Lab 44

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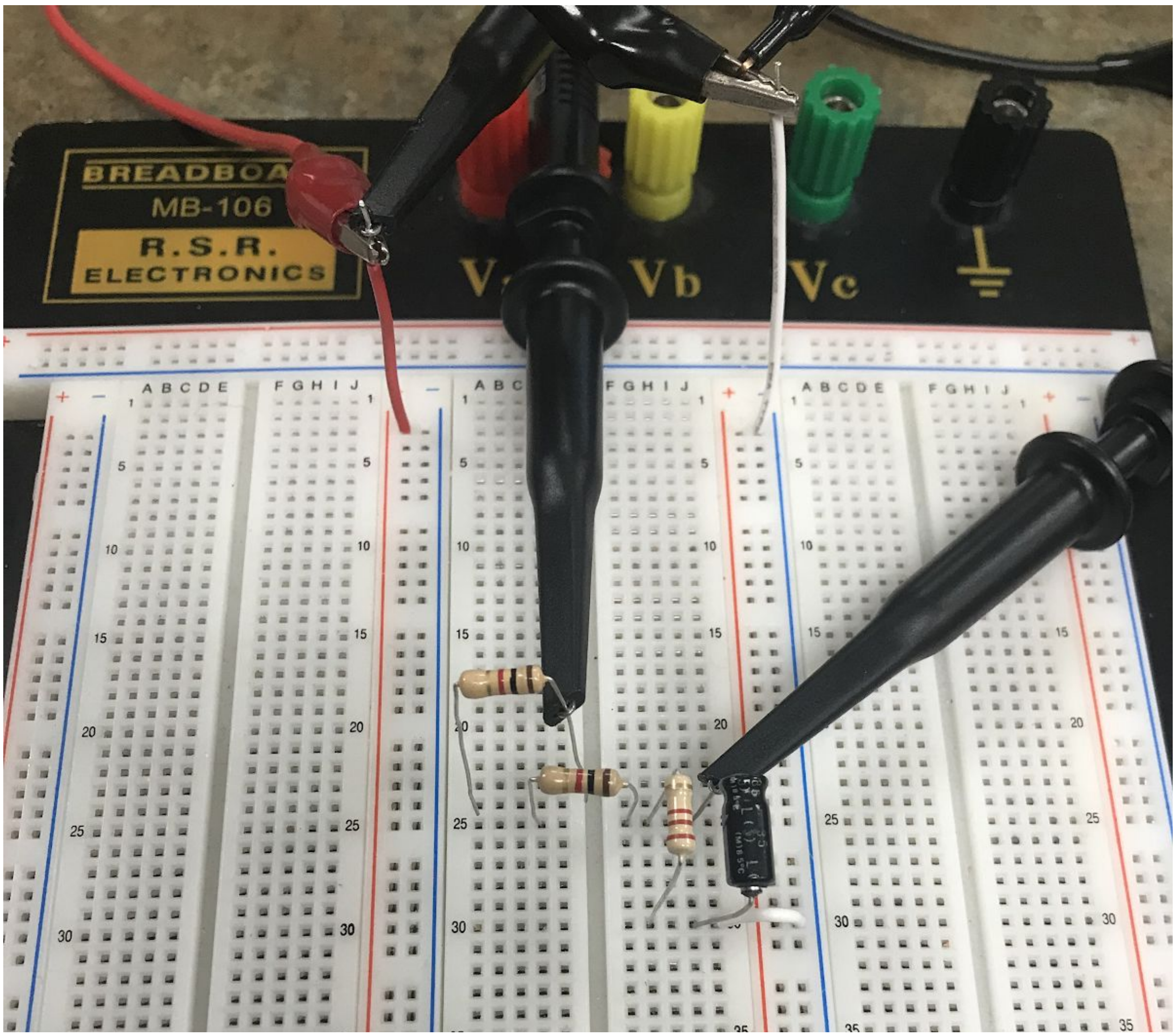


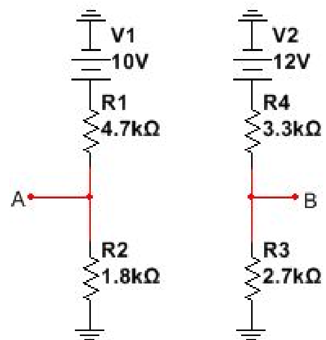
Lab 44

Objective: In this lab a sinusoidal waveform with a non-zero volt reference voltage will be observed as well as observing the effects of coupling and bypass capacitors.

Materials:

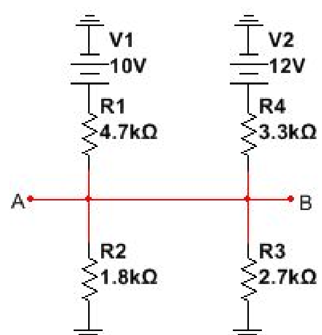
- 0-20 volt variable power supply
- Dual-trace oscilloscope
- Digital multimeter
- 2-1 KΩ resistors
- 1.8 KΩ resistor
- 2.2 KΩ resistor
- 3.3 KΩ resistor
- 4.7 KΩ resistor
- 2-10µF capacitors

Procedure:



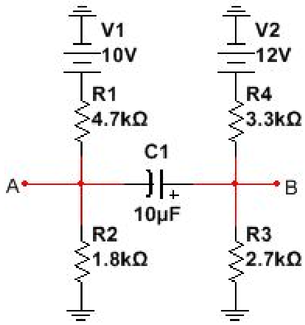
Schematic 1

First we constructed the circuit in schematic 1 and measured the voltage at point A and B and found that point A measured 4.4 volts and point B measured 1.2 volts.



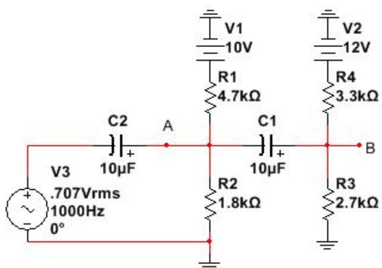
Schematic 2

Once we had constructed the circuit in schematic 2 we measured the voltage at points A and B to be 2 volts, also we noticed that the new voltage was roughly the average voltage of the voltages from schematic 1.



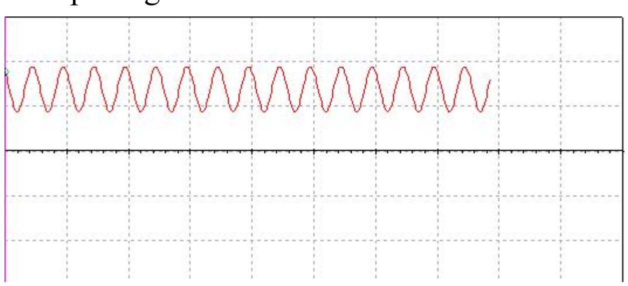
Schematic 3

Next we replaced the jumper wire from schematic 2 with a 10 µF capacitor to construct schematic 3. After that we measured the DC voltage at points A(4.5 volts real, 4.4 volts sim) and B(1.2 volts real,1.3 volts sim) individually and then we measured DC voltage across the capacitor to be 2.5 volts real and 2.6 volts sim. These measurements meant that the capacitor was open, making the voltage mesurments the same as schematic 1.

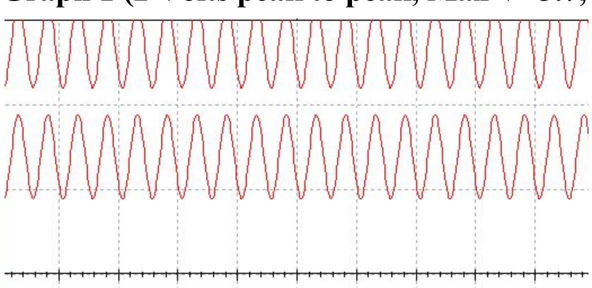


Schematic 4

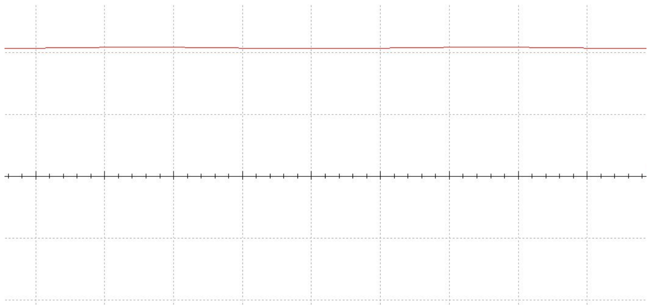
Then schematic 4 was constructed and the DC voltage at point A was measured as shown in graph 1, the DC voltage of point B and A was measured as shown in graph 2, and then the two were put together and subtracted on the oscilloscope as shown in graph 3.



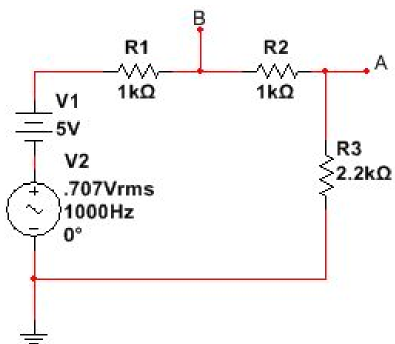
Graph 1 (2 Volts peak to peak, Max V=3.7, Min V=1.7) 2 Volts/Division



Graph 2, 2 Volts/Division, Point B is the same as point A voltage wise

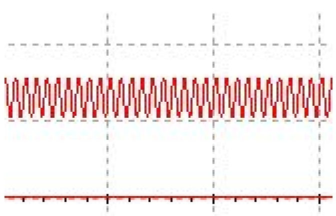


Graph 3, The voltage is 2.6 Volts DC

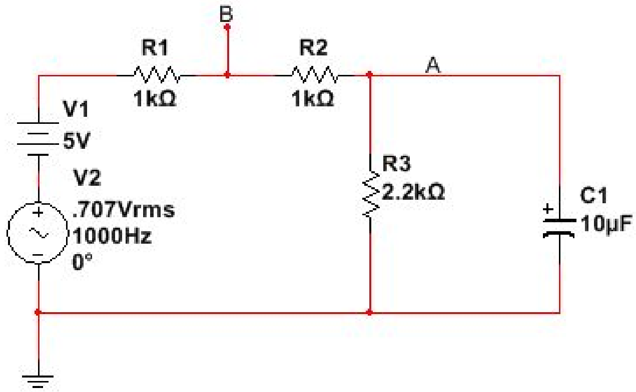


Schematic 5

Then we constructed the circuit in schematic 5 and measured the voltages for resistors 1, 2, and 3 which were 1.32 volts real, 1.3 volts sim(R1), 1.33 volts real,1.3 volts sim(R2), and 2.92 volts real, 2.9 sim(R3). Next we used an oscilloscope to find the peak voltages of point A and point B which were 0.5Vpk at point A and 0.75Vpk at point B. The oscilloscope measurements for resistor 3 of schematic 5 are in graph 4.



Graph 4, Peak to Peak voltage is .8V, with a max voltage of 3.1 Volts and a min voltage of 2.3 and a reference voltage of 2.7 Volts



Schematic 6

Then the circuit in schematic 6 was built and measured and found that the DC voltages of the new circuit are slightly higher than the DC voltages in schematic 5(new voltages V_{R1}=1.35V real,1.3 Vsim,V_{R2}=1.36V real, 1.3 V sim,V_{R3}=3V real, 3V sim). After that we measured the values of point A (0.01 Vpk) and point B (0.05 Vpk). When measuring the peak ac voltage across a dc supply with an oscilloscope it comes out to being .5 volts peak and when measuring the dc voltage on the ac generator a value of 707 MV was measured.

Observation Questions:

1. When the capacitor was inserted into the circuit shown in the circuit labeled Schematic 3, the DC voltages didn't change.
2. Using Schematic 3 as a reference, the voltage at point A is greater than the voltage at point B with point A's voltage minus point B's voltage being 3.2 volts. The dc voltage does not pass through the capacitor.
3. The dc voltages measured in Step 6 are the same values indicated as dc reference voltage on the waveforms, both being 2 Volts.
4. The voltage across the capacitor in Step 11 is .6 volts. We determined this by taking the difference of the voltages measured at points A and B as shown in Schematic 4
5. Using the observation from Step 11, there can be ac voltage across the capacitor.
6. If the capacitor between Points A and B were made smaller, there would be ac voltage across the capacitor.
7. The value of the capacitor versus the frequency is important because capacitors offer greater reactance at lower frequency and as frequency increases its resistance decreases.
8. In step 6 the same measurements would be made if the coupling capacitor were shorted
9. 1 V ac peak would be measured at Point A. At Point B, there will be no ac voltage because it is no longer connected to the AC source.
10. 2 volts peak to peak was read at point A on schematic 4.
11. 2 volts peak to peak was also measured at point B on schematic 4.
12. The capacitors on schematic 4 dropped both 1 V peak ac voltage and 2.5 V dc voltage.
13. The total dc resistance decreased when the capacitor was added.
14. The total ac impedance increased when the capacitor was added going to 2010 ohms.

15. The AC voltage across R3 in schematic 5 is 370 mV while in schematic 6 it is 5.607mV

16. The AC voltage across R1 increased from schematic 5 to 6.

17. The voltage increases in R1 due to the fact of the capacitor charges, but can't discharge due to the high time constant of the capacitor, therefore the reason to why the voltage is higher is because the voltage from the AC source is being stored in the capacitor.

18. It would increase because the smaller capacitor's time constant is even higher than the 10 microfarad capacitor.

19. If the bypass capacitor opened their would be voltage across R3 because the other capacitor branch is open so all electricity would go down the other branch.

20. If the bypass capacitor shorted there would be no voltage across R3 since the shorted capacitor would be working as a wire with no resistance all of the voltage would be blocked.

Discussion:

To get both 12V and 10V in schematics 1 through 4, a voltage divider was used to achieve these two voltage inputs. The reason to adding a voltage divider instead of using two variable power supplies is that a common ground was required for these circuits in the lab. As well there can be differing answers from the real world to multisim due to inconsistencies when with real world components. Otherwise we had no serious problems when completing the lab.

Conclusion:

A sinusoidal waveform is a wave that does not have a zero-volt reference voltage, but still looks like a sine wave. A coupling capacitor is used to remove the non-zero-volt reference voltage or to isolate one dc reference voltage from another dc reference voltage. Coupling capacitors are used in bypass filter circuits, and can couple an ac signal from one ungrounded point to another, allowing for dc isolation between two dc voltage points. A coupling capacitor can be used to maintain a constant dc voltage in a circuit when an ac voltage is also applied to the same point.