International Journal of Electrical, Electronics and Mechanical Controls

A Scientific and Scholarly Resource for Publication of Research Manuscripts

http://www.ijeemc.com

Volume 1 Issue 1 November 2012

EFFECT OF CENTER FREQUENCY ON THE DIRECTIVE GAIN AND BANDWIDTH OF AN ANTENNA

Pushpa U.S. *Smita Chopde*

Department of Electronics and Telecommunications, Vashi, Navi Mumbai 400703,India

Department of Electronics and Telecommunications

pushpa_us@rediffmail.com *chopde.smita@gmail.com*

Abstract-For a given center frequency fc, the directive gain and the bandwidth is found out for classical, printed and micro-strip antennas. The classical antennas considered are dipole, quad and square loop(narrow band antennas). The printed antennas considered are slot, spiral(broadband) and the dipole(narrowband). The micro-strip antenna considered is circularly polarized (narrowband antenna).

INTRODUCTION

Antenna is a metallic structure which can transmit and receive electro-magnetic energy. Depending on the construction, they can be classified into three categories namely a) Classical b) Printed and c) Micro-strip. Some of the Classical antennas are Monopole, Dipole, quad, Loop, helical, planar disc etc. Printed antennas can be of the following types like YagiUda, Log-Periodic, slot, dipole, Spiral etc. The Micro-strip can be Broad side, End fire, compact, circularly polarized, rectangular suspended and Rectangular etc.

Monopole antennas have a single conductor and their radiation pattern is half of the dipole antenna. The beam width is half of the dipole antenna. These are mostly used in broad band radio and mobile communications. The dipole antennas have two conductors and they are most widely used antennas may be as the radiators of yagi-uda antenna or as the rabbit ears of a portable television etc. The loop antennas may take different forms like square, rhombic or circular etc. These are mainly used in television communications.

Yagi-Uda antennas have a folded dipole antenna, reflector and many directors to constitute an array antenna. These are too directional antennas and mainly used for television communication. The log-periodic antennas have a wide band width. They produce two kinds of radiation patterns such as at low frequency of 700MHz and at higher frequency of 1.25GHz. The radiation pattern of an antenna is basically a plot of radiation intensity as a function of direction.

International Journal of Electrical, Electronics and Mechanical Controls
A Scientific and Scholarly Resource for Publication of Research Manuscripts

http://www.ijeemc.com

Volume 1 Issue 1 November 2012

The Micro-strip antenna is basically a metallic patch on some substrate and are the recent inventions. They find their main applications in high performance aircrafts, space crafts, missiles, satellites etc. due to their small size, less weight, low cost, ease of installation, aero dynamic profile constraints, ruggedness, less maintenance etc. For government applications and commercials like mobile, radio and wireless communications also micro-strip antennas are necessary.

Some of the Classical, Printed and Micro-strip antennas are shown in the below given figures.The radiation pattern of some of the antennas is shown in Fig.4

a)Dipole b)Quad c) Square loop

Fig.1 Classical antennas

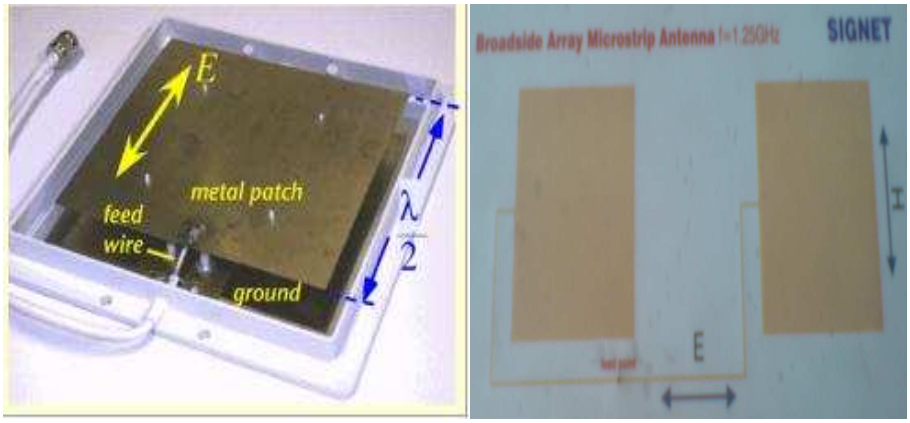
a) Slot antenna b) Log spiral c) Dipole

International Journal of Electrical, Electronics and Mechanical Controls
A Scientific and Scholarly Resource for Publication of Research Manuscripts

http://www.ijeemc.com

Volume 1 Issue 1 November 2012

Fig.2 Printed antennas



a) Square patch b) Broad side array antenna

Fig.3 Micro-Strip antennas

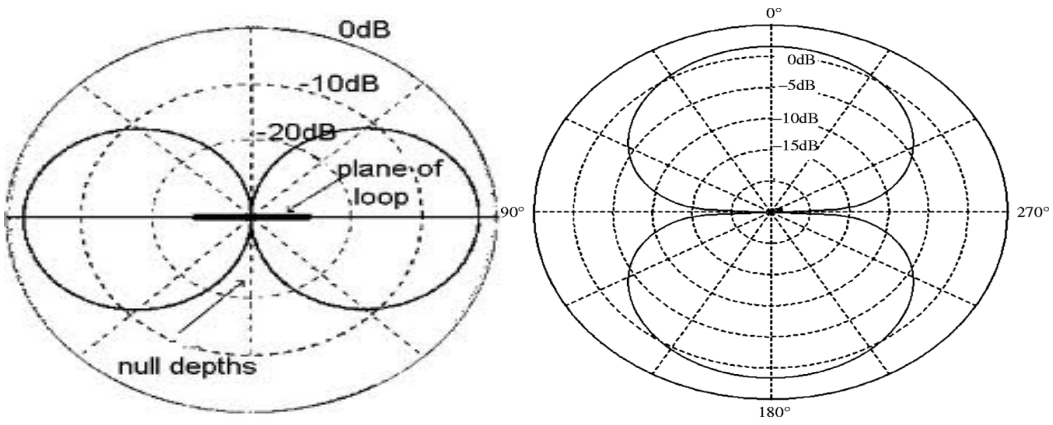


Fig.4 Radiation pattern of loop and spiral antennas

International Journal of Electrical, Electronics and Mechanical Controls
A Scientific and Scholarly Resource for Publication of Research Manuscripts

http://www.ijeemc.com

Volume 1 Issue 1 November 2012

The classical antennas have a feature that their conductors are free in the space whereas the micro-strip and printed have their metallic parts or radiators attached to their substrate. Irrespective of the type of application of antennas or antenna system, all the antennas have certain fundamental features like radiation pattern, radiation intensity, polarization gain, directivity power gain, efficiency, effective area, front to back ratio, beam width and band width etc. In this paper the directive gain or directivity has been tested and discussed.

The directivity is defined as the ratio of the radiation intensity in a given direction to the average radiation intensity of an antenna. The front to back ration is the ratio of the radiation intensity in the forward direction to the radiationintensity in the opposite direction. The beam solid angle is that angle through which all the energy from an antenna is radiated into the free space, if its radiation intensity is constant for all the angles within the beam solid angle. The beam width is the angular width in degrees measured on the major lobe of the radiation pattern between the points where the radiated power has fallen to half its maximum value. The beam width mainly decides the directional capability of any antenna, like more the beam width lesser is the directional capability that is smaller is the range of an antenna.

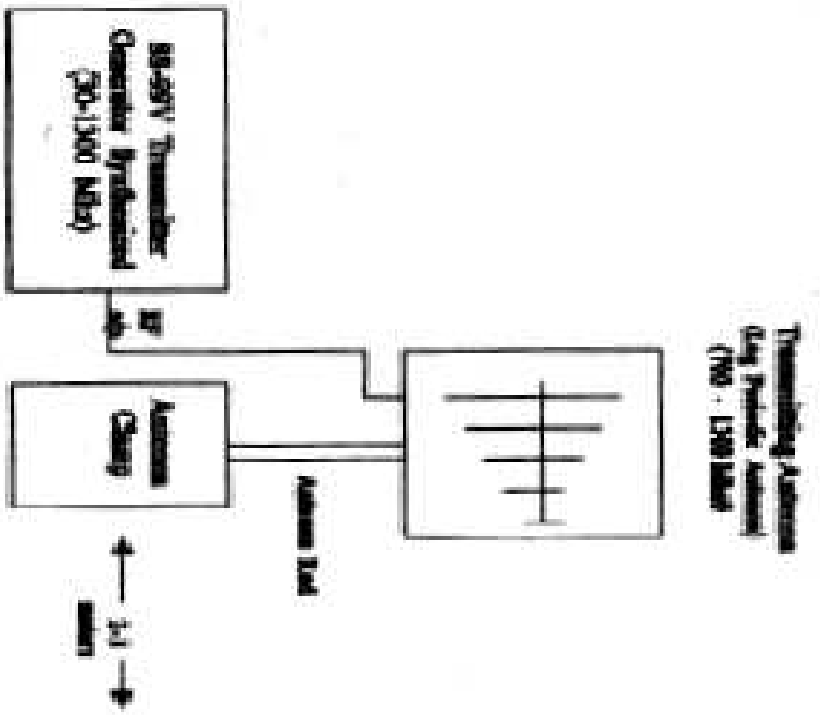
ANALYSIS

An experiment is conducted on the above three kinds of antennas at a frequency of 800 MHz and 1.25GHz for classical and printed or micro-strip antennas respectively using Antenna System Trainer to get the radiation pattern in the various directions i.e. from 0^0 to 360^0. From the radiation pattern graph the directivity has been found out and tabulated as in Table no.1. The experimental set up for this is shown in Fig.5

International Journal of Electrical, Electronics and Mechanical Controls
A Scientific and Scholarly Resource for Publication of Research Manuscripts

http://www.ijeemc.com

Volume 1 Issue 1 November 2012



International Journal of Electrical, Electronics and Mechanical Controls
A Scientific and Scholarly Resource for Publication of Research Manuscripts
http://www.ijeemc.com
Volume 1 Issue 1 November 2012

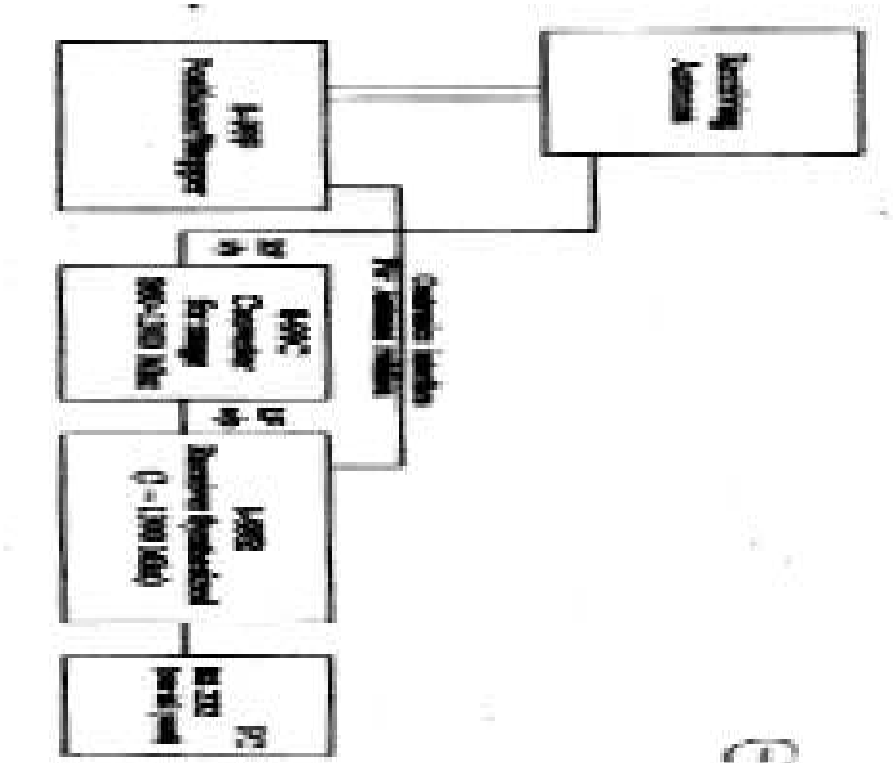


Fig.5 The experimental set up of Antenna System Trainer

The center frequency for a narrowband antenna is defined by

$f_c=(f_1-f_2)/BW$

For a broad band antenna the fc is given by

$f_c=(f_+f_2)/2$; *BW is the bandwidth*

f_1 *is the higher cutoff frequency and* f_2 *is the lower cutoff frequency*

RESULTS

Table No.1

International Journal of Electrical, Electronics and Mechanical Controls
A Scientific and Scholarly Resource for Publication of Research Manuscripts

http://www.ijeemc.com

Volume 1 Issue 1 November 2012

Type of antenna	Directivity		
Classical	dipole	quad	Square loop
	1.024	1.09	1.08
printed	dipole	slot	spiral
	1.01	1.04	1.08
Micro strip	Circularly polarized square patch		
	1.067		

Table No.2

Type of antenna	Bandwidth		
Classical	dipole	quad	Square loop
	18%	11%	10%
printed	dipole	slot	spiral
	11%	1150-1300MHz	600-1300MHz
Micro strip	Circularly polarized square patch		
	4.5%		

It is observed from the results that at a given center frequency, the directivity is almost the same for the classical, printed and micro-strip antennas. The bandwidth is varying between 4.5% and 18% for narrowband antennas and 600MHz to 1300MHz for broadband antennas. It is observed that the bandwidth is minimum for circularly polarized micro-strip antenna and maximum for dipole classical antenna.

CONCLUSION

It is necessary to find the above features since it is useful in deciding the directional capability of an antenna which is important in the design of antennas depending on the application.

REFERENCES

International Journal of Electrical, Electronics and Mechanical Controls
A Scientific and Scholarly Resource for Publication of Research Manuscripts

http://www.ijeemc.com

Volume 1 Issue 1 November 2012

[1] Constantine A. Ballanis,*Antenna Theory, Analysis and* Design , Second Edition
[2] K. D. Prasad, *Antenna and wave propagation*
[3] Antenna System Trainer Manual from IIT,Bombay