Microstrip Patch Antenna with circular Superstrate for Dual band generation

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Abstract

Dual band antenna has many uses especially for mobile devices. The antenna which operates on dual band or dual frequencies can work simultaneously or can use single frequency at a time. The main advantage of these dual band antennas is that they provide stable and strong wireless connection. Since the single band antenna resonates at one frequency and cannot handle two different frequencies at time. Dual band antennas are used in place of single band antenna. In many applications like satellite, radar, WLAN, WIMAX dual band antennas can be used. Depending upon the frequency the antennas can operate on many bands. Microstrip patch antennas can be used for dual band operation because of compactness, ease of fabrication and low cost.

KEYWORDS—Dual bandantenna, Single band antenna, microstrip patch antenna

INTRODUCTION

The concept of Microstrip radiators was 1st given by Dechamps in 1953.But Gutton and Baissinot of France gave the 1st patential documentation in 1955.Howell and Munson made first practical antennas. Robert (bob) Eugens Munson is founder of practical microstrip patch antenna. Robert (bob) Eugene Munson is considered as the father of practical microwave patch antenna. Antenna acts as a link between any transmitter and receiver and it is a basic component in any system. To find Characteristic of any system antenna plays a very important role. In different systems antenna has been used in different forms. According to the IEEE standard definition 'Antenna or aerial means for radiating or receiving radio wave'.Microstrip patch antennas has many advantages when compared to other types of conventional antenna. They provide dual provide dual frequency operation, circular polarization, beam scanning, omnidirectional pattering etc.Wireless Communication systems has become very popular due to rapid growth population. Dual frequency patch antennas can be used in applications where large bandwidth is necessary for operating at two separate bands. Microstrip patch antennas are very popular for many attractive features like light weight, low weight, low cost. Operating in two or more bands for many applications is a desired feature of an antenna.

LITERATURE SURVEY

Parminder Singh, Amandeep Sharma, Avinash Kaur, Amandeep Kaur has proposed a system which is designed for only single band applications. Here the antenna has been designed for frequency 5.65 GHz using CST software. The antenna as got only single

band with bandwidth of 385 MHz with S_{11} of 45db .This antenna as been designed mainly for WIMAX and WIFI applications [1].

Ehab K.I Hamad has proposed two different structures for obtaining dual band H shaped slot is etched on the radiating patch and rectangular slot is etched on the ground plane in the first structure .Two rectangular shaped slots are etched on both ground and patch in the second structures and they can be used for microwave RFID reader application [2].

Mohammad Ayoub sofi, Jyoti saxena, Khalid Muzaffar has proposed a system where H shaped structure has been etched on a ground plane and the H shaped has a triangular cut to obtain dual band. The antenna is designed for WLAN and WIMAX applications. The antenna resonates at 2.4 GHz and 5.5 GHz. And antenna has designed using CST software. The antenna has got a bandwidth of 275 MHz and 756 MHz [3].

Alaa A Yassin and Rashid A Saeed, Rania A, Mokhtar has proposed a dual band microstrip antenna which can be used for WIMAX and WIFI applications. In this structure C slot has been etched on patch and on the ground two slits has been etched. It is resonates at 3.5 GHz and 5.2Ghz.The antenna has got a dual band. This antenna has got a return loss of -18db for first band and -31db for second band. The antenna has got a bandwidth of 42 MHz and 138Mhz with gain of 5.8dbi and 6.7dbi respectively [4].

M. Haroon Tariq, Saba Rashid and Farooq A. Bhatti has proposed a dual band antenna for WiMAX and WIFI applications. Here the antenna resonates at 5.15 GHz and 5.82 GHz. This structure consists of three parallel slots and two vertical slots. This antenna has as got a bandwidth of 150 MHz and 200 MHz and S_{11} of -22db and -13db respectively. The antenna has got the gain of 2.6dbi and 2.7dbi [5].

ANTENNA DESIGN AND CALCULATIONS

While designing any microstrip patch antenna three parameters has to be choosen.Frequency (fr) die-electric constant (ε_r) and height of the substrate (h) has to be considered. The conventional antenna is designed using analytical formula's .The conventional antenna is designed for f=10.2 GHz, ε_r=4.4, and h=1.6mm.

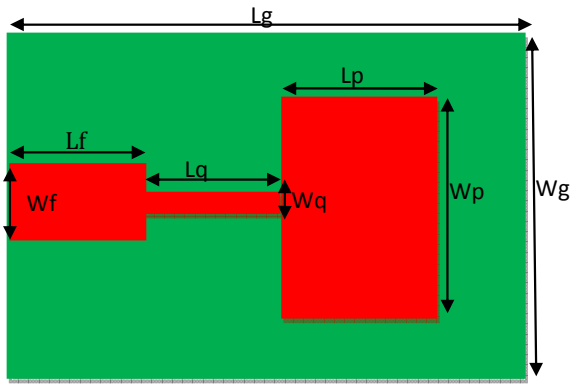

Fig 1 Conventional microstrip patch antenna

The analytical formulas used for designing conventional antenna are as follows.

1. $W = \frac{c}{2 f_0 \sqrt{\frac{\varepsilon_r + 1}{2}}}$

2. $\varepsilon_{reff} = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2}\left[1 + 12\frac{h}{W}\right]^{-\frac{1}{2}}$

3. $L_{eff} = \frac{c}{2 f_0 \sqrt{\varepsilon_{reff}}}$

4. $\Delta L = 0.412\, h \frac{(\varepsilon_{reff} + 0.3)\left(\frac{W}{h} + 0.264\right)}{(\varepsilon_{reff} - 0.258)\left(\frac{W}{h} + 0.8\right)}$

5. $Lp = L_{eff} - 2\Delta L$

Where Wp=Width of the patch.

ε_{reff} = Effective dielectric.

ΔL=Fringe factor.
Lp=Length of the patch.

Values used for designing Conventional antenna are given below:

Wp	8.94mm
Lp	6.27mm
Ls	17.79mm
Ws	16.62mm
Lg	17.79mm
Wg	16.62mm
Lq	3.84mm
Wq	1mm
Lf	3.84mm

Wf	3.05mm

Ls=length of substrate,Ws=width of substrate,Wg=width of ground,Lg=length of ground.Wf=width of feed line,Lf=length of feed line,Lq=length of quarter wave feed,Wq= width of quarter wave feed.

Proposed antenna is consists of superstrate which is placed above the conventional microstrip patch antenna at the height of 3mm from the patch.The shape of the superstrate is circular with outer circle of 4.5mm and inner circle of 4mm.

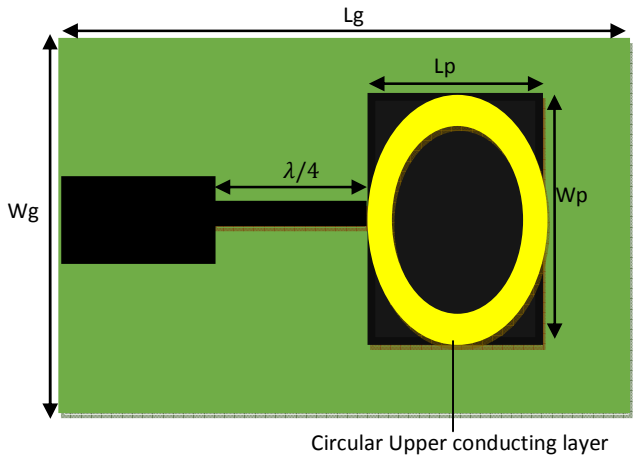

Fig 2.Proposed Microstrip patch antenna

RESULTS AND ANALYSIS

The Conventional Microstrip patch antenna resonates at 10.09 GHz and has got a return loss S_{11} of -19.30 db and it has got only single band with bandwidth of about 610 MHz has shown in figure 3.a .While the proposed microstrip patch antenna first resonates at 9.48 GHz and has got a return loss S_{11} of -14.16 db and it resonates again at 11.33 GHz and it has got a return loss S_{11} of -22.48db.The proposed antenna has got bandwidth of 510Mhz and 360Mhz respectivelyhas shown in figure 3.b.

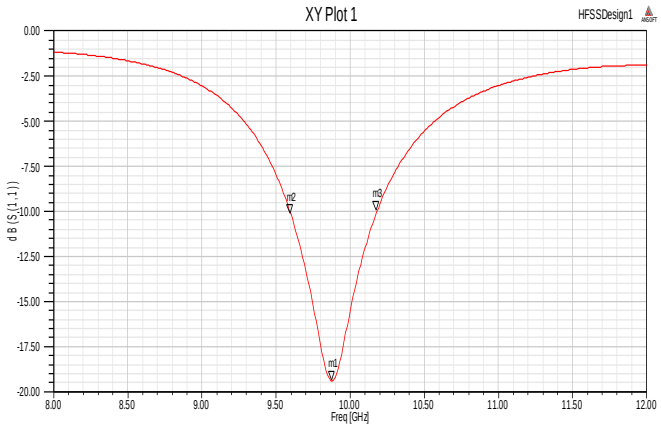

Fig 3.aS_{11} of Conventional antenna

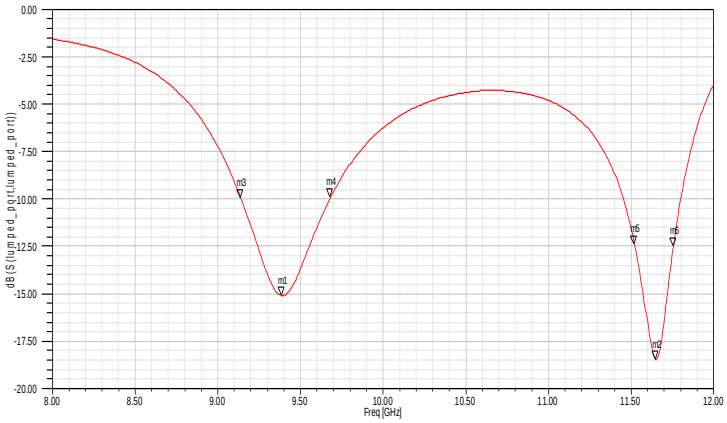

Fig 3.b S_{11} of Proposed antenna

The Conventional Antenna has got only gain of 4.66dbi has shown in figure 4.a but both the bands of proposed microstrip patch antenna has got Gain which is high. When compared on Conventional antenna i.e. for the first band the Gain is 6.17dbi and for the second band the Gain is 7.03dbi has shown in figure 4.b and 4.c

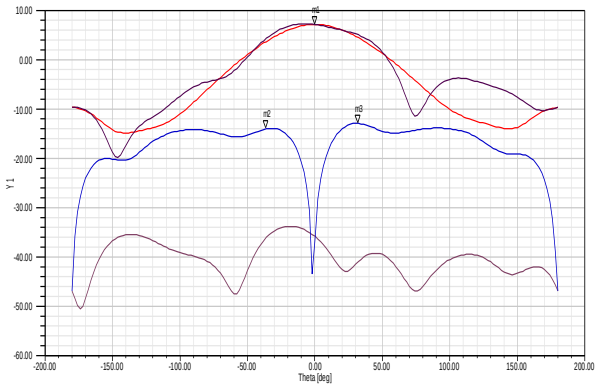

Fig 4.a Gain plot of conventional antenna

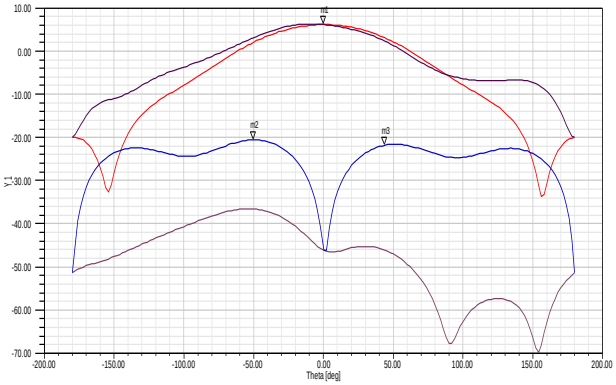

Fig 4.b Gain plot of Proposed antenna for frequency 9.48 GHz

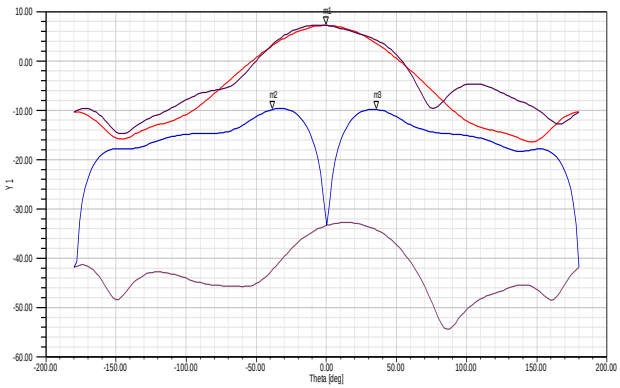

Fig 4.c Gain plot of Proposed antenna for frequeny 11.33 GHz

CONCLUSION

The Conventional and proposed microstrip antenna has been designed for frequency 10.2Ghz.It can be seen that in order to get dual band superstrate has been placed over conventional antenna. And it is seen that the proposed antenna resonates at two frequencies and gain of the proposed antenna is high compared to conventional antenna. The designed antenna can be used for X-band applications.

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