Walkthrough Videos for EE-2049 Remote Version

1. Resistance measurements:

https://youtu.be/AXVbaL-Et9Y

2. O-Scope and Function Generator

https://youtu.be/Vss1DooaFN4

3. Low Pass Filter

https://youtu.be/i0qvTLsPxBc

4. Circuit Simulations

https://youtu.be/P4N-QpX74Js

5. Basic Divider Rules

https://youtu.be/dKAl6jEWgAU

6. KVL and KCL

https://youtu.be/_Z83rfTc1Dc

7. Two Power Supply Functionality of ADALM

https://youtu.be/tAfRyfDbYUs

8. Intro to Electrical Resonance and Q Factor

https://youtu.be/WGNUzehiN7A

Technology Resources

Resources for ADALM1000

https://www.analog.com/en/design-center/evaluation-hardware-and-software/evaluation-boards-kits/adalm1000.html#eb-overview (https://www.analog.com/en/design-center/evaluation-hardware-and-software/evaluation-boards-kits/adalm1000.html#eb-overview)

Good starting video if you need it:

https://www.analog.com/en/education/education-library/videos/4865877204001.html (https://www.analog.com/en/education/education-library/videos/4865877204001.html)

Link to PixelPulse:

https://wiki.analog.com/university/tools/m1k/pixelpulse (https://wiki.analog.com/university/tools/m1k/pixelpulse)

Simulation Software Resources

PSpice at CSULA

If you are able to access a CSULA computer using this link, it may be much easier to use the PSPice interface to design and solve your circuits. (These are all windows machines, so Mac users cannot use this feature without some serious workarounds)

https://remoteaccess.labstats.com/calstatela-ecst (https://remoteaccess.labstats.com/calstatela-ecst)

If you are able to connect that way, please follow these instructions because the software is VERY finicky about how you use it:

1. Choose **Capture CIS** from desktop or by searching for the application
2. Create Folder
3. New Project
4. Create a Blank Project
5. In "Place" menu on upper toolbar, choose PSpice Component and build circuit
6. Change values of circuit elements by selecting the element with the arrow tool from the right tool bar and editing the element's parameters.
7. In "PSpice" menu on upper toolbar, choose New Simulation Profile.

8. Name your simulation
9. Select your simulation parameters (time, type, etc. usually just do nothing here for DC circuit)
10. Apply and hit OK
11. In the "PSpice" menu on the upper toolbar select Run
12. Set voltage or current markers in the proper locations and watch the results on the black graph that will pop up somewhere on your computer after you have Run the simulation.

LTSpice resources

Here is another option for simulating circuits:

https://www.analog.com/en/design-center/design-tools-and-calculators/ltspice-simulator.html (https://www.analog.com/en/design-center/design-tools-and-calculators/ltspice-simulator.html)

Getting started with LTSpice:

https://learn.sparkfun.com/tutorials/getting-started-with-ltspice/all (https://learn.sparkfun.com/tutorials/getting-started-with-ltspice/all)

CircuitLab

This one costs a little money, but it is much easier to use for what we will be simulating in this class, and it is all online:

https://www.circuitlab.com/ (https://www.circuitlab.com/)

Resistance Measurements with ADALM1000 Lab Report

Published

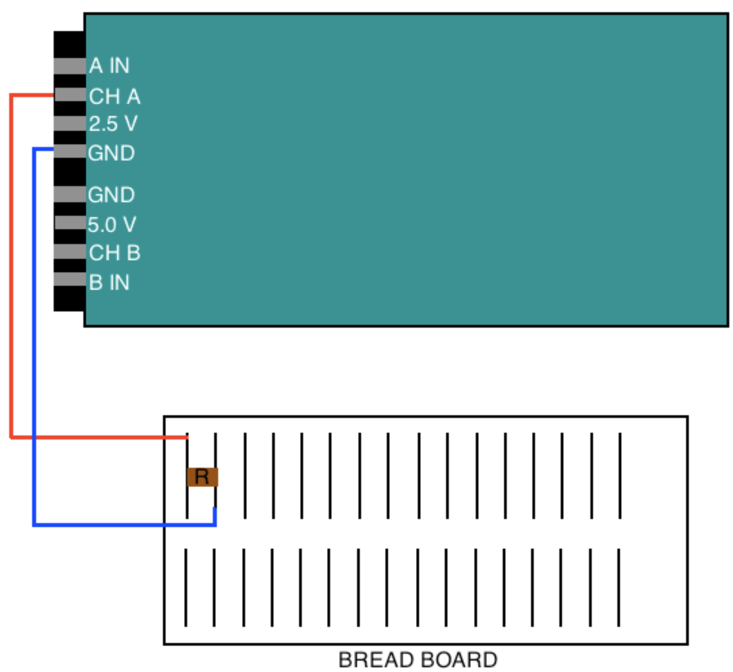
Experiment Instructions

PART A

1. Identify the resistors included in the ADALP2000 Analog Parts Kit by their appearance and or color stripes. Note that some of the color stripes are very hard to determine with this set.

2. Organize your resistors the best way you can. I found some little plastic baggies and labeled them each with the proper value and keep the resistors in these, but that is just me.

3. Place each of your resistors (one at a time) from 1.1 Ohms to 4.7 kOhms into your bread board and measure the current that is drawn through them when you source a desired voltage. (Input voltage comes out of the CH A or B pin, and the output goes to the respective GND) From the current drawn, and the voltage supplied, you will calculate the resistance. **Important! The ADALM1000 can take a max current of 0.2 amps, so make sure you do not use too much voltage if you have a small resistor (i.e. the 1.1 Ohm). On the other hand, you will also notice that you need a certain amount of voltage to get a good reading. It is a balancing act. It is probably best to use channel B, because you can source up to 5V from it.**

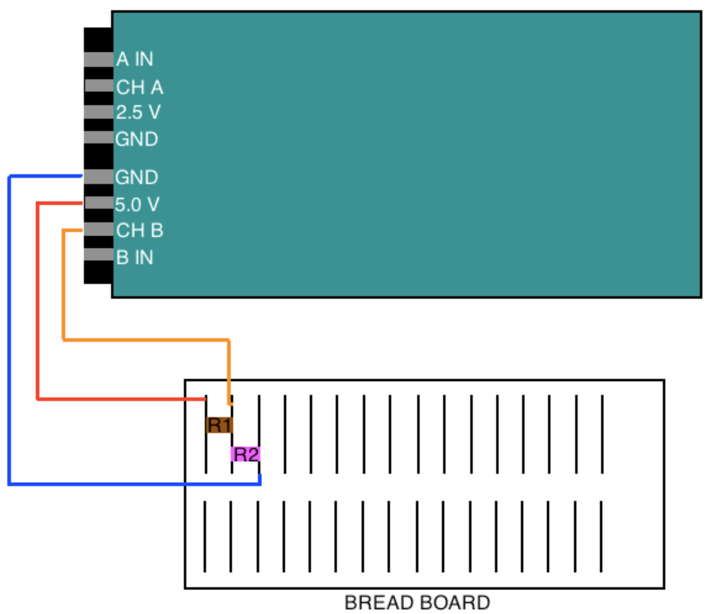


4. Calculate the percent difference between the calculated resistance (from v=i/r) and the listed nominal resistance for each one. *(Note: It is not required, but I highly recommend picking up a digital Ohm meter from Home Depot or some other hardware store, or online. It will make measuring circuits sooo much easier for you in this class and in your future. You should just have one in your tool box as an EE anyway. However, if you have one, do not use it in place of the ADALM1000 for these measurements , because the point of this lab is to show the very limitations of the ADALM1000. But feel free to use it to identify your resistors out of the box. So much easier than trying to see the colors of the stripes in my opinion.)*

PART B

1. Build a voltage dividing circuit with two resistors on your breadboard. The first resistor (connected to the input voltage) should be the 1k Ohm and the second should be the 1.5k Ohm.

2. Set up your ADALM1000 to measure voltage (not sourcing anything. Put the input into the 5V pin and the output to GND. Connect a third probing wire to the CH B pin. That is the probe you will use to measure the voltage with respect to ground, i.e. put it in between the two resistors.)



3. Use voltage division to determine the value of resistor 2 based on the voltage you measure across it.

4. Calculate the percent difference between the nominal value for resistor 2 and the calculated value.

5. Now remove the 1k Ohm resistor, move the 1.5 k Ohm resistor to position 1, and place the 2.2kOhm resistor in position 2.

6. Repeat steps 2-4

7. Keep moving the measured resistor into position one and replacing it with the next highest resistor in your kit until you have completed steps 2-4 for all of the remaining resistors.

PART C

1. Install the variable resistor (blue box with white dial that can be turned with included screwdriver) onto your bread board.

2. Place 5 volts across it from your ADALM1000

3. Measure the voltage with respect to ground for pin 1, pin 2 and pin 3 in three configurations each. 1. Full CCW, 2. Turned so line is Vertical (half way turn), and 3. Full CW. That's a total of 9 measurements.

Report Requirements

1. Cover page with title and your name at least

2. Abstract briefly stating what you did and a few interesting observations you made. Please write in a professional manner.

3. Brief paragraph describing your procedure for part A. Discuss the limitations of this method for measuring resistances. *(always avoid statements like 'first I had to, and then I was supposed to..', instead pretend that the experiment was your idea and that you are interested in sharing your results.)*

4. Table of all data for part A.

Color Bands on Resistor	Voltage across circuit	Current Drawn	Calculated Resistance	Nominal Resistance	Percent Difference

5. Description under that table describing the results for the reader.

6. One sample calculation from part A *(always use equation editor, not handwritten)*

7. Brief paragraph describing your procedure for part B. Discuss the limitations of this method with respect to the difference between the two resistors.

8. Table of all data for part B.

Color Bands on Test Resistor (R2)	Dividing with Known Resistor (R1)	Voltage In	Voltage Drop Across R2	Calculated Resistance of R2	Nominal Resistance of R2	Percent Difference between Calculated and Nominal	Percent Difference between the nominal values of the two resistors [(R2-R1)/R1]*100%

9. Description under that table describing the results for the reader.

10. One sample calculation from part B.

11. Brief paragraph describing your procedure for part C.

12. Table of all data for part C.

Variable Resistor Pin	Voltage Across	Voltage full CCW	Voltage Full CW	Vertical Position Voltage

13. Description under that table describing the results for the reader. Mention how you would use the variable resistor in a circuit and which pin controls the value of the resistance, and the function of the other pins.

14. A summarizing paragraph that discusses the limitations of the ADALM1000 for measuring resistance. Some solutions to those limitations, and the limitations of those solutions.

See the sample lab report in the syllabus for formatting recommendations.

Points 100

Submitting a file upload

Due	For	Available from	Until
Sep 24, 2020 at 6:57pm	Everyone	-	-

ADALM1000 Oscilloscope and Function Generator Capabilities Lab Report

Published

Experiment Instructions

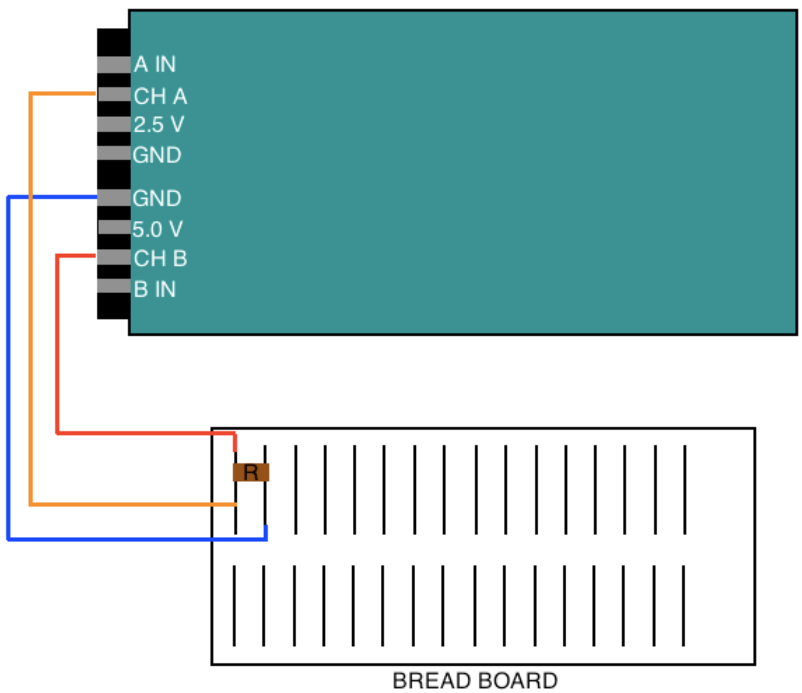
PART A

1. Build a simple 1k Ohm resistor circuit in your breadboard. Connect the CH B to the input of your resistor and connect the output of your resistor to GND.

2. Set up Pixelpulse to source Voltage on Ch B, and read Voltage on Ch A.

3. Change the Voltage on CH B to a Sine wave. Adjust the amplitude to 3V, and the frequency to 100 Hz.

4. Connect a probe from the CH A pin of your ADALM1000 to the start of your circuit.



5. Take data for

   a. Peak to peak voltage by looking at the amplitude graphically

   b. The peak to peak value number that the interface shows you on CH A

   c. The RMS (AC) value that the interface shows

d. The (roughly determined) measured frequency by using the time difference between your measured peaks. Include some margin of error.

6. Repeat this procedure for all of the other wave form shapes available (Triangle, Saw, Stair and Square)

PART B

1. Return the CH B output to a sine function. Again with 3V output (p2p) and 100Hz frequency.

2. Stop the power and then run again for a few seconds.

3. Export that data to excel

4. Verify that the RMS reported by the ADALM1000 agrees with your exported data by performing the following mathematical analysis:

$$RMS = \sqrt{\frac{\sum_i^N {x_i}^2}{N} - \left(\frac{\sum_i^N x_i}{N}\right)^2}$$

which tells us to take the square root of the difference between the average of the squares of the data and the average of the data not squared.

5. Repeat steps 1-4 for all of the other wave-forms (and note that RMS depends on the function).

PART C

1. Return the CH B output to a 3V p2p 100 Hz sine function.

2. Go to settings (the cog icon) and change your sample time to 10 ms

3. Do the same for 100 ms, 1 s , and 10 sec sample rates.

4. Take screen shots of the waveform displayed for each sample rate.

Report Requirements

1. Cover page with title and your name at least

2. Abstract briefly stating what you did and a few interesting observations you made. Please write in a professional manner.

3. Brief paragraph describing your procedure for part A.

4. Table of data for part A.

5. A screen shot or two would be nice as well. Not too large, format them to fit nicely in your report.

6. Always include descriptions beneath tables and figures.

7. Brief description of procedure for part B.

8. Table of data for part B that compares the recorded RMS with the calculated RMS from your data points. Include percent difference. I don't need to see all of your data points.

9. Include a sample calculation for the RMS of a couple of the different wave forms.

10. Always include descriptions for tables, figures,...and formulae! :)

11. Brief description of your procedure for part C.

12. Images of all of the runs from part C. Make them small enough so that you can see them all on the same page for comparison.

13. Description beneath those images that summarizes what we see and discusses why they look different and what that means for you when, as an engineer, you are determining the sample rate you want to employ while taking a measurement.

14. Brief conclusion discussing the limitations of using the ADALM1000 as an Oscilloscope.

See the sample lab report in the syllabus for formatting recommendations.

Points 100

Submitting a file upload

Due	For	Available from	Until
Sep 28, 2020 at 11pm	Everyone	-	-

Determining Properties of a Low Pass Filter using ADALM1000 Lab Report

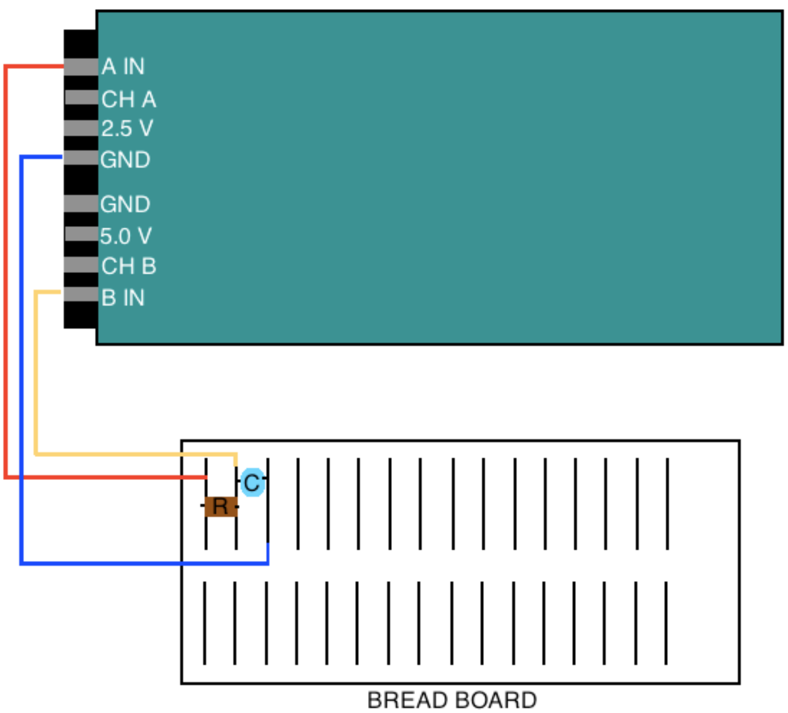
Published

Experiment Instructions

PART A

1. Construct a simple low pass filter on your breadboard. Use a 470 Ohm resistor in series with the 1 micro Farad blue cylindrical capacitor (resistor first and then the capacitor feeding to the output). You can read the value for the capacitance on the side of the cylinder.

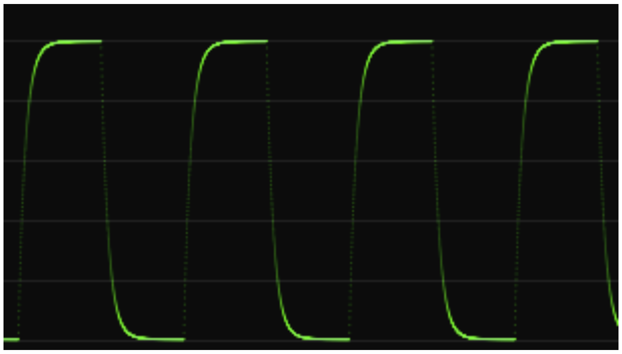
2. Connect the input of your circuit to A IN and connect the output to ground. Connect a probe wire with one end at the input of your capacitor and the other end connected to B In.



3. Open PixelPulse and set channel A to Source Voltage and Read Current. Set Channel B to measure Voltage. Set the output voltage of Channel A to be a Square Function with an amplitude of 2.5 V peak to peak, and a frequency of 100Hz.

4. Run the power by clicking the play symbol.

5. You should expect an output in Channel B that looks like this...



6. If you do not see a similar shape, change the capacitor for a different one until you do.

7. Export your ADALM1000 scope data to excel.

8. From your data, determine the amount of time it takes for your voltage to ramp up from the minimum amount to 63.2% of the maximum possible (2.5 V). It is important to know that the data you export is sampled once every 10 micro seconds. This means that 10^{-6} seconds elapses between each data point. So that if you count, for example, 20 cells of data to go from one value to another then 200 microseconds elapsed between those data.

9. Make a table for yourself that looks something like this to keep things organized:

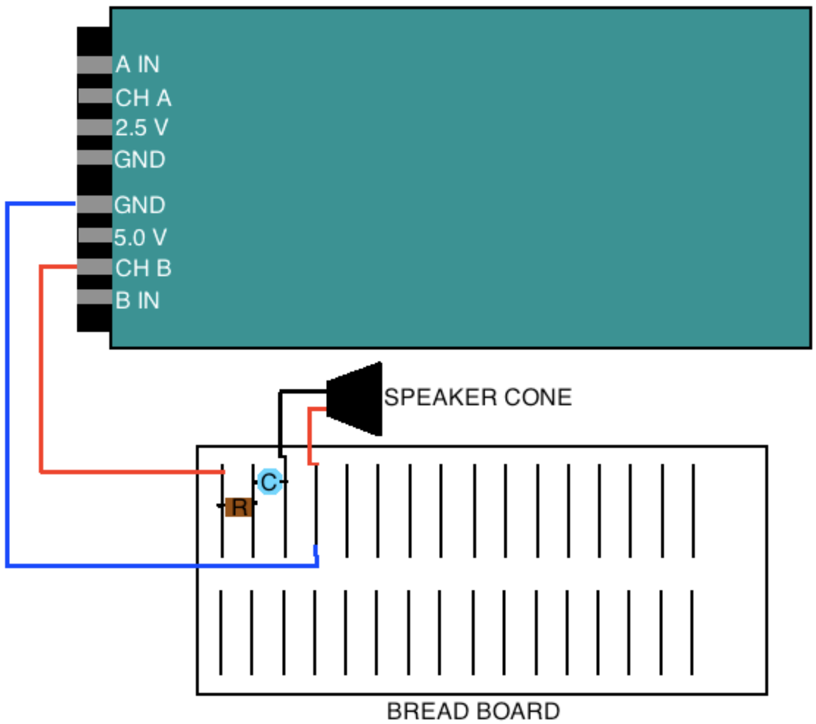
Known Resistor (Ohms)	Input Voltage Peak to Peak Amplitude (V)	Input Frequency (Hz)	Nominal Capacitance Value (F)	Time to 63.2% of Max Voltage (s)	Expected Value for Time Constant of Filter	Observed \

10. Take your data and repeat the experiment for 5 different combinations of resistors and capacitors. So, build 5 different Low Pass filters and determine the parameters in the table for each one.

PART B

1. For one of your low pass filter circuits, connect the speaker that comes in your kit in series between the capacitor and ground.

2. Connect the input of your circuit (which now goes: resistor-capacitor-speaker-ground) to CH B.



3. Set pixelpulse to output voltage and measure current on channel B. Do not worry about channel A in this part.

4. Set the output voltage to a Square Function with an output voltage of 5V peak to peak and an output frequency of 100Hz. Let the power enter your circuit.

5. Note the tone you should be hearing now. If there is no tone, maybe try stopping and restarting the software or try a different low pass filter combination.

6. Take data of the measured current in Channel B as you change the frequency to:

200, 300, 400, 500, 600, 700, 800, 900, 1000, 2000, 4000, 8000, 16000, and 20000 Hz.

Report Requirements

1. Cover page with title and your name at least

2. Abstract briefly stating what you did and a few interesting observations you made.

3. Brief paragraph describing the properties of a low pass filter and possible applications of low pass filters.

4. Brief paragraph describing procedure for part A.

5. Show and explain, with an equation or two, why we use the rise time to 63.2% of max Voltage output for determining the RC time constant of a simple low pass filter.

6. Table of your observations from part A with a description beneath the table.

7. Brief paragraph explaining procedure for part B

8. Show and explain with an equation or two what we expect to observe in the output of a low pass filter as the signal frequency increases.

9. Describe what you observed, and support your observations with a plot of the current measured as function of the input frequency.

10. Include a description beneath the plot.

11. A nice conclusion summing everything up, including limitations of the ADALM1000 for this type of experiment.

See the sample lab report in the syllabus for formatting recommendations.

Points 100

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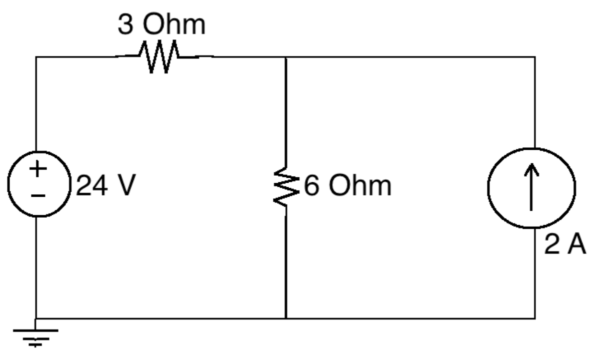
Due	For	Available from	Until
Oct 6, 2020 at 11pm	Everyone	-	-

Using a Simulation to Analyze a Circuit Lab Report

Published

This experiment is very short and straight forward, and is mostly so you can get a handle on the simulation software you will use for further experiments.

1. Using your simulation software of choice, please build this virtual circuit



2. Calculate, by hand, the voltages across each resistor and the current magnitude and direction through each resistor.

3. Run your simulation and gather the same information from 2 (voltages and current for each resistor).

4. Take some screen shots of your output for including in your report.

Report Requirements

1. Cover page with title and your name at least

2. Abstract briefly stating what you did and a few interesting observations you made.

3. Brief paragraph describing the step by step method you devised for building your circuit in the simulator and testing it.

4. Screen shot of your simulation circuit with a description below.

5. Table of data including the values of the voltages across and current through each resistor you calculated by hand along with the values determined by your simulation software.

6. Screen shots of the simulation output data with descriptions below.

7. A conclusion paragraph discussing the benefits and drawbacks of using a simulation to analyze a circuit.

See the sample lab report in the syllabus for formatting recommendations.

Points 100

Submitting a file upload

Due	For	Available from	Until
Oct 13, 2020	Everyone	-	-

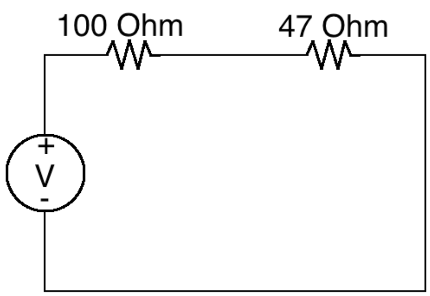
Basic Circuit and Divider Rules Lab Report

Published

Procedure

Part A

1. Build the following circuit on your bread board. Use CHA for the output of your power supply and use GND for the return.



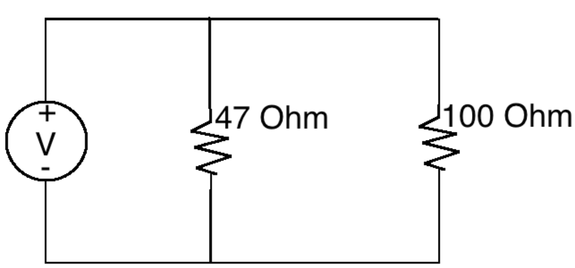
2. Calculate the theoretical total series resistance of the circuit.

3. Measure the total resistance using Ohm's law and the current that is drawn through the resistors for your given voltage. CHA can give up to 2.5 volts of output, use what you wish for the best measurement. Just set up CHA on PixelPulse to 'source voltage and measure current'. The current will be measured through the GND port. No extra wires needed.

4. Repeat the experiment using CHB as the output channel.

Part B

1. Build the following circuit on your bread board. Use CHA for the output of your power supply and use GND for the return.



2. Calculate the theoretical total parallel resistance of the circuit.

3. Measure the total parallel resistance using Ohm's law and the total current that is drawn through the circuit for your given voltage. CHA can give up to 2.5 volts of output, use what you wish for the best measurement. Again, the ADALM1000 will take current into the GND port and PixlePulse will show you the value.

4. Repeat the experiment using CHB as the output channel.

Gather data for all values (V, I R, nominal, calculated, measured, etc)! Basically, if it has a value attached to it, write it down for further use.

Report Requirements

1. Cover page with title and your name at least

2. Abstract briefly stating what you did and a few interesting observations you made.

3. Brief paragraph describing your procedure for part A. Do not copy the procedure. Write what you did and why.

4. Picture of your actual circuit with a description below.

5. Table of data for Part A including:

Individual Nominal resistor values, Voltage used, Calculated current drawn, Measured Current Drawn, Calculated series resistance, Measured Series resistance (from measured current), percent differences for current (calc v meas) and resistance (calc v meas)

6. Brief paragraph describing your procedure for part B.

7. Picture of your actual circuit from part B with a description below.

8. Table of data for Part B including:

Individual Nominal resistor values, Voltage used, Calculated current drawn, Measured Current Drawn, Calculated Total Parallel resistance, Measured Total Parallel resistance (from measured current), percent differences for current (calc v meas) and resistance (calc v meas)

9. A conclusion paragraph summarizing the results.

See the sample lab report in the syllabus for formatting recommendations.

Points 100

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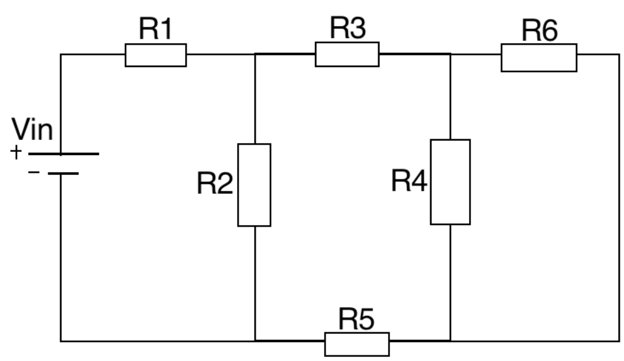
KVL and KCL Lab Report

Published

Procedure

Part A

1. Analyze this theoretical circuit using Kirchhoff's Laws for Voltage and Current to determine the voltage drop across each resistor. Take each odd resistor (R1, R3, R5) to have a value of 47 Ohms, while the even resistors (R2, R4, R6) will be 100 Ohm resistors. Use a Vin of 5 Volts for your theoretical power supply.



PART B

1. Build the circuit from part A onto your breadboard. This is a little more complicated compared with the circuits you have constructed thus far in this class, but if you make sure that the ends of your resistors are sharing the proper voltage row on your board you will have done it correctly.

For example, from the schematic in part A you can see that the Power is connected to the top of R1, this means that the power and the top of R1 must be connected to the same row on your breadboard. Next, you see that the bottom of R1 connects to the tops of R2 and R3. This means that the bottom of R1 must be on the same row as the tops of R2 and R3 in your breadboard assembly. The point is that your breadboard circuit will not look like the schematic, but it will be equivalent in terms of operation.

Continue to connect all of your resistors in this way until the circuit is complete, and then be sure that the ground wire (represented by the negative pole of your power supply in the schematic) is connected to the same row that the bottoms of R2 and R5 are connected to.

2. Now energize your circuit by connecting the power in wire to the 5V pin of the ADALM1000, the ground wire to GND, and your USB cable from the ADALM1000 to your computer. Run

PixelPulse to simply measure voltage on Channel B. You do not need to source any voltage or current.

3. Now measure the voltage in each occupied row of your breadboard by probing the row with a wire that is connected to CH B (or B IN) on your ADALM1000. That is the voltage of that row with respect to ground.

4. Make a neat schematic of your breadboard showing all of the resistors in their proper locations. You can do this by hand if it is neat, if not use a drawing program like paint or something else to make it clear.

5. Label each resistor with R1, R2, R3...etc along with the nominal resistance value (either 47 or 100 Ohms)

6. Label each row with a number 1,2,3,4,... (these do not necessarily correspond to the resistor numbers. these are just row numbers).

7. Show the voltage you measured for each row in a table.

8. Show the subtraction you must do between specific rows to find the voltage drop across that specific resistor. For example, if R3 is connected from row 2 (top) to row 4 (bottom), then the voltage drop across R3 would be the voltage on row 2 minus the voltage on row 4.

Lab Report Requirements

1. Cover page

2. Brief intro explaining how to use KVL and KCL to analyze a circuit.

3. Sample of your calculations from Part A (with description beneath explaining what you did)

4. Table of calculated voltage drops across each resistor in the circuit (with description beneath explaining the results and the method used to find them)

5. Photo of the circuit you build (with description beneath explaining why you constructed it the way you did.) It would be really nice if you could label the resistors in the image with an arrow and their name/value. You could do this by importing you photo into some paint program or powerpoint and working from there to make it look really nice. This will be one of the important things I look for in this report.

6. Show the diagram you made of your breadboard with all of the measured voltages for all of the rows labeled. (include a description that explains how you found those values.) If you want to use another photo instead of a diagram, that is fine, as long as you label the rows and the voltages you measured.

7. Show all of the calculations used to find the voltage drops across each resistor. (with

description of why this is how you find the voltage drops)

8. A table comparing the calculations from part A with the results of part B, including percent difference. (with description discussing the low or high percent error you found. If it was very high for your tastes, then just explain why that was the case.)

9. Short conclusion.

Points 100

Submitting a file upload

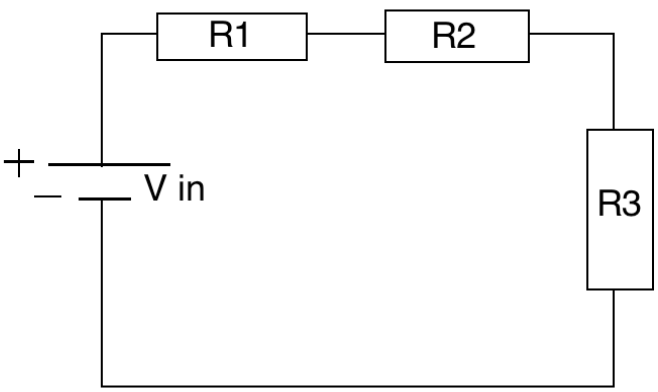
Due	For	Available from	Until
Oct 27, 2020	Everyone	-	-

Voltage Division Lab Report

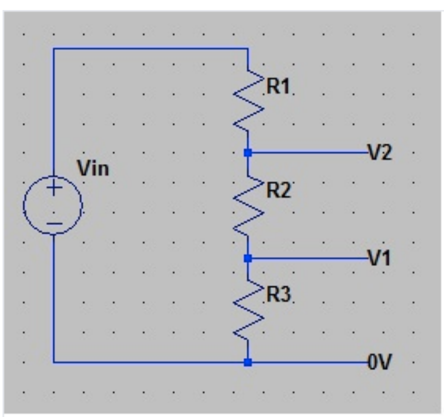
Published

Procedure

1. Build this circuit on your breadboard, using the 5V pin of your ADALM1000 for your input voltage, the GND pin for your return, 47 Ohms for R1, 100 Ohms for R2, and 470 Ohms for R3. When you run your circuit with Pixelpulse, use 'Measure Voltage'.



2. Use the voltage division equations



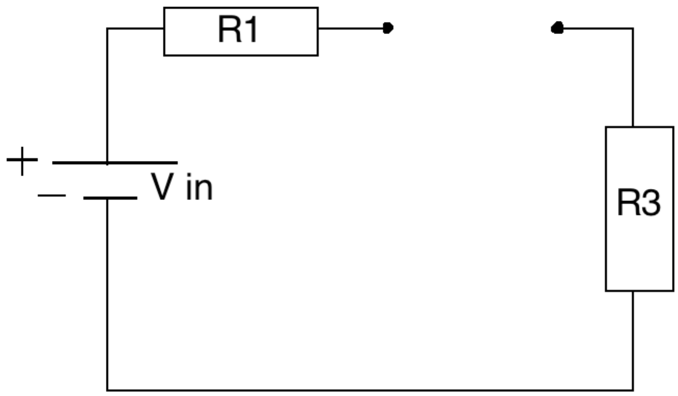
$$V2 = \frac{R2 + R3}{R1 + R2 + R3} * Vin$$

$$V1 = \frac{R3}{R1 + R2 + R3} * Vin$$

to predict the voltages you will measure at the nodes labeled V2, V1 and 0V in that picture.

3. Measure the voltages at those nodes on your breadboard with a probe to BIN.

4. Now remove R2 from your breadboard, but do not change the other resistors locations or configurations at all so that you have an open circuit that looks like this



5. Using the same image and formulas from step number 2, predict your new voltages for those same nodes on your breadboard. Imagine that your R2 is now replaced by the open circuit. What is the theoretical resistance of an open circuit? That should help you calculate.

6. Measure V2, V1 and 0V again.

Lab Report Requirements

1. Coverpage

2. Brief paragraph where you explain voltage division and then use KVL (or whatever method you prefer)to derive the equations shown in step 2 of the procedure above.

3. A picture of your circuit with a description.

4. A table that compares the calculated values compared with the measured values from steps 2 and 3. include a description explaining the procedure you used to obtain the values.

5. A table that compares the calculated values compared with the measured values from steps 5 and 6. include a description explaining the procedure you used to obtain the values.

Points 100

Submitting a file upload

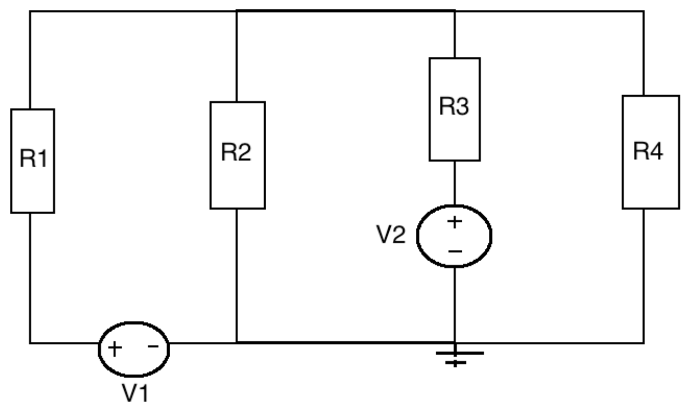
Due	For	Available from	Until
Nov 3, 2020	Everyone	-	-

Two Power Supply Circuit with ADALM1000

Published

Procedure

1. Analyze this circuit using any method you wish to determine the theoretical voltage drops across each resistor.



(use R1 = 47 Ohms, R2 = 68 Ohms, R3 = 470 Ohms, and R4 = 100 Ohms)

(use V1 = 2.5V and V2 = 5V).

2. Now build that circuit on your breadboard. Use the 2.5V pin for the supply(+) voltage V1, use the 5V pin for the supply(+) voltage of V2. Connect one jumper wire to the GND pin for the ground. Either GND pin will work. This is also the - or return voltage.

3. Probe the four nodes on your breadboard and measure their voltages with a jumper wire from the row you are measuring to CH A. (You only need to be in 'Measure Voltage' mode and press play to energize the circuit)

4. As in the previous experiments, subtract the voltages measured on the rows to determine the measured voltage drops across the respective resistors.

Lab Report Requirements

1. Coverpage

2. Your analysis steps and results for calculating the voltage drops

3. A picture of your circuit with description.

4. Table of results comparing calculated to measured voltage drops including percent differences.

5. Conclusion discussing using an ADALM1000 to build a two power supply circuit. Discuss limitations.

Points 100

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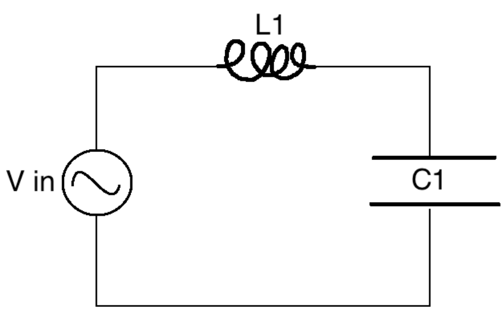
Due	For	Available from	Until
Nov 10, 2020	Everyone	-	-

Resonant Circuit Lab Report

Published

Procedure

1. Build this circuit on your breadboard. This is a series LC circuit. Use the Inductor labeled '103' from your kit for L1, and use the 1 micro farad capacitor for C1. The inductors look like black cylinders with copper wire coiled around them.



Calculate the expected resonant frequency for the circuit using

$f = \frac{1}{2\pi\sqrt{LC}}$, where both the L and the C are under the root. Remember that mH is milliHenrys, and the capacitor is in micro Farads, so use the correct decimals.

2. Connect Channel B to the 'top' of the inductor, and connect the 'bottom' of the capacitor to your ground channel.

3. Set up your pixelpulse to Source Voltage and Measure current on channel B.

4. Set the output waveform to Sine Wave

5. Set the output voltage to 5V

6. Press play and gather data for the RMS Current measured in CH B as a function of frequency.

Gather a data set for frequencies 100Hz through 3000Hz stepping up by 100 Hz each time. This is approximately 30 data points, but please take your time. Be sure to listen carefully to your circuit when making measurements around the resonant frequency you calculated. What do you hear? Why?

7. Make a plot of your data that is neat and properly labeled on the axes.

8. Find the center of the peak in your plot, either by eye or with a fit.

9. Try to measure the width of your peak (this is in units of Hz). It can be found by measuring the

FWHM. This is the full width of your peak at half of the maximum value. Call this value Δf

10. Make a table that compares the expected resonant frequency with the measured value (location of center of peak), and the percent difference. Also calculate what the value of the inductor would actually be if the resonant frequency you calculated before was actually what you measured. In other words, plug the experimental value for f into this equation $f = \frac{1}{2\pi\sqrt{LC}}$, and solve for L, keeping C what it was before. Give the percent difference between this calculated L and the nominal value. Put that in the table as well.

11. Finally, calculate $\frac{f}{\Delta f}$, where f in the numerator is the resonant frequency you measured and delta f is the FWHM. This is known as the Q for your circuit and is a measure of how much energy your circuit is dissipating over time. It is unitless. High Q means low energy dissipation. Low Q means lots of energy is lost. What is the Q for your circuit? What do you think would happen if you added a resistor to your circuit. Would your Q increase or decrease?

Lab Report

Write the best report you can based on everything you did here. Include tables, pictures, graphs and equations. You have had lots of practice so I don't want to tell you how to do this one. Freestyle! But be sure to talk for a little bit about resonance, induction and dissipation (Q) either at the beginning or end of the paper.

Points 100

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Nov 17, 2020	Everyone	-	-