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Comparative Study of Radiation Pattern of Some Different Type Antennas

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ABSTRACT

In this we report radiation pattern of some important antennas as well as area covered by them. The paper starts by giving the reader a refresher on antenna pattern parameters and then shows typical patterns for the most common antennas used in EMC. As the improvements on the communication and navigation systems of aircrafts go on, new edge cutting technologies are developed and new approaches to the system components are required. The antenna represents the interface between the transmitted and/or received microwaves traveling on free space and the signal processing hardware and software. Optimizing the antenna characteristics can lead to great improvements to the overall system performance, like lower noise figures, suppressed multipath and interference signals and higher signal levels, i.e. better accuracy, better aerodynamics, lighter weight, etc. The peak value of radiation for A1 dipole L/2 antenna is typically 63.2 dB µA at 95^0. For A6 telescopic antenna the value of high radiation along space is 54.9 µA at 75^0. A2 folded dipole L/2 antenna and A6 telescopic antenna shows similar directional property along at an angle 75^0 of 360^0 space. There is very low variation in radiation pattern for A4 loop L/4 antenna along 360^0.

Key words: Antennas, Radiation pattern, Beamwidth

1. INTRODUCTION

At present, wireless market is grown rapidly therefore, new technologies being investigated to enhance the performance and its applications in the available spectrum. Smart antennas with controllable directionality are one of the promising candidates which allow higher reuse of channels and system performance. Basically, antennas are metallic devices in the form of wires, discs, or horns, whose main purpose is to receive or transmit electromagnetic waves from one place to other. Antennas are designed for the purpose to deliver/receive power from one specified direction to other specified direction and they should work satisfactorily within a specified frequency range (bandwidth) of the electromagnetic spectrum. When used as a transmitter, the antenna is excited electrically and can radiate electromagnetic waves into the open space depending on such specified requirements as directivities, half-power beam widths, and main-lobe to side-lobe power ratios,' different types of antennas can be selected. The geometric and excitation parameters of the antennas depend on their design. Mathematical expressions are readily available to describe the radiation patterns of most antennas, but approximate solutions are frequently used to describe such antenna characteristics as beam width and main-lobe to side-lobe power ratio.'

An antenna radiation pattern or antenna pattern is a mathematical function or a graphical representation of the radiation properties of the antenna as a function of space coordinates [1]. That is, as we rotate the antenna around on two orthogonal axes we measure the intensity of the radiated field. To facilitate the graphical representation of radiation patterns, we usually plotted two single orthogonal planes of the pattern. Rather than arbitrarily plot a plane for a given angle of the spherical coordinate system.

Optical antennas have fascinated scientists because of their ability to manipulate light beyond the diffraction limit [2, 3]. Such an achievement has enabled scientists to overcome technological barriers and enhance the properties antennas near field imaging [4], solar cells [5], nanolithography [6], optical data storage [7], heat assisted magnetic recording [8], light emitting devices [9], spectroscopy [10], medical applications [11], and bio-chemical sensors [11]. Optical antennas with unidirectional far-zone radiation patterns play an important role for photovoltaic devices, in which antennas have been utilized to improve the energy conversion efficiency [5, 13]. One important factor that needs to be addressed to improve the performance efficiency is the mismatch between the directionality of the incident.

Therefore, in this paper a systematic study of radiation pattern of different type antennas are compared and presented.

2. EXPERIMENTAL DISCRIPTIONS

In most cases the measured pattern is good enough to give the user of the antenna an idea of the coverage. Therefore we have used ATS-B antenna system for measurements.For studying the characteristics of an antenna we need two sections namely, transmitting section and receiving section shown in figure1.

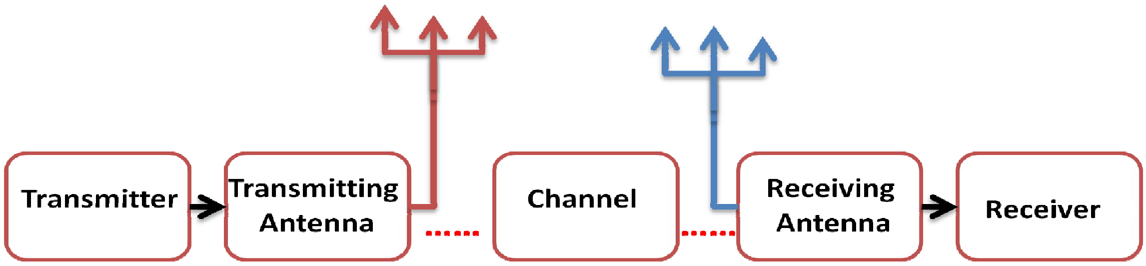

Figure: 1 Experimental block diagram.

The receiver which is used for the measurement of RF signal level with high accuracy and repeatability within the frequency range 750 MHz to 800 MHz. Each data have been taken with the difference of 5 degree. The specification of receiver is given below-

- Frequency Range: 750 MHz to 850 MHz
- Input Impedance: 75 ohm nominal
- Level resolution: 1 dB
- Level range: > 55 dB
- Level accuracy: 2 dB at 75 ohm.
- Level array: array of 72 points for strong polar dB µV.
- Power: 230 V AC rms ± 10%, 50 Hz

Transmitting source with frequency range 750 MHz to 850 MHz and variable source with nominal output below 150 dB µV at 75 ohm have been used.

3. RESULTS & DISCUSSION

3.1 Radiation Pattern

Radiation pattern of an antenna is a mathematical function or a graphical representation of the radiation properties of the antenna as a function of space coordinates. As we rotate the antenna around on two orthogonal axes we measure the intensity of the radiated field. If we look at a radiation pattern we observe a series of features. There is going to be an area of the pattern where most of the radiation is directed. That is the main lobe. To the sides of the main lobe we may find areas where the radiation is higher than the adjacent areas. These are side lobes. The side lobes are usually separated by areas of little radiation called nulls. There is usually a side lobe in the direction opposite the main lobe. This special side lobe is known as the back lobe. Figure 2 shows a typical plot between magnitudes of radiation from an antenna versus direction of (a) A2 folded dipole L/2 (b)A1 dipole L2 (c) A6 Telescopic (d) A4 Loop L/4.

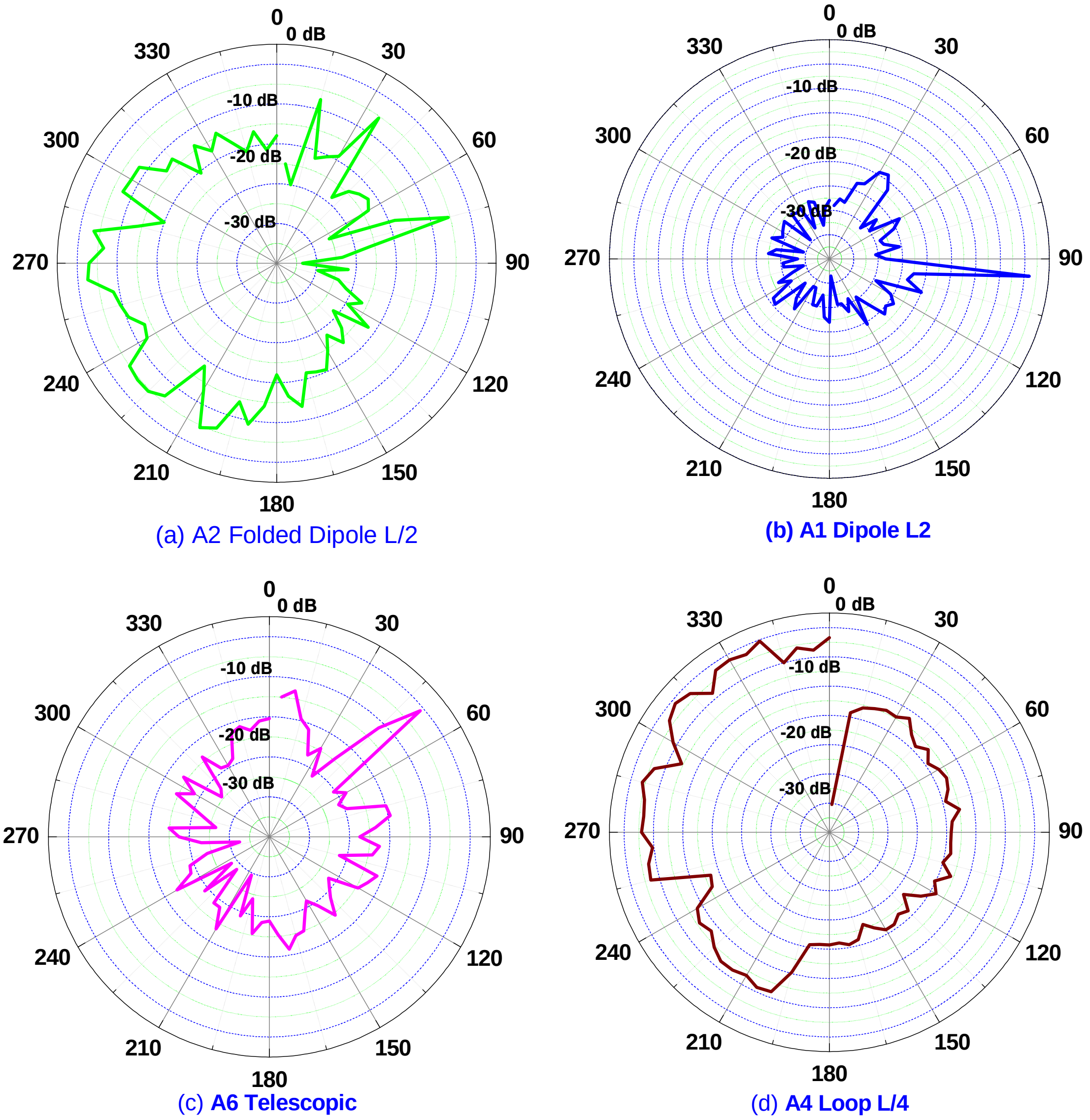

Figure: 2 Shows radiation pattern of (a) A2 folded dipole L/2 (b)A1 dipole L2 (c) A6 Telescopic (d) A4 Loop L/4.

From figure, it is clear that the radiation patterns of three antennas in same conditions are very close to each other. It also has been observed that in antenna A1 dipole L/2, the radiation value is very high than other two antennas. The peak value of radiation for A1 dipole L/2 antenna is typically 63.2 dB µA at 95^0 whereas that values for A2 folded dipole L/2 antenna is 53.6 dB µA at 75^0. For A6 telescopic antenna the value of high radiation along space is 54.9 µA at 75^0. A2 folded dipole L/2 antenna and A6 telescopic antenna shows similar directional property along at an angle 75^0 of 360^0 space. There is very low variation in radiation pattern for A4 loop L/4 antenna along 360^0.

3.2 **BEAMWIDTH**

Figure 3 shows beam width variation for different antennas. The beam width Depends on the radio system in which an antenna is being employed there can be many definitions of beam width.

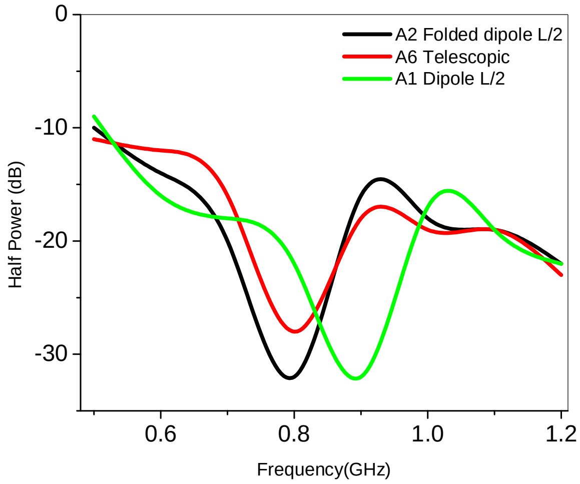

Figure: 3 Shows beam width variation for different antennas.

A common definition is the half power beam width (HPBW). The peak radiation intensity is found and then the points on either side of the peak represent half the power of the peak intensity are located. The angular distance between the half power points traveling through the peak is the beam width. Half the power is -3dB, so the half power beam width is sometimes referred to as the 3dB beam width. Another important fact is that the HPBW, like any other pattern parameter, is a free space, far field parameters. The beam width will give us an idea of the area covered by antennas.

4. CONCLUSIONS

The radiation patterns of three antennas namely A2 folded dipole L/2, A1 dipole L/2 and A6 Telescopic in same conditions are very close to each other. It also has been observed that in antenna A1 dipole L/2, the radiation value is very high than other two antennas. The peak value of radiation for A1 dipole L/2 antenna is typically 63.2 dB µA at 95^0. For A6 telescopic antenna the value of high radiation along space is 54.9 µA at 75^0. A2 folded dipole L/2 antenna and A6 telescopic antenna shows similar directional property along at an angle 75^0 of 360^0 space. There is very low variation in radiation pattern for A4 loop L/4 antenna along 360^0. Variation of beam width is similar as for found in common antennas.

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