實驗四　Microwave Polarization

Introduction

The microwave radiation from the Transmitter is linearly polarized along the Transmitter diode axis (i.e., as the radiation propagates through space, its electric field remains aligned with the axis of the diode). If the Transmitter diode were aligned vertically, the electric field of the Transmitted wave would be vertically polarized, as shown in Figure 4.1.If the detector diode were at an angle θ to the Transmitter diode, as shown in Figure 4.2, it would only detect the component of the incident electric field that was aligned along its axis. In this experiment you will investigate the phenomenon of polarization and discover how a polarizer can be used to alter the polarization of microwave radiation.

Procedure

1. Arrange the equipment as shown in Figure 4.3 and adjust the Receiver controls for nearly full-scale meter deflection.
2. Loosen the hand screw on the back of the Receiver and rotate the Receiver in increments of ten degrees. At each rotational position, record the meter reading in Table 4-1.
3. What happens to the meter reading if you continue to rotate the Receiver beyond 180-degrees?
4. Set up the equipment as shown in Figure 4.4. Reset the Receiver angle to 0-degrees (the horns should be oriented as shown with the longer side horizontal).
5. Record the meter reading in Table 4-2 when the Polarizer is aligned at 0, 22.5, 45, 67.5 and 90-degrees with respect to the horizontal.
6. Remove the Polarizer slits. Rotate the Receiver so the axis of its horn is at right angles to that of the Transmitter. Record the meter reading in Table 4-3. Then replace the Polarizer slits and record the meter reading with the Polarizer slits horizontal, vertical, and at 45-degrees.

Question

1. If the Receiver meter reading (M) were directly proportional to the electric component (E) along its axis, the meter would read the relationship

$M=M_0\cos\theta$ (where θ is the angle between the detector and Transmitter diodes and M_0 is the meter reading when $\theta=0$). (See Figure 4.2). Graph your data from step 2 of the experiment. On the same graph, plot the relationship $M_0\cos\theta$. Compare the two graphs.

2. The intensity of a linearly polarized electromagnetic wave is directly proportional to the square of the electric field (e.g., $I = kE^2$). If the Receiver's meter reading was directly proportional to the incident microwave's intensity, the meter would read the relationship $M=M_0\cos^2\theta$. Plot this relationship on your graph from question1. Based on your graphs, discuss the relationship between the meter reading of the Receiver and the polarization and magnitude of the incident microwave.
3. Based on your data from step 5, how does the Polarizer affect the incident microwave?
4. Can you explain the results of step 6 of the experiment? How cans the insertion of an additional polarizer increase the signal level at the detector? (HINT: Construct a diagram like that shown in Figure 4.2 showing (1) the wave from the Transmitter; (2) the wave after it passes through the Polarizer; and (3) the component detected at the detector diode.)

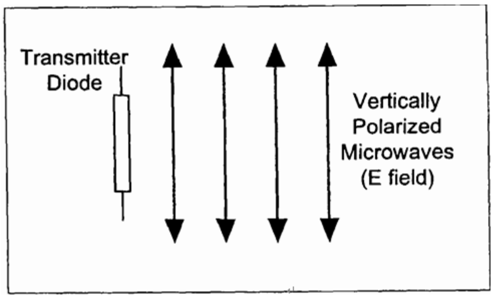

Fig 4-1

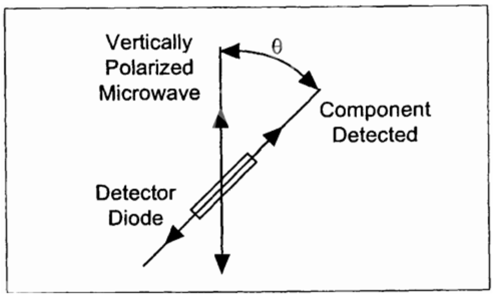

Fig 4-2

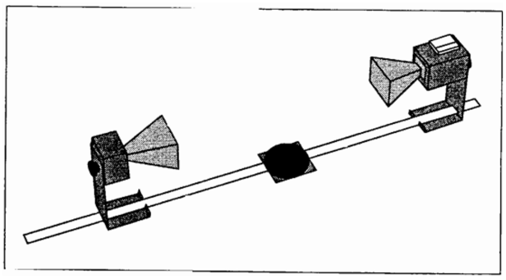

Fig 4-3

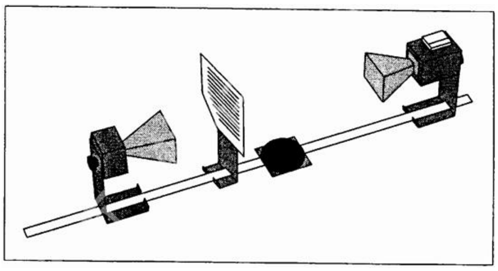

Fig 4-4

Table 4-1

Angle of Receiver	Meter Reading	Angle of Receiver	Meter Reading	Angle of Receiver	Meter Reading
0^o		70^o		140^o	
10^o		80^o		150^o	
20^o		90^o		160^o	
30^o		100^o		170^o	
40^o		110^o		180^o	
50^o		120^o			
60^o		130^o			

Table 4-2

Angle of Polarizer	Meter Reading
0^o	
22.5^o	
45^o	
67.5^o	
90^o	

Table 4-3

Angle of Slits	Meter Reading
Horizontal	
Vertical	
45^o	