California State University, Bakersfield

ECE 3320 – Fields and Waves

Lab 9 –Microwave Propagation

Introduction:

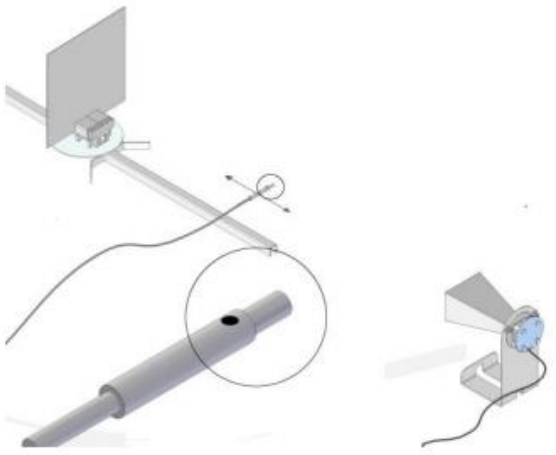
In this lab, we will demonstrate some of the fundamental properties of electromagnetic waves. We will be using a microwave transmitter and receiver to observe the effects of wave propagation and the various behaviors these waves can exhibit.

The equipment we will be using utilizes an oscillator to modulate an input signal to very high frequencies. These frequencies are then sent to the transmitter, a horn antenna, and is sent through space. At the receiver side, a similar horn antenna intercepts the signal, and then demodulates the high frequency signal back to the original input signal. This concept is the basis of nearly all digital and analog telecommunication.

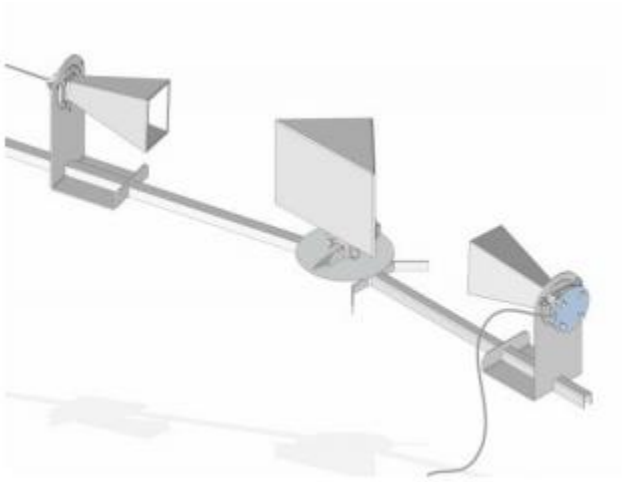
Procedure:

1. Ensure that all power switches are off. Transformer switch in the down position, speaker switch on the microwave unit to the left, and modulator switch on the microwave unit in the middle (0) position. Set the amplification dial to a quarter of the max. The dial should be facing toward the left.
2. Connect the transformer box to the outlet. Then connect the power adaptor to the microwave unit and the plug to the transformer. Note: The plug will be inserted on the right side, upside down. On the back of the transformer, ensure that the voltage selection plug is inserted in the 110V slot.
3. Next, set up the rails. To connect the rails, insert the screw on the bottom of the base into the longer rail. This will allow you to easily move the longer rail around the base.
4. Connect the transmitter and microwave probe to the control box. Connect the BNC to banana cables to the oscilloscope. The banana plugs should be inserted into the voltmeter plugs on the microwave box. The oscilloscope will allow us to view the received signal.
5. Now that all of the equipment is set up, we are ready to turn the equipment on. Turn on the transformer, and set the modulation switch to “INT”.

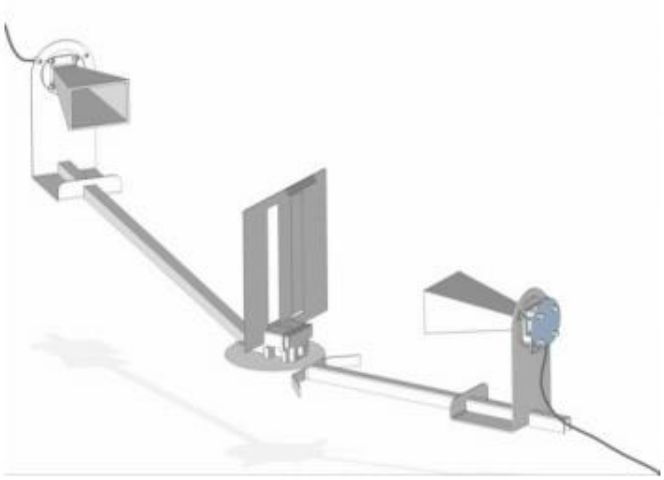
6. Set the transmitter and the reflector plate facing each other, so that the waves are being reflected back towards the transmitter antenna. Now, using the microwave probe with the marking facing upwards, measure the distance between two consecutive minima. You may want to use a straight edge in order to measure the distances on the rail. In your report, create a graph/picture that represents the standing wave of this setup.



7. The distance you have measured will be half of the wavelength of the modulation frequency. Use this information to find the approximate frequency of the modulation frequency. Where does this lie on the electromagnetic spectrum?
8. Remove the microwave probe, and connect the receiver antenna to the control box. Place the transmitter on the shorter rail and the receiver on the longer rail.
9. Set up the stand (angle bracket) on the base so that the prism can rest on the stand. Place the prism on the stand so that one of the shorter sides is at a slight angle in respect to the transmitter as shown.



10. Next, adjust the receiver angle so that received signal is at its maximum. What do you notice about the arrangement of the antennas? Are they in line with each other? If not, how is the signal being altered by the prism? (Think of the classic light through a prism experiment.)
11. Remove the prism and stand, and replace it with the metal plate with two slits in it. Use the metal piece that is curved at one end to cover one of the slits, and center the other slit on the base. Make sure that the plate is perpendicular to the transmitter as shown.



12. Now adjust the angle around the base. Do you get a signal even though the receiver isn't pointing directly towards the transmitter? Why do you think this is?
    Explain all results and observations in your report.