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Performance of Micro Strip Patch Antenna for Dual Band Application

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Abstract:

This research work presents analysis of dual band rectangular micro strip patch antenna for WLAN application. An antenna is design using FR-4epoxy substrate material with thickness 1.6 mm and dielectric constant 4.4. The proposed antenna has a compact size of 30 mm×30 mm and patch dimension 20 mm ×20 mm. The design antenna fed with coaxial feed technique. The simulated design antenna is operated at 5.4 GHz to 9.5 GHz, having resonating two different frequencies at 5.6GHz and 8.9GHz which is operated in C & X-bands. The rectangular Micro strip antenna have minimum return loss is -21.44 dB at 5.6GHz and -27.68dB at 8.9GHz. In this antenna the maximum gain is 5 dBi at 8.9GHz and 3.75dBi at 5.6GHz respectively are achieved. The simulation of the design antenna is done using Ansoft HFSS software.

Keywords — **FR-4, Antenna,Patch, HFSS, Return Loss, Dual Band, Gain.**

I. INTRODUCTION

In today's era, Micro strip antenna (MSAs) demand increased due to its use in high frequency, high speed data communication application and also having many advantages in which it is concluded with light weighted, low cost and compact size easy to fabricate and they can be made conformal to the host surface [1]. Day by day new wireless devices are introducing which increasing demands of compact antennas. Increase in the satellite communication and use of antennas in the aircraft and spacecraft has also increased the demands a low profile antenna that can provide reliable communication.

C-BAND is used for electromagnetic spectrum in microwave range of frequencies ranging from 4.0 to 8.0 GHz. It is used for many satellite communication transmissions, some Wi-Fi devices, WLAN, some cordless telephones and some weather radar system .It has an infrared band from 1530nm to 1565nm.Particle accelerators may be powered by c-band RF sources. The frequencies are than standardized at 5.996 to 5.412 GHz [2].

X-BANB is used for electromagnetic spectrum with frequency ranging from 8GHz to 12GHz .It is used in traffic light, motion detectors, electron paramagnetic resonance (EPR), compact linear collider (CLIC)[3].

Furthermore the demand for dual band antenna is also increasing. Single dual band antenna can be used to cover many applications so multiple antennas can be replaced by a single dual band antenna. So various techniques have been published for constructing antenna for dual band performance including slotted shape, fractal shape and stacked configuration of patches[4]

.The patch is made of conducting material such as copper or gold and can take any possible shape. The patch is generally square rectangular, circular and triangular or any other shape. Micro strip Patch Antennas can be fed by a number of techniques. The most admired feeding means used are micro strip line, coaxial probe, aperture coupling and proximity coupling. The proposed antenna is designed using coaxial probe feed [5].

Size reduction of patch antenna with dual band response is obtained by using three parallel slots on the patch but impedance bandwidth was very narrow for both the bands.

II. ANTENNA DESIGN PROCEDURE

The proposed antenna having dimension 30mm × 30mm using FR-4 substrate materials with height 1.6mm. The proposed antenna is shown in fig.(1)and fig.(2)

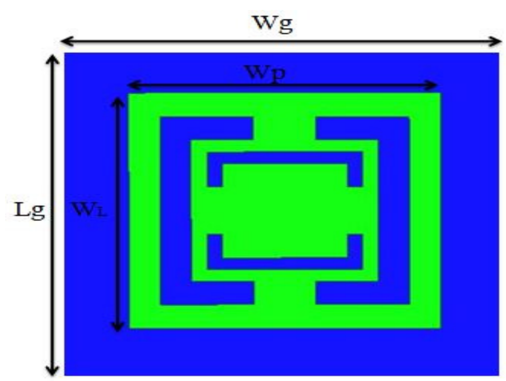

Fig. 1 Top view of proposed Antenna

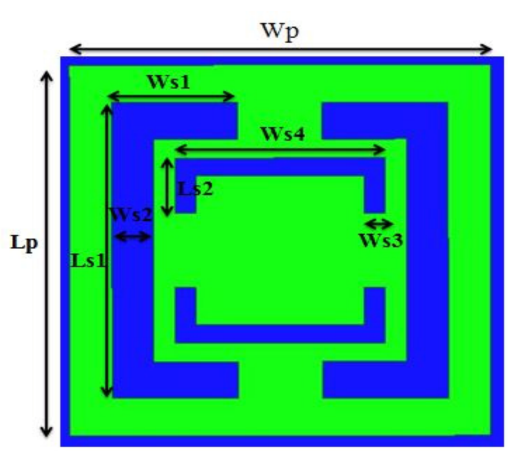

Fig. 2 Geometry of patch of proposed Antenna

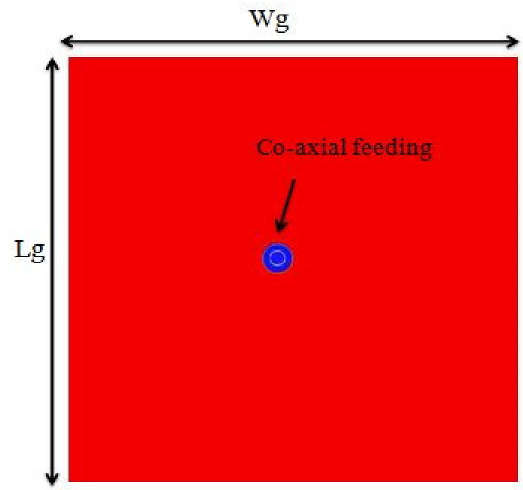

Fig. 3 Back view of proposed antenna

The conductive patch is fed with a coaxial probe feeding technique. Theposition of coaxial feed are (14,15,0).The two horizontal rectangular slots inserted in the patch of antenna having dimension 12mm×2mm as well as two vertical slots with dimension 10mm×1mm also loaded in the patch of antenna .These horizontal and vertical slots increases the current distribution path on the conducting plane.

Table I

List of design parameters of the designed Antenna

Width of ground (W_g)	30mm
Length of ground (L_g)	30mm
Width of patch (W_p)	20mm
Length of patch (L_p)	20mm
Width of slot (W_{s1})	12mm
Length of slot (L_{s1})	2mm
Width of slot(W_{s2})	1mm
Length of slot (L_{s2})	10mm

Therefore the proposed antenna achieves dual band operation. The operating frequency 2.4GHz considered for this design antenna.

III. RESULTS

The antenna parameters like return loss, VSWR, gain, Directivity, Radiation pattern and Bandwidth are compared for two resonant frequencies at 5.6GHz and 8.9GHz all the parameters have shown acceptable results. The return loss graph is shown in fig.4

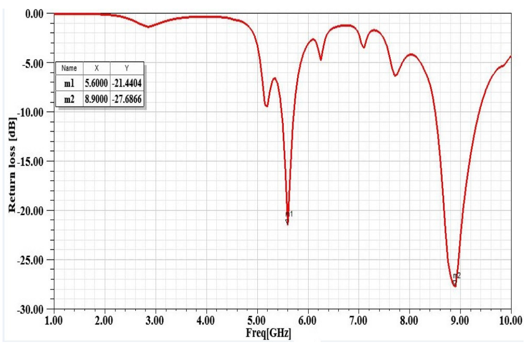

Fig. 4: Return loss against frequency curve (FR-4)

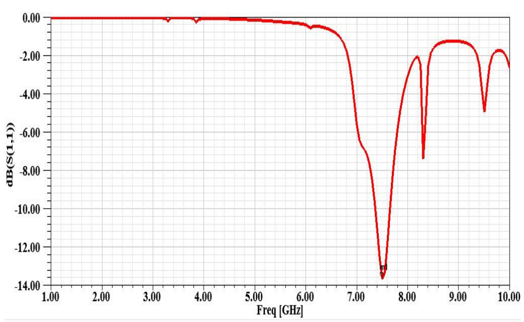

Fig. 5: Return loss against frequency curve (Neltec NY9220)

The return loss value of proposed antenna for epoxy FR-4 is -21GHz and -27GHz at two different resonant frequencies 5.6GHz and 8.9GHz respectively and for Neltec NY9220 is -16GHz and -10GHz respectively.

The graph in fig 6 and fig 7 shows the VSWR versus frequency (GHz) at two resonant frequencies at -21GHz,-27GHz (for FR-4) and -16GHz,-10GHz (for Neltec NY9220).From fig it is concluded that the VSWR are <=2 at all resonant frequency which maintain tolerable limit of VSWR.

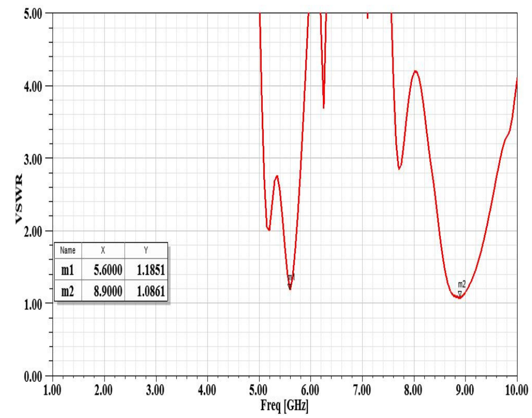

Fig. 6: VSWR versus frequency curve (FR-4)

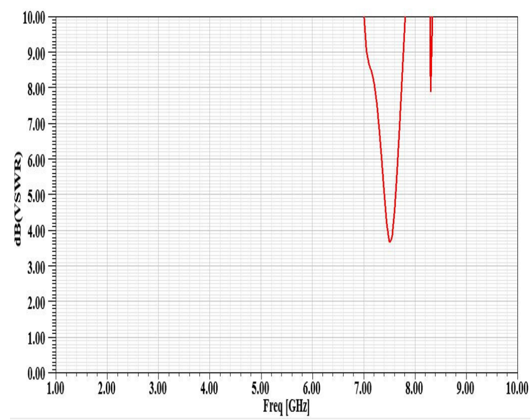

Fig. 7: VSWR versus frequency curve (Neltec NY9220)

Fig 8 and fig 9 shows the variation of gain versus frequency for the proposed antenna for two substrate materials .These antenna has gain 3.75dB and 4.00dB at 5.6GHz and 5.00dB and 4.21dB at 8.9GHz.

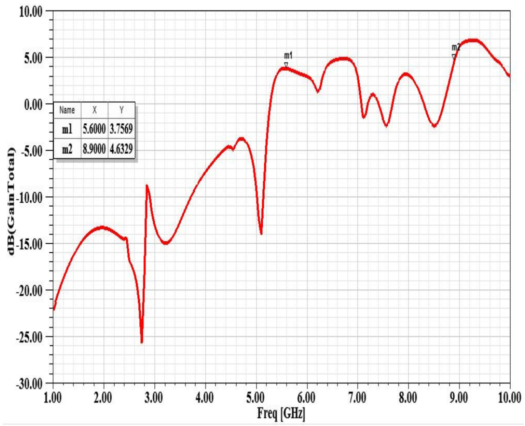

Fig. 8: gain versus frequency (FR-4)

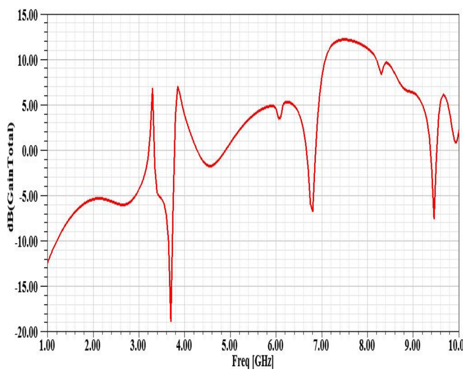

Fig. 9: gain versus frequency (Neltec NY9220)

The design antenna having directivity of 5.5dBi and 7.16dBi (for FR-4) and 4.8dBi and 7.18dBi (for Neltec NY9220) at the two resonant frequencies 5.6GHz and 8.9GHz respectively is shown in fig 10 & 11.

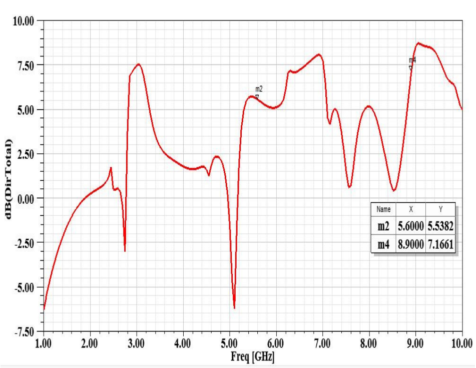

Fig. 10: Directivity (dB) versus frequency (GHz) (FR-4)

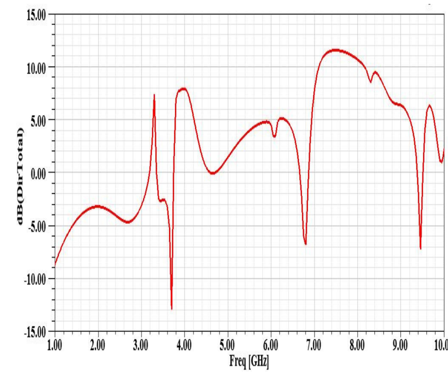

Fig. 11: Directivity (dB) versus frequency (GHz) (Neltec NY9220)

In fig 12 (a) & (b) shows the simulated radiation pattern in E-plane and H-plane at the resonant frequencies 5.6GHz and 8.9GHz respectively.

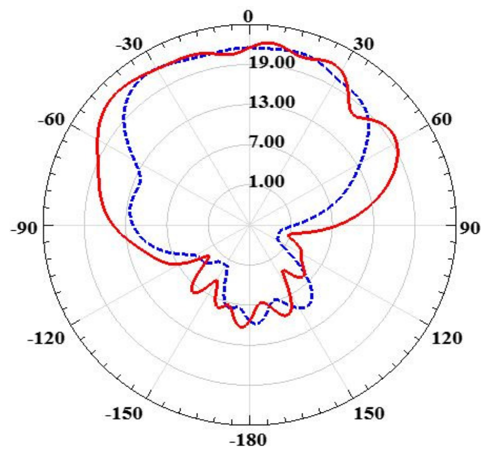

Fig. 12(a) Radiation pattern of E-field (red) & H-field (blue) for 5.6 GHz

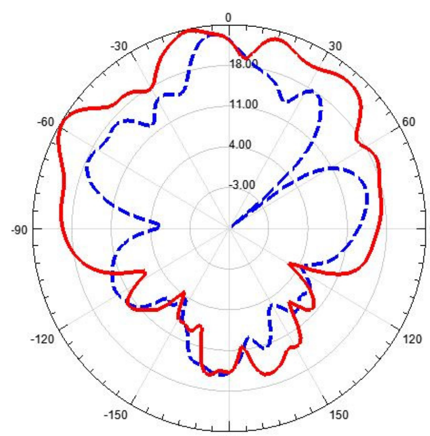

Fig. 12(b) Radiation pattern of E-field (red) & H-field (blue) for 8.9 GHz

Table II

List of output using FR-4 substrate

Freq. (GHz)	Return loss (dB)	VSWR	Gain (dB)	Directivity (dBi)
5.6	-21	1.17	3.72	5.5
8.9	-27	1.13	5.00	7.16

Table III

List of output using Neltec NY9220

Freq. (GHz)	Return loss(dB)	VSWR	Gain (dB)	Directivity (dBi)
5.6	-2	1.18	3.75	4.8
8.9	-15	1.06	5.24	7.18

IV. CONCLUSION

A dual band micro strip antenna is proposed in this paper by designing and simulation has been done by using Ansoft HFSS software.

The dual frequency band can be achieved by using two rectangular slots (Horizontal and vertical) loaded in the patch of antenna. In this design the comparison between substrate materials has been shown for different parameters like return loss, VSWR, gain, directivity.

The dimension of proposed antenna is 30mm×30mm with using FR-4 and Neltec NY9220 substrate material with the thickness of 1.6mm.

So, it is concluded that the simulated result of the proposed antenna has very good impedance matching.

V. REFRENCES

[1] Dahele, J. S., K. F. Lee, and D. P. Wond, "Dual frequency stackedannular ring microstrip antenna," *IEEE Trans. Antennas Propag.*,Vol. 35, 1281–1285, 1987.

[2]C.A. Balanis, "Antenna TheoryAnalysis and Design ", John Wiley & Sons, INC., NY,1997.

[3]C. M. Wu, C. N. Chiu, and C. K. Hsu, "A new nonuniform meanderedand fork-type grounded antenna for triple-band WLAN applications,"*IEEE Antennas Wirel. Propag.Lett.*, vol. 5, no. 1, pp. 346–348, 2006.

[4]S. Maci and G.B. Gentili, "Dual-frequency patch antennas", IEEEAntennas and Propagation Magazine, vol.39, nº6, pp.13-20, Dec.1997.

[5]Anguera, J.; Puente, C.; Borja, C.; Delbene, N.; Soler, J., "Dual frequency broad-band stacked microstrip patch antenna," Antennas andWireless Propagation Letters, IEEE , vol.2, no.1, pp.36-39, 2003.

[6] M. M. Bait-Suwailam and H. M. Al-Rizzo, "Size reduction ofmicrostrip patch antennas using slotted Complementary Split-RingResonators," in Technological Advances in Electrical, Electronicsand Computer Engineering (TAEECE), 2013 InternationalConference on, 2013, pp. 528-531.

[7] A. Das and B. Datta, "Multi-Band Microstrip Slotted Patch Antenna for Application in Microwave Communication," International Journal of Science and AdvancedTechnolog, vol. 2, no. 9, pp. 91–95, 2012.

[8]Kin- Lu Wong, "Compact and Broadband Microstrip Antennas" John Wiley & Sons,Inc., 2002.

[9]. Ching Yuan Chiu, Pey Ling Teng and Kin Lu Wong, Shorted, folded planar monopole antenna for dual-band mobile phone, IEE Electronics Letters, Vol. 39 No. 18,pp.1301 - 1302, September 2003.

[10]ShimelsMamo,"Analysis and Design of Dual band MicrostripAntennas for Mobile Handsets Master's thesis, Unpublished, 2005.

[11] "Design of C-Band Microstrip Patch Antenna for Radar Applications Using IE3D" IOSR Journal of Electronics and Communication Engineering (IOSR-JECE) e-ISSN: 2278-2834,p- ISSN: 2278-8735. Volume 5, Issue 3 (Mar. - Apr. 2013), PP 49-58.