

California State University, Bakersfield  
ECE 3320 – Fields and Waves  
Lab 10–Microwave Propagation III

**Introduction:**

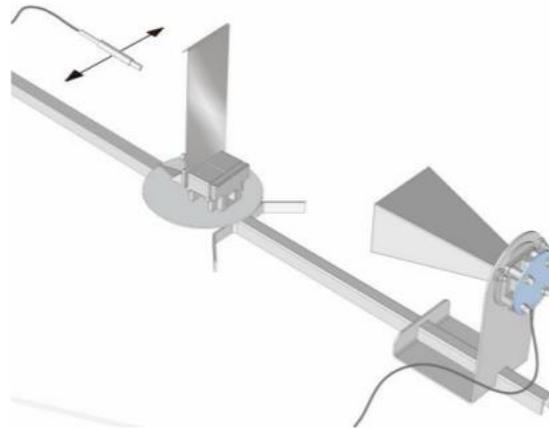
In this lab, we will demonstrate some of the fundamental properties of electromagnetic waves. We will be using a microwave transmitter and receiver to observe the effects of wave propagation and the various behaviors these waves can exhibit.

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.

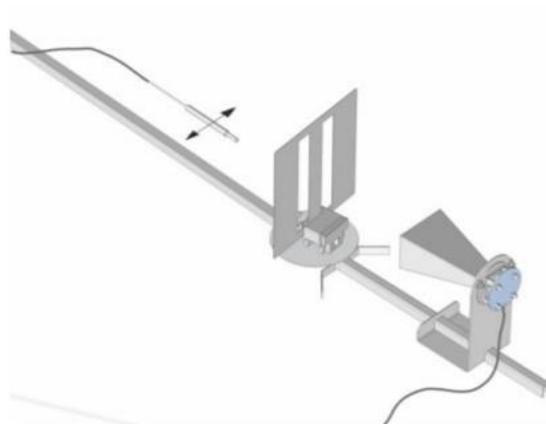
**Procedure:**

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. Place the transmitter antenna on the shorter end of the rail. Attach the cover plate (metal piece that is bent on one end) to the base and tighten the screw to hold it into place so that it is perpendicular to the transmitter.

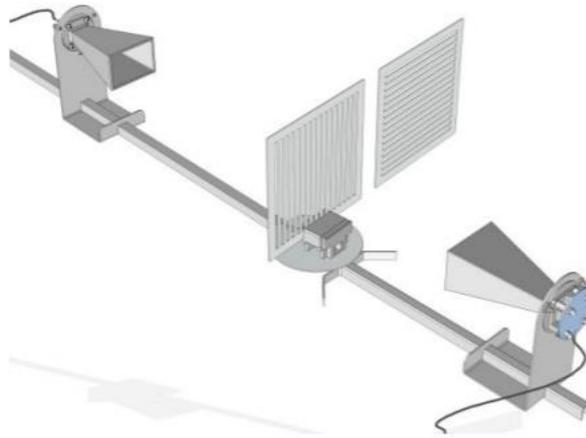


6. Now that all of the equipment is set up, we are ready to turn the equipment on. Turn on the transformer, and set the modulation switch to "INT".
7. Using the microwave probe, place it behind the cover plate. Adjust its position so that you get a signal. Is it possible to get a signal even though the transmitter is not in the line of sight of the probe? If so, why is this phenomenon possible?
8. Replace the cover plate with the metal plate with two slits in it. Ensure that the center of the slits is centered on the base.

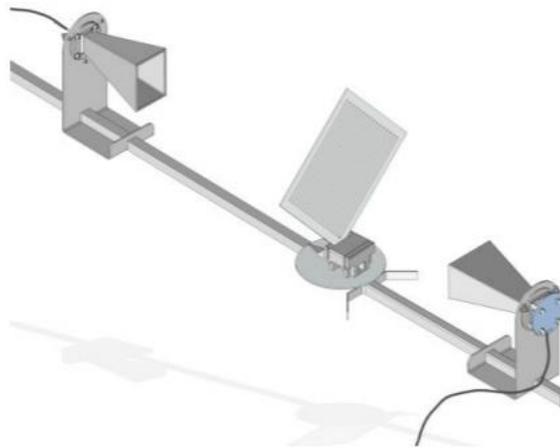


9. Using the microwave probe, measure the signal pattern behind the plate. Be sure to maintain a constant distance from the plate of about 6cm. What do you notice about the observed pattern? What causes this pattern?

10. Replace the double slit plate with the polarization grating. Remove the microwave probe and connect the receiver antenna. Place the receiver on the longer rail so that it is facing directly towards the transmitter.



11. Orient the polarization grating so that the slits are vertical. What do you observe?
12. Change the orientation of the grating so that the slits are horizontal. What do you observe now? Why is this different than your results with the slits vertical?
13. Adjust the polarization grating so that it is at a 45 degree angle. Also adjust the orientation of the antenna so that the longer side of the antenna is vertical as opposed to horizontal as shown.



14. What do you notice about the signal? Remove the polarization grating. What happens to the signal? What affect does the polarization grating have on the propagation of the signal?
15. Remove the polarization grating and return the receiver antenna to its default horizontal position. Next, connect the second BNC cable to the function generator. The banana plugs go into holes on the right side of the control box. Ensure the voltage is set to 1V RMS. Change the output waveform to a square wave. Now select a frequency between 200 Hz and 2kHz.

16. Change the modulation from "INT" to "EXT" on the control box and turn the speaker on. You should notice that the sound being played by the speaker matches the output of the function generator. You can also adjust the frequency of to change the pitch of the sound.
17. You will notice that even though the input signal is now different than the signal we were using previously, the antennas will exhibit the same behavior as before. Therefore, we can pass any signal into the system and expect to receive the same signal. What does this tell you about the usefulness of antenna systems for telecommunications?