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ANALYSIS OF A MODIFIED GROUND PLANE MICROSTRIP PATCH ANTENNA USING CO-AXIAL FEED

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Abstract:
A wandered probe-fed rectangular microstrip patch antenna (RMPA) with rectangular slots on a finite ground plane with dielectric material substrate (4.4) is proposed in this paper. The proposed antenna finite ground plane dimension is only 18mm x 21mm. The simulated result shows two distinct resonant frequencies at 4.5 and 9.5 GHz. A 10-dB wide-impedance bandwidth of 1000 MHz and 4100 MHz ranging from 3.8-4.8 GHz and 5.9–10 GHz is achieved. The proposed antennas have achieved wider bandwidth (51.3%) with reasonable gain (4 dBi).

Keywords: *Rectangular Microstrip Patches Antenna (Rmpa); Rectangular Slot; Ground Plane; Ie3d Software.*

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1. Introduction

A Microstrip patch antenna technology began in the behind 1970s [1]. The microstrip antenna consists of conducting patch on a lower layer separated by a dielectric substrate. In recent years, microstrip patch antenna has aroused general applications, especially in low power wireless communication [2-3]. Moreover, the narrow band antenna can sustain reasonable gain and stable radiation pattern throughout the application band. Narrowband is the main drawbacks of the patch antenna [1]. A Microstrip patch antenna consists of a radiating patch on one side of a dielectric substrate which has a ground plane on the other side [1]. The patch is generally made of conducting material such as copper or gold and can take any possible shape. The radiating patch and the feed lines are usually photo etched on the dielectric substrate. [1-5] Numerous techniques have been proposed to relax the system burdens. By miniaturization of microstrip patch antenna, the size will open up ways of solving problems for applications [1-5]. However, conventional ways of size reduction in patch antenna are a shorting pin, slots, etc. Wireless communication systems require wider bandwidth, multiband or dual band and low-profile antennas for singular applications [6-7].

2. Design A Proposed Antenna Using Introducing Slot in Ground Plane

The widely popular, method-of-moments-based electromagnetic (EM) software for high-performance network distributed simulation and optimization (IE3D) tool is used for the design and simulation of the proposed antenna. Like other typical patch antennas, the proposed antenna contains probe feed connector on its side, a meandered structure probe feed the radiating part, a rectangular type radiating surface introduced with slot line of the same width on top and a rectangular ground plane at the bottom [4-5].

Table 1: Specifications of the Microstrip Patch Antenna [7]

	Magnitude	**Unit**
Dielectric Constant (ϵ_r)	4.4	-
Loss Tangent (tan ∂)	0.002	-
Thickness (h)	1.6	mm
Operating Frequency	8	GHz
Length (Lp)	8.3	mm
Width (Wp)	11. 4	mm
Ground Length (L_g)	18	mm
Ground Width (W_g)	21	mm
Feed	Coaxial Feed	-

After designing the conventional microstrip patch antenna, Introducing slots (parametric study) in the ground plane of the antenna is used for design a compact rectangular microstrip patch antenna for the C-band and X-band, which may be useful for the current miniaturized wireless communication system. This modified proposed antenna to have characteristics of wideband operation, enhance bandwidth, along with reducing the size and meandered gain. These modifications include the introducing of slots in the ground plane. These slots, when accordingly designed to the dimensions of the slot by hit and trial rule and increase the current path within the patch area. These help in lowering the resonant frequency of the microstrip patch antenna and, therefore, lead to size-reduction as well as enhance the bandwidth [7-8].

3. Simulate A Proposed Antenna Using Electromagnetic Simulation Software IE3D

A parametric study was carried out by changing the length and position of the slot in ground plane or the patch. The design and analysis of a novel structure using a novel technique for upper ultra wideband (5.6- 10.6 GHz) frequency range. This proposed wideband rectangular microstrip patch antenna is designed by using an introducing slot in ground plane and simulated by electromagnetic simulation software IE3D, which is based on the method of moment

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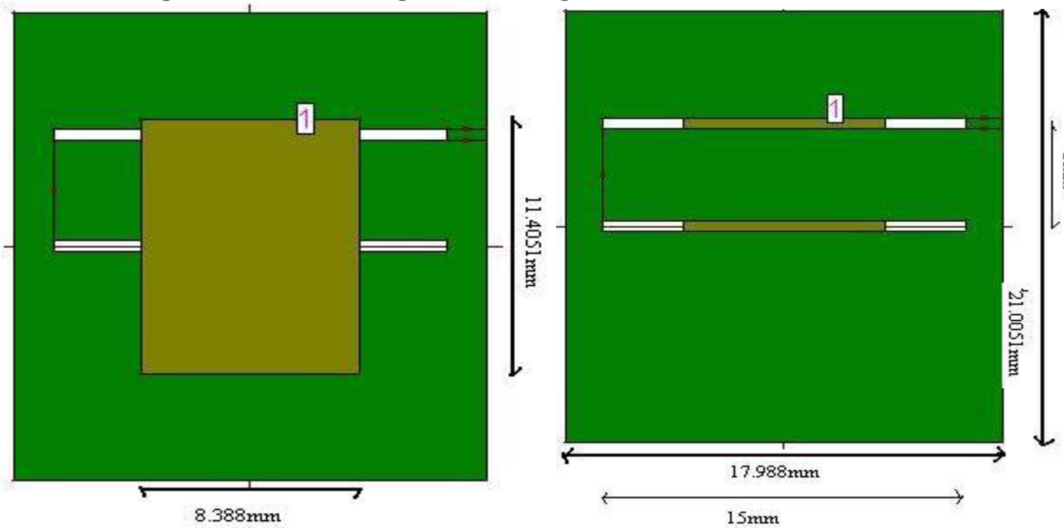

Figure 1: Antenna 1

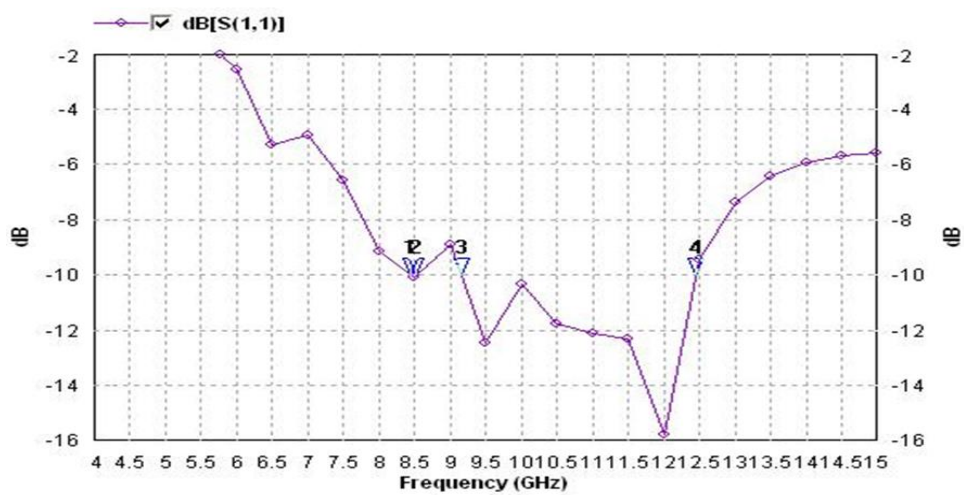

Figure 2: Return Loss of Multiband Antenna

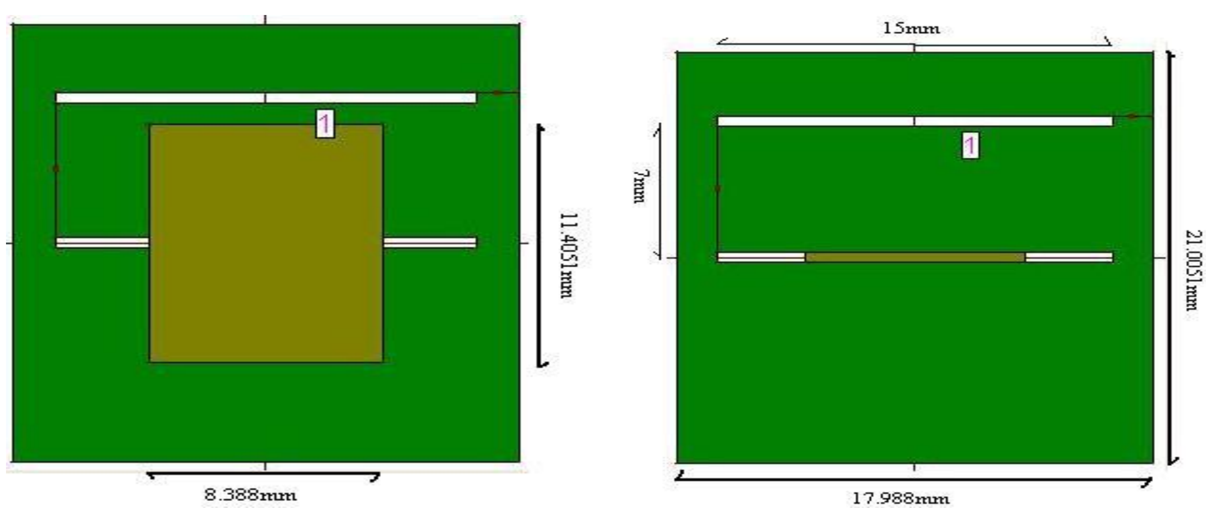

Figure 3: Antenna 2

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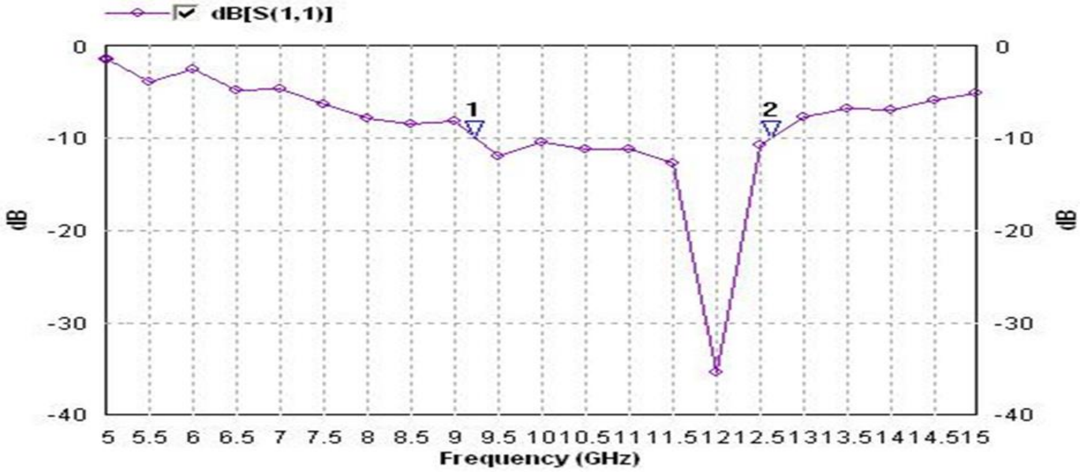


Figure 4: Graph of Return loss of wideband RMPA

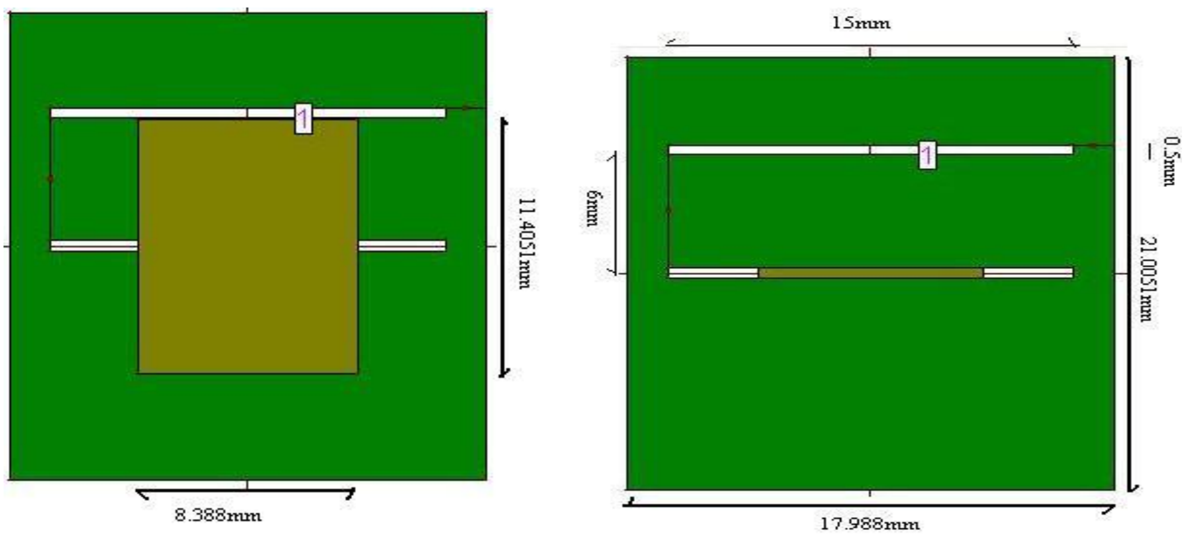


Figure 5: Upper Layer and Ground Layer Antenna 3

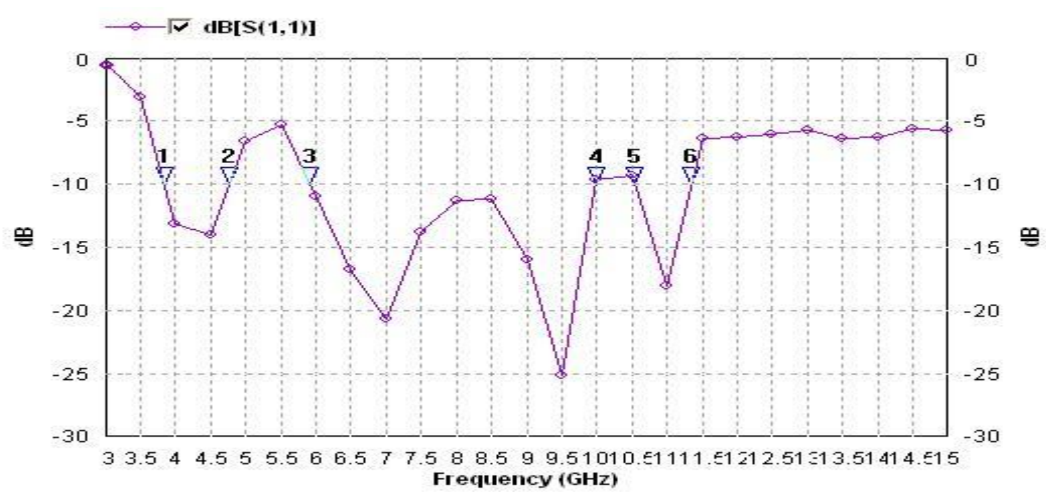
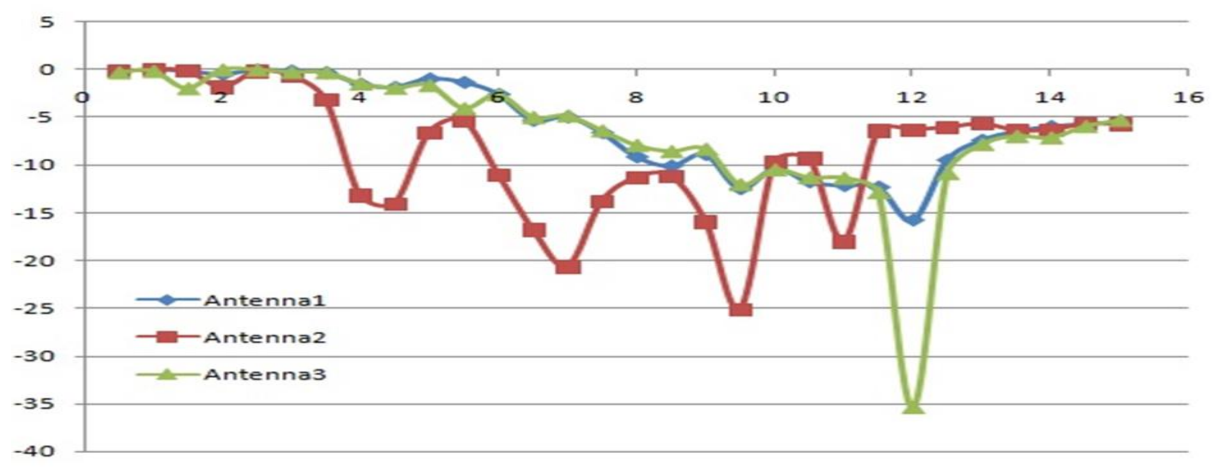


Figure 6: Graph of Return loss of Multiband Antenna 3

Table 2: Simulated Results of the Antenna by parametric studying of The Dimension of Ground-Plane Slots

Parametric studying of antenna(mm)	Lower Frequency Band (GHz)	BW (%)	Return Loss (dB)	VSWR	Upper Frequency Band (GHz)	BW (%)	Return Loss (dB)	VSWR
L1=15, W1=0.5, L2=15, W2=0.5, d=5	8.45-8.53 GHz	1	-10.1	1.9	12.5-9.2	33.6	-15.8	1.38
L1=15, W1=0.5, L2=15, W2=0.5, d=6 **(Proposed Antenna)**	3.8-4.8	22.4	14.0	1.5	10.0-5.9	51.3	-25.1	1.20
L1=15, W1=0.5, L2=15, W2=0.5, d=7	NA	NA	NA	NA	12.6-9.2	31.2	-35.4	1.03

Comparisons between Simulation Results of Antenna1, 2 and 3



4. Discussion of Results

The simulated outcomes demonstration that the proposed RMPA have achieved broader bandwidth with acceptable gain by presenting probe fed in associate of finite a ground plane. It is experimental that, the −10 dB impedance bandwidth of the projected RMPA 1, 2 and 3. This alignment and parametric revision have been approved out by the support of the commercially existing IE3D simulator, and a respectable agreement is observed in the simulated results.

Table 3: Comparisons between Simulation Results of Antenna1, 2 and 3

S. No.	Reference	Antenna Size (mm^2)	Frequency Band (GHz)	BW (%)	Gain (dBi)	Applications
1	[8] 2013	32 x32	(9.4-10.6)	12.2	8.7	X-band
2	[9] 2014	30 x 30	(4.0-7.3)	60.3	3	C-band
3	[10] 2014	21 x 30	(6.8-7.3)	7.0	5.5	C and X-band
4	[11] 2014	17.2 x 20	(8.7-9.1)	5.0	4.4	X-band
5	[12] 2015	32 x 32	(6.9-9.5)	37.8	8.3	C and X-band
6	Proposed Antenna	18 x 21	(5.9-10.0)	51.3	4	C and X-band

5. Conclusion

The proposed compact RMPA with modified ground plane is presented in this paper. The simulated results show that the proposed antennas have achieved wider bandwidth (51.3%) with reasonable gain (4 dBi). The Miniaturized antenna is designed for the ranging from 3.8-4.8 GHz and 5.9–10.0 GHz which include C-band and partial X-band. The accurate simulation results are obtained. In future, the antenna needs to be fabricated and tested.

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