

A Multiband Monopole Antenna with Slots Optimization for Wireless Communication System (Wi-Fi/WLAN/WiMAX) Applications

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Abstract:

In this paper, A Multiband Slotted Microstrip Antenna with DGS (Defect Ground Structure) is designed and is characterized by multiband with increase in Modified Slotted Structure using Ansoft HFSS antenna simulation software. This paper focuses on the designing of miniature microstrip antenna with coaxial probe feed and modifying its patch and ground plane to achieve increase in number of bands so that it can be used for various wireless applications like Wi Fi/ WLAN/ Wi Max etc. The unique feature of these antennas is its compact and small size. The multi frequency miniature patch antennas have been designed for the frequency ranging from 2.5 GHz to 5.5 GHz using co-axial probe feeding.

Keywords — DGS, Multi band, Microstrip Antenna, Modified Structure Resonator, WLAN, IEEE802.11a/b/g

I. INTRODUCTION

Recently, the necessity for the design of an antenna having multiband operation has increased since such an antenna is necessary for integrate more than one wireless communication standard in a single compacted system to effectively promote the portability of a current individual wireless system. For this order, the developed antenna must not only be with a multiband operation but also have a plain structure, compressed size, and effortless integration with the circuit. Among the known multiband antenna prototypes, the planar antenna with various structures has become a common aspirant because of its attractive characteristics include low shape and lightness, low cost, and flexible structure for exciting wide

impedance bandwidth or multi significance mode, and desirable radiation characteristics [3].

However, the complexity in designing antenna challenges like when the sizes of the antenna reduce and the number of working frequency bands increase. So far, for size reduction, bandwidth enhancement, and resonance-mode increment, many antennas have been proposed by employ. Various promising feed structures such as the coaxial probe, the microstrip feed, and the coplanar waveguide (CPW). In these presented monopole antennas, a large solid ground plane having the shape of a rectangle with slots, circle, or ellipse is usually adopt. Different from this, a prominent ground structure named defect ground structure (DGS) has recently been investigate and found to

be a simple and efficient method to reduce the antenna size as well as incite additional resonance modes [4]. Designing of antenna in this paper is done by HFSS antenna software simulation, with the standard parameters like permittivity of $\epsilon_r=4.4$, probe feed, tangent loss of 0.02 and overall 50 x 50 mm ground plane.

II. DESIGN PARAMETERS

The design of a slotted microstrip antenna (Antenn1,2 3, 4 and 5) using coaxial probe feeding technique satisfying the given specifications: As for the substrate selection, the major thought will be the dielectric constant. A high dielectric will result in a small patch size but this will normally reduce bandwidth efficiency and might have difficulty in fabricating a very small patch size antenna. The conventional microstrip antenna is miniature in size the overall dimension of the 50 mm X 50 mm in length and width with the patch dimension of 34 x 38 mm provides the one of the objective of compact size. The probe feed is at distance of 2.45 mm.

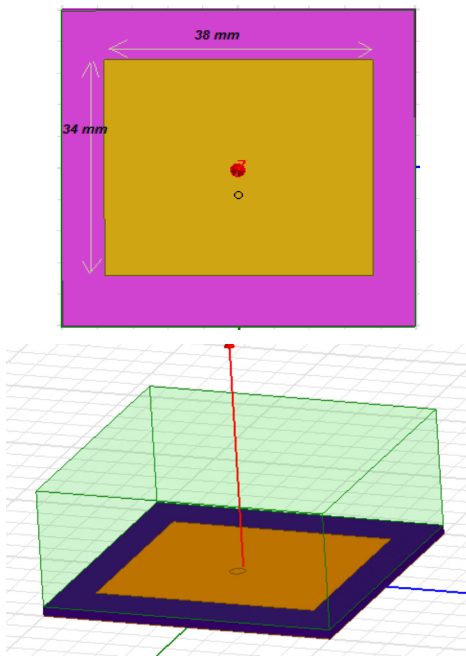


Figure 1. The conventional patch antenna

As shown in Figure 1, the conventional patch antenna.

Patch Dimensions:

L=38 mm; W=34 mm; $\epsilon_r=4.4$;

Tangent Loss = 0.01

Feed Line Dimensions:

Radius = 1.3 mm

Ground Plane: 50x50 mm

Feed: Co-axial probe feed (wave port)

DGS Dimensions (mm) :

$L_p=14.22$

$\rho=2.45$

$g=6$,

$w_1=9$,

$a=4$,

$t=2.89$,

$d=1.3$,

$h=1.575$

With the above parameters, a microstrip patch antenna is designed and simulated for the range of 2.5 GHz to 6 GHz, which is commonly used for wireless communication systems. In Figure 2, designed structured on the HFSS is shown.

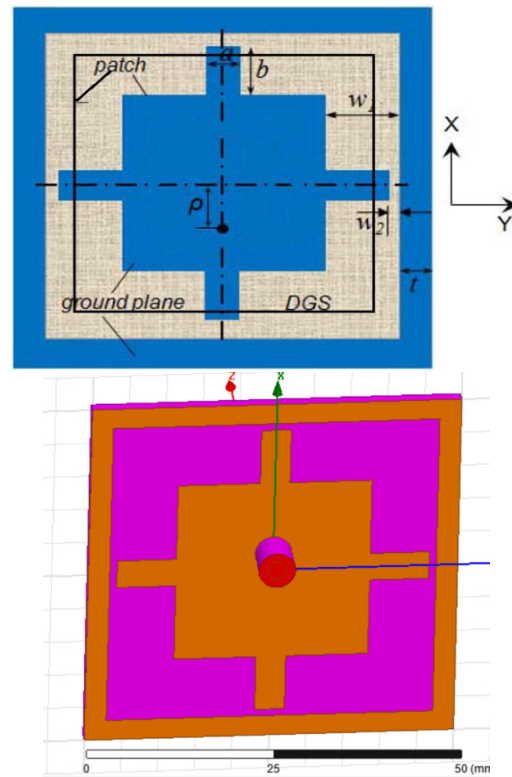


Figure 2 Proposed designs for DGS with parameters

Antenna 1 is conventional Patch and Antenna 2 is Patch with DGS (Defect Ground Structure). Figure 3 shows the return loss of conventional patch and DGS patch.

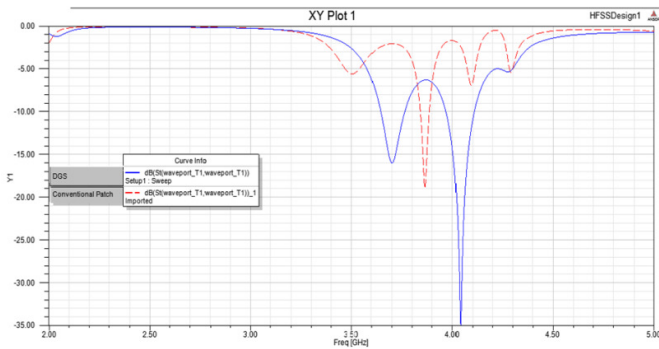


Figure 3 Return Loss of Antenna 1 and Antenna 2 with DGS (S_{11} in dB).

The design of a slotted microstrip antenna (Antenna 3, 4, 5)

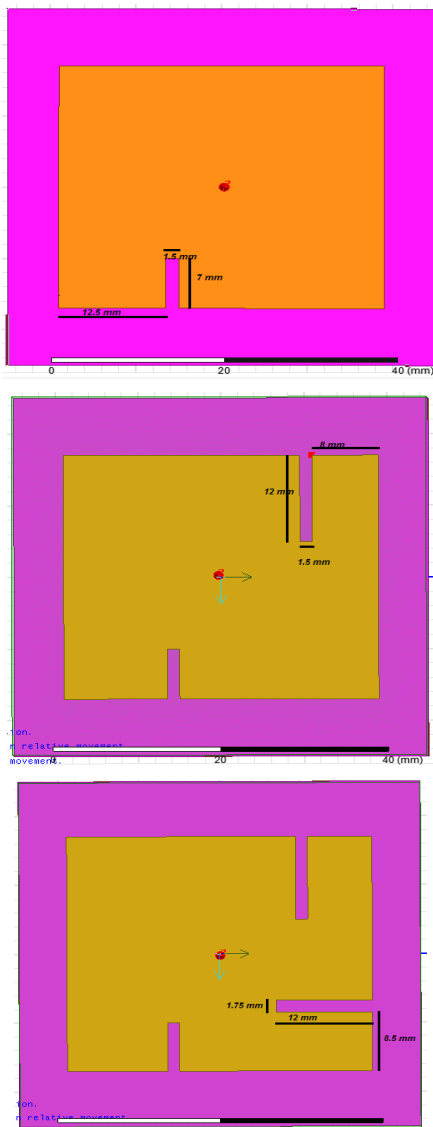


Figure 4 a) Antenna 3, b) Antenna 4 and c) Antenna 5

III. SIMULATION RESULT

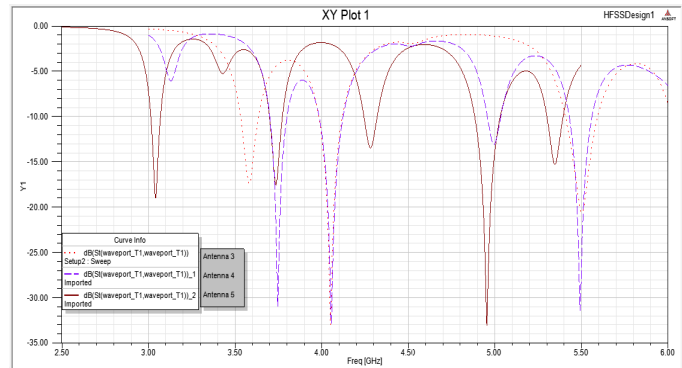


Figure 5 S_{11} for antenna 3, antenna 4 and antenna 5

Firstly a dual band antenna was simulated with appropriate parameters for better functioning antenna. Next stage was to introduce slots in the rectangular patch. The cutting of first rectangular slot resulted in triband microstrip antenna. The second slot resulted in four- band microstrip antenna. And last but not the least third rectangular slot was introduced in the rectangular patch which resulted in pentavalent band microstrip antenna which was then termed as multiband microstrip antenna. Commenced our work by designing a conventional patch antenna with rectangular patch then introduced defect in the ground plane.

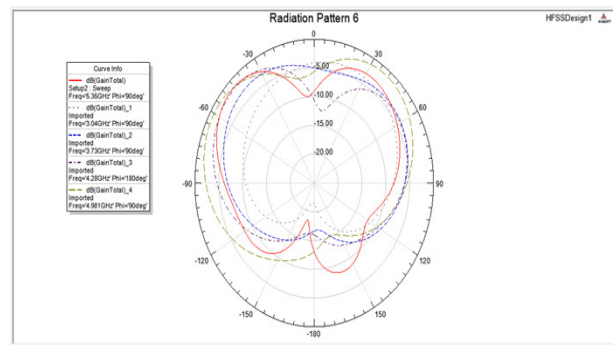


Figure 6 Radiation pattern for antenna 3, 4 and 5.

As a results a dual band antenna was simulated with appropriate parameters for better functioning antenna. Our next stage was to introduce slots in the rectangular patch. The cutting of first rectangular slot resulted in triband microstrip design antenna 3. The second slot resulted in four- band microstrip antenna 4. And last but not the least third rectangular slot was introduced in the rectangular patch which resulted in pentavalent band microstrip antenna 5 which was then termed as multiband

microstrip antenna. The final results satisfy all the parameters of an efficient antenna

Table I Comparative results of all designs

Geometry	Bands	Resonant freq GHz	S ₁₁ (dB)	Directivity	Gain	B/W (MHz)
Antenna 1	1	3.86	-18.84	2.66	0.52	45
Antenna 2	2	3.61	-14.88	2.66	3.5	114
		3.93	-24.58	3.2	3.8	128
Antenna 3	3	3.58	-17.4	5.58	4.26	100
		4.05	-32.95	3.98	4.66	140
		5.5	-20.6	4.9	2.26	190
Antenna 4	4	3.74	-30.8	4.63	4.05	110
		4.05	-32.8	3.66	3.67	140
		4.99	-13	4.06	4.56	110
		5.49	-30.7	4.42	3.92	140
Antenna 5	5	3.04	-18.9	2.88	3.65	65
		3.73	-17.5	4.66	3.66	88
		4.28	-13.4	4.89	4.06	95
		4.98	-33	3.84	2.26	163
		5.35	-15.2	2.26	2.74	110

IV. CONCLUSION

The Proposed antenna final results satisfy all the parameters of an efficient antenna. The designed antenna works efficiently under all conditions with low return loss and proper impedance matching. The second and very important work is done in this paper is to implement the dual and multi bands Microstrip antenna using HFSS simulation software. This miniature multiband band antenna has wide application in WiMax Wi-Fi/WLAN of wireless communication. Frequency range from 1 - 6 GHz used in wireless communication can be achieved by using designed multiband antennas.

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