CS1025 Lab Report n°2

Samuel Petit

Student Number: 17333946

Performed on 3/11/17, session 4pm – 6pm

Observing the effect of a diode on the output of a circuit

During this lab, 3 circuits were built, all 3 using an AC power supply set to 5 Volts. All circuits contained also a 2.2K and a diode. The rest of the components changed for each circuit which made observing the cut-in voltage of the diodes for each circuit interesting.

First Circuit

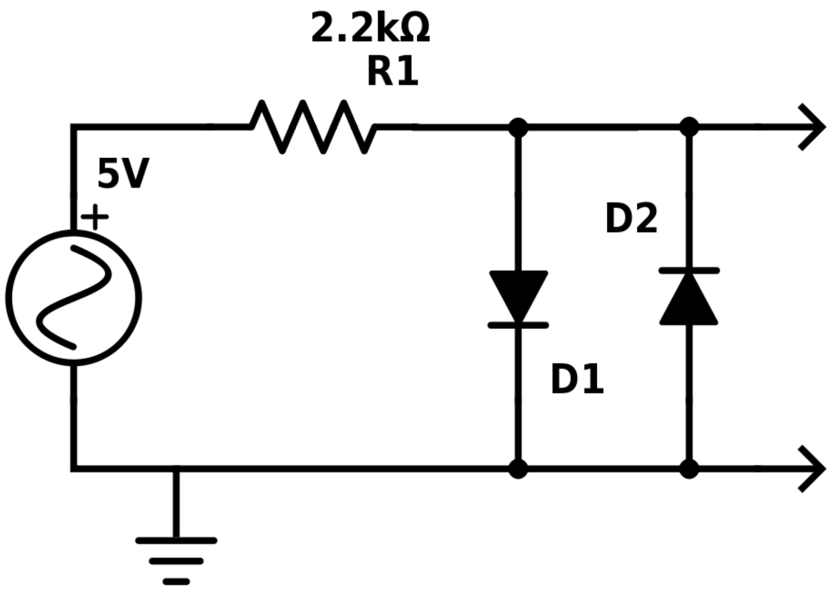
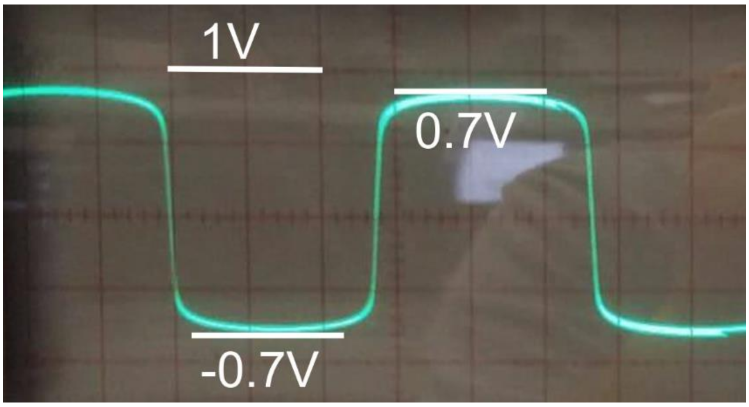


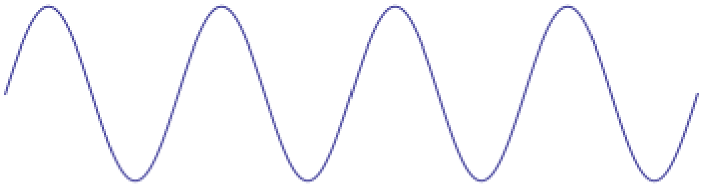
Diagram of the 1st Circuit, using a 5V AC supply



Output observed on the oscilloscope

Understanding AC Signal

An AC signal (Alternating current) goes through positive and negative phases in other words it flows one way then the other way. It changes at a rate (Hz), during this whole experiment it was set to a sinusoidal form:



In the circuit above, we can observe the cut-in voltages of both diodes are of 0.7V. This circuit involves two diodes connected in parallel, in opposite directions. Since the 2 diodes are in opposite directions current will flow in both directions (positive and negative).

To go a bit more in depth: when the signal is positive, the current flows through the resistor. The diode used requires about 0.7V to function. So as current rises from 0 to 5V and we have the output connected in parallel to the diode, we then know during the whole positive section it will have a steady voltage of 0.7V as, after the diode's cut in voltage is met, it will soon become a 'short circuit'.

When the signal is negative, the same process is happening except it is making the second diode operate (which is connected in the opposite direction from the first one). This time as current is rising from 0V to -5V, the output will remain of 0V until -0.7V is reached which will put the diode in function and will remain constant as the current keeps rising and then going back until it is not able to power the diode anymore and will then start its positive shift.

Second Circuit

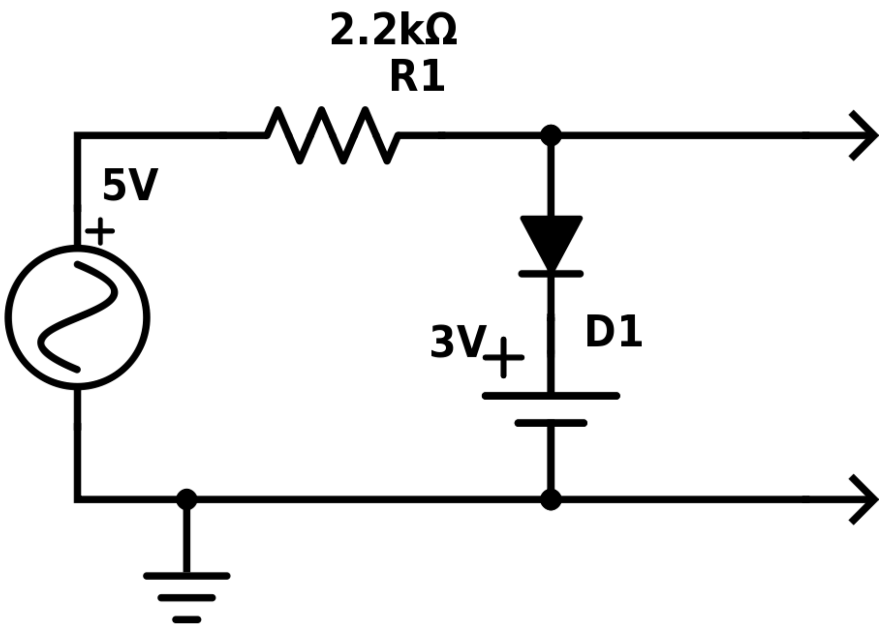
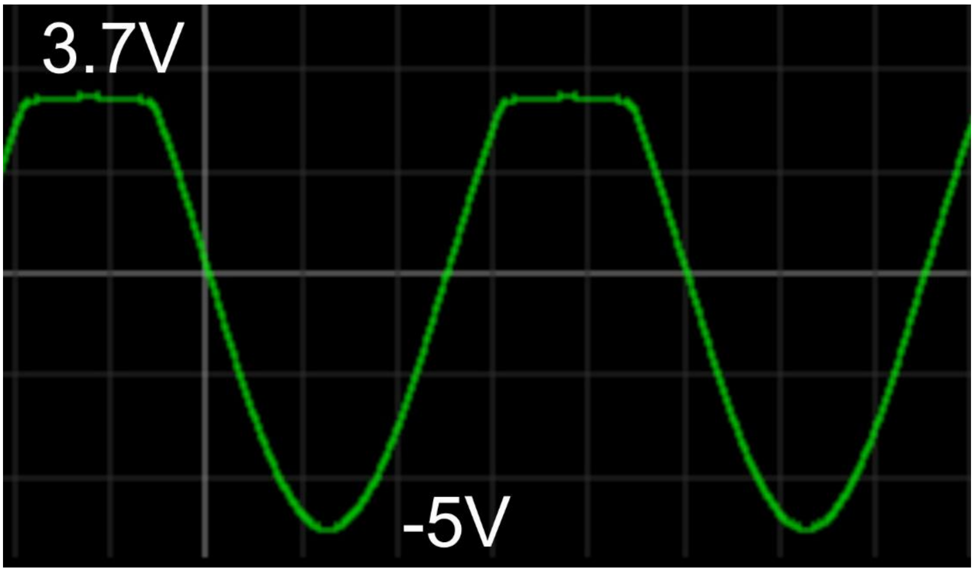


Diagram of the 2nd Circuit, using a 5V AC supply as well as a 3V DC supply

This time, the second diode connected in parallel is taken out and a 3V DC supply is connected in series to the circuit.



Output observed on the oscilloscope

Adding a 3V DC power supply at the output rises the cut-in voltage of the diode. This means the signal will clip at, in this case 3.7V. The purpose of adding a dc voltage is to basically make the cut-in voltage higher. To work the diode and supply must be oriented in the same direction, otherwise current will not be able to flow through both the diode and supply. Therefore, during the positive section of the AC Voltage, current will flow as soon as it reaches the cut-in voltage of the power needed for the diode as well as the dc supply (3.0V + 0.7V = 3.7V).

During the other section of the AC signal (negative), current will not flow as it can't go through from the anode to the cathode of the diode (note: a diode will only let current flow in one way). Since no current can flow no voltage is dropped through the resistor, diode and so the output will be equal to the AC voltage supply (a sinusoidal form going from 0V to 5V and to 0V again).

Third Circuit

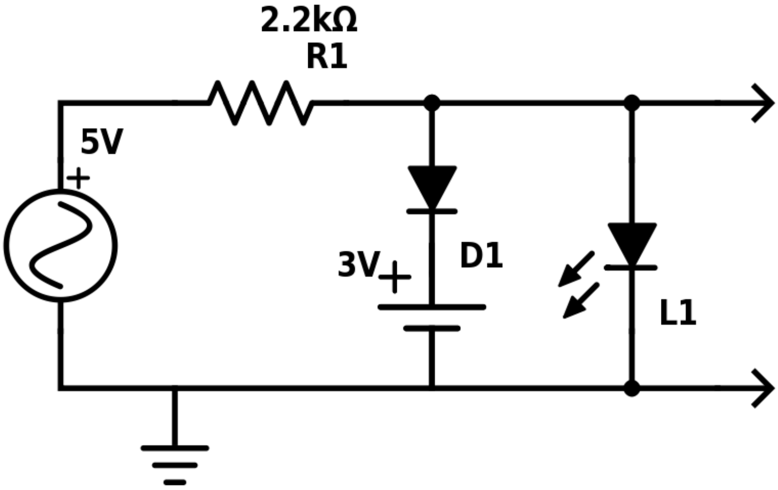
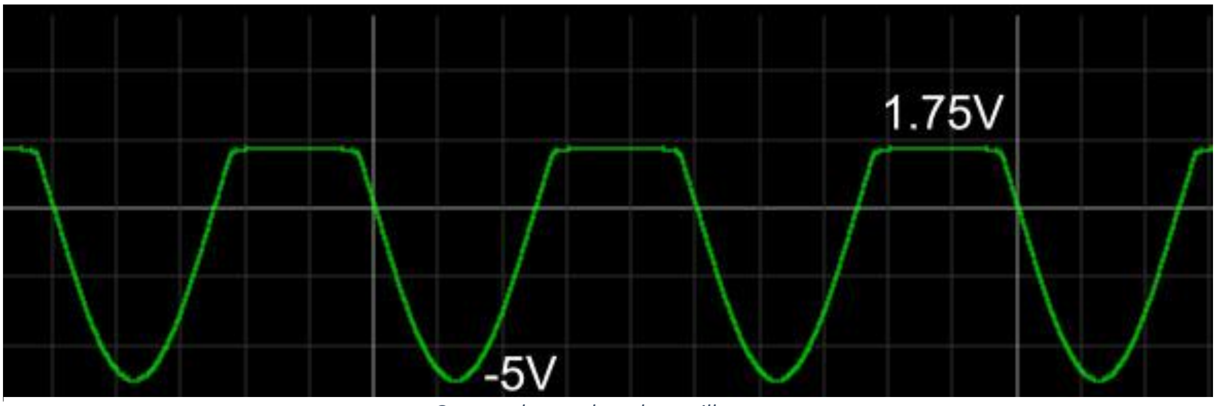


Diagram of the 3rd Circuit, using a 5V AC supply as well as a 3V DC supply

This third circuit is the same as the second but adding in parallel an LED.



Output observed on the oscilloscope

During the negative-half of the AC signal, the same thing is observed as in the 2nd circuit, current will not flow, therefore the output is the same as the AC voltage input (from 0V to -5V back to 0V in a sinusoidal form).

For the positive section of the signal, as the diode and the dc supply, and the LED are connected in parallel, the voltage across one branch does not affect the other, so as the cut-in voltage of an LED is lower than the cut-in voltage for the power supply + the diode, current will pass through the resistor and through the LED, therefore the output will display the cut-in voltage of the LED only.

Conclusion

Using the output waveforms can be really useful to determine characteristics of a circuit once the flow of current in the circuit is understood.

Websites used:

For creating the diagrams of each circuit:

- https://www.digikey.com/schemeit/

For the last 2 waveforms:

- http://www.falstad.com/circuit/

This website was used as, in the first lab we did not have correct outputs during the first session on 3/11/17. Besides for the first circuit which was correct.

During the second session of this lab, this time we did obtain correct outputs. For the output of the first circuit, I edited a picture I took of the oscilloscope to make it more readable.