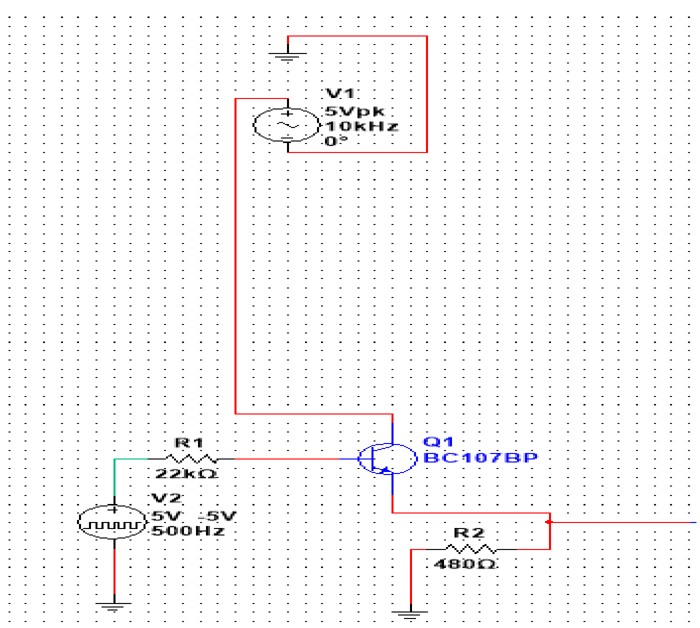
Digital Modulation- Amplitude Shift Keying

Abstract:
The main purposes of this project is to improve the quality of the recovered signal and to send a signal through the components of a general purpose transistor (BJT), a national semiconductor, and a low pass filter that has a capacitor and resistor. After the system was built, different scenarios that dealt with different values were tested to see if it would cause improvement to the quality of the recovered signal. It was found that increasing the resistor or capacitor values for the low pass filter did not lead to an improvement in signal quality and that the quality had some improvement when either the resistor or capacitor decreased in value. The bipolar pulse voltage source frequency change was another way to improve the quality of the recovered signal and this meant that the frequency value had to decrease. Overall, this project dealt with how values can change the quality of the signal.

Background:
This main focus is on digital modulation, specifically in the form of amplitude shift keying (ASK). When it comes to digital modulation, amplitude shift keying (ASK) and frequency shift keying (FSK) are its most basic forms. The intelligence signal for this modulation will be in digital form. Pertaining to the ASK form, the digital signal will be encoded in the amplitude of a carrier. The states that exist within the ASK are the carrier and no-carrier. The no-carrier state is also known as On-Off-Keying (OOK). The carrier is able to convey intelligence by simply turning on and off, which depends on the prearranged code. This type of transmission is known as continuous wave (CW).



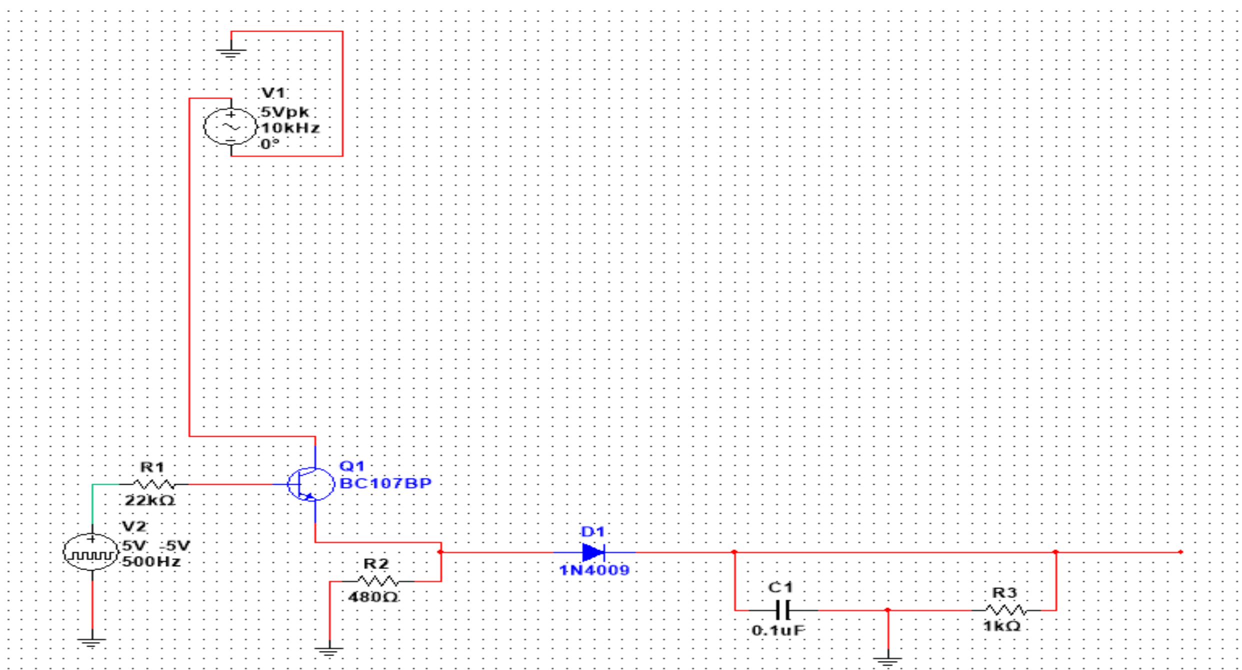
The beginning of the circuit in MultiSim.

Methods

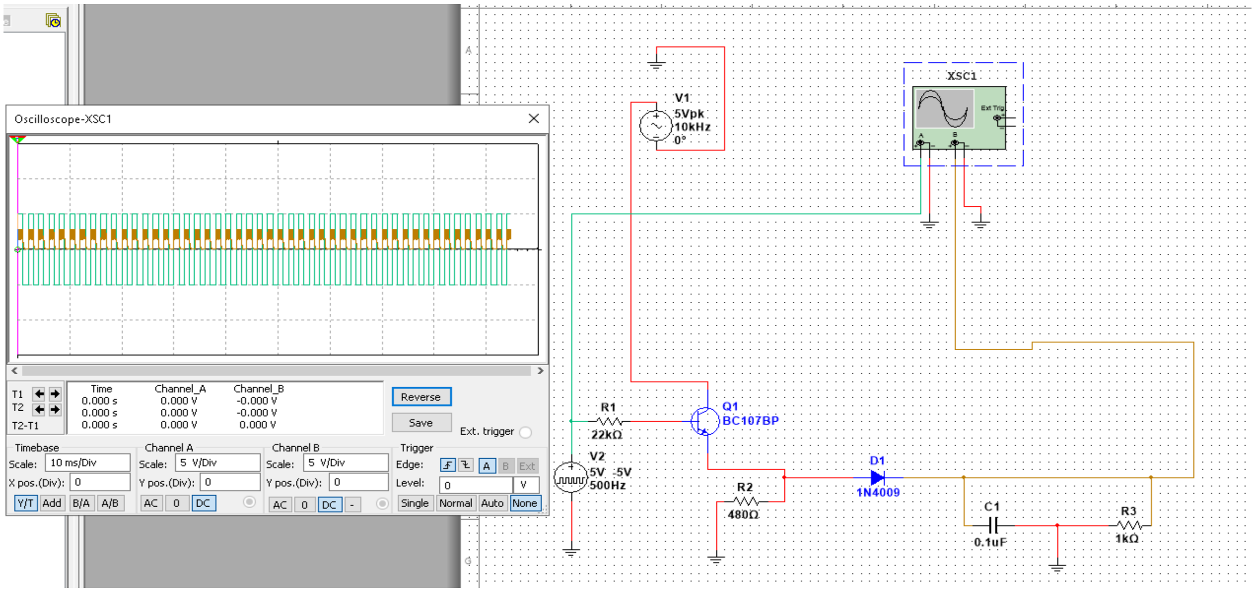
There are many specific components needed to create the system for this project. The amount of grounds needed throughout the system is four. The voltage source is a bipolar pulse where the positive side is connected to a 22k ohms resistor and the negative side to ground. The 22 k ohms resistor is connected to the BJT or NPN General purpose transistor (BC107BP), this is connected on one side to an AC signal voltage source that has 5 Vpk and 10 kHz and the other side is connected to a resistor with 480 ohms that connected to ground. Between the 480 ohms resistor and the transistor a connection is made that will connect the National Semiconductor (1N4009). The low-pass filter that is made up of a capacitor of 0.1 microFarads and a resistor with 1k ohms and a ground is connected to the semiconductor. There is a voltage out line that will be important for the oscilloscope . The values that the bipolar voltage source should be set to is 5 V for the positive pulse voltage, 5 V for the negative pulse voltage, 100% for the duty cycle, and 500 Hz for the frequency.

The oscilloscope will need two channels for this project. The positive of the first channel will be connected to the bipolar voltage source because this is considered the intelligence signal. The negative of this channel will go to ground. The second channel will have the positive go to Vout, which is the ASK output and the negative will be connected to ground.

Results:



The above image shows all the main components like the bipolar pulse voltage source, the AC signal voltage source, the BJT or general purpose transistor (BC107BP), the national semiconductor (1N4009), and resistors and a capacitor of specific values.

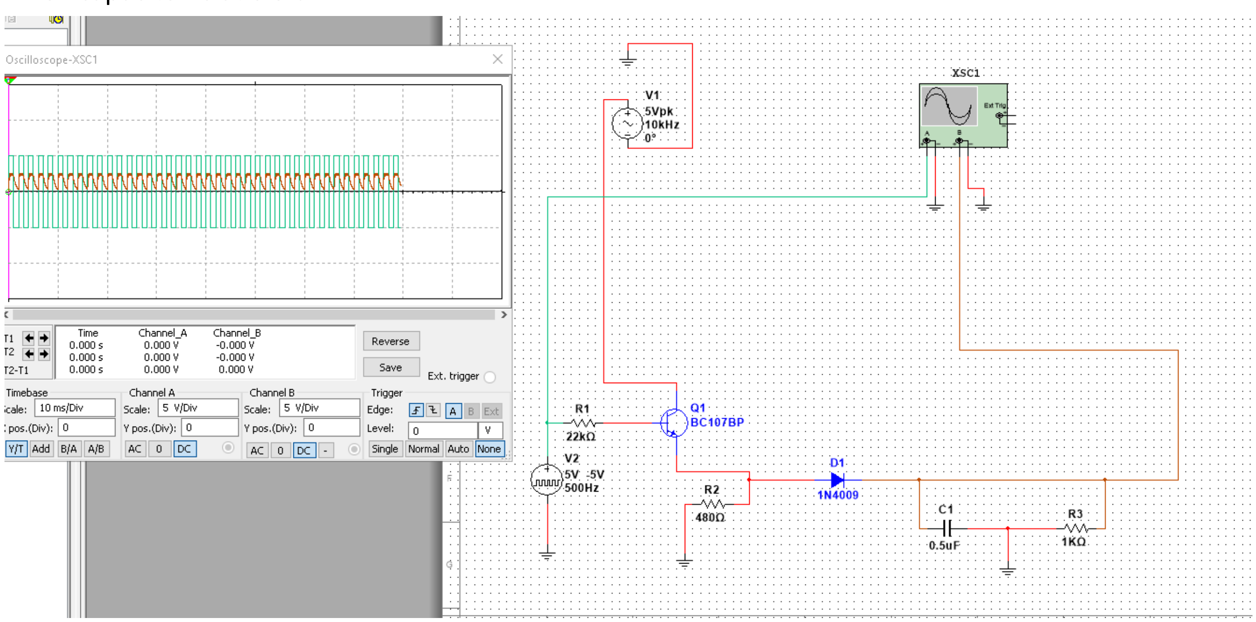


The above image shows the results of the oscilloscope that is connected to the bipolar voltage with one channel and the voltage out with the other. Resistor 3 is 1k ohms and capacitor 1 is 0.1 uF. The frequency produced by the bipolar voltage source is 500 Hz.

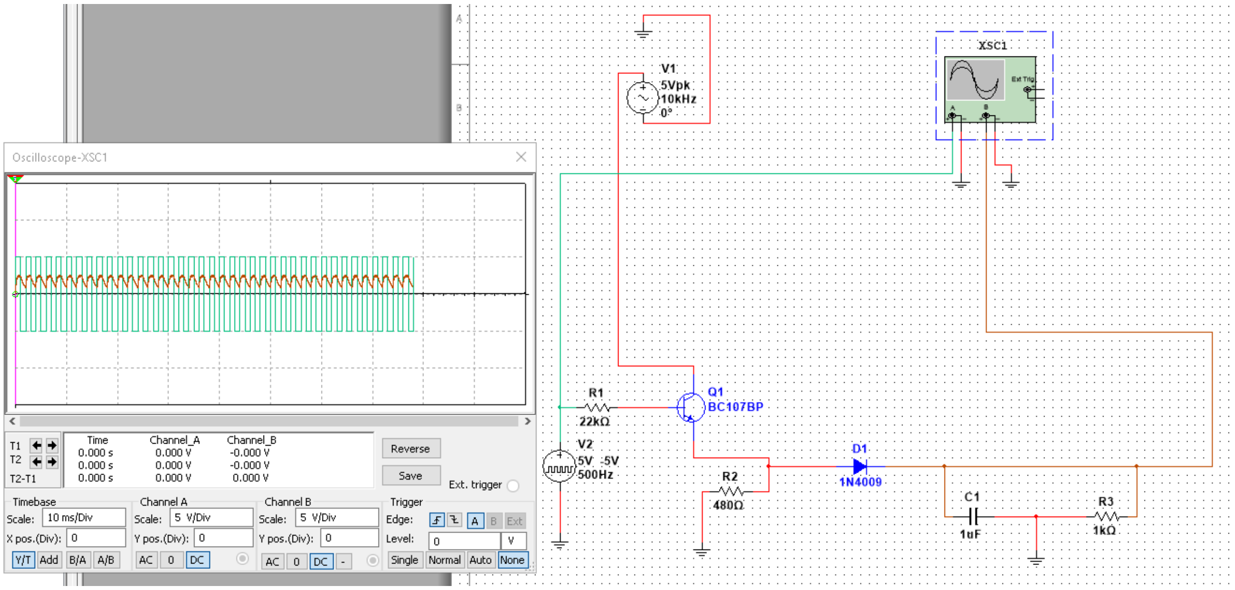
The above image has shown the oscilloscope with specific values and the digital modulated signals is the outcome. This recovered signal can be improved in quality if values of certain components like the resistor or capacitor that make up the low-pass filter are changed.

Below shows the outcome of when the capacitor value is increased.

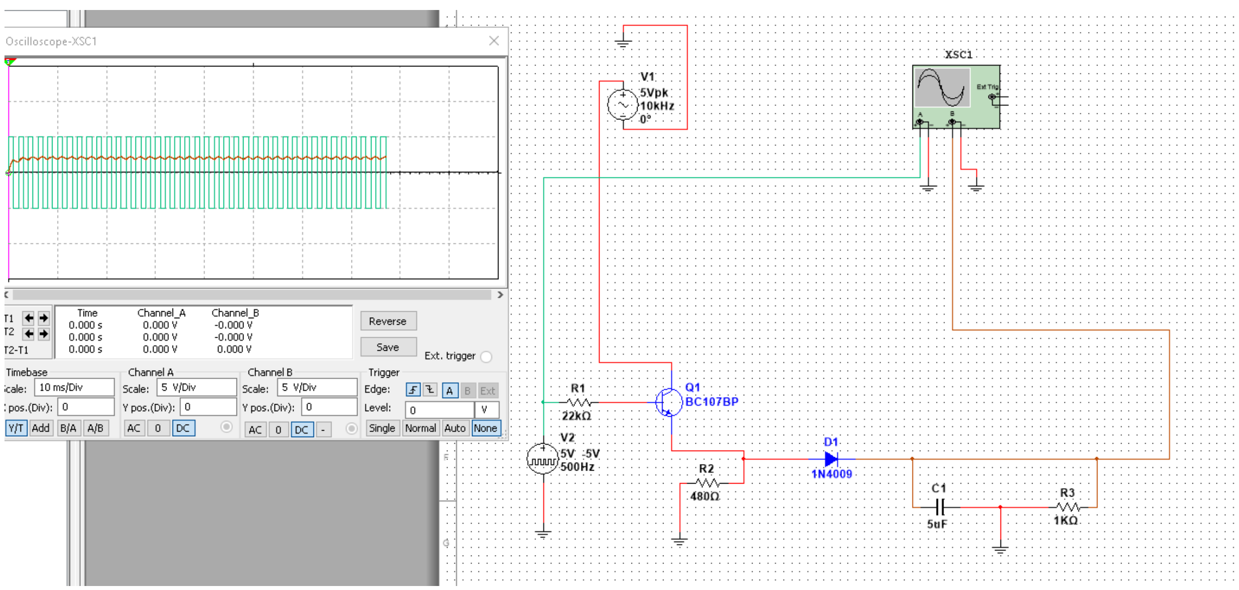
When capacitor is at 0.5 uF



When capacitor is at 1 uF



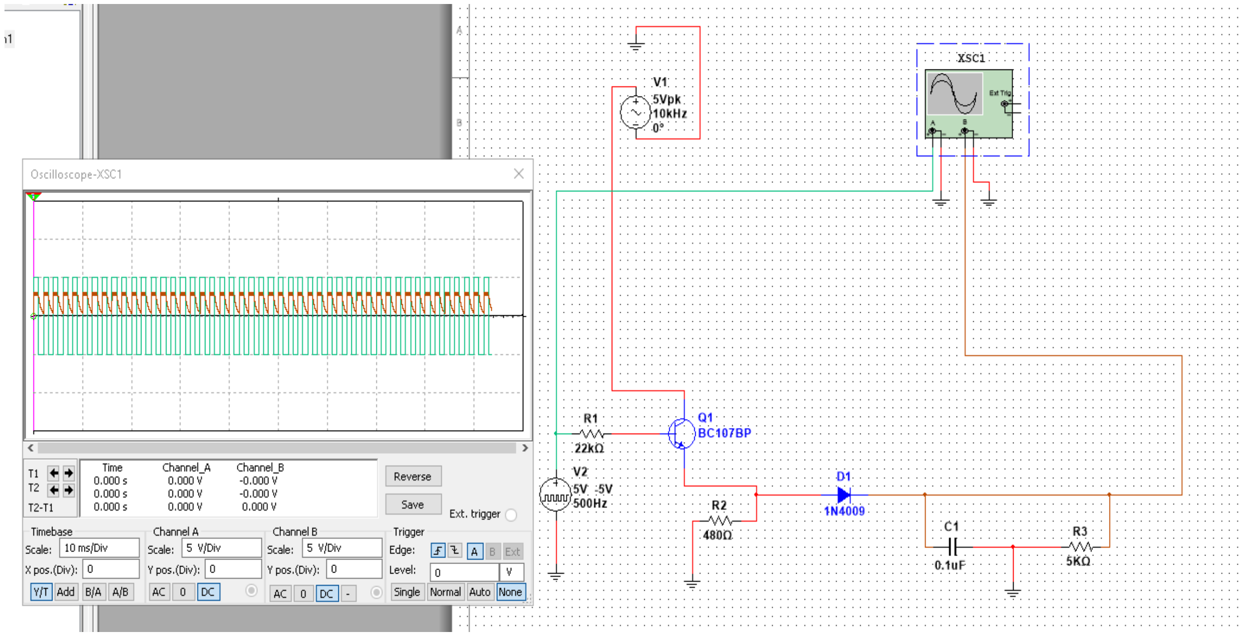
When capacitor is at 5uF



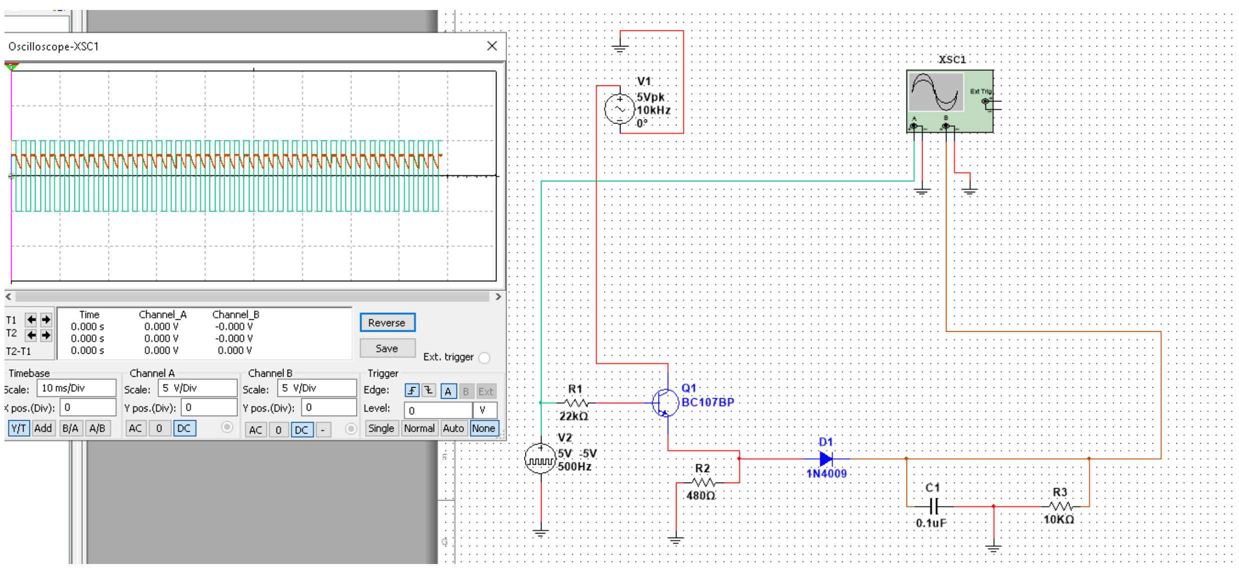
As seen in the above three situations, when the capacitor values increase, the signal shown is not an improved quality of the recovered signal, so increasing the capacitor value is not the solution.

Below shows the outcome of when the resistor value is increased.

When resistor is at 5k Ohms

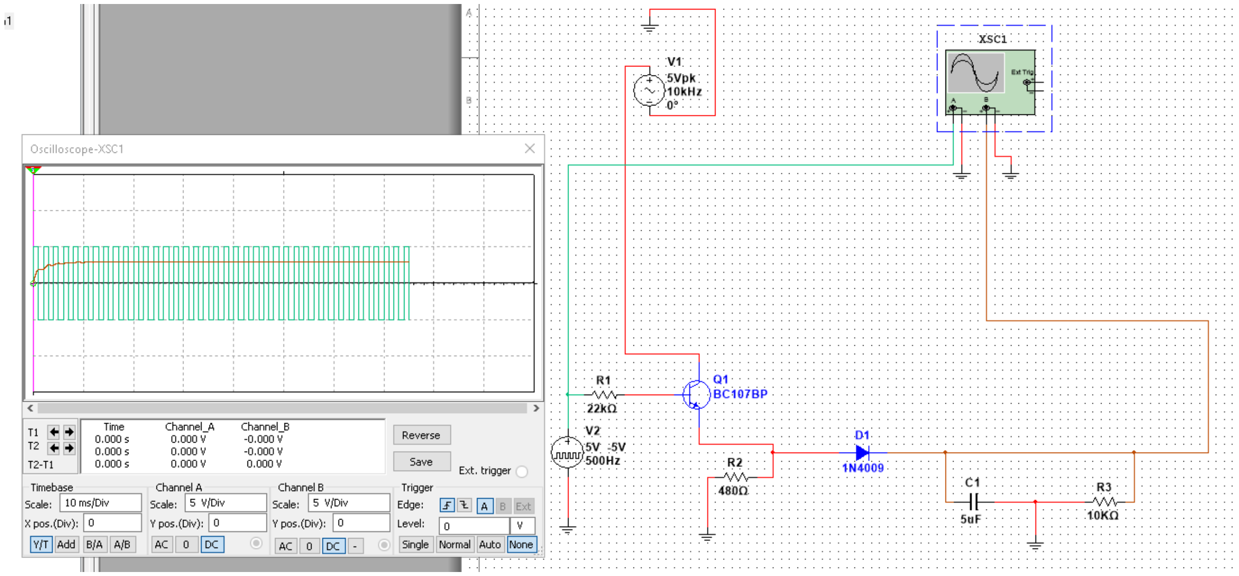


When resistor is at 10k Ohms



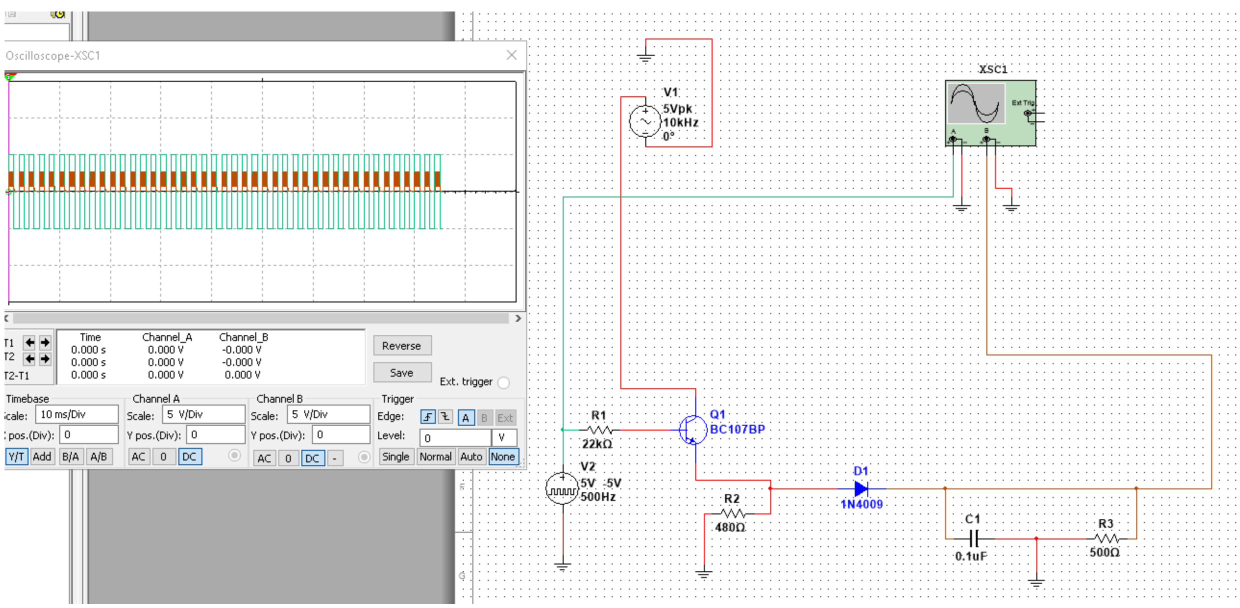
As seen in the above two situations, when the resistor values increase, the signal shown is not an improved quality of the recovered signal, so increasing the resistor value is not the solution. The quality produce is better than the situation that requires an increase in capacitor values.

When the capacitor is 5 uF and the resistor is 10k Ohms.



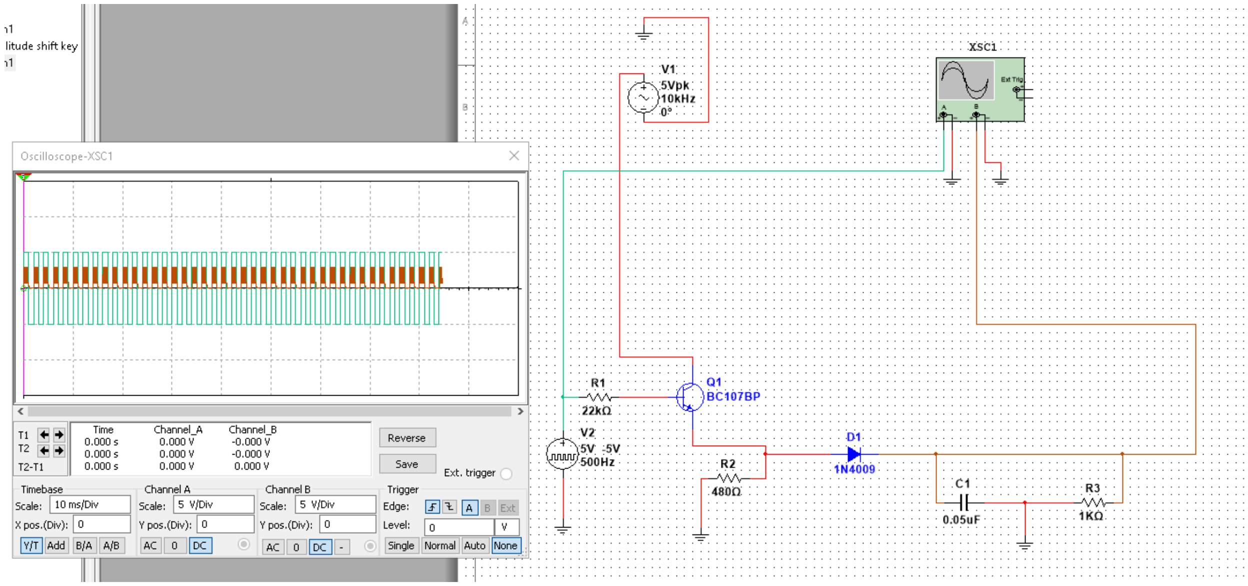
Both the capacitor and resistor increase in values and the quality of the recover signal is not good, overall it can be stated that increasing the values of the capacitor and the resistor that makes up the low-pass filter will not improve the quality of the recovered signal greatly.

Below shows what happens when the resistor values decrease from 1k ohms to 500 ohms.
When resistor is at 500 ohms



As shown above the quality of the recovered signal has improved and this is due to the value of the resistor decreasing.

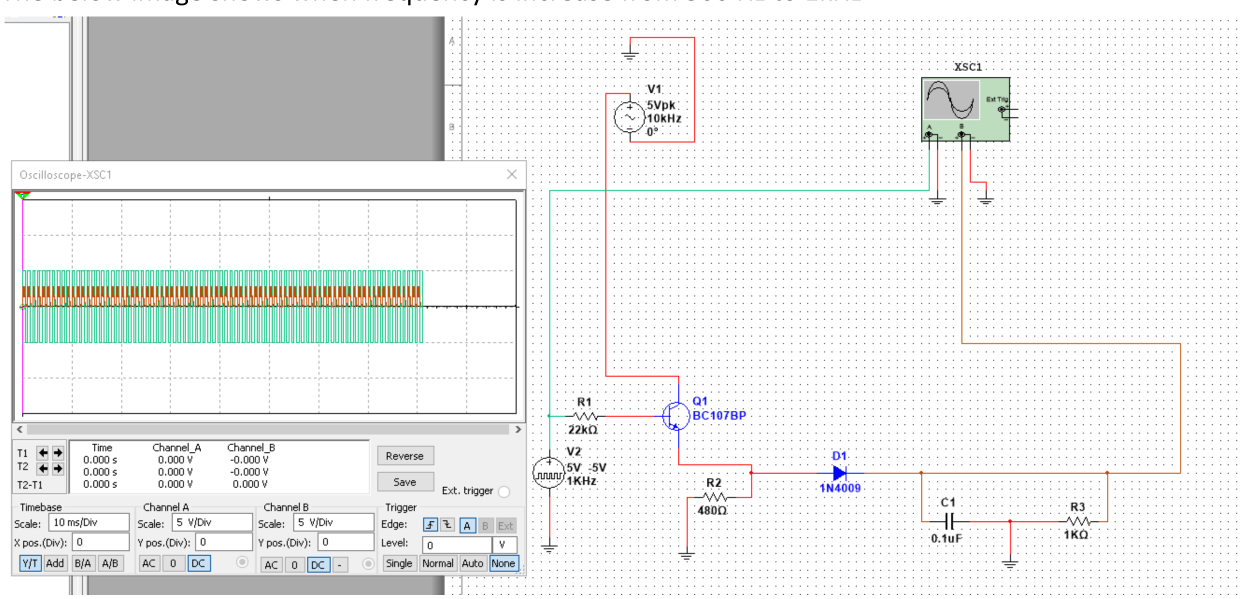
Below shows what happens when the capacitor values decrease from 0.1uF to 0.05uF.
When capacitor is lower to 0.05uF



As shown above the quality of the recovered signal has improved and this is due to the value of the capacitor decreasing. Overall, it can be concluded that when the value of either the capacitor or the resistor decreases, then the signal quality of the recovered signal will get better.

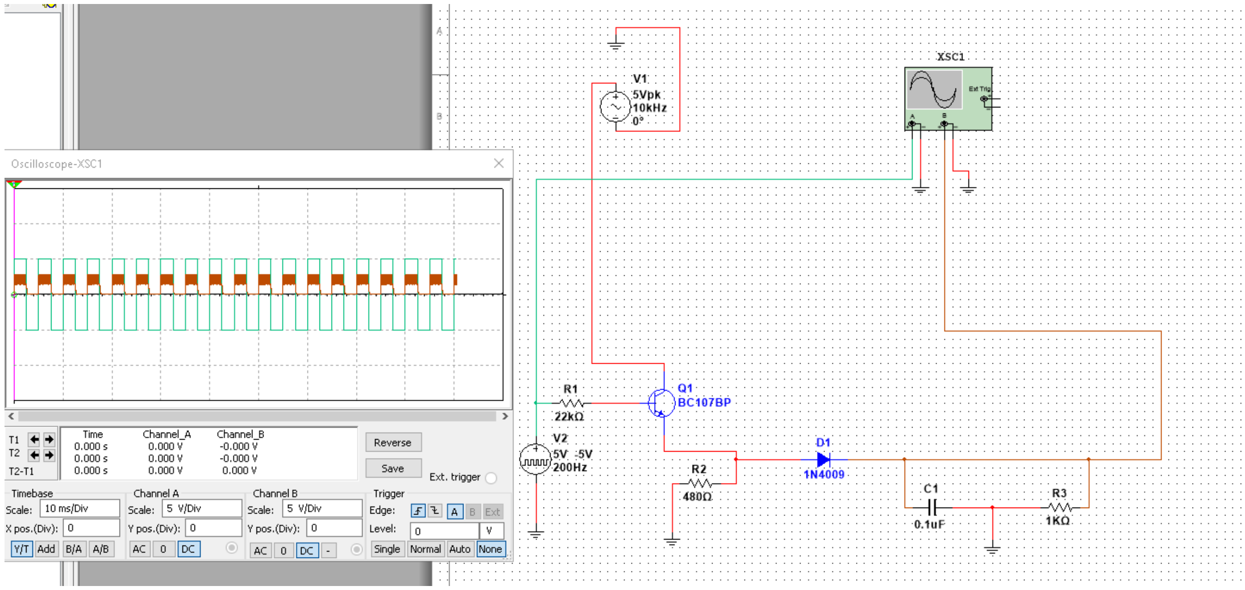
Since there are other factors that make up the outcome of the recovered signal, then the other methods that should be considered for trying to improve the quality of the recovered signal is to change the frequency that is expressed in the bipolar voltage source.

The below image shows when frequency is increase from 500 Hz to 1kHz



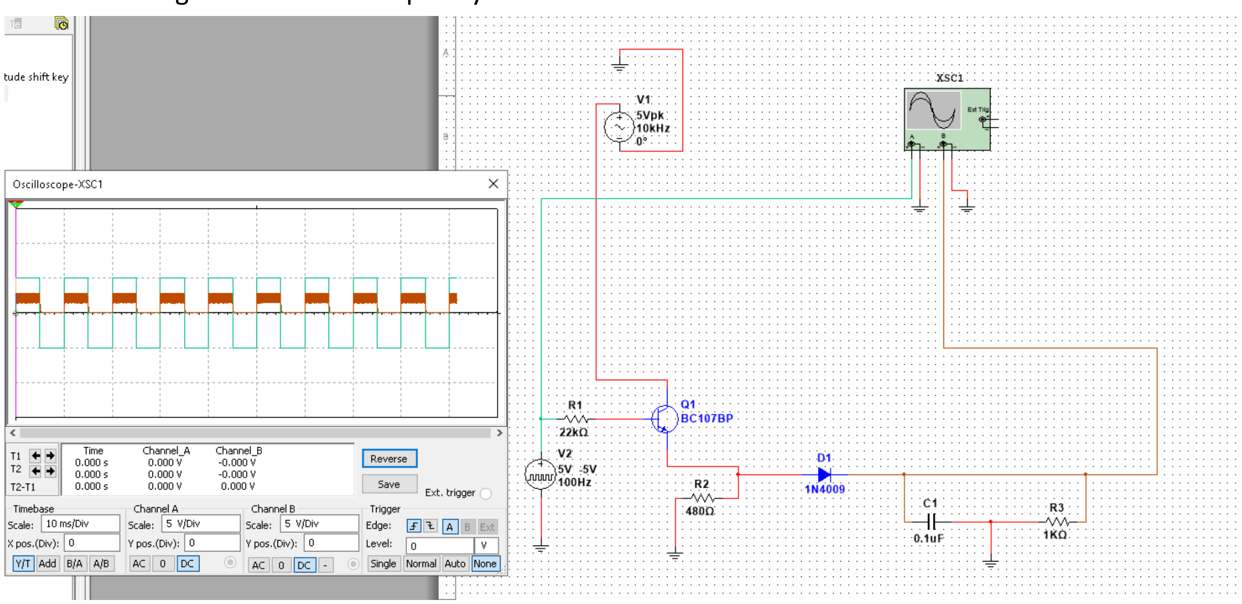
As seen in the above image the recovered signal is more chaotic in quality, so an increase in the frequency value will not lead to a better recovered signal.

The below image shows when frequency is decreased from 500 Hz to 200Hz.



As seen in the above image, the lower frequency value results in an improvement in the quality of the recovered signal. The details of the signal are seen better, the downside will be a slower signal.

The below image shows when frequency is decreased from 500 Hz to 100Hz.



As seen in the above image, the lower frequency of the bipolar voltage source leads to a better quality of the recovered signal.

The results that can be concluded is that the quality of the recovered signal can be improved when the values that make up the capacitor and resistor of the low-pass filter are lower. The quality can also be improved when the value of the frequency for the bipolar voltage source is lower from 500 Hz to either 200Hz or 100Hz. Lowering the frequency leads to the greatest improvement in the quality of the signal, but it will lead to slower transmission.

Purpose of project:

The team worked towards improving the quality of the recovered signal by changing the factors. At first the capacitor value was increased and afterward the resistor value was increased. Both of these situations led to a lack of improvement in the quality of the recovered signal. The next action was to decrease the capacitor and resistor value separately and there was improvement in the quality of the signal. Another method that was considered for improvement of the signal that did not deal with the values of the capacitor and the resistor that makes up the low-pass filter was to increase and then decrease the value of the frequency for the bipolar voltage source. In this testing, the quality of the signal only improved when the frequency was decreased.

Conclusion:

This project displays the essentials of values and how it will affect the generating of an ASK signal. The main software system used for this project is Multisim, which was used for the virtual building and testing of the ASK signal.