Investigation on the Effect of circuit components on the output voltage of a Sinusoidal waveform CS1025

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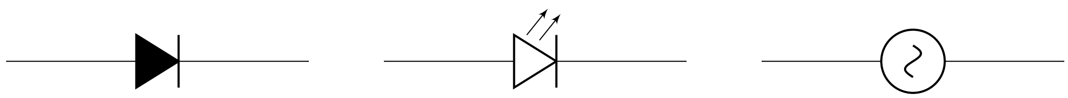
7th November 2017

Date Performed:	3rd November, 2017
Lab Session:	Lab 2

1 Introduction

The objectives of this experiment is to investigate on how the output waveform of a sinusoidal wave is effected by the positioning of different circuit components in a circuit by observing the output waveform on a oscilloscope. For the purposes of this experiment, the frequency for the a.c. voltage source is set to 40 Hertz.
Our main circuit components for the basis of this experiment are as follows:

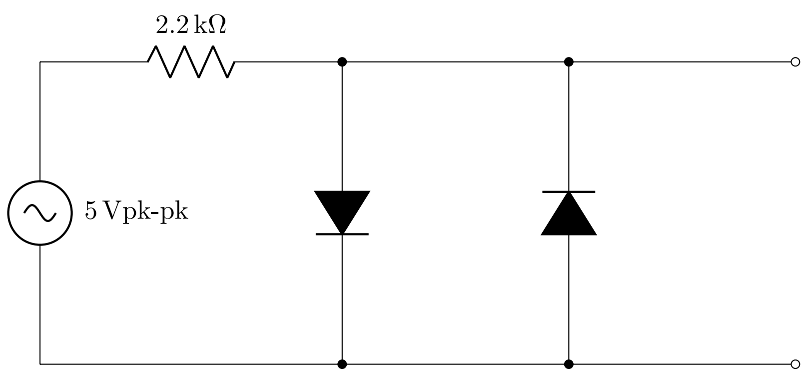


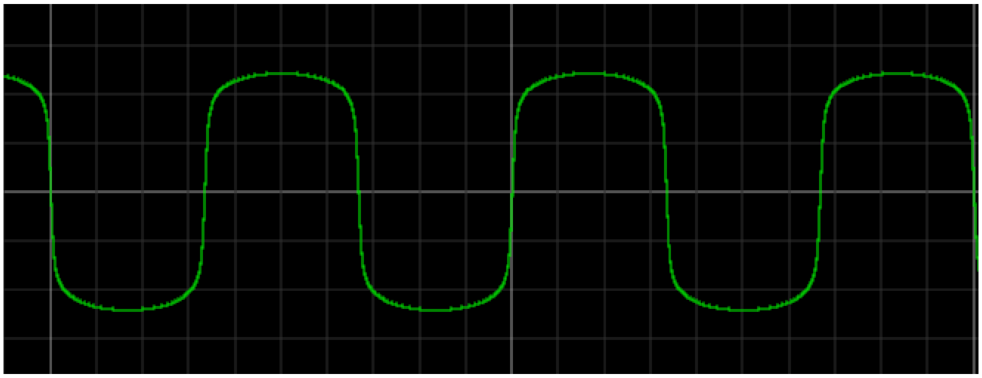
Diode LED A.C Voltage Source

As for the instrument used to detect the output waveform, the oscilloscope, is a type of electronic test instrument that allows observation of constantly varying signal voltages as a function of time.[1]

2 Data and Analysis

The first circuit and output waveform are as shown:





Where the vertical plane represents the output voltage of the circuit is measured in V and the horizontal plane represents time with a time step of 5 µs. The peak voltage for the graph is 0.7V peak, which is at 0.7 V for forward bias and -0.7 V for reverse bias.

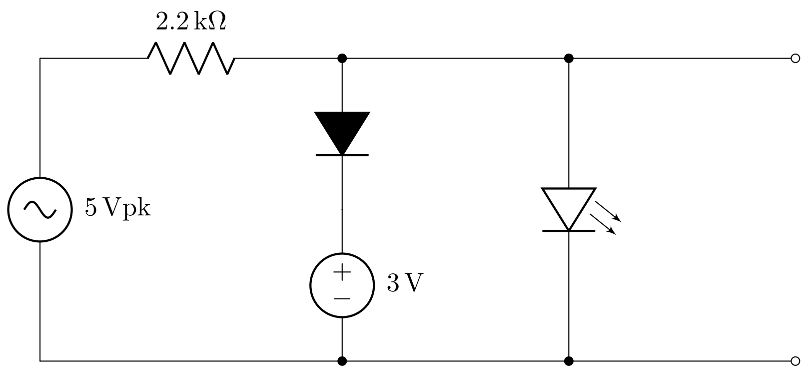
The circuit consists of one resistor of relatively high resistance connected in series with the a.c source and two identical non-ideal diodes, one in forward bias and one in reverse bias, which are in parallel.The output voltage across the circuit is connected to an oscilloscope.

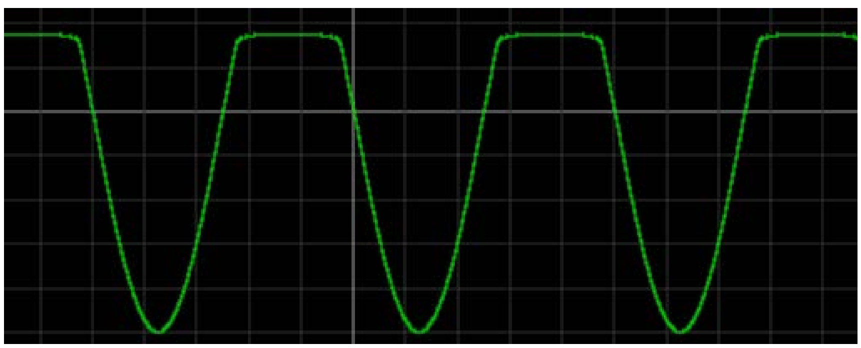
During the rising of the graph, the diode in forward bias requires a voltage of 0.7 V for the diode to conduct due to it not being an ideal diode. Hence the maximum peak for forward bias of the image observed on the oscilloscope being 0.7 V and no more as the diode is free to conduct from thereon i.e.cut-in voltage of diodes is 0.7 V. The -0.7 V during the descending of the graph is due to the same reasoning but for the other diode to become in forward bias.

However, during this process, the diode in reverse bias is "turned off" as it acts like an open circuit, this discontinuation of the permits no voltage through it, cutting the circuit off.

When one diode is in reverse bias the other is always in forward and vice versa, thus for the repetitive pattern of the sinusoidal wave.

The second circuit and output waveform are as follows:





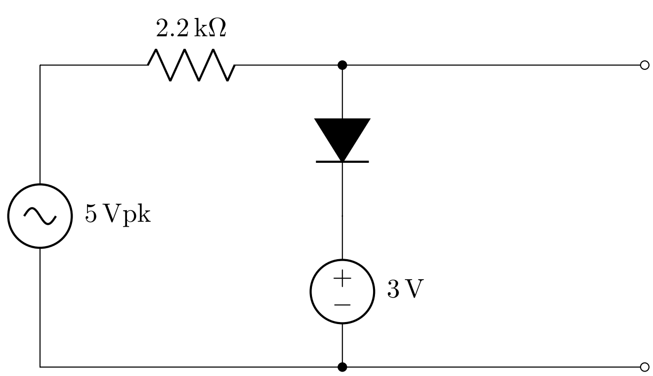
Where the vertical plane represents the output voltage of the circuit is measured in V and the horizontal plane represents time with a time step of 5 µs. The maximum voltage value for forward bias the graph is 2 V and minimum value(reverse bias) is -5 V.

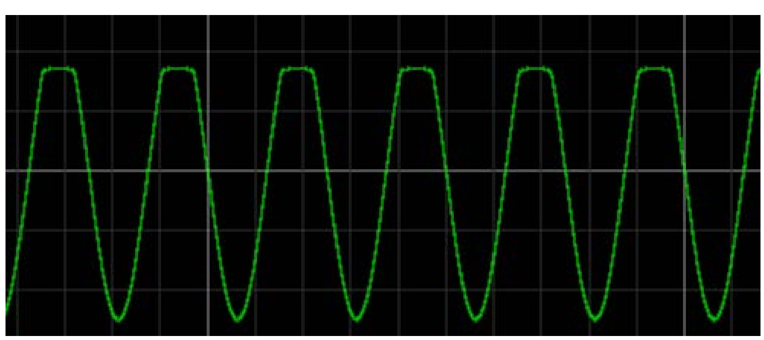
As we observe from the set-up of the circuit, it consists of one resistor of high resistance value connected in series with the a.c. voltage source, a diode in series with a 3 V d.c. supply which is in parallel with an LED all in parallel with the a.c. source and the resistor. The output voltage across the circuit is connected to an oscilloscope.

The voltage would go through the path which has less requires from it. The voltage required for the diode and the direct current source is 3.7 V in total, whereas the voltage required to conduct through the LED is only 2 V.

During the forward bias cycle of the LED, the voltage chooses the path with only the LED, hence resulting for the 2 V for forward bias on the graph. In the reverse bias of the LED, the diode is in reverse bias as well, resulting in a discontinuation of graph in both paths, thus the output voltage of the graph being the voltage across the a.c. source which is 5 V peak, displaying as -5 V on the scope diagram. A continuation of the operation of the circuit causes the continuation of the patterns to be observed of the sinusoidal wave on the oscilloscope.

The third circuit and output waveform are as shown:





Where the vertical plane represents the output voltage of the circuit is measured in V and the horizontal plane represents time with a time step of 5 µs.The maximum voltage value for the graph is 3.7 V and minimum value is -5 V.

As we observe from the set-up of the circuit , it consists of one resistor of high resistance value connected in series with the a.c. voltage source, diode and a 3 V d.c. supply. The output voltage across the circuit is connected to an oscilloscope. Differing from the second circuit by the missing LED.

Unlike the second circuit, the voltage does not have a path to choose, therefore it can only supply the required voltage, which is 3.7 V (0.7 V for the diode and 3 V for the d.v supply) and conduct through this only path, resulting in the peak for the forward bias to be 3.7 V. During the reverse bias of the diode, it act as if an open circuit, causing a discontinuation of the entire circuit, therefore the voltage is measured as -5V peak in the descending part of the graph.

A continuation of the operation of the circuit causes the continuation of the patterns to be observed of the sinusoidal wave on the oscilloscope.

3 Conclusion

From the above experiments, it is estimated that the cut-in voltage for the diodes used are approximately 0.7 V and approximately 2 V for the LED. The positioning of a component in a circuit effects the output waveform greatly including the peak values of the sinusoidal waveform.

[1] Definition for the oscilloscope taken from Wikipedia.