DUAL T SLOTTED RECTANGULAR MICROSTRIP PATCH ANTENNA FOR WLAN/WIMAX APPLICATIONS

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ABSTRACT

A new, compact, simple and slotted wideband microstrip patch antenna is presented in this paper In this work the rectangular microstrip patch antenna design is loaded by two T slot and two notch so that the bandwidth of rectangular microstrip antenna is improved upto 57.90% at -10dB return loss .The proposed antenna design has frequency band in the frequency range 1.820 GHz to 3.303 GHz. This frequency band is suitable for WLAN/WiMAX and other wireless communication applications. The microstrip patch antenna suffers from narrow bandwidth hence the present work provide an alternative solution to increase the bandwidth. The gain of proposed antenna has been improved up to 3.85dBi and antenna efficiency is 99.88%. The proposed slotted Microstrip antenna is directly fed by 50 Ω microstrip line feed. The proposed antenna is simulated by IE3D(9.0 version)Zealand simulation software based on method of moments.

Keywords: T Slot, Notch, Enhance Bandwidth, Compact, Microstrip Patch, Gain, Microstrip Line Feed.

I. INTRODUCTION

The rapid development of wireless communication systems has increased the demand for compact microstrip antennas with high gain and wideband operating frequencies, Microstrip patch antenna possesses many advantages such as low profile, light weight, small volume and compatibility with microwave integrated circuit (MIC) and monolithic microwave integrated circuit (MMIC) [1] but the major drawback of microstrip antenna is its narrow bandwidth and lower gain[12]. The need for antennas to cover very wide bandwidth is of continuing importance, particularly in the field of electronic warfare and wideband radar and measuring system. In the present work the bandwidth of microstrip antenna is enhanced by T slotted patch directly fed by 50ohm microstrip line feed. The proposed slotted antenna is shown in Figure 1. The frequency band of proposed antenna is between 1.820GHz -3.303 GHz which is suitable for WLAN/WiMAX and other communication applications [2-5]. The dielectric constant of the substrate (ε_r) is typically in the range of $2.2 \leq \varepsilon_r \leq 12$ as in [8],[10]. The proposed antenna has been designed on glass epoxy substrate (ε_r=4.4)[6].The substrate material has large influence in determining the size and bandwidth of an antenna. Increasing the dielectric constant

decreases the size but lowers the bandwidth and efficiency of the antenna while decreasing the dielectric constant increases the bandwidth but with an increase in size. A trade-off relationship exists between antenna size and band-width [11]. The design frequency of proposed antenna is 2.45GHz.

II. ANTENNA DESIGN

For designing a rectangular Microstrip patch antenna, the length and width are calculated as below [7][8]

$$w= \frac{c}{2fr\sqrt{\frac{2}{\varepsilon r+1}}} \quad (1)$$

Where c is the velocity of light($3x10^8$ m/s), ε_r is the dielectric constant of substrate(4.4), f_r is the antenna design frequency(2.45GHz), W is the patch width, and the effective dielectric constant ε_{reff} is given as [7][8]

$$\varepsilon reff = \frac{\varepsilon_r+1}{2} + \frac{\varepsilon_r-1}{2}\left[1+12\frac{h}{W}\right]^{-\frac{1}{2}} \quad (2)$$

At h=1.6mm

The extension length ΔL is calculated as [7] [8]

$$\frac{\Delta L}{h} = 0.412\frac{(\varepsilon_{reff}+0.3)(\frac{W}{h}+.264)}{(\varepsilon_{reff}-.258)(\frac{W}{h}+0.8)} \quad (3)$$

By using the above mentioned equation we can find the value of actual length of the patch as [7][8]

$$L = \frac{c}{2fr\sqrt{\varepsilon reff}} - 2\Delta L \quad (4)$$

The length and the width of the ground plane can be calculated a [7][8]

L_g=6h+L (5)

W_g=6h+W (6)

III. ANTENNA DESIGN SPECIFICATIONS

The design of proposed antenna is shown in figure1. The proposed antenna is designed by using glass epoxy substrate of a dielectric constant 4.4 and the design frequency 2.45 GHz is taken. The calculated patch width and length are 37.26 mm and 27.69 mm respectively. The ground plane length and width are taken 37.29 mm and 46.86 mm respectively. Height of the dielectric substrate is 1.6 mm and loss tangent tan δ is 0.0013. Antenna is fed through 50Ω microstrip line feed. Simulation work is done by using IE3D simulation software. All the specifications are given in the table1 (all lengths in mm and frequency in GHz).

IV. ANTENNA DESIGN PROCEDURE

All the dimensions of proposed antenna should be calculated very carefully by using the equations 1, 2, 3, 4, 5 and 6. Design frequency is 2.45GHz taken. For making the proposed microstrip antenna the antenna is loaded with two T slot and two notch. The geometry of proposed antenna is shown in figure1. During the designing of proposed antenna on IE3D ground plane is starting from (0,0) at lower left corner. The microstrip line feed of 50Ω is placed at lower left corner of the patch through a strip of length 1.6 mm and width 4 mm to achieve maximum bandwidth.

Table1: Antenna Design Specifications.

S.No.	Parameters	Value
1.	Design frequency f_r	2.45 GHz
2.	Dielectric constant ε_r	4.4
3.	Substrate height h	1.6 mm
4.	Patch width Wp	37.26 mm
5.	Patch length Lp	27.69 mm
6.	Ground plane width Wg	46.86 mm
7.	Ground plane length Lg	37.29 mm

Table 2. Antenna Parameters

S.No.	Parameters	Value(mm)
1.	A	10.85
2	B	10.85
3	C	6
4	D	16
5	E	8
6	F	4.8
7	G	4
8	X	4
9	Y	1.6
10	Z	7.85
11	P	6x6
12	Q	6x6
13	R	6x4
14	S	12x6

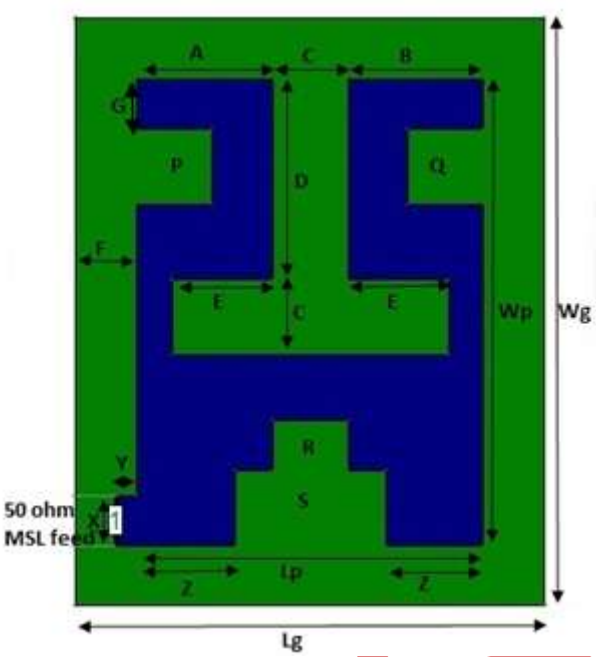

Fig.1. Geometry Of Proposed Microstrip Antenna.

V. SIMULATION RESULT AND DISCUSSION

The narrow bandwidth of microstrip antenna is one of the important features that restrict its wide usage**.** In the present work the bandwidth of rectangular microstrip antenna is enhanced by T slot loading. The fractional bandwidth of proposed antenna is 57.90% at -10db return loss. The efficiency of proposed antenna is found to be 99.88 %.The maximum gain of the antenna has been improved up to 3.85 dBi and the VSWR of the antenna is in between 1 to 2 in entire frequency band. The simulation performance of proposed microstrip patch antenna is analyzed by using IE3D version 9.0 software at design frequency of 2.45 GHz. The performance specifications like bandwidth, radiation pattern, gain, VSWR etc of proposed antenna is shown in the figures 2 to 8.

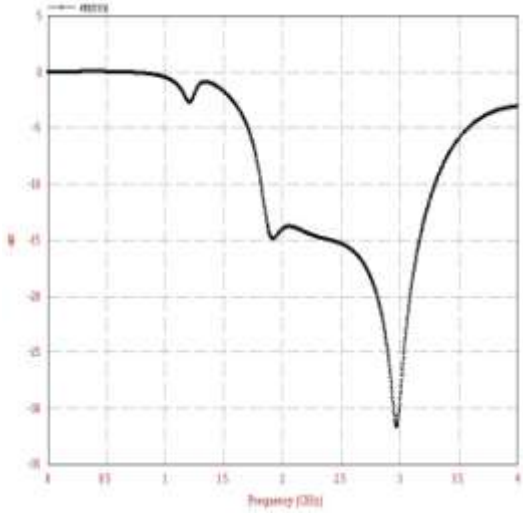

Fig.2. Return Loss V/S Frequency Graph

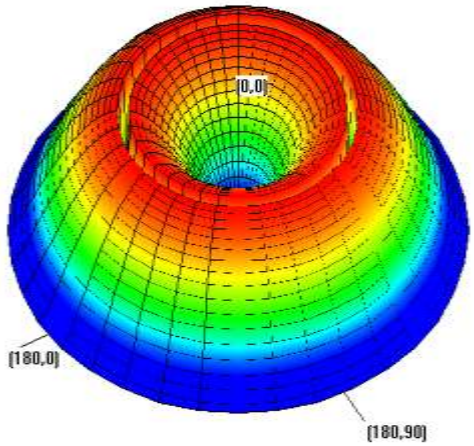

Fig.3. 3D Radiation Pattern Of Proposed Antenna

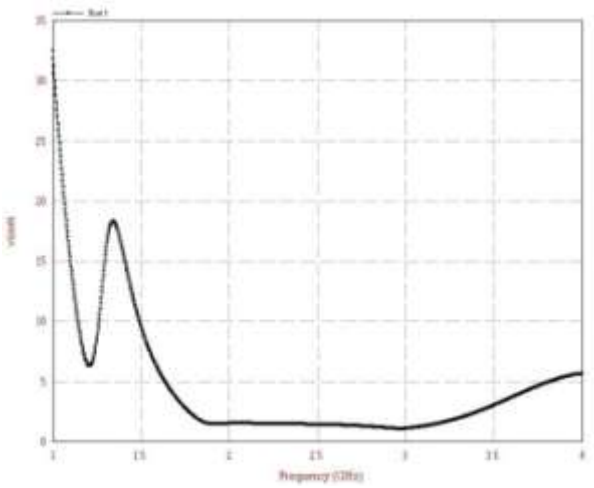

Fig.4. VSWR Of Proposed Antenna

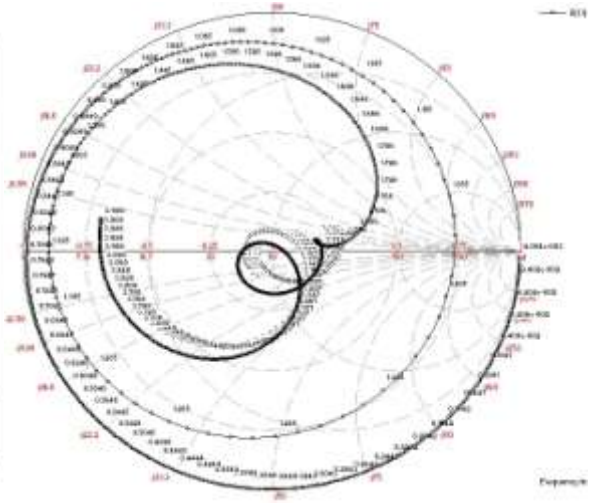

Fig.5. Smith Chart

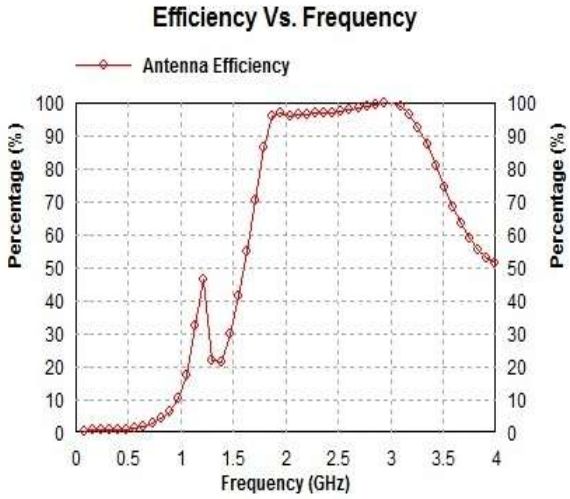

Fig.6: Efficiency Vs Frequency Graph

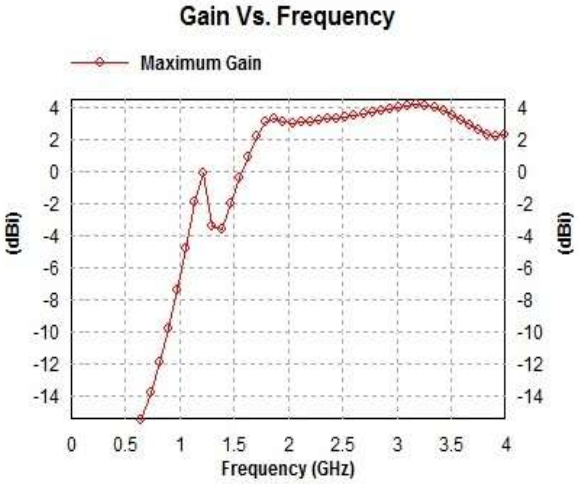

Fig.7. Gain Vs Frequency Graph

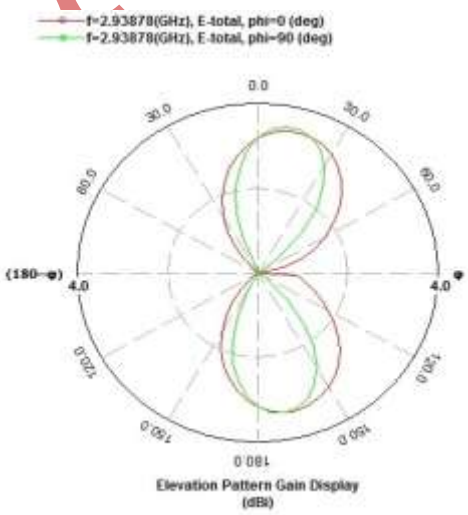

Fig.8. 2D Radiation Pattern of Proposed Antenna

VI. CONCLUSION

The characteristics of proposed T slotted antenna are studied. In general, the impedance bandwidth of the traditional microstrip antenna bandwidth is only a few percent (2% -5%) [9]. Therefore, it becomes very important to develop a technique to enhance the bandwidth of the microstrip patch antenna. Proposed antenna improved the fractional bandwidth upto 57.90% at -10dB return loss in the frequency range 1.820 GHz to 3.303 GHz. The proposed antenna has been designed on glass epoxy substrate to give a maximum antenna efficiency of about 99.88 % and gain of about 3.85 dBi.

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