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Dual Band Gap-Coupled Antenna For X and Ku Band

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ABSTRACT

A design of gap-coupled patch antenna for the operation in X and Ku band is proposed here. In this design one parasitic element is gap-coupled to the radiating edge and two parasitic elements to the non-radiating edges of the driven patch. This antenna design is giving an impedance bandwidth of 4.429GHz. This antenna is providing resonance at two frequencies of 11.7GHz and 13.95GHz. The design is simulated by using the MOM based IE3D software.

Keywords – **Dual-band antenna, gap-coupling, non-radiating edges, radiating edges, RF spectrum**

I. INTRODUCTION

Microstrip antenna has its remarkable advantages over conventional antennas, such as small size, low weight, easy to fabricate, compatibility to planar and non-planar surfaces, ease of being integrated with circuits, mechanically robust, simplicity of creating antenna arrays and suitable for multi-frequency operation. These attractive features made patch antennas more applicable in many noticeable communication systems. However their further use in specific systems is limited because of their relatively narrow bandwidth. Intensive research has been carried out to develop the bandwidth-enhancement techniques by keeping the size of the patch antenna as small as possible. Several bandwidth enhancement techniques like thick substrate, low dielectric constant substrate material, various configurations of trapezoidal shaped antennas, parasitic strips capacitively coupled to the non-radiating edges of square patch antenna, rectangular antenna with its radiating edges gap coupled to the quarter wavelength short-circuited parasitic elements, multilayer structures, stagger tuned resonators, log-periodic structures, quasi-log-periodic structures etc have been reported in the literature. Some of these techniques have been combined to obtain broad bandwidth with increased gain.

In this paper we are proposing an antenna design which can operate at two frequencies in X band and Ku band. As all the frequency bands below 10GHz are almost filled so for the future communication purpose the frequency bands which will be allotted are above 10 GHz.

II. ANTENNA GEOMETRY

The antenna geometry is shown in Fig.1. This antenna design consists of a rectangular patch of dimensions L X W. The central patch is gap-coupled to two unequal parasitic elements of dimensions L_1 X W_1 and L_2 X W_2 along its both non-radiating edges and a parasitic element of dimension L_3 X W_3 along its one of the radiating edges. The dimensions are shown in Table1.The patches are etched on a substrate of dielectric constant 2.55 and a thickness of 1.59mm. The central patch or driven patch is fed by a coaxial probe of diameter 1.2mm at feed location of 1.7 mm from the edge on the XX-axis of the driven patch. The air gap between the central patch and the parasitic patches is S_1, S_2 and S_3. The proposed antenna design is simulated by using MOM based IE3D software.

III. METHOD OF ANALYSIS

The increase in substrate thickness results in undesirable spurious radiations and the permittivity cannot be reduced below a limit value practically. So BW is increased by using parasitic patches. IE3D is the first SCALABLE EM design and verification plate form that delivers the modeling accuracy for the combined needs of high frequency circuit design and signal integrity engineers across multiple design domains. It is based on method of moments (MOM). IE3D's multi-threaded and distributed simulation architecture and high-design capacity is the most cost-effective EM simulation and modeling solution for component-level and circuit-level applications. IE3D offers the highest simulation capacities and fastest turnaround times for the broadest number of applications making it the best choice for improving your design team productivity and meeting design schedules on time.

IV.RESULTS AND DISCUSSION

In Fig. 2, the VSWR versus frequency plot shows that this antenna is capable of operating at two resonating frequencies of 11.7GHz and 13.95GHz leading to a wide bandwidth of 4.428GHz. The simulated results for the VSWR plot, return loss plot, Smith chart plot, input impedance plots and radiation patterns are shown in fig. 2,3,4,5 and 6 (a) to 6(l) respectively.

In Fig.3, the plot for return loss versus frequency plot also shows similar results as shown by the VSWR plot. A return loss of -30.3222dB at frequency of 11.7GHz and -38.5446dB at resonance frequency of 13.95GHz is obtained with central frequency at 12.825GHz.

V. CONCLUSION

Asymmetrical structure for the dual band microstrip patch antenna operating in X band and Ku band is investigated and simulated in this paper. The simulated plots of various parameters like return loss, input impedance and radiation pattern have shown well performance for the operation of this dual band antenna in the above stated RF bands..

REFERENCE

[1] G.Kumar and K.C.Gupta, "Broad-Band Microstrip Antennas Using Additional Resonators Gap-Coupled to the Radiating Edges", IEEE Transactions on antennas and propagation, vol. Ap-32, no. 12, December 1984, pp.1375-1379.

[2] G.Kumar and K.C.Gupta, "Nonradiating Edges and Four Edges Gap-Coupled Multiple Resonator Broad-Band Microstrip Antennas", IEEE Transactions on antennas and propagation, vol. Ap-33, no. 2, February 1985, pp.173-178

[3] IE3D 14.1, Zeland Software Inc., Fremont, CA, 2008

[4] I.J. Bahl and P. Bhartia, Microstrip antennas, Artech House, Norwood, MA, 1980.

[5] G. Kumar and K.P. Ray, Broadband Microstrip Antennas, Artech House, Norwood, MA, 2003.

[6] Sarthak Singhal, A.K.Singh and M.K.Meshram, "Broadband Microstrip Antenna Using Radiating Edge Coupled Parasites", AEMC-2011 Conference proceedings.

[7] Sarthak Singhal, A.K.Singh and M.K.Meshram, "Slot Loaded Broadband Microstrip Antenna With Parasitic Elements", 2011 National Conference on Recent Advances in Microwave Engineering proceedings.

[8] Sarthak Singhal, "Microstrip Antenna Bandwidth Enhancement Using Slot Loading And Parasitic Elements", ICEEE-2012 conference proceedings organized by IRNET at Delhi.

Table1. Dimensions of the proposed antenna design

ε_r	h	L	W	L_1	W_1	S_1
2.55	1.59mm	10mm	7mm	10mm	5.5mm	0.1mm

L_2	W_2	S_2	L_3	W_3	S_3
10mm	5.7mm	0.1mm	5.5mm	7mm	0.1mm

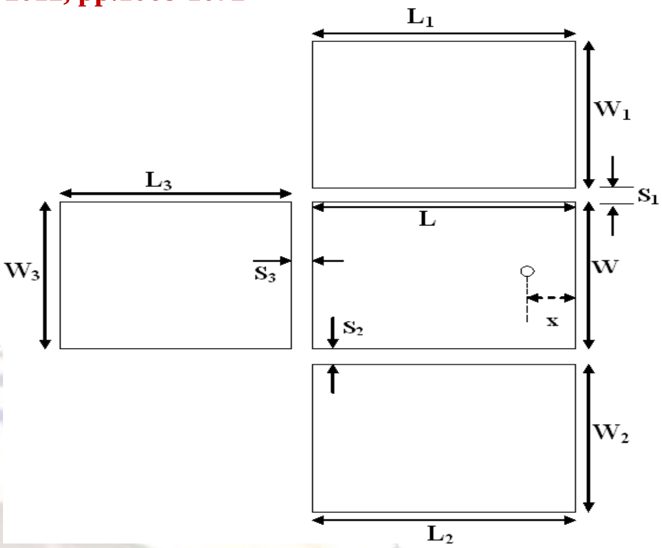


Figure 1. Geometry of the proposed antenna

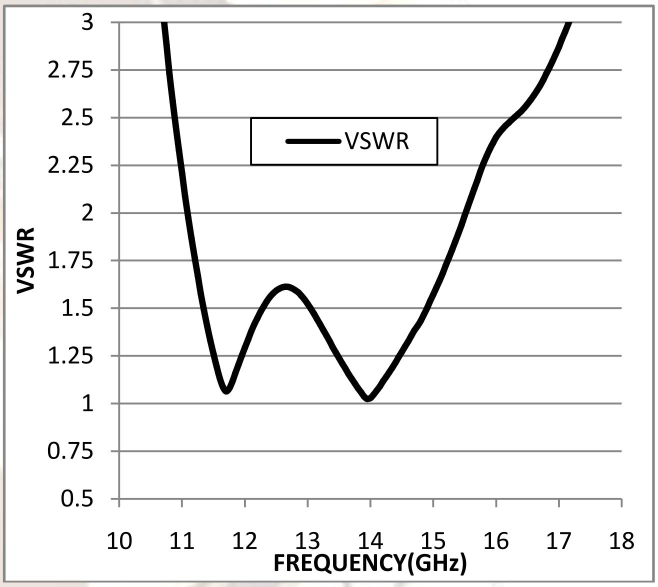


Figure 2. VSWR v/s frequency plot

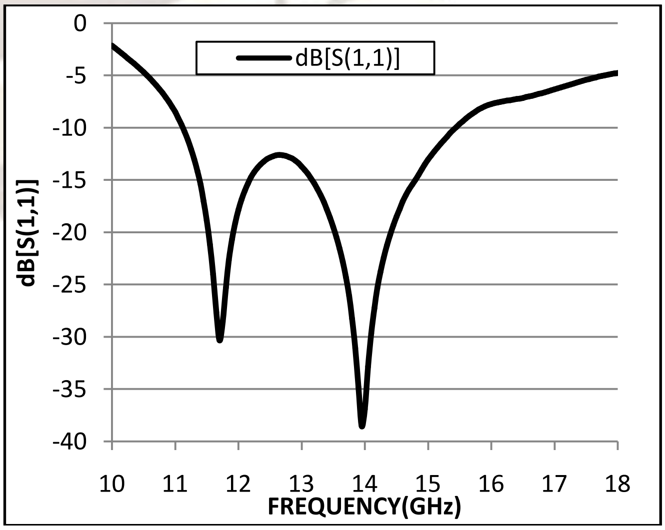


Figure 3. Return loss v/s frequency plot

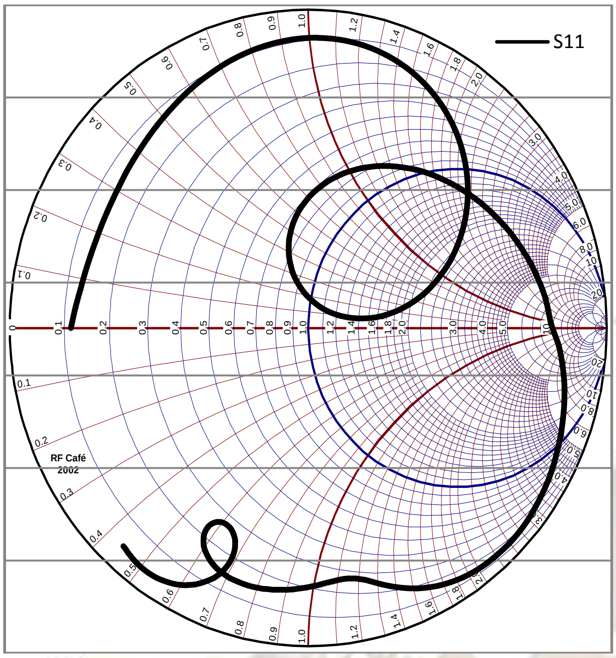


Figure 4. Smith Chart plot

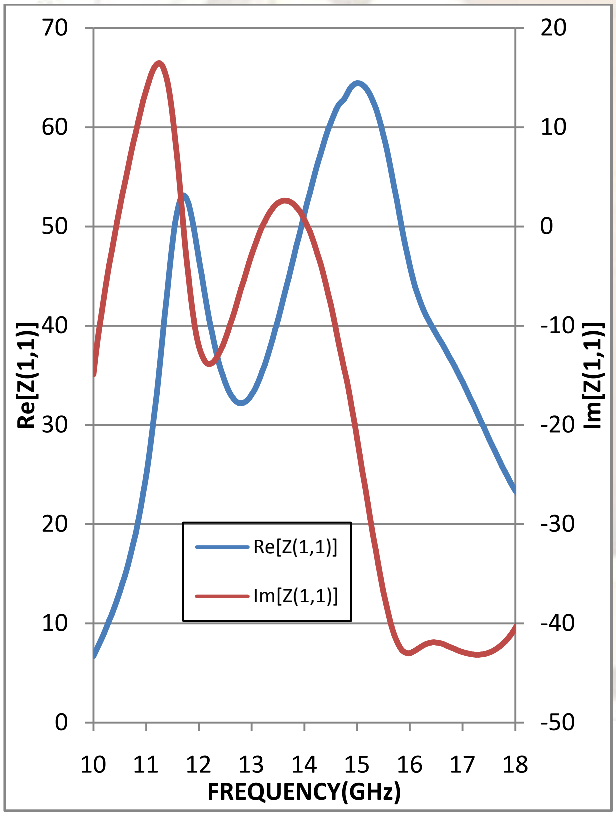
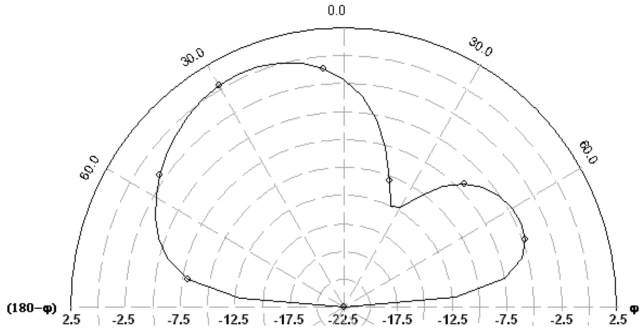
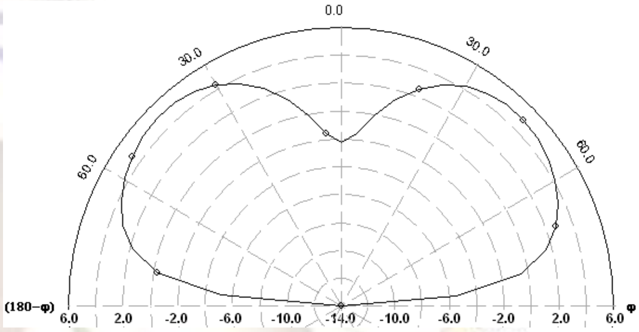


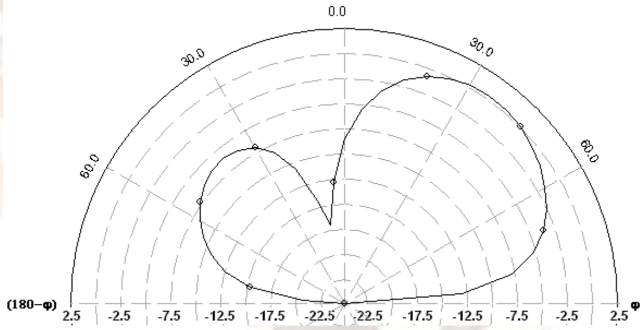
Figure 5. Input Impedance v/s frequency plot



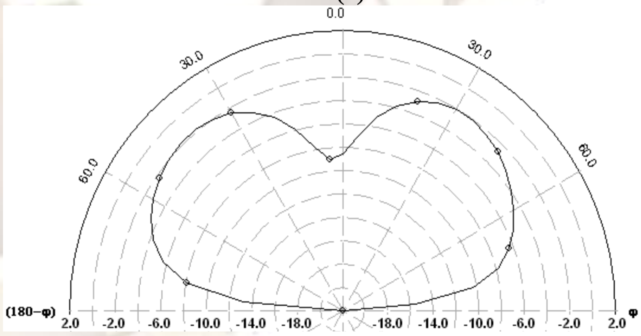
(a)



(b)



(c)



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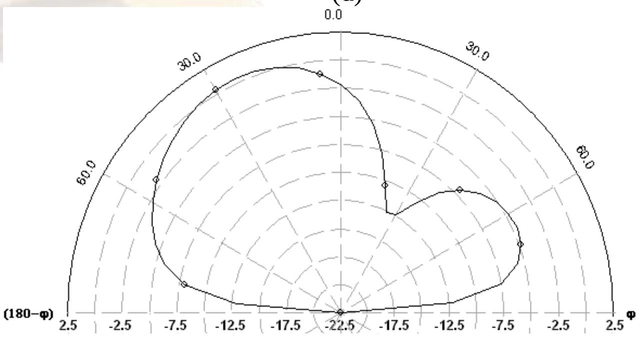

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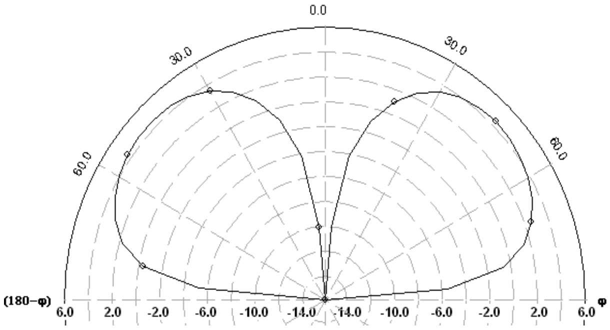
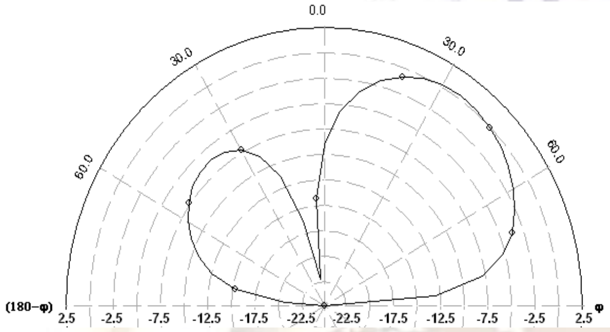
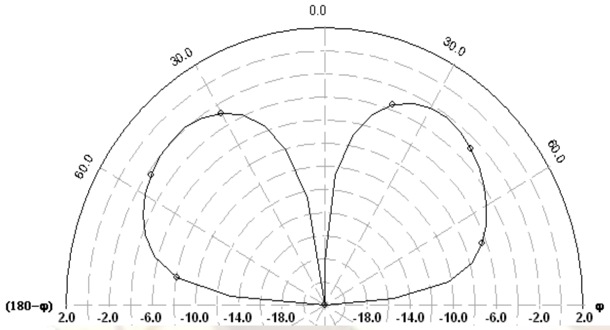


(f)



(g)



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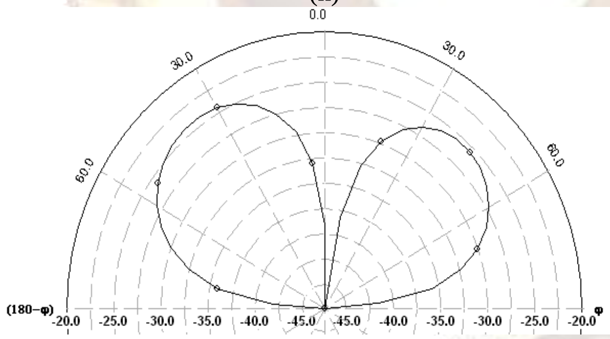
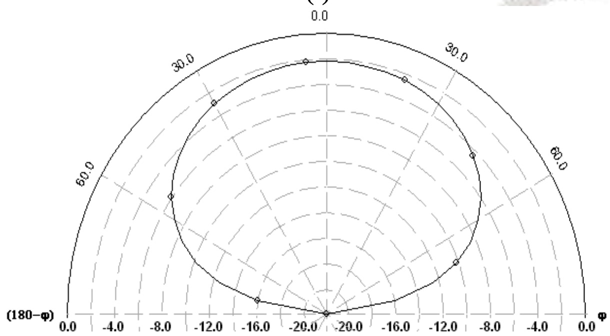
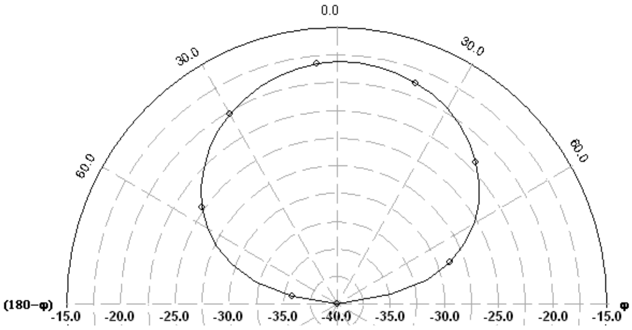


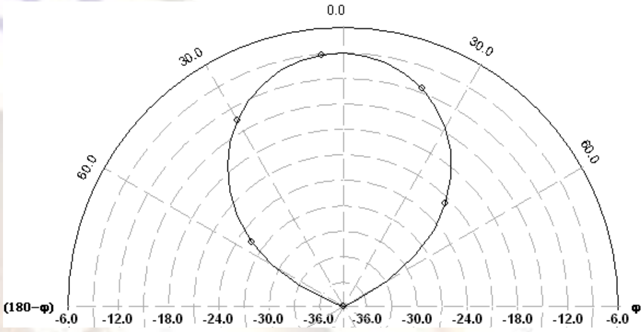
(i)



(j)



(k)



(l)

Figure 6. Radiation patterns at both resonance frequencies:

(a) E_{Total} for $\Phi=0^o$ at 11.7GHz
(b) E_{Total} for $\Phi=90^o$ at 11.7GHz
(c) E_{Total} for $\Phi=0^o$ at 13.95GHz
(d) E_{Total} for $\Phi=90^o$ at 13.95GHz
(e) E_θ for $\Phi=0^o$ at 11.7GHz
(f) E_θ for $\Phi=90^o$ at 11.7GHz
(g) E_θ for $\Phi=0$ at 13.95GHz
(h) E_θ for $\Phi=90$ at 13.95GHz
(i) E_φ for $\Phi=0^o$ at 11.7GHz
(j) E_φ for $\Phi=90^o$ at 11.7GHz
(k) E_φ for $\Phi=0^o$ at 13.95GHz
(l) E_φ for $\Phi=90^o$ at 13.95GHz

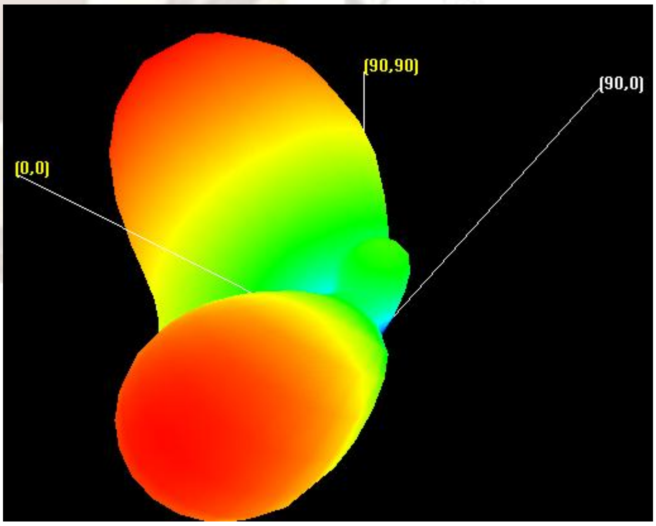


Figure 7. 3D radiation pattern