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A Compact Dual Band Printed Antenna for WiMAX & HIPERLAN Applications

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***Abstract* — A single feed compact rectangular microstrip antenna for dual band application is proposed in this paper. Two T slits are introduced at the right edge of the patch to reduce the resonant frequency. For the proposed antenna two resonant frequencies are obtained at 3.51 GHz and 4.9 GHz with bandwidth of 15.8 MHz, return loss –31 dB and bandwidth of 35.19 MHz, return loss -13.5 dB respectively. An extensive analysis of the return loss, radiation pattern, gain and efficiency of the proposed antenna is presented. The size of the antenna has been reduced by 62.70% when compared to a conventional microstrip patch. The simple configuration and low profile nature of the proposed antenna make it suitable for the applications in Wireless communication system.**

***Keywords* — Conventional patch, Compact, Dual band, Slit.**

I. Introduction

In recent years demand for small antennas on wireless communication has increased the interest of research work on compact microstrip antenna design among microwaves and wireless engineers [1-4]. This paper presents a compact microstrip antenna [5-6] with dual band application for wireless Communications system which is suitable for the 3.51 GHz and the 4.9 GHz operations. These systems may include the combinations of WiMAX [7-8] (Worldwide Interoperability for Microwave Access) and High Performance Radio LAN (HIPERLAN).The size of the antenna is effectively reduced by cutting two T slot on the patch. The proposed antenna has gain of 2.5 dBi at 3.51 GHz and 5 dBi at 4.9 GHz. Efficiency of antenna has been achieved about 40 % for the lower band and 60% for the higher band of operation.

II. Antenna Configuration

The configuration of the Conventional antenna is shown in Figure 1(a). The antenna is a 20 mm x16 mm rectangular patch. The dielectric material selected for this design with ε_r=2.4 and substrate height =1.5875 mm.

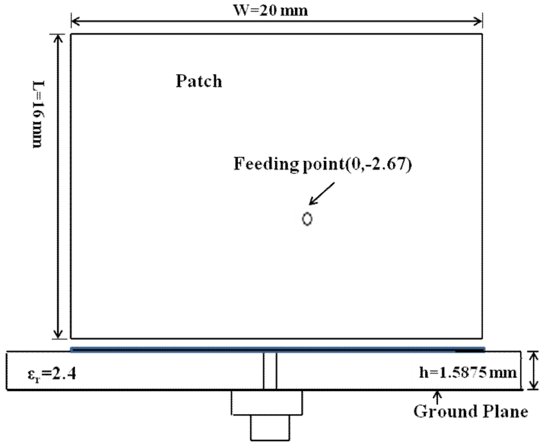
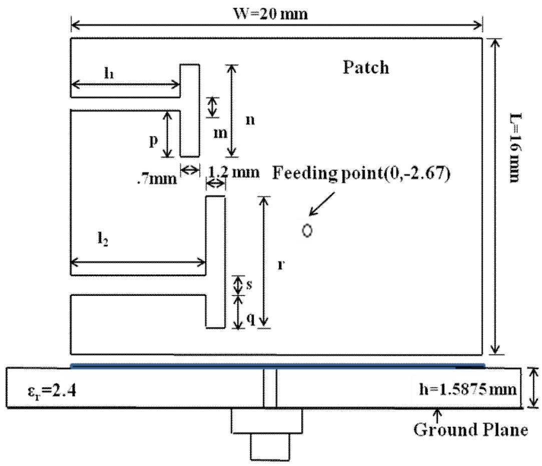


Fig.1. (a) Antenna 1 configuration



(b) Antenna 2 configuration

Figure1.(b) Shows the configuration of antenna 2 designed with similar substrate. Two unequal T slits (l_1 & l_2) each are created whose dimensions and the location of coaxial probe- feed (radius=0.5 mm) are shown in this figure .The optimal parameter values of the T slits are listed in Table1.

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Table 1:

Parameters	m	n	p	l_1
Values (mm)	1	6	1.5	3.65

Table 2:

Parameters	q	r	s	l_2
Values (mm)	2.3	5.8	.5	6.75

III. RESULTS & DISCUSSION

Simulated (using IE3D [10]) results of return loss of the Conventional & proposed antenna are shown in Figure 2. A significant improvement of frequency reduction is achieved in with respect to a conventional microstrip antenna.

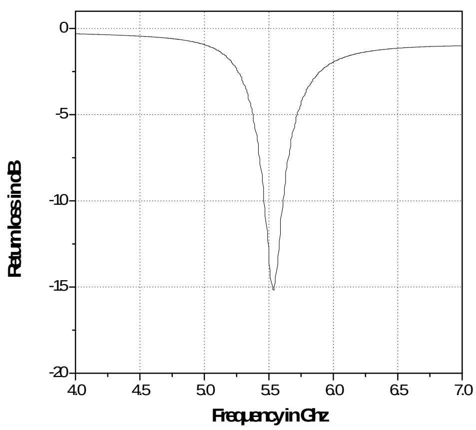
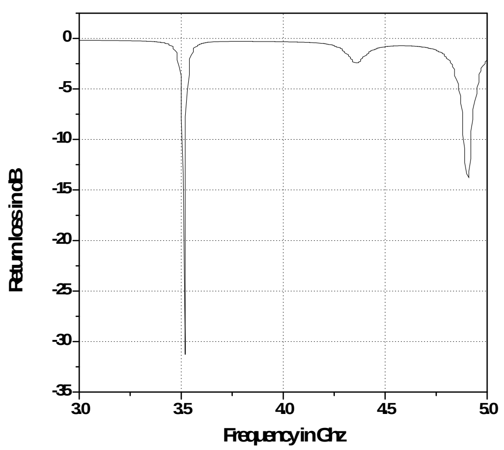


Fig.2. (a) Return loss of the antenna 1



(b) Return loss of the antenna 2.

Simulated radiation pattern

The simulated E & H plane radiation patterns for proposed antenna are shown in Figure 3-4.

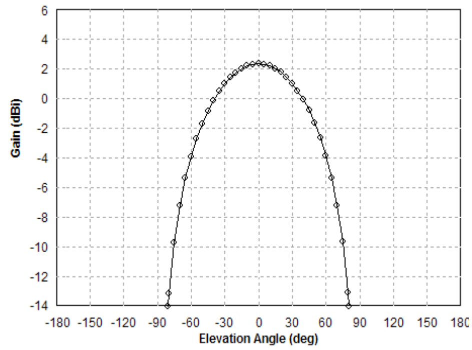
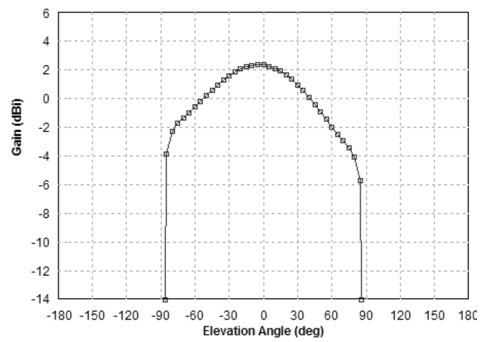


Fig.3.(a) E plane Radiation Pattern of the antenna 2 at 3.51 GHz



(b) H plane Radiation Pattern of the antenna 2 for 3.51 GHz

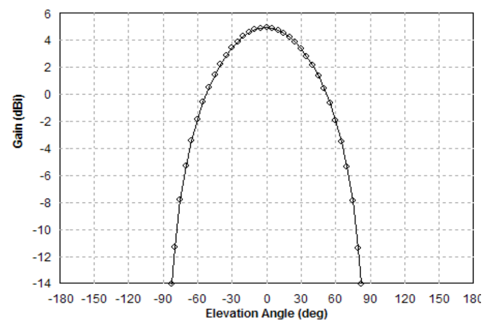
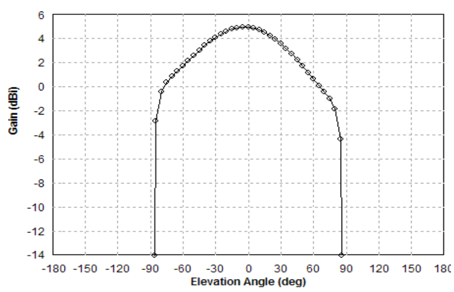


Fig.4. (a) E plane Radiation Pattern of the antenna 2 for 4.9 GHz



(b) H plane Radiation Pattern of the antenna 2 for 4.9 GHz.

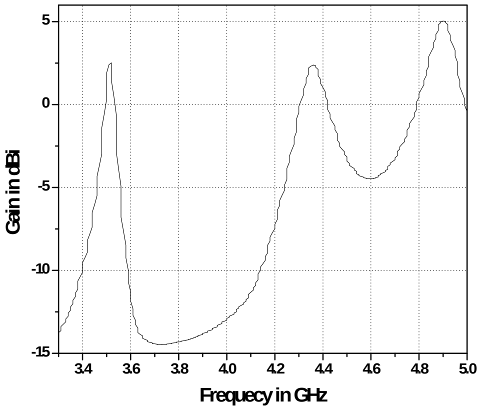


Fig.5. Gain versus frequency plot for the antenna 2.

Figure 5 shows the Gain versus frequency plot for the antenna 2.It is observed that in the first band of operation gain is about 2.5 dBi and for the second band of operation gain is about 5 dBi .

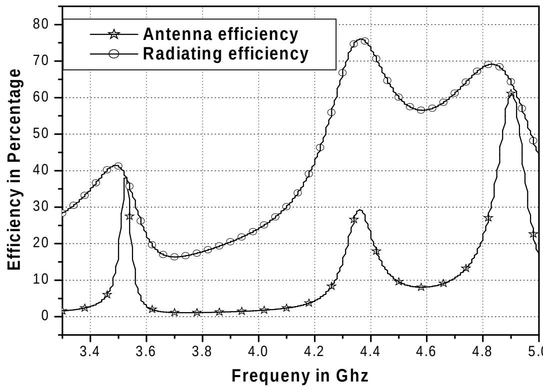


Fig.6. Antenna efficiency versus frequency plot for the antenna 2.

Efficiency of the antenna with the variation of frequency is shown in figure 6.It is found that for the lower band of operation antenna efficiency is about 40% and for the second band antenna efficiency is about 60%.

Simulated results of the antenna are shown in the table 1 & 2.

Table1: Simulated results for antenna 1 and 2

Antenna structure	Resonant frequency (GHz)	Return Loss (dB)	10 dB Bandwidth (MHz)
1	5.54	-15.1	144.42
2	3.51	–31	15.8
	4.9	- 13.5	35.19

Table2: Simulated results for antenna 2

Antenna structure	Resonant frequency (GHz)	3dB Beam width (°)	Absolute gain (dBi)
1	5.54	For h plane:133.92	6.4
		For e plane:130.24	
2	3.51	For h plane:136.34	2.5
		For e plane:96.34	
	4.9	For h plane:144.23	5
		For e plane:112.51	

IV. Experimental Results

Comparisons between the measured return loss with the simulated ones are shown in Fig.7 and 8. All the measurements are carried out using Vector Network Analyzer (VNA) Agilent N5 230A.The agreement between the simulated and measured data is reasonably good. The discrepancy between the measured and simulated results is due to the effect of improper soldering of SMA connector or fabrication tolerance.

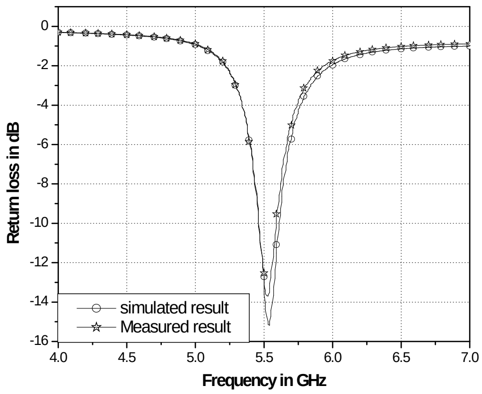


Fig.7. Comparison between measured and simulated return losses for antenna 1

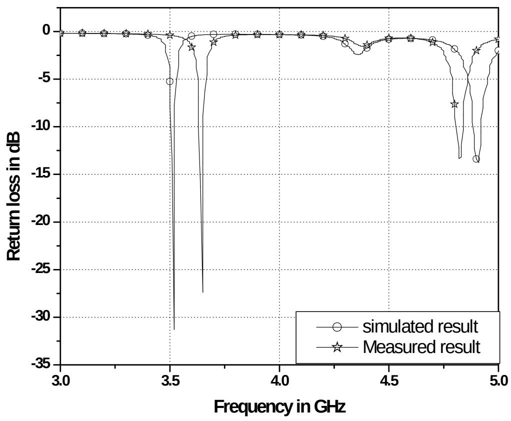


Fig.8. Comparison between measured and simulated return losses for antenna2

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V. Conclusion

A single feed dual band compact T slits microstrip patch antenna has been proposed in this paper. It is shown that the proposed antenna can operate in two frequency bands. For the lower band operation bandwidth of the antenna is 15.80MHz with -31 dB return loss and absolute gain 2.5 dBi. For the upper band, bandwidth of the antenna is 35.19 MHz with a return loss of -13.5 dB and absolute gain about 5 dBi. Efficiency of antenna found to be 40 % for the lower band and 60 % for the higher band of operation. Size of the antenna has been reduced by 62.70% when compared to a conventional microstrip patch. Change of the parameter values of the slot may reduce the size of the patch area more than 62.70% but an optimization between size reduction and gain-bandwidth performance is maintained in this work.

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