Experiment # 8

EM WAVE RADIATION AND PROPAGATION OF A HORN ANTENNA

OBJECTIVE

To acquaint the students with the idea of polarization of electromagnetic (*EM*) waves and to introduce some microwave components. Also, the radiation patterns of a horn antenna will be measured.

EQUIPMENT REQUIRED

1. Microwave oscillator.
2. Attenuator.
3. Horn radiators (two).
4. Oscilloscope.

INTRODUCTION

Linearly polarized waves are radiated by a waveguide horn antenna, the direction of polarization being parallel to the narrow dimension of the waveguide feeding the antenna. The reason is that the waveguide field has only one electric field component parallel to the narrow wall of the guide. Because of this and by virtue of the principle of reciprocity such a horn can only receive waves of the same polarization as that it radiates, and so if the incident field is arbitrarily polarized the horn selects the components of the field aligned with its direction of polarization. If the only field component is perpendicular to the horn's direction of polarization, then the horn does not receive the incident field.

PROCEDURE

PART A: Demonstration of microwave components and EM wave radiation

1. The instructor will explain the different components of a microwave transmission and receiving components. This includes the oscillator, the attenuator, the waveguide, the horn antenna and the detector.
2. The instructor will also explain the basic concept of polarization.

PART B: EM wave polarization

1. Connect the circuit shown in Figure 1.
2. Align the two antennas for maximum reception. Adjust the received power to maximum reading on the meter.
3. Rotate the receiving antenna about its center (Figure 2) from –90 degrees to +90 degrees in steps of 10 degrees. In each setting, read the received power from the meter or the oscilloscope. (*Note: The oscilloscope may provide a finer resolution*).
4. Readjust the receiving antenna for maximum reception and repeat step (3) using the polarizing screen.

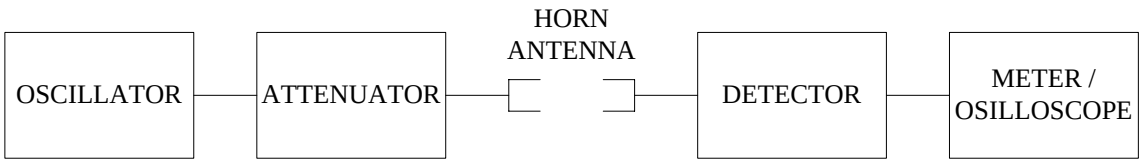


Figure 1: Experimental setup

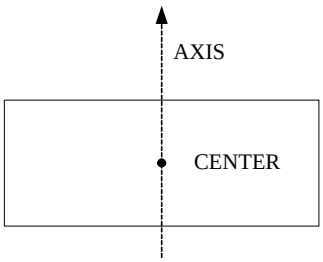


Figure 2: Front view of the receiving horn antenna

Table 1: Rotating Receiver about its Center

Angle (degree)	**V_{pp} (mV)**	**I (mA)**	**P (µW)**
-30			
-25			
-20			
-15			
-10			
-5			
0			
5			
10			
15			
20			
25			
30			

Table 2: Rotating Receiver about its Center using the Polarizing Screen

Angle (degree)	V_{pp} (mV)	I (mA)	P (µW)
-30			
-25			
-20			
-15			
-10			
-5			
0			
5			
10			
15			
20			
25			
30			

PART C: Radiation patterns

1. Connect the circuit shown in Figure (1).
2. Align the two antennas for maximum reception. Adjust the received power to maximum reading on the meter.
3. Rotate the receiving antenna about its axis (Figure 2) from –90 degrees to +90 degrees in steps of 10 degrees. In each setting, read the received power from the meter or the oscilloscope. (*Note: The oscilloscope may provide a finer resolution*).
4. Move the receiving antenna in a semicircle around the transmitting antenna from –90 degrees to +90 degrees in steps of 10 degrees. In each setting, obtain maximum reception and read the received power from the meter or the oscilloscope. (*Note: The oscilloscope may provide a finer resolution*).

Table 3: Rotating Receiver about its axis

Angle (degree)	V_{pp} (mV)	I (mA)	P (µW)
-90			
-80			
-70			
-60			
-50			
-40			
-30			
-20			
-10			

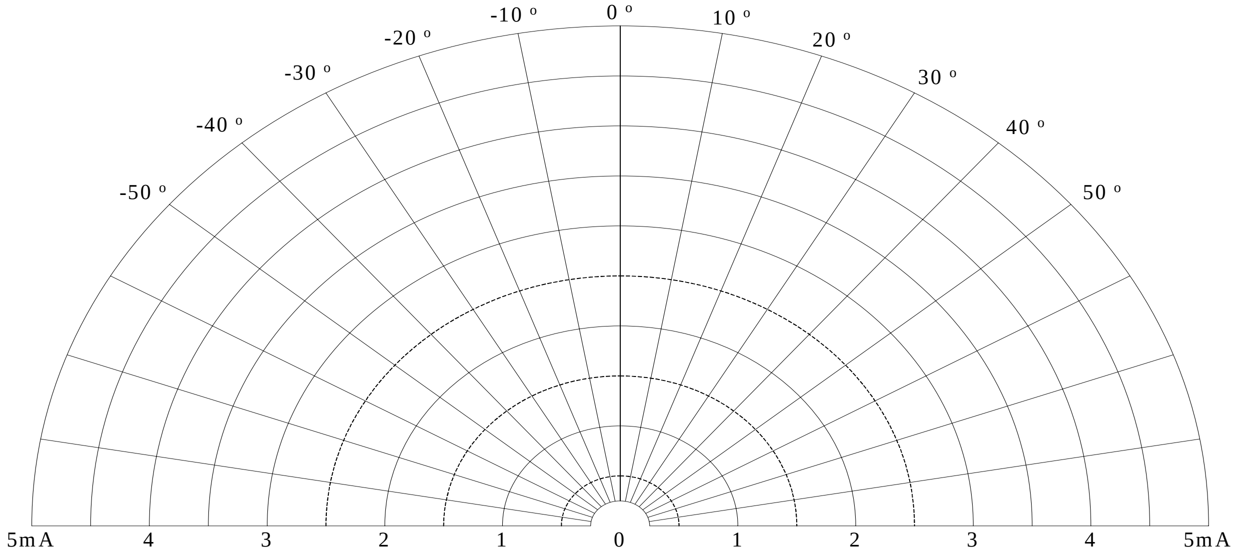
0			
10			
20			
30			
40			
50			
60			
70			
80			
90			

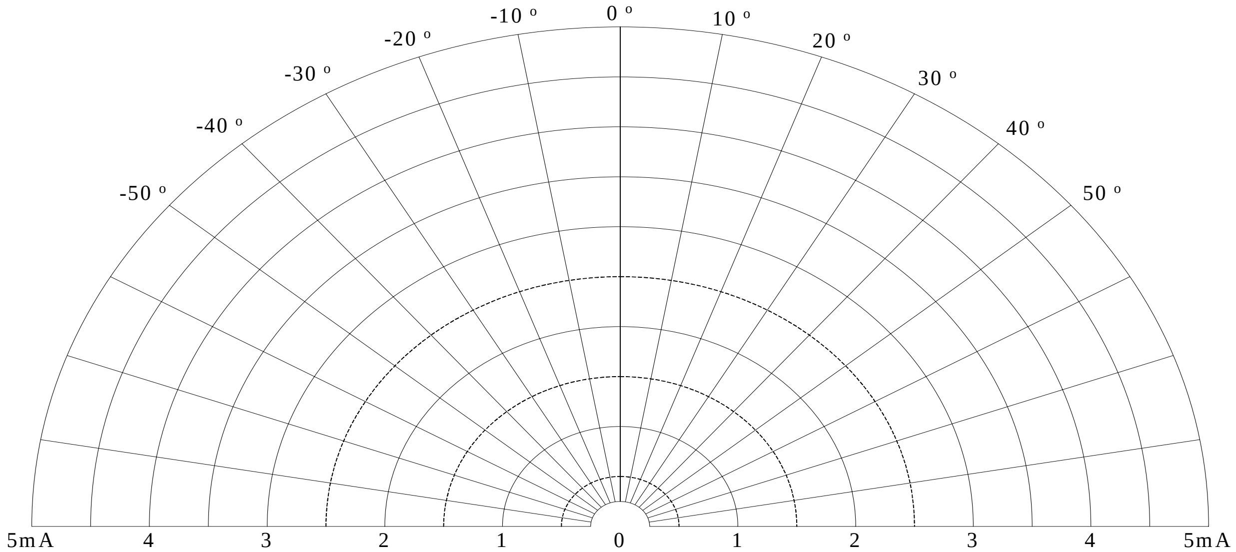
Table 4: Rotating Receiver in a semicircle around the tranmitter

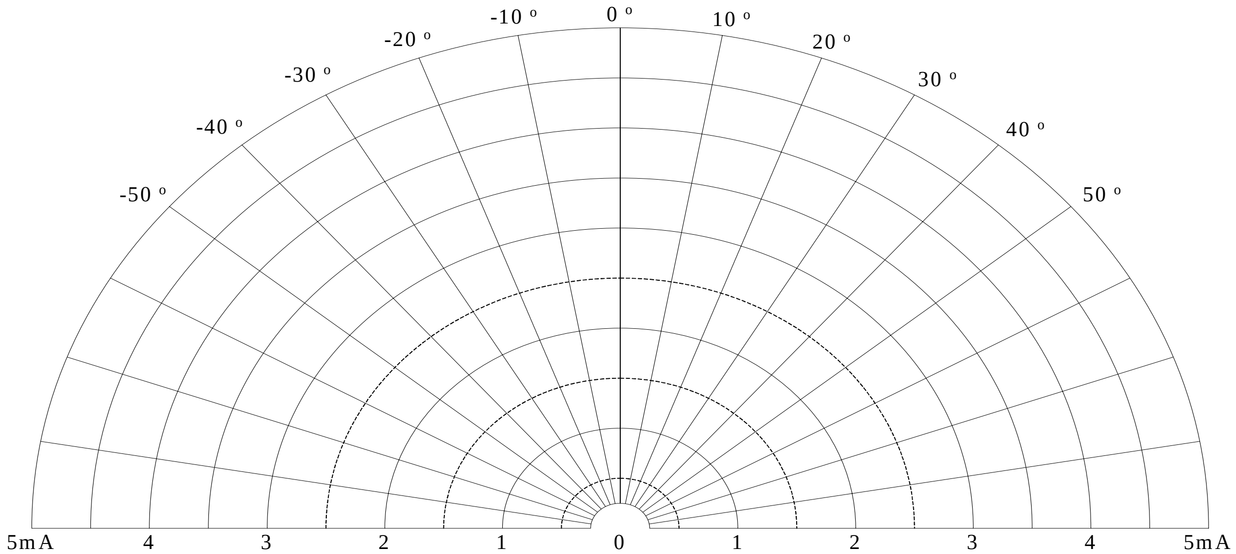
Angle (degree)	**V_{pp} (mV)**	**I (mA)**	**P (µW)**
-90			
-80			
-70			
-60			
-50			
-40			
-30			
-20			
-10			
0			
10			
20			
30			
40			
50			
60			
70			
80			
90			

QUESTIONS FOR DISCUSSION

1. Draw a normalized curve of your results in *PART B* on a polar plot (*provided).*
2. Explain the results with relation to polarization.
3. Draw normalized radiation patterns of the antenna using your results in *PART C* on a polar plot (*provided*). Discuss these curves.







Polar Plots for the Questions