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U AND H SHAPED STACKED MICROSTRIP PATCH ANTENNA FOR C AND X BAND APPLICATIONS

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ABSTRACT:
The C and X band ranges of operation have wide range of applications which include satellite communications, Terrestrial communications and motion detection. In this paper we simulated and presented the results of radiation pattern, return loss, power dissipation and quality factor of stacked Microstrip patch antenna which operates in C and X bands. The results of antenna are simulated by using Concerto software. This antenna consists of a U-slot loaded patch stacked with H shaped parasitic patch which exhibits dual frequency of operation.

I. INTRODUCTION

Microstrip patch antennas, in spite of having advantages like light weight, low profile, compact and cost effective, they also have disadvantages of narrow bandwidth and low gain. To overcome these disadvantages we employed stacked patch due to its capability of providing dual frequency characteristics and wider bandwidth.

Here we contain two patches one is a U-slot loaded rectangular patch of area 39.4 X 29.4 mm and other is a parasitic H- shaped patch of area 26 X 18 mm. A combination of these two resulted in a dual frequency of operation with a low return loss , thus antenna will be having maximum power transmission. Generally for good antenna performance a thick dielectric substrate having a low dielectric constant is preferred.

The substrate we selected here is RT DUROID as this provides better efficiency, larger bandwidth and better radiation. Of all the types of RT DUROID we selected RT DUROID 5880 of dielectric constant 2.2 in order to obtain better return loss. Hence for lower patch we use RT DUROID substrate of dielectric constant 2.2 and for stacked patch the substrate is air, dielectric constant is 1. Thus by employing stacked patches, substrates with low dielectric constant, proper feed location we are able to obtain dual frequency of operation with minimum return loss.

The software Concerto is a state of the art system for high frequency field simulation. The main components of this are modeller, quick wave simulator, quickwave2D, CLASP, SOPRANO/EV and post processor. Concerto provides a complete tool chain for RF and microwave electromagnetic design for use on 32 or 64 bit windows platform. Concerto Modeller is used to generate data and models for electromagnetic simulation. The Quick wave simulator uses a finite difference time domain (FDTD) method with conforming elements ideally suited to the analysis of microwave devices. Quick wave 2D also uses FDTD to simulate asymmetric geometrics such as circular waveguides, horn antennas and coaxial connector. CLASP uses the method of moments (MOM) to calculate antenna radiation patterns. The post processor displays and performs further calculation results of CLASP analysis.

II. DESIGN SPECIFICATION FOR PROPOSED ANTENNA:

The geometry of proposed antenna is illustrated in fig (1) . It consists of a lower U-slot loaded patch fabricated on a 39.4 X 29.4 mm2 RT-Duroid substrate with a dielectric constant of €r=2.2 and a substrate thickness of t=6mm. The upper one is a H shaped stacked patch fabricated on a 26 X 18 mm2 AIR substrate with a dielectric constant of €r=1 and a substrate thickness of t=5.5mm.

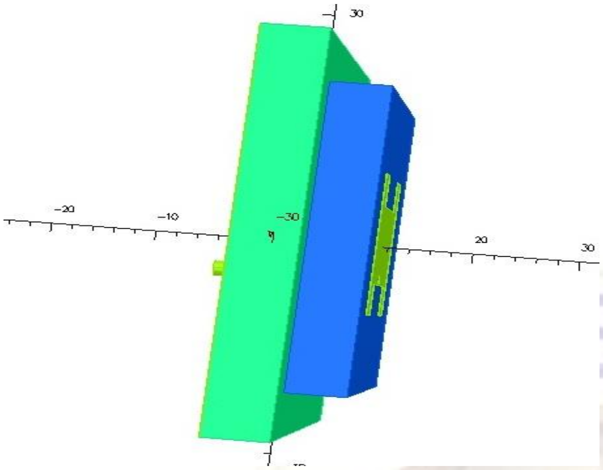

Fig 1: U and H shaped stacked microstrip patch antenne block view

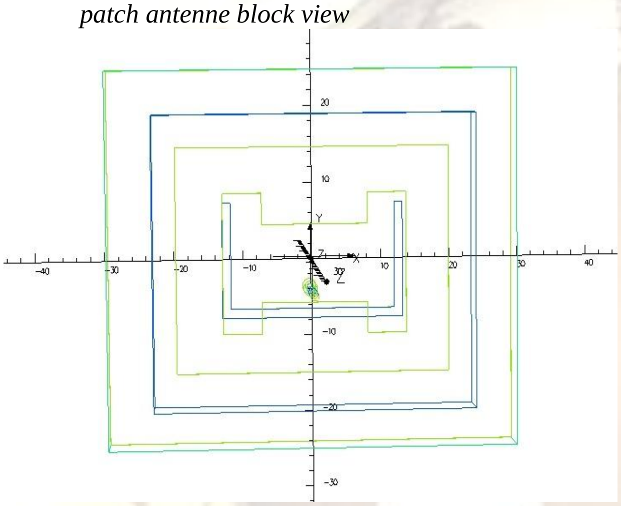

Fig 2: U and H shaped stacked microstrip patch antenna detailed view

The antenna has following parameters U-slot length Ls of 15mm, width Ws of 26mm and thickness s of 1.2mm. For the H-shaped patch length of cut slot d is 15mm and height Wn of 4mm. The feed location is given by (0, -4.77). The inner radius of the coaxial feed is 0.3mm and outer radius is 1mm.

III.RESULTS AND DISCUSSIONS:

a. Return Loss :

The simulated results of return loss is shown in Fig (3).The frequency range of this antenna is 4 GHz to 12 GHz(C and X band range).The return loss observed for the designed model is -31.266dB at 7.66 GHz operating frequency and -24.10542dB at 9.73 GHz operating frequency.

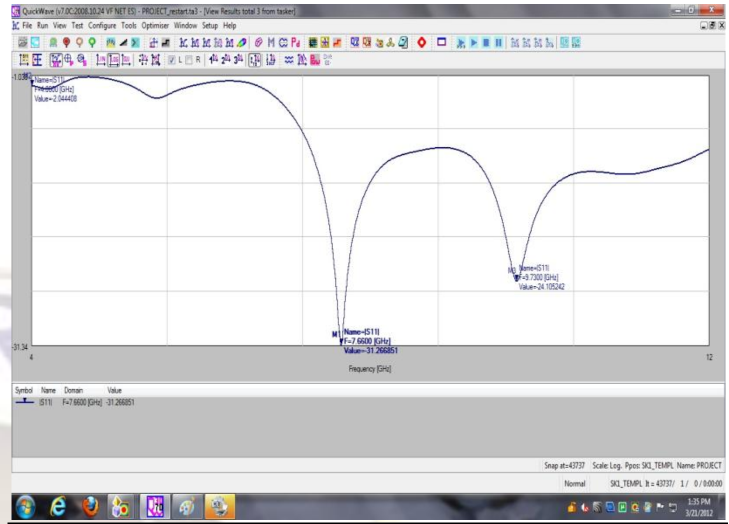

Fig 3: Return loss

b. Radiation pattern in 3D view:

Fig (4) and (5) shows the simulated 3D radiation pattern in log form by using CONCERTO software .The results depict, E_θ and E_Φ polarization patterns in azimuth cut (x-y plane) and the elevation cut (y-z plane and x-z plane) for the antenna frequency of 7.66GHz and 9.73GHz.

The radiation pattern yields the antenna gain as 4.63+e dB at 7.66GHz and 6.06+e dB at 9.73GHz in linear polarization.

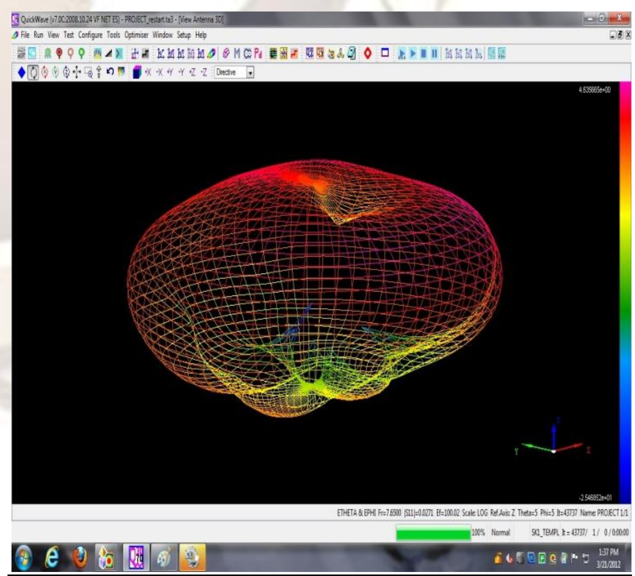

Fig 4: 3D radiation pattern for 7.66 GHz

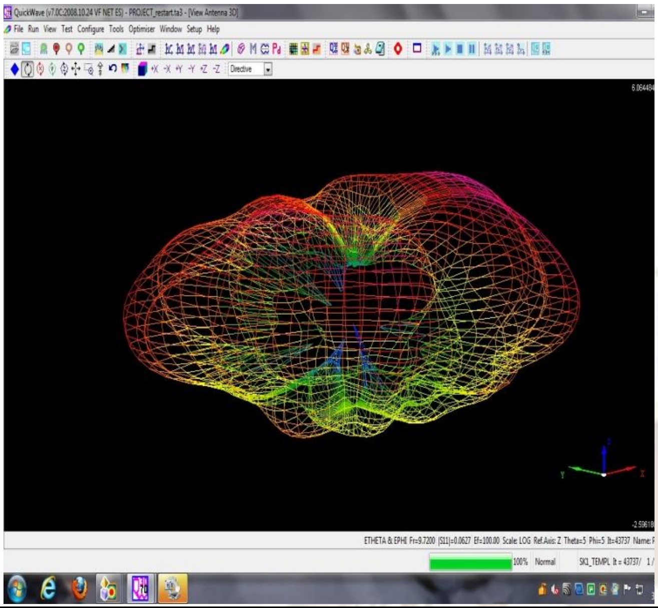

Fig 5: 3D Radiation pattern for 9.73 GHz

c. Radiation pattern in 2D view:

Radiation pattern of the proposed antenna in polar coordinates is observed for $\Phi=0^0$ and 90^0 where θ varies between -90^0 to 90^0 .Fig (6) and Fig (7) shows the radiation patterns in polar coordinates as linear form for the two cases $\Phi=0^0$ and 90^0 respectively for 7.66GHz operating frequency.

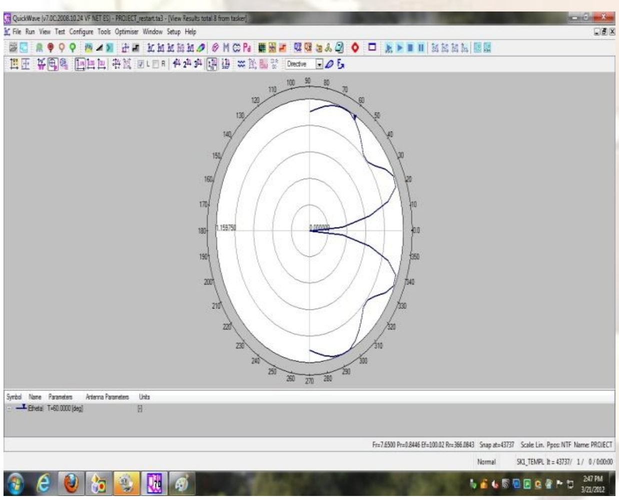

Fig 6: polar plot at 7.66GHz for $\Phi=0^0$

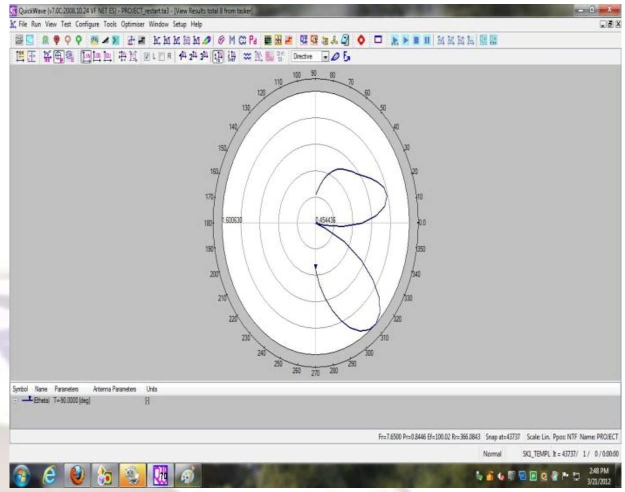

Fig (7) polar plot at 7.66GHz for $\Phi=90^0$

Fig (8) and Fig (9) shows the radiation patterns in polar coordinates as linear form for the two cases $\Phi=0^0$ and 90^0 respectively at 9.73GHz.

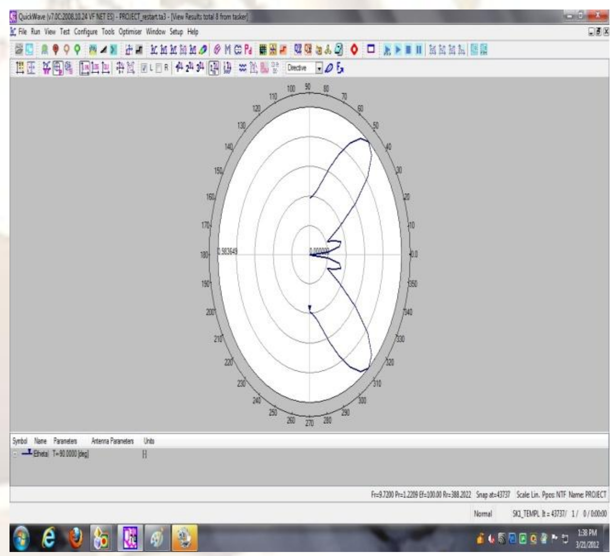

Fig 8: polar plot at 7.66GHz for $\Phi=0^0$

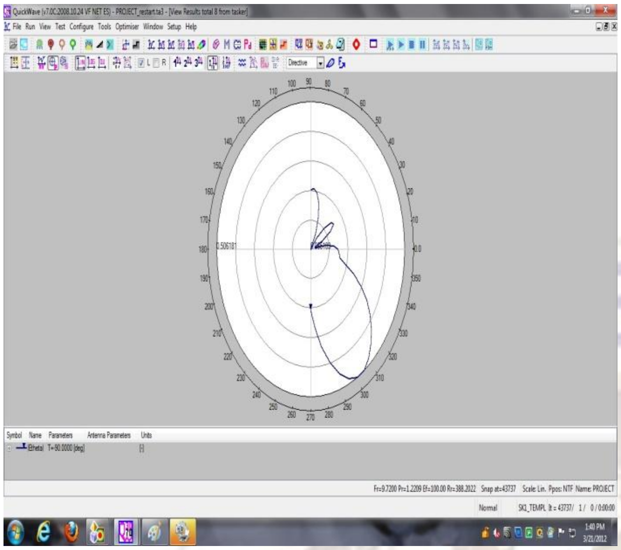

Fig 9: polar plot at 9.73GHz for $\Phi=90^0$

d. Field distributions in different directions:

Total electric and magnetic field distributions in X, Y, Z axis has been shown in Fig (10) and Fig (11).

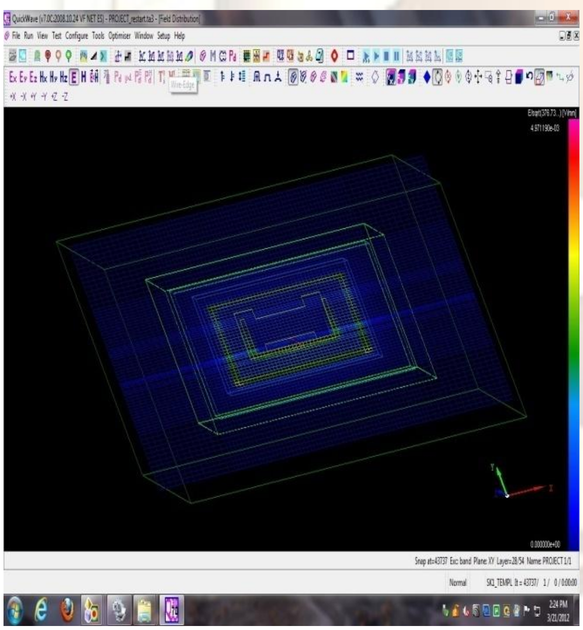

Fig 10: E field distribution

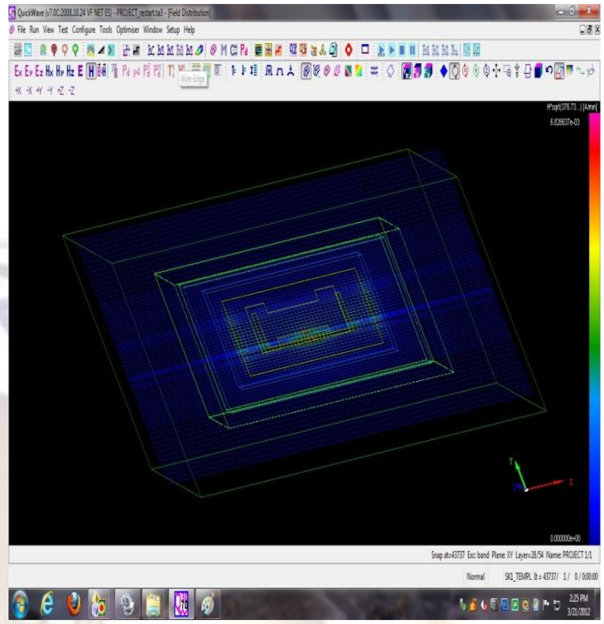

Fig 11: H field distribution

e. Quality factor and energy:

Electric field energy, magnetic field energy and total filed from the proposed antenna are calculated by CONCERTO and same is presented in Fig (12).The quality factor is the additional parameter that can be observed in Fig (12) which can able to specify the quality of the designed antenna.

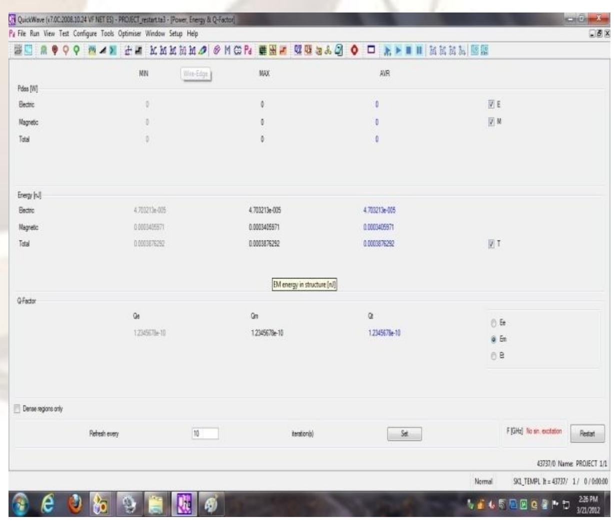

Fig 12: Quality factor and energy: Electric filed energy $4.703213e^{-005}$ magnetic field energy 0.0003405971, total 0.0003876292, Q-factor $1.2345678e^{-10}$

VI. CONCLUSION:

Dual frequency operation of rectangular patch antennas with stacked patch has been investigated by FDTD (finite difference time domain) technique. This antenna resonates at 7.66 GHz and 9.73 GHz frequencies .The antenna is giving the gain of 4.63dB and 6.03dB, quality factor $1.2345678e^{-10}$ and energy 0.0003876292 nJ. Thus these results ensure that the antenna could operate successfully for C and X band applications.

V. ACKNOWLEDGEMENT:

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