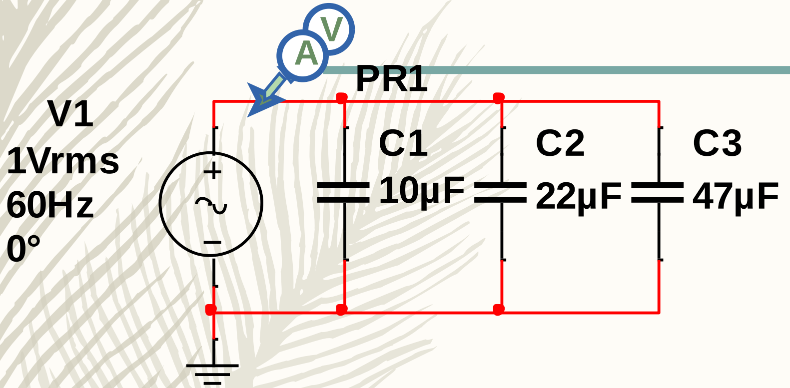

| | Expected | Measured |
|---|---|---|
| C1 = | 10 µF | 7.09 µF |
| C2 = | 22 µF | 17.57 µF |
| C3 = | 47 µF | 34 µF |
| CT = | 5.99µF | 4.375 µF |



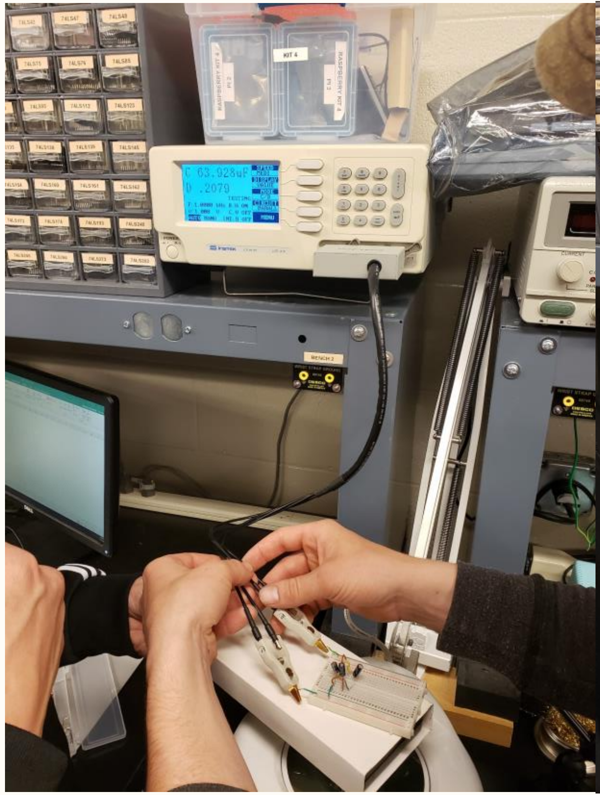


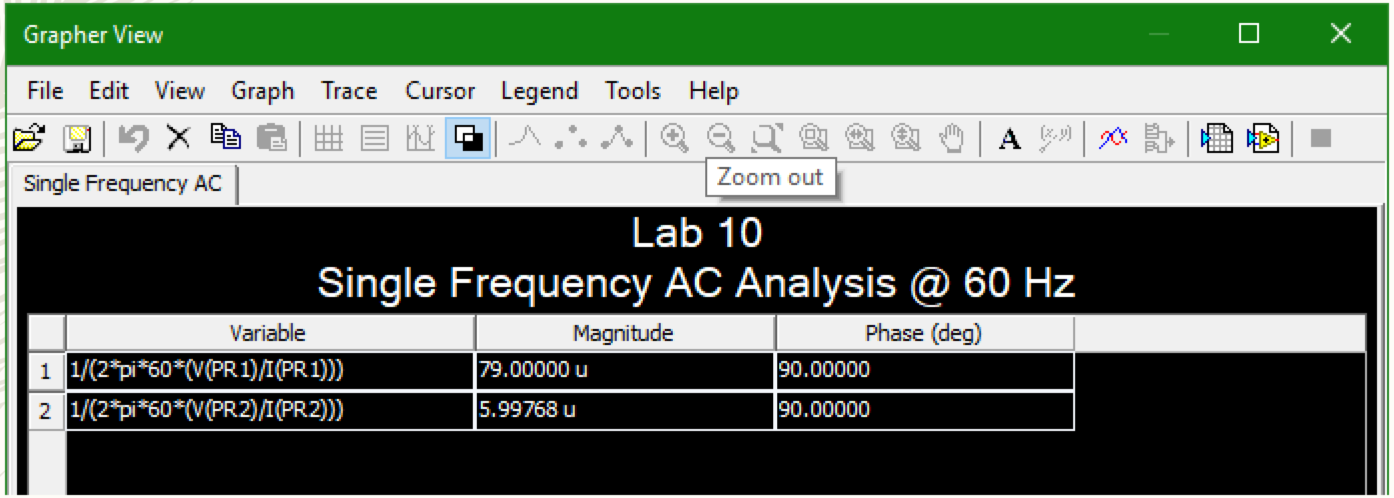
# Lab 10 – Parallel Capacitor





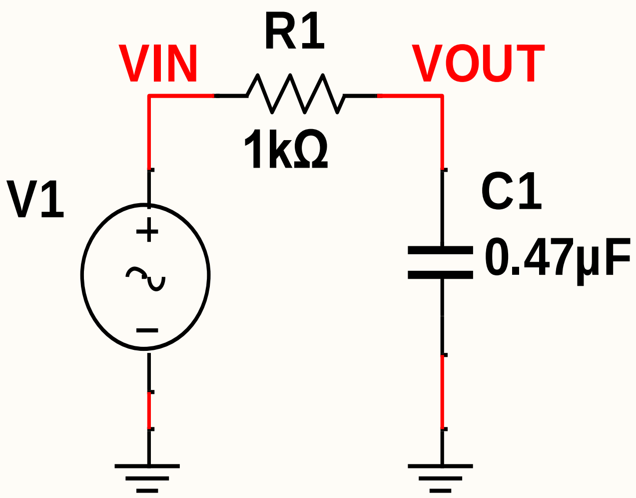

| | Expected | Measured |
|---|---|---|
| C1 = | 10 µF | 8.46 µF |
| C2 = | 22 µF | 17,15 µF |
| C3 = | 47 µF | 39.47 µF |
| CT = | 79 µF | 63.93 µF |






Observations: Capacitors were reading much lower than their assigned capacitance. Used previous multisim simulations for expected measurements.

# Lab 11: RC



# Lab 11



The purpose of this lab is to:

- Experiment with RC (Resistor & Capacitor) circuits.
- The following capacitors are needed (1 each of the following): 0.47uF, 1uF and 2.2uF
- Measure and record the resistor value using the DMM and measure and record the capacitor values using the LCR meter in Table 1. Connect the resistor and capacitor as shown in Figure 1. Connect the Function Generator to the input at V1 and connect Channel 1 of the Oscilloscope to the input and Channel 2 to the output. Adjust the voltage of the Function Generator to 1Vpp at the frequencies shown in Table 2. Measure the input and output voltages using the Oscilloscope. Record the results in Table 2.
- Change the capacitor and retest.

# Lab 11



| | Capacitance or Resistance | |
|---|---|---|
| | Expected | Measured |
| C1 = | 0.47E-6F | 0.47uF |
| C2 = | 1E-6F | 1uF |
| C3 = | 2.2E-6 | 2.2uF |
| R1 = | 1k | 1k |

Table 1 – Resistance and Capacitances

Expected = value you expect it to be

Measured = using LCR Meter or DMM

| | Output Voltage L = V1 | | | Output Voltage L = V2 | | | Output Voltage L = V3 | | |
|---|---|---|---|---|---|---|---|---|---|
| | Expected | Measured | | Expected | Measured | | Expected | Measured | |
| Frequency | Output Voltage | Input Voltage | Output Voltage | Output Voltage | Input Voltage | Output Voltage | Output Voltage | Input Voltage | Output Voltage |
| 10 | | 1 | 1.3823m | | 1 | 628.3184u | | 1 | 2.9531m |
| 50 | | 1 | 6.9131m | | 1 | 3.1424m | | 1 | 14.7676m |
| 100 | | 1 | 13.8217m | | 1 | 6.2831m | | 1 | 29.5181m |
| 200 | | 1 | 27.6435m | | 1 | 12.5690m | | 1 | 58.9761m |
| 300 | | 1 | 41.6184m | | 1 | 18.9308m | | 1 | 88.6324m |
| 400 | | 1 | 55.2391m | | 1 | 25.1392m | | 1 | 117.3716m |
| 500 | | 1 | 68.9676m | | 1 | 31.4083m | | 1 | 146.1051m |
| 600 | | 1 | 83.0041m | | 1 | 37.8350m | | 1 | 175.1426m |
| 700 | | 1 | 96.9248m | | 1 | 44.2284m | | 1 | 203.5589m |
| 800 | | 1 | 110.0026m | | 1 | 50.2445m | | 1 | 230.0686m |
| 900 | | 1 | 124.2148m | | 1 | 56.8233m | | 1 | 258.1229m |
| 1,000 | | 1 | 136.9281m | | 1 | 62.7082m | | 1 | 283.2184m |
| 2,000 | | 1 | 266.510m | | 1 | 124.7168m | | 1 | 508.5581m |
| 3,000 | | 1 | 383.9364m | | 1 | 185.9628m | | 1 | 662.6728m |
| 4,000 | | 1 | 483.9226m | | 1 | 243.8504m | | 1 | 763.0938m |
| 5,000 | | 1 | 568.5790m | | 1 | 299.7700m | | 1 | 827.9097m |
| 6,000 | | 1 | 638.1098m | | 1 | 353.6427m | | 1 | 869.6466m |
| 7,000 | | 1 | 694.2925m | | 1 | 403.7256m | | 1 | 898.6093m |
| 8,000 | | 1 | 741.5209m | | 1 | 449.2035m | | 1 | 920.7403m |
| 9,000 | | 1 | 777.7795m | | 1 | 492.9159m | | 1 | 934.6899m |
| 10,000 | | 1 | 810.2139m | | 1 | 532.0180m | | 1 | 947.1682m |

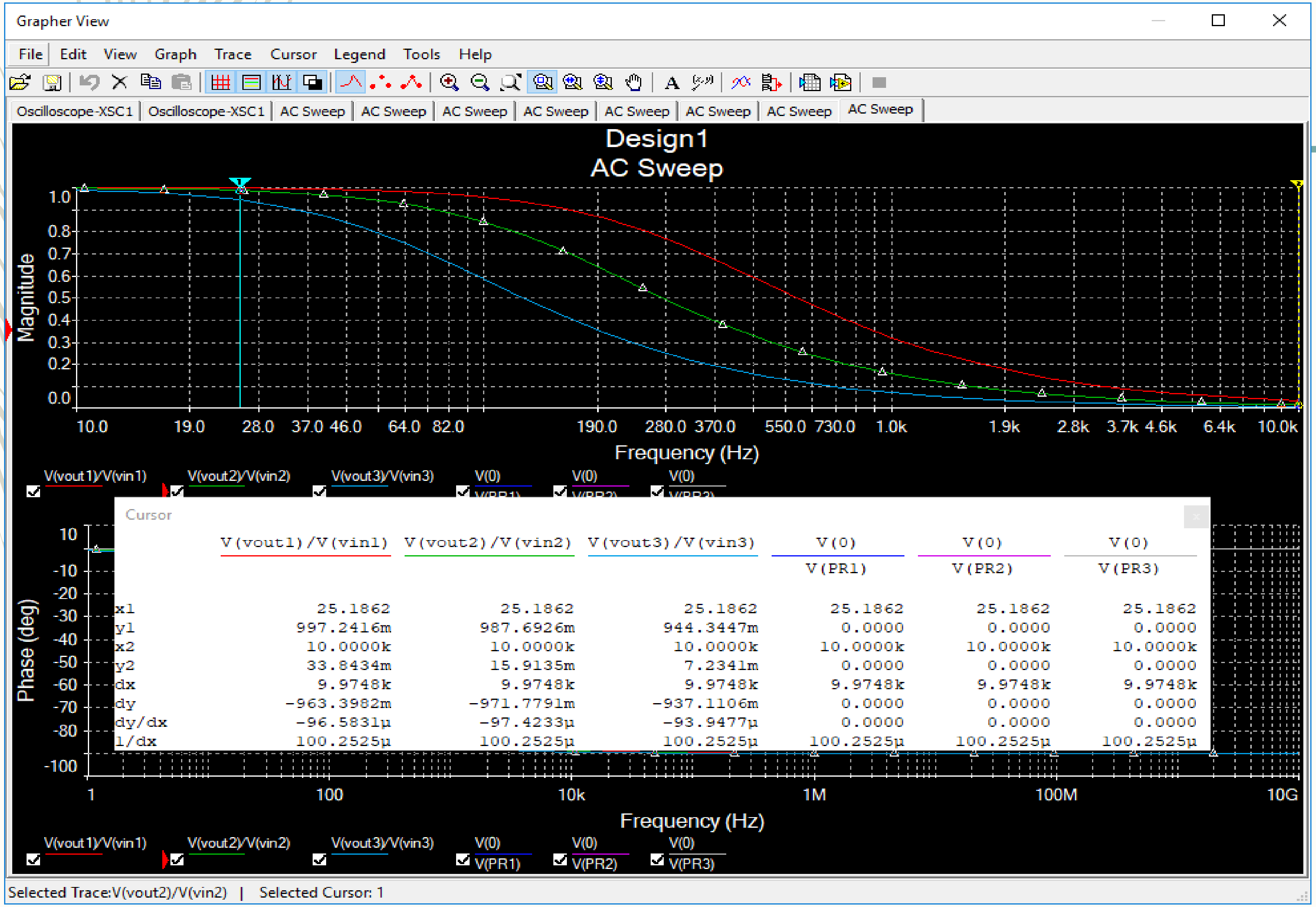
RL Frequency Response

Expected = value you expect it to be

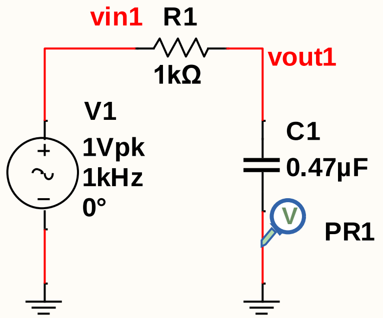
Measured = Using Oscilloscope

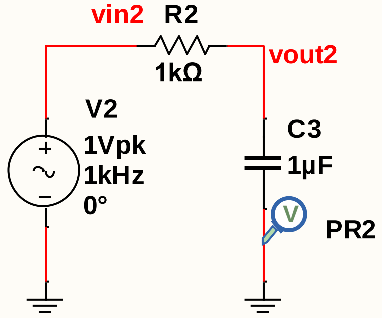
# Lab 11

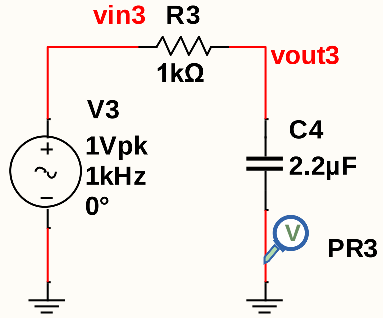




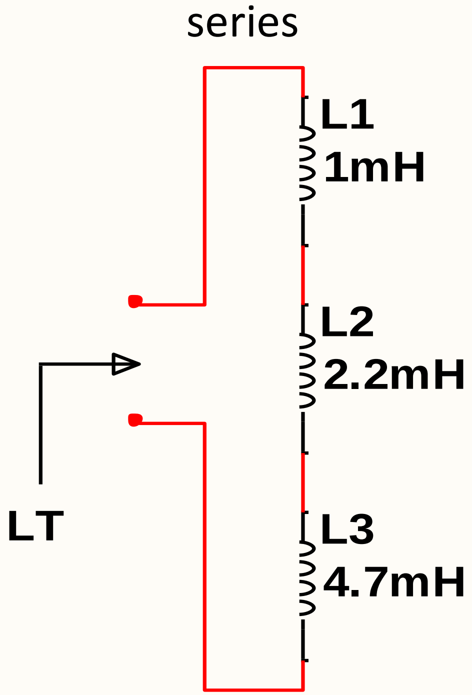

| | V(vout1)/V(vin1) | V(vout2)/V(vin2) | V(vout3)/V(vin3) | V(0) V(PR1) | V(0) V(PR2) | V(0) V(PR3) |
|---|---|---|---|---|---|---|
| x1 | 25.1862 | 25.1862 | 25.1862 | 25.1862 | 25.1862 | 25.1862 |
| y1 | 997.2416m | 987.6926m | 944.3447m | 0.0000 | 0.0000 | 0.0000 |
| x2 | 10.0000k | 10.0000k | 10.0000k | 10.0000k | 10.0000k | 10.0000k |
| y2 | 33.8434m | 15.9135m | 7.2341m | 0.0000 | 0.0000 | 0.0000 |
| dx | 9.9748k | 9.9748k | 9.9748k | 9.9748k | 9.9748k | 9.9748k |
| dy | -963.3982m | -971.7791m | -937.1106m | 0.0000 | 0.0000 | 0.0000 |
| dy/dx | -96.5831µ | -97.4233µ | -93.9477µ | 0.0000 | 0.0000 | 0.0000 |
| 1/dx | 100.2525µ | 100.2525µ | 100.2525µ | 100.2525µ | 100.2525µ | 100.2525µ |

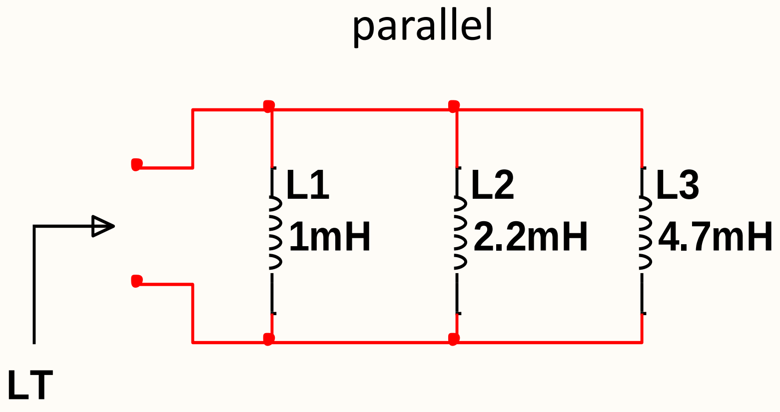


# Lab 12: Series/Parallel Inductors



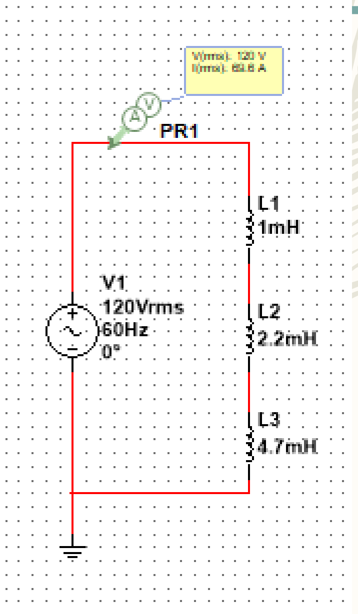
# Lab 12



The purpose of this lab is to:

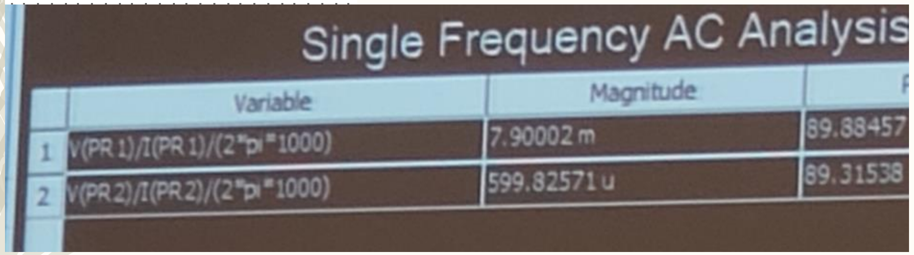
- Experiment with series circuits and parallel combinations of inductors.
- The following inductors are needed (1 each of the following): 1mH, 2.2mH and 4.7mH
- Measure and record the inductance of each inductor using the LCR meter. Connect the inductors as shown in Figure 1 and measure and record the total inductance, LT. Then connect the inductors as shown in Figure 2 and measure and record the total inductance, LT.

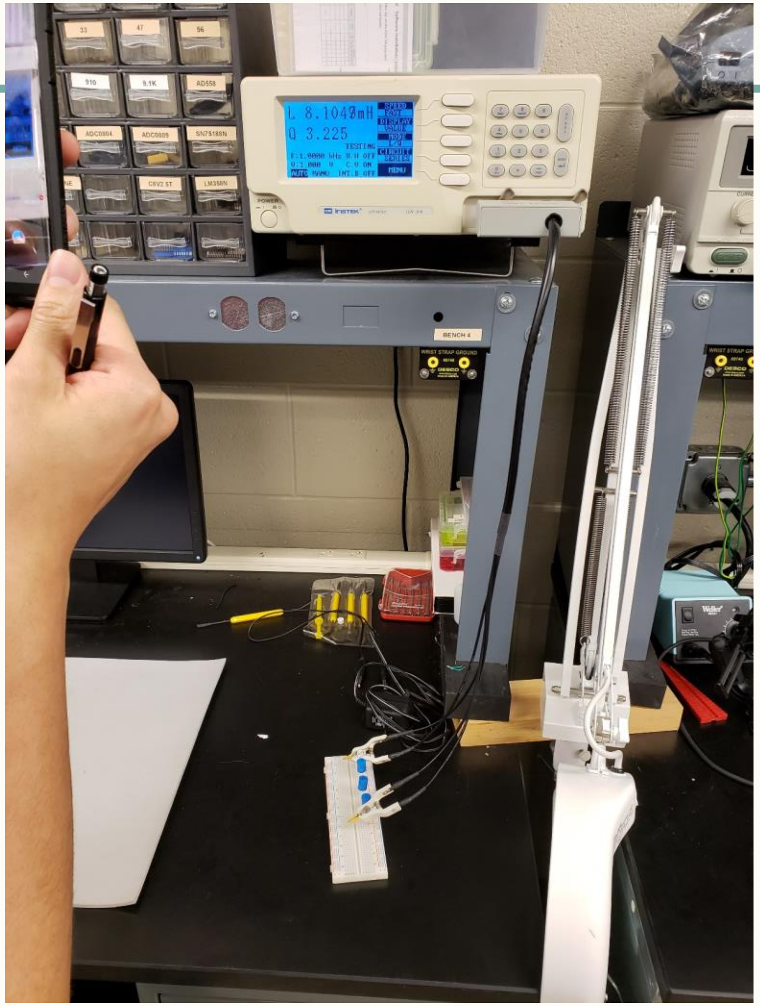
# Lab 12 – Series Inductors



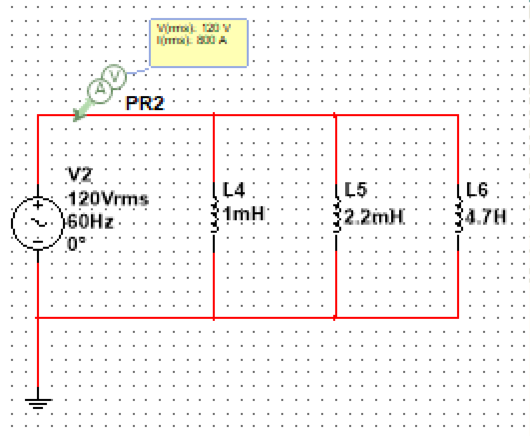

| | Expected | Simulated | Measured |
|---|---|---|---|
| L1 = | 1mH | 1mH | 1.1109 mH |
| L2 = | 2.2mH | 2.2 mH | 2.4901 mH |
| L3 = | 4.7mH | 4.7mH | 5.3772 mH |
| LT = | 7.9mH | 7.9mH | 8.1049mH |

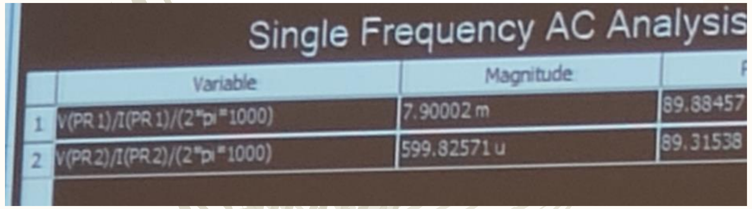
Expected = value you expect it to be



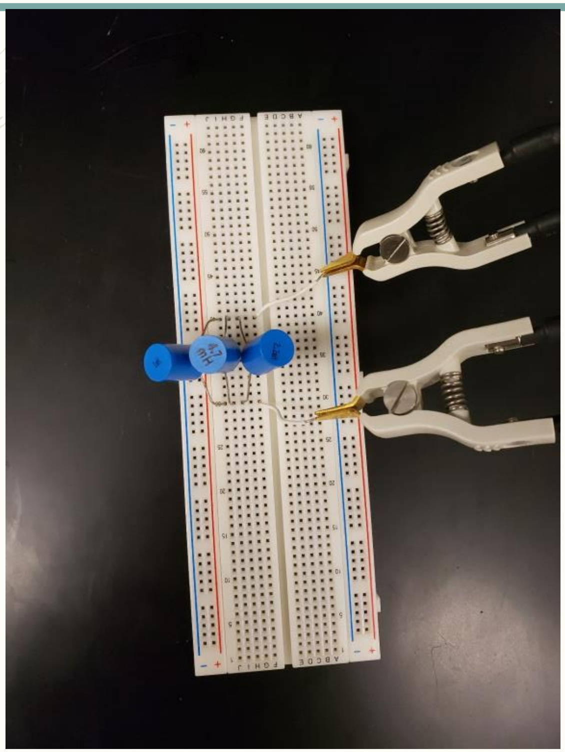
# Lab 12 – Parallel Inductors

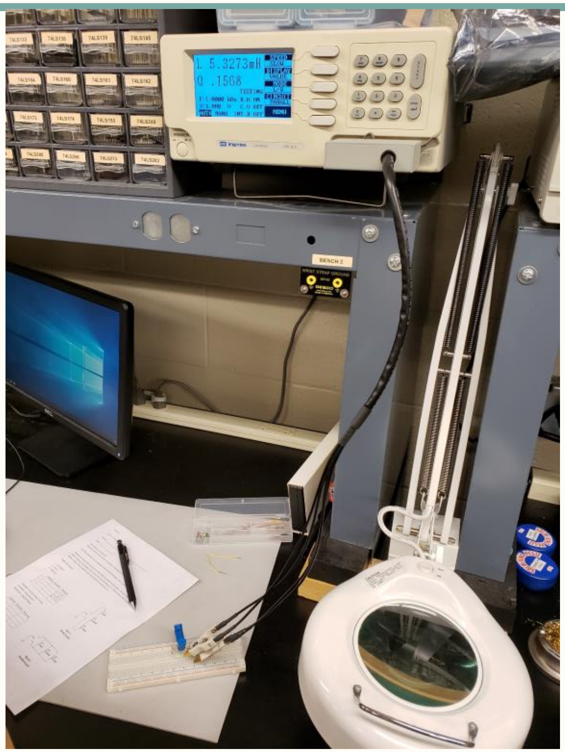


Single Frequency AC Analysis

| | Variable | Magnitude |
|---|---|---|
| 1 | V(PR1)/I(PR1)/(2*pi*1000) | 7.90002 m |
| 2 | V(PR2)/I(PR2)/(2*pi*1000) | 599.82571 u |





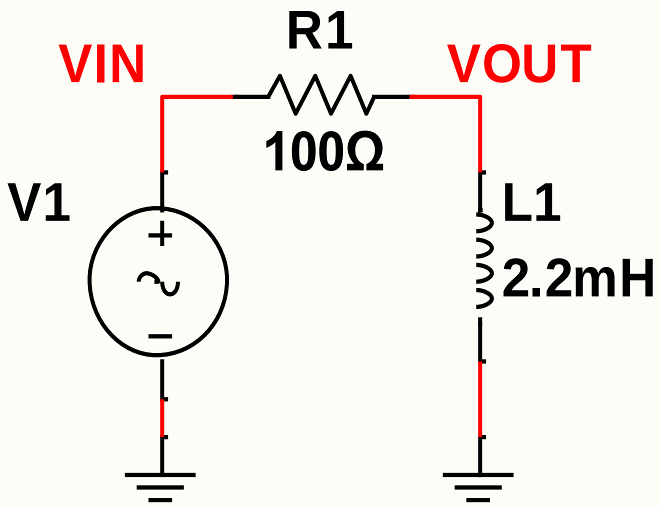
| | Expected | Simulated | Measured |
|---|---|---|---|
| L1 = | 1mH | 1mH | 1.1109mH |
| L2 = | 2.2mH | 2.2mH | 2.4901mH |
| L3 = | 4.7mH | 4.7mH | 5.3772mH |
| LT = | .5882mH | .5882mH | .6583 mH |

Expected = value you expect it to be
Simulated = using Multisim
Measured = using LCR Meter

# Lab 12

- Observations: we were on bench 2 and couldn’t get a proper reading so we cleaned up and moved to bench 4 were our reading were within acceptable (lcr at bench 2 might be bad?)

# Lab 13: RL

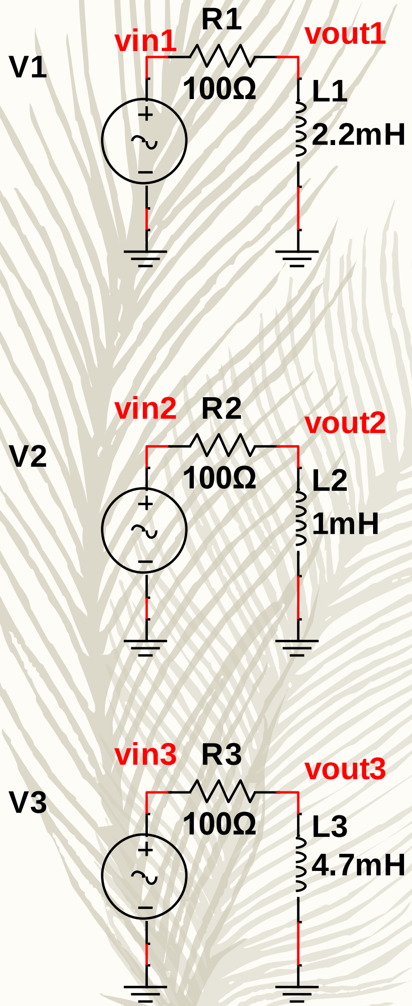


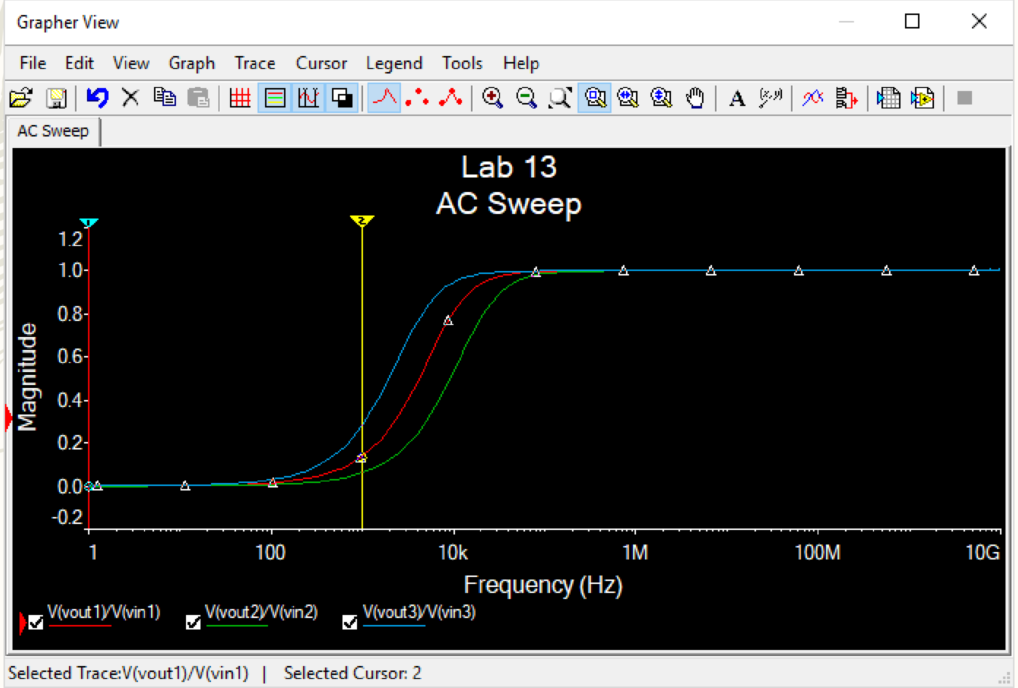
# Lab 13

The purpose of this lab is to:

- Experiment with RL (Resistor & Inductor) circuits.
- The following inductors are needed (1 each of the following): 1mH, 2.2mH and 4.7mH
- Measure and record the resistor value using the DMM and measure and record the inductor values using the LCR meter in Table 1.  Connect the resistor and inductor as shown in Figure 1.  Connect the Function Generator to the input at V1 and connect Channel 1 of the Oscilloscope to the input and Channel 2 to the output. Adjust the voltage of the Function Generator to 1Vpp at the frequencies shown in Table 2. Measure the input and output voltages using the Oscilloscope. Record the results in Table 2.
- Change the inductor and retest.

# Lab 13




Cursor

| | V(vout1)/V(vin1) | V(vout2)/V(vin2) | V(vout3)/V(vin3) |
|---|---|---|---|
| x1 | 1.0000 | 1.0000 | 1.0000 |
| y1 | 138.2301µ | 62.8319µ | 295.3097µ |
| x2 | 1.0000k | 1.0000k | 1.0000k |
| y2 | 136.9281m | 62.7082m | 283.2184m |
| dx | 999.0000 | 999.0000 | 999.0000 |
| dy | 136.7899m | 62.6454m | 282.9231m |
| dy/dx | 136.9268µ | 62.7081µ | 283.2063µ |
| 1/dx | 1.0010m | 1.0010m | 1.0010m |

# Lab 13

| | Output Voltage L = V1 | | | Output Voltage L = V2 | | | Output Voltage L = V3 | | |
|---|---|---|---|---|---|---|---|---|---|
| | Expected | Measured | | Expected | Measured | | Expected | Measured | |
| Frequency | Output Voltage | Input Voltage | Output Voltage | Output Voltage | Input Voltage | Output Voltage | Output Voltage | Input Voltage | Output Voltage |
| 10 | | 1 | 1.3823m | | 1 | 628.3184u | | 1 | 2.9531m |
| 50 | | 1 | 6.9131m | | 1 | 3.1424m | | 1 | 14.7676m |
| 100 | | 1 | 13.8217m | | 1 | 6.2831m | | 1 | 29.5181m |
| 200 | | 1 | 27.6435m | | 1 | 12.5690m | | 1 | 58.9761m |
| 300 | | 1 | 41.6184m | | 1 | 18.9308m | | 1 | 88.6324m |
| 400 | | 1 | 55.2391m | | 1 | 25.1392m | | 1 | 117.3716m |
| 500 | | 1 | 68.9676m | | 1 | 31.4083m | | 1 | 146.1051m |
| 600 | | 1 | 83.0041m | | 1 | 37.8350m | | 1 | 175.1426m |
| 700 | | 1 | 96.9248m | | 1 | 44.2284m | | 1 | 203.5589m |
| 800 | | 1 | 110.0026m | | 1 | 50.2445m | | 1 | 230.0686m |
| 900 | | 1 | 124.2148m | | 1 | 56.8233m | | 1 | 258.1229m |
| 1,000 | | 1 | 136.9281m | | 1 | 62.7082m | | 1 | 283.2184m |
| 2,000 | | 1 | 266.510m | | 1 | 124.7168m | | 1 | 508.5581m |
| 3,000 | | 1 | 383.9364m | | 1 | 185.9628m | | 1 | 662.6728m |
| 4,000 | | 1 | 483.9226m | | 1 | 243.8504m | | 1 | 763.0938m |
| 5,000 | | 1 | 568.5790m | | 1 | 299.7700m | | 1 | 827.9097m |
| 6,000 | | 1 | 638.1098m | | 1 | 353.6427m | | 1 | 869.6466m |
| 7,000 | | 1 | 694.2925m | | 1 | 403.7256m | | 1 | 898.6093m |
| 8,000 | | 1 | 741.5209m | | 1 | 449.2035m | | 1 | 920.7403m |
| 9,000 | | 1 | 777.7795m | | 1 | 492.9159m | | 1 | 934.6899m |
| 10,000 | | 1 | 810.2139m | | 1 | 532.0180m | | 1 | 947.1682m |

RL Frequency Response

Expected = value you expect it to be

Measured = Using Oscilloscope

Observations: In multisim be sure to have the capacitors value corrected if you copy and paste the first circuit built.