Maxwell Wisnieski and Librado Anglero 10/21/2021

[mw9sv@virginia.edu](mailto:mw9sv@virginia.edu) and [lba9wf@virginia.edu](mailto:lba9wf@virginia.edu)

Communication through electromagnetic waves may be one of the most significant human advancements ever made. The ability to communicate at nearly the speed of light has enabled so many functions of modern life that it is impossible to separate modern life from achievements that led to the technologies that we use today. It led to the development of the internet, the ability to do commerce on a global scale, and it allows me to submit this assignment to an online webpage. Historically, the first major uses of radio communication through amplitude and frequency modulation could be found in expensive Morse code communications between ships at sea, companies, and government organizations, with the development of the consumer radio being representing a massive change in the nature of human communication. Today radio is used for intelligence communications, organizational broadcasts, and consumer purposes, becoming slightly obsolete to the convenience of modern digital devices but still a recognized facet of human life. Our experiments will be a very much confined to the room we are in but will nonetheless allow us to test the basic methods through which one can send and receive radio signals, along with giving us an understanding of the circuitry that allows us to carry out these experiments.

The basic idea behind our experiments will be using a circuit to send a signal in the form of a voltage wave that will oscillate with a given frequency and amplitude. By modulating either of these, we can encode information in the signal we are sending, which can then be demodulated by whoever is receiving it. Sending the signal itself is a matter of using an antenna or coil of wire which can have a current run through it. As the current runs through it, it induces a disturbance in the magnetic field in the surrounding air, which then induces a disturbance in the electric field, and back and forth to propagate through space until it reaches a detector. We will have the receiver and detector loops incredibly close together so there is hopefully no signal loss, and so that the radio signals do not get too far and violate broadcasting laws. To ensure that everything is working, we will do numerous tests on the resonance circuit that will be used to receive the signal, which should behave as an LC resonance circuit. By measuring the Q factor at the resonant frequency, we can determine the inductance *L* and capacitance *C*, as per:

(1),

Which will matter if the signals are modulated to within the resonance range, since the voltage being received would then increase even if we did not want it to, thus created unwanted amplitude changes. To gather data on our experiments and check that we are doing things correctly, we will be using a speaker to allow us to hear the results of the signal demodulation, and MatLab to collect and allow us to analyze the data. MatLab comes with a suite of functions that will allow us to fit curves to our data and visualize the data so that we can visually confirm our expectations for the results. We should be able to use this data to check the state of our circuits and our signals being sent to make sure that we are doing everything correctly, and that the data matches our expectations for how the signal modulation and demodulation should be working.