A Novel Quad Band Rectangular Microstrip Patch Antenna for Wireless Applications

Shiv Charan Puri
Asansol Engineering College
Asansol, India

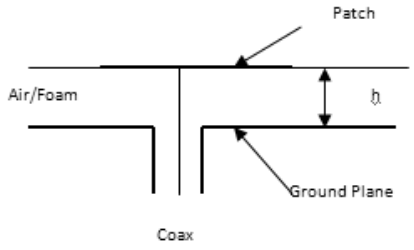
M.G.Tiary
Asansol Engineering College
Asansol, India

ABSTRACT
A novel simple single layer single feed triangular slot patch antennas with air dielectric (ε_r = 1) substrate providing quad frequency operation is proposed to operate in different wireless applications. The measured quad frequencies are 2.04GHz, 2.62GHz, 3.16GHz and 3.8GHz. The simulated radiation patterns at each measured resonant frequency are also shown.

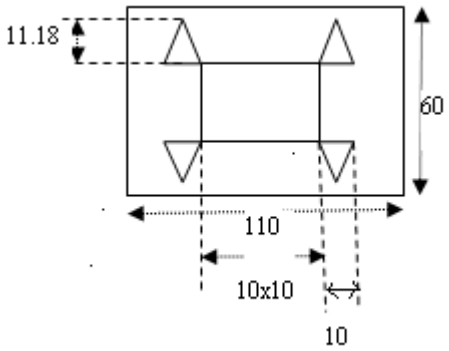
Keywords: Dual frequencies, Quad frequency, Radar, Rectangular patch Antenna, Wireless Communication.

1. INTRODUCTION
In various wireless applications patch antennas have attracted much interest being inexpensive to fabricate and light in weight. A cross slot dual frequency patch antenna with dielectric constant ε_r = 4.4 has been studied in [3].Triple frequency bands of operation have been reported in [1, 2, 4]. Quad frequency bands of operation have also been reported in [1]. The detailed inspection of the proposed quad frequency microstrip-antennas is given in the literature. By cutting a square slot at the centre of a rectangular microstrip patch and four Isosceles triangles at the ends of another square ends, quad frequency operation at 2.04GHz, 2.62GHz, 3.16GHz and 3.8 GHz is obtained. The IE3D simulation software based on Method of Moments (MoM) is used for simulation [7].

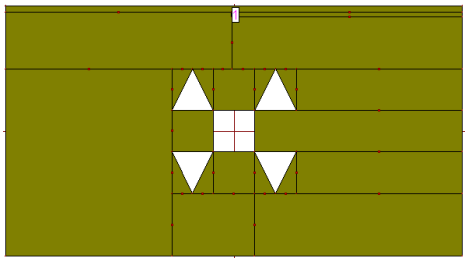
2. ANTENNA DESIGN
Analysis is performed for single layer single feed cross slot rectangular patch antenna. Air (ε_r = 1) is used as substrate and the proposed microstrip antenna has patch dimensions of 110 X 60 mm^2 with square slot dimensions of 10 X 10 mm^2 and an isosceles triangular slot of two equal sides dimension 11.18 mm and other side 10 mm across the corner of the square as shown and at a height of 6 mm from ground plane. Its geometry is shown in Fig. 1 (a-c). The tri frequency microstrip patch antenna probe is fed at (X = 0, Y = 28 mm) from the patch centre and the Antennas parameters like Reflection Coefficient, Gain and Radiation Patterns at the corresponding resonance frequency point is also simulated.



(a)



(b)



(c)

Figure 1: Antenna 1 (dimensions are in mm) a. side view.b. Side View (h = 6 mm) c.IE3D simulated.

3. ANALYSIS AND RESULT
For running simulations in IE3D, infinite ground plane is considered to ensure faster convergence.

Simulation gives quad-frequency at 2.04GHz, 2.62GHz, 3.16GHz and 3.8 GHz.

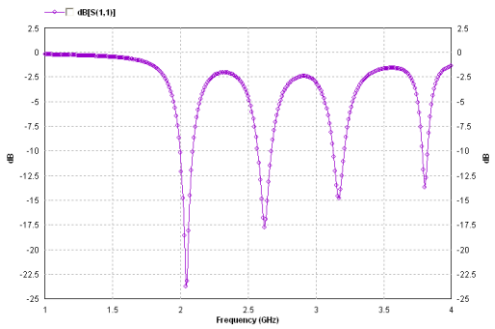


Figure 3: Measured variation of return loss for the proposed antenna with frequency.

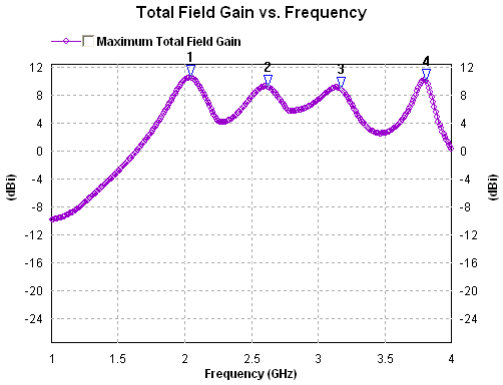
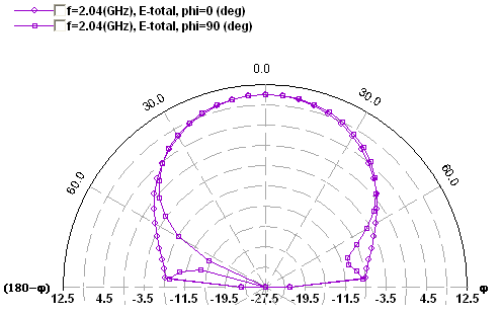
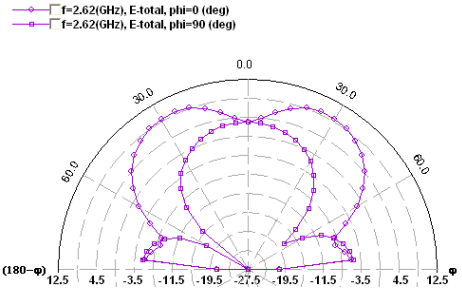


Figure 7 Computed variation of total field Gain for the proposed antenna with Frequency.

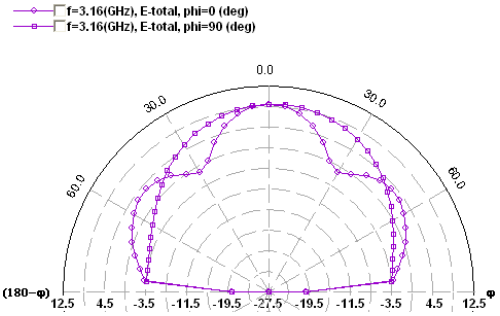
Simulated radiation patterns at the corresponding measured operating frequencies are shown in Fig.4 (a –d).



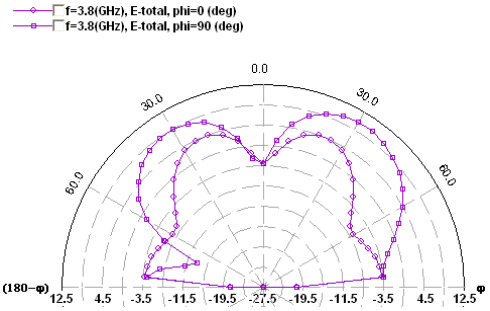
(a)



(b)



(c)



(d)

Figure 6: Antenna 2, a. Radiation Patterns at 1.93 GHz b. Radiation Patterns at 2.72 GHz c. Radiation Patterns at 3.16 GHz d. Radiation Patterns at 3.8 GHz.

Table 1. The different results are tabulated below.

Band	f_1(GHz)	f_2(GHz)	f_r(GHz)	B.W(MHz)	Gain(dbi)
1	2.000	2.090	2.04	90	10.51
2	2.575	2.670	2.62	95	9.17
3	3.130	3.205	3.16	75	8.98
4	3.785	3.820	3.8	45	10.04

4. CONCLUSION

A simple single layer single feed quad frequency with a novel slotted patch antenna is presented. The proposed antennas show considerably good radiation characteristics at the resonance frequencies. Novelty of the structures lies in their versatility. The proposed patch antenna is a rugged, low cost, moderate gain antenna solution for Radar and Space applications.

5. REFERENCES

[1] Lolit Kumar Singh, Bhaskar Gupta and Partha P Sarkar,"Analysis of Multifrequency Cross Slot Patch Antennas". International Journal of Electronic Engineering Research ISSN 0975 - 6450 Volume 2 Number 5 (2010) pp. 765–776. © Research India Publications.

[2] Shiv Charan Puri; Dr. M.G.Tiary "Analysis of Triangular Slotted Microstrip Patch Antenna" 3rd International Conference on "Recent Advances in Mathematics, Technology & Management" BITM, Bolpur, Birbhum West Bengal.(Accepted for oral presentation).

[3] Wong, K.L.; Yang, K.P.; "Small dual-frequency microstrip antenna with cross slot". Electronics Letters, Vol.33, No.23, Nov. 6, 1997, pp. 1916-1917.

[4] Bao, X.L.; Ammann, M.J.; "Compact concentric annular-ring patch antenna for triple –frequency operation". Electronics Letters, Vol.42, No.20, Sept. 28, 2006, pp. 1129-1130.

[5] Constantine A. Balanis: 'Antenna Theory, Analysis and Design' (John Wiley & Sons).G. Kumar. & K. P. Ray, "Broadband Microstrip Antennas", Artech House, antennas and propagations library. 2003.

[6] Yogesh Bhomia, Ashok Kajla and Dinesh Yadav, "Slotted Right Angle Triangular Microstrip Patch Antenna". International Journal of Electronic Engineering Research ISSN0975 - 6450 Volume 2 Number 3 (2010) pp. 393–398 © Research India Publications.

[7] IE3D Software Release 9 developed by M/S Zeland Software, Inc