DESIGN AND ANALYSIS OF DUAL FREQUENCY PENTAGON SHAPED SLOTTED MICRO STRIP PATCH ANTENNA USING HFSS SOFTWARE

CH SURESH KUMAR,
Assistant Professor in ECE, Geethanjali College of Engineering and Technology, Cheeryal

RVNR SUNEEL KRISHNA,
Assistant Professor in ECE, Geethanjali College of Engineering and Technology, Cheeryal

K AMITH NARAYANA,
Student,Department of ECE, Geethanjali College of Engineering and Technology, Cheeryal.

G UDAY BHASKAR YADAV,
Student,Department of ECE, Geethanjali College of Engineering and Technology, Cheeryal.

NAGAM SRIKANTH
Student,Department of ECE, Geethanjali College of Engineering and Technology, Cheeryal.

ABSTRACT

In this paper we give the design and analysis of dual frequency microstrip patch antenna. Instead of basic rectangular microstrip patch we introduce a pentagonal slot on the rectangular patch to get perfect impedance matching. Design and Simulation is performed using HFSS software. Obtained results reveal that, choosing a 50 ohm coaxial feed at perfect position the antenna operates at frequencies 7.95GHz and 9.48GHz respectively with corresponding bandwidths of 260MHz and 300MHz.

Different antenna parameters are measured and are compared in contrast with the single pentagonal slot microstrip patch antenna. The antenna has good resonance characteristics.

KEYWORDS:*Microstrip patch antenna, Dual frequency, coaxial feed.*

1. INTRODUCTION

Nowadays the most developing ways of communication is wireless communication. Antennas play a major role in wireless communication. They act as both transmitters and receivers. So, antenna performance is directly proportional to the efficiency of wireless communication.

In the 1970s antenna technology was looking towards microstrip antennas. By the early 1980s the fabrication of microstrip antenna became quite popular.During the past ten years printed antennas have been largely studied. The advantages of the microstrip antenna is its highly stable structure, less weight, different feeding methods, small size, cost efficiency, compatibility with devices. A general microstrip patch antenna consists of a radiating patch on top of dielectric substrate and a ground plane on the bottom of the substrate. The patch is generally made of conducting material such as copper or gold. The patch is generally made up of a conducting material such as copper or gold and can take any possible shape like rectangular, circular, triangular, and elliptical or some other common shape. The radiation in microstrip antenna is mainly due to fringing fields between the patch edge and the ground plane. In the contacting method, the RF power is fed directly to the radiating patch using a connecting element such as a Micro strip line or probe feed. In the non-contacting scheme,

electromagnetic field coupling is done to transfer power between the Micro strip line and the radiating patch this includes proximity feeding and aperture feeding. They can be designed to have many geometrical shape. Recently even after the introduction various types and shapes of patches rectangular and circular Micro strip resonant patches have been used extensively in many applications.

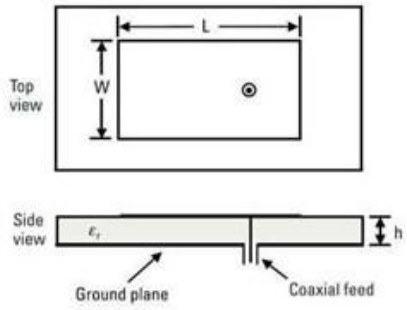

Figure 1: Micro strip patch Antenna

2. MICROSTRIP PATCH ANTENNA

The structure of the proposed antenna is shown in Figure 2.

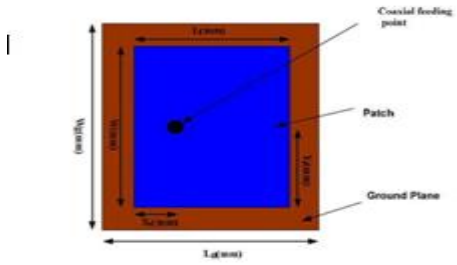

Figure 2: Dimensions of Rectangular patch Micro strip Antenna

Where,

L= length of the patch
W=width of the patch
L_g=length of substrate
W_g=Width of substrate
X_f=feed point on x-axis
Y_f=feed point on y-axis

The dielectric substrate used is Taconic TLT. Its dielectric constant is 2.55. Thickness of the substrate is 0.8mm. Length of the substrate is 1.55cm, Width of the substrate is 1.66cm, Length of patch is 8.9mm, Width of patch is 11mm. The location of the feed point is 2.7mm by 2.2mm on the patch.

3. PHYSICAL PARAMETERS OF ANTENNA

Antenna parameters can be calculated by the transmission line method.

3.1. Width of the patch

The width of the antenna can be calculated by the formula:

$$W = \frac{C}{2f_0\sqrt{\frac{\epsilon_r+1}{2}}}$$

3.2. Length of the patch

Length of the patch is given by

$$L = \frac{\lambda_0}{2} - 2\,\delta L$$

Where, δL is the dimension of the patch along its length that has been extended on each end.

3.3. Feed point

The feed position is given by (X_f, Y_f) where
X_f and Y_f are given be equations:

$$X_f = \frac{L}{2\sqrt{\varepsilon_{reff}}}$$

And

$$Y_f = \frac{W}{2}$$

3.4. Ground Plane Dimension

The ground plane dimensions is given by

$L_g = 6h + L$
$W_g = 6h + W$

3.5. Antenna Dimensions

The designed parameters and its dimensions are given in table 1:

Table. 1: Antenna dimensions

Parameters	Dimensions
Length	8.9mm
Width	11mm
Thickness	0.8mm
X size	2.7mm
Y size	2.2mm

4. SIMULATION RESULTS

The antenna is designed using ansoft HFS simulator and the designed antenna is shown in figure 3.

4.1. Radiation Pattern

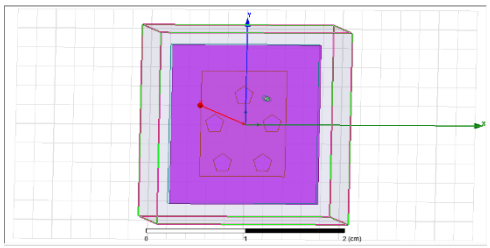

Figure 3: Design of Pentagonal slotted Micro strip patch Antenna

The 3D radiation pattern obtained for the designed antenna is shown in figure 4:

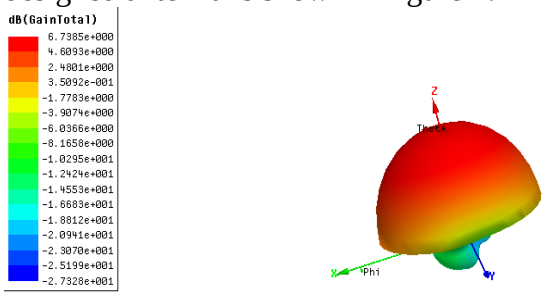

Figure 4: The 3D radiation pattern

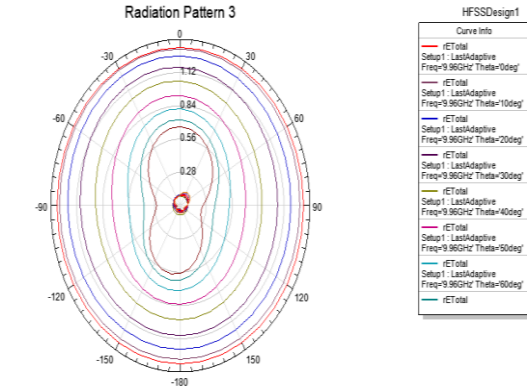

Figure 5: The radiation pattern

4.2. Rectangular Plot

The rectangular plot for the micro strip patch antenna is shown in figure 6. It shows that the designed antenna operates at two frequencies.

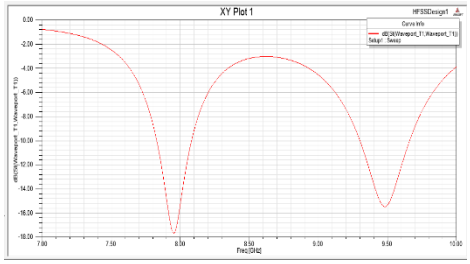

Figure 6: Rectangular plot

4.3. Comparison Table

The obtained parameters of the designed antenna are compared with various other antennas and the comparison results were furnished in table 2.

Table 2: Comparison Table

Properties	Single Pentagon Slot	Pentagon shaped pentagon slots
Operating Frequencies	7.5GHz, 9.11GHz	7.95GHz, 9.48GHz
Gain	8.64dB, 7.86dB	17.1dB, 15.2dB
Bandwidth	7.3GHz-7.9GHz, 8.55GHz-9.6GHz	7.82GHz-8.08GHz, 9.3GHz-9.6GHz

5. CONCLUSION

A pentagonal slotted microstrip patch antenna operates across two different frequencies. The lowest resonant frequency is 7.95GHz with bandwidth 7.82GHz-8.08GHz and highest resonant frequency is 9.48GHz with bandwidth 9.3GHz-9.6GHz.The simple feeding technique is used for the design of this antenna that makes this antenna a good choice in many communication systems in future.

The designed antenna is verified for its performance using Ansoft HFSS simulator and various parameters have been obtained.

REFERENCES.

[1] LV HONG, Hua ZhiXiang, Sun Dengzhi, “DESIGN OF DUAL-BAND MICROSTRIP ANTENNA” , IEEE 2016 978-1-5090-4743-7/16.

[2] P Naresh Kumar, CH Suresh Kumar, RVNR Suneel Krishna, ”DESIGN AND ANALYSIS OF HIGHLY MINIATURIZED WIDE BAND PATCH ANTENNA”, Anveshana’s International Journal of Research in Engineering and Applied Sciences, VOL 3 ISSUE 2 (2018 FEB) ISSN-2455-6602.

[3] Andrenko, I. Ida, T. Kikuzuki, "Dual-band patch antenna with monopole-like radiation patterns for BAN communications", 7th European Conf. on Antennas and Propag. (EuCAP), pp. 1922-1926, 2013.

[4] Zhen-Hua Huang. Miniaturization of multifrequency research and design of microstrip antenna[D]. Shanghai Jiao Tong university,2007.

[5] Y. J. Wang & C. K. Lee, Design of dual-frequency microstrip patch antennas and application for IMT-2000 mobile handsets, Progress In Electromagnetics Research, PIER 36, 265-278,2002.

[6] Indra Surjati, "Dual Frequency Operation Triangular Microstrip Antenna Using A Pair of Slit, " 2005 Asia-Pacific Conference on communications, Perth Western Australia, 3-5, pp.124-126, October 2005.