Experiment Details

|  |  |
| --- | --- |
| Department Name | Electronics & Telecommunication |
| Class | T. Y.B.Tech |
| Semester | Vth |
| Subject Name | Antenna & Wave Propagation |
| Experiment No. | 01 |
| Experiment Name | To study radiation pattern of linear dipole. |

Version History

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Sr. No. | Version Number | Created By | Approved By | Date |
| 1 | v1.0 | Rani Bhendigeri | Mr. Eknath Patil | 10/10/2020 |
|  |  |  |  |  |

AIM:

To study the radiation pattern of linear dipole & to calculate different parameters of antenna.

THEORY:

Dipole Antenna

The Hertz dipole has a limitation that its radiation resistance is too small and consequently is not a very efficient radiator. In practice dipole antennas of lengths comparable to the wavelength are used. A dipole antenna of length 2H oriented in the z-direction with its center at the origin of the coordinate system is shown in Fig.



For these antennas since the length is comparable to the wavelength, the current distribution can not be uniform as we assumed for the Hertz dipole. The rigorous analysis show that the current distribution on a linear dipole antenna is sinusoidal with zero current at the ends of the antenna. The current distribution is given as



The radiation electric field due to the dipole can be obtained by dividing the dipole into small Hertz dipoles with appropriate currents and superposing their radiation fields with proper phase.

Assuming that , R>>H the total field at a point is given as



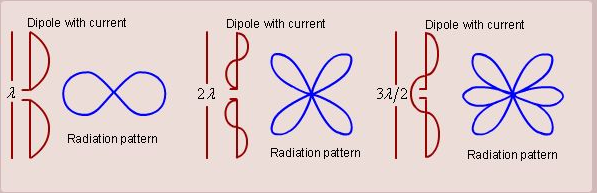
Where we have defined



The function F(θ) gives the variation of the electric field as a function of θ , and hence gives the E-plane radiation pattern of the dipole.

**Radiation Pattern of a Dipole Antenna**

The current distribution and the radiation pattern of dipoles of different lengths are shown in Fig.



Since the electric field is independent of , the H-plane radiation pattern is a circle which is same as that of the Hertz dipole.

The three dimensional radiation patterns for the dipole antennas of length are shown in Figs.



In general a dipole antenna has multiple beams and multiple nulls. Generally, finding the directions of the nulls is easier compared to finding the directions of the maximum radiation. We therefore obtain the directions of the nulls and place one maximum approximately half way between two adjacent nulls.The directions of the nulls can be obtained by equating F(θ) to zero. The directions of the nulls are



Where m = 0,1,2,3,…

**Half Wavelength Dipole antenna**

The most commonly used dipole is the half wavelength dipole.

This antenna offers many advantages like

(1) Reasonable size

(2) Radiation pattern with single maximum

(3) Manageable input impedance

A -dipole is shown in Fig.



For the -dipole .

The **current distribution on the dipole** is



The **radiation electric field** is given as



The radiation pattern for the dipole is shown in Fig.



The **total power radiated by the -dipole** is



Solving the integral numerically the total **radiated power and the radiation resistance** of the -dipole are

**The radiation resistance of the -dipole is about 73 ohms.** The dipole due to the near fields has a reactance of

about 34 ohms which can be removed by reducing the length of the dipole to about .

The -dipole dipole has an impedance which can be easily matched to 50 ohms using impedance transformers.

For the -dipole dipole we have following parameters:

Radiation pattern very similar to the dipole antenna

BWFN = 180 deg

HPBW = 78 deg

Directivity = 1.64 = 2.15 dB

Input resistance = 73.1 ohm

Effective Aperture = 1.15\*10-3



PRE TEST:

1. The standard reference antenna for the directive gain is the

a. Infinitesimal dipole

b. Isotropic antenna

c. Elementary doublet

d. Half-wave dipole

**ANSWER:b**

2. Which of the following antennas receives signals in the horizontal plane equally well from all directions?

a. Horizontal Dipole antenna

b. Vertical loop antenna

c. Vertical Yagi antenna

d. A vertical antenna

**ANSWER:a**

**3.** If the length of the antenna is changed from 2.5 meters to 2.8 meters, its resonant frequency will

a. Increase

b. Decrease

c. Depend on the velocity factor so the resonant frequency can either be increased or decreased

d. Will be unchanged

**ANSWER:b**

4. If the antenna current is doubled, the field strength at a particular position is

a. Doubled

b. Halved

c. Multiplied by a factor of four

d. Multiplied by a factor of 1.414

**ANSWER:a**

5. Directivity of antenna is defined as it is the ratio of

a. Pmax/Pd

b. Pavg/Pmax

c. Pmax/Pavg

d. Pd/Pavg

ANSWER:c

PROCEDURE:

Use HFSS simulator to perform this practical

POST TEST:

1. What is the beamwidth of a symmetrical pattern antenna with a gain of 30 dB as compared to an isotropic radiator?

a. 3.2 degrees

b. 6.4 degrees

c. 37 degrees

d. 60.4 degrees

ANSWER:b

2. HPBW of antenna is 30degree & antenna is unidirectional then how much will be the directivity of antenna?

a. 45.83

b. 50.2

c. 55.99

d. 40.5

ANSWER:a

3. Under which conditions of the polarization maximum power delivered to receiving antenna?

a. Perpendicular

b. Copolarization

c. Crosspolarization

d. Parallel

ANSWER:b

4. Linear polarization can be obtained only if the wave consists of \_\_\_\_\_\_\_\_

1. Ex

b, Ey

1. Both Ex & Ey & in phase
2. Both Ex & Ey & out of phase

ANSWER:c

5. If a half-wave dipole operates at 300 MHz with λ = 0.5m & D0 = 1.643, what will be its effective area?

a. 0.032 m2

b. 0.047 m2

c. 0.65 m2

d. 0.99 m2

ANSWER:a

REFERENCES:

1. Antenna for all Application-John D Kraus, third edition-TMH publication

2. Antenna Theory-Constantine A. Balanis -Third edition-Wiley Publication

3. Antennas and Wave Propagation–G. S. N. Raju (Pearson)