A Compact Printed Antenna For Wimax, Wlan & C Band Applications

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Abstract:
A single feed compact microstrip antenna is proposed in this paper. One L slit & one H slit are introduced on the right edge of the patch to study the effect of the slit on radiation behaviour with respect to a conventional microstrip patch. An extensive analysis of the return loss, radiation pattern and efficiency of the proposed antenna is shown in this paper. For the optimize value of the slit parameters antenna resonant frequencies are obtained at 2.53, 4, 5.73 & 7.54 GHz with corresponding bandwidth 12.48 MHz, 37.97 MHz, 80.68 MHz , 230.67 MHz and return loss of about -17.4, -32.5, -12.4 & -29.7 dB respectively. The antenna size has been reduced by 75% when compared to a conventional microstrip patch. The characteristics of the designed structure are investigated by using MoM based electromagnetic solver, IE3D. The simple configuration and low profile nature of the proposed antenna leads to easy fabrication and make it suitable for the applications in Wireless communication system. Mainly it is developed to operate in the WiMAX & WLAN application.

Keywords: Compact, patch antenna, Quad band, slit.

1. Introduction:

Microstrip patch antennas [1] are popular in wireless communication, because they have some advantages due to their conformal and simple planar structure. They allow all the advantages of printed-circuit technology. There are varieties of patch structures available but the rectangular, circular and triangular shapes [2] are most frequently used. Design of WLAN antennas also got popularity with the advancement of microstrip antennas. Wireless local area network (WLAN) requires three bands of frequencies: 2.4GHz (2400-2484MHz), 5.2GHz (5150-5350MHz) and 5.8GHz (5725-5825MHz). WiMax [7] (Worldwide Interoperability for Microwave access) has three allocated frequency bands. The low band (2.5-2.69 GHz), the middle band (3.2-3.8 GHz) and the upper band (5.2-5.8 GHz).The size of the antenna are effectively reduced by cutting slot in proper position on the microstrip patch. It has a gain of 4.60 dBi at 4 GHz, 4.35 dBi at 5.73GHz & 3.49 dBi at 7.54 GHz presents a size reduction of about 75% when compared to a conventional microstrip patch. Due to the Small size, low cost and low weight this antenna is a good candidate for the application of wireless communication systems [4-6], mobile phones and laptops.

2. Antenna Design: The configuration of the proposed antenna is shown in the fig 1. The antenna is an 18mm x 14mm rectangular patch. The dielectric material selected for this design is an FR4 epoxy with dielectric constant (ε_r) =4.4 and substrate height (h) =1.6 mm.

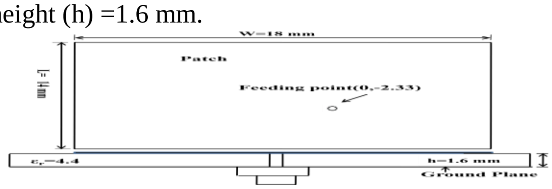

Fig 1. Antenna 1 configuration.

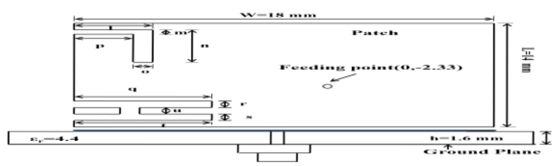

Fig 2. Antenna 2 configuration.

The optimal parameter values of the L slits & H slits are listed in Table:

Table:

Parameters	l	m	n	o	p	q	r	s	t	u
Values (mm)	4.45	.45	9.85	1.2	3.25	7.5	1	.8	7.5	1

3. Simulated Results & Discussion: Simulated (using IE3D [9]) results of return loss of the Conventional & proposed antenna are shown in Figure 3 & 4. In Conventional antenna only one frequency is obtained below -10 dB which is 4.73 GHz & return loss is found about -20.43 dB with 103.09 MHz bandwidth. For the proposed antenna resonant frequencies are 2.53 GHz, 4GHz, 5.73 GHz, 7.54 GHz and their corresponding return losses are -17.4 dB, -32.5 dB, -12.4 & -29.7 dB respectively. Simulated 10 dB bandwidths are 12.48 MHz, 37.97 MHz 80.68 & 230.67 MHz respectively.

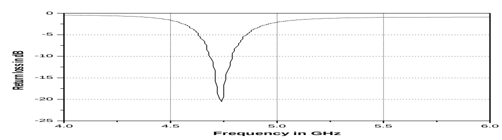

Fig 3. Return loss of the Conventional antenna

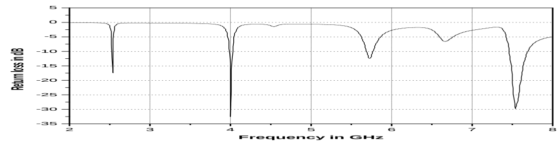

Fig 4. Return loss of the proposed antenna

Simulated radiation pattern

The simulated E –H plane radiation patterns for antenna 2 are shown in Figure 5-12**.**

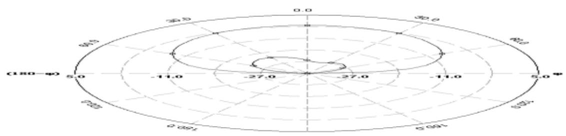

Fig 5. E plane Radiation Pattern of the antenna for 2.51 GHz

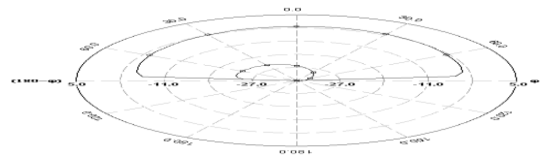

Fig 6. H plane Radiation Pattern of the antenna for 2.51 GHz

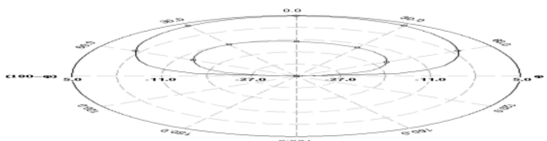

Fig 7. E plane Radiation Pattern of the antenna for 4 GHz

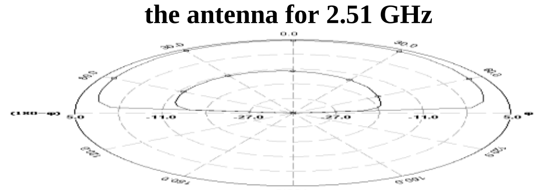

Fig 8. H plane Radiation Pattern of the antenna for 4 GHz

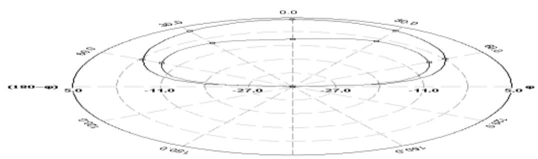

Fig 9. E plane Radiation Pattern of the antenna for 5.73 GHz

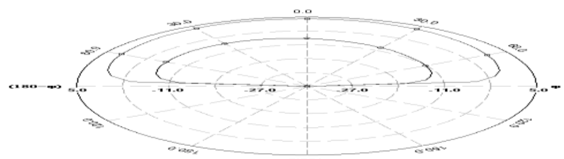

Fig 10. H plane Radiation Pattern of the antenna for 5.73 GHz

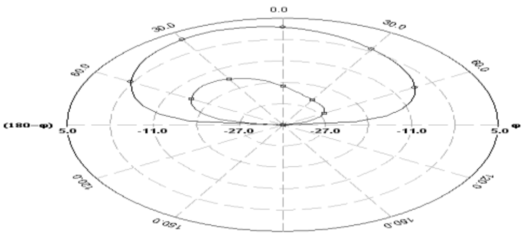

Fig 11. E plane Radiation Pattern of the antenna for 7.54 GHz

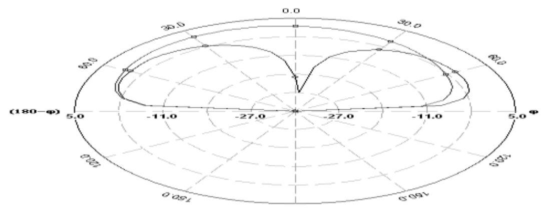

Fig 12. H plane Radiation Pattern of the antenna for 7.54 GHz

Figure 13 shows the Gain versus frequency plot for the antenna 2.It is observed that gain is about 4.6 dBi for 4GHz, 4.35 dBi for 5.73 GHz & 3.49 dBi for 7.54 GHz.

Efficiency of the antenna 2 with the variation of frequency is shown in figure 14. It is found that antenna efficiency is about 67.52 % for 4 GHz, 61.94 % for 5.73 GHz & 46.06 % for 7.54 GHz

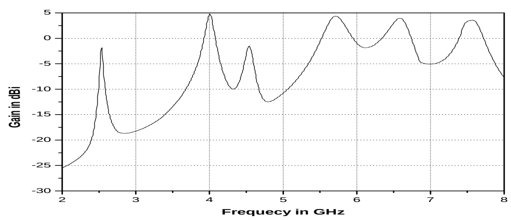

Fig 13. Gain versus frequency plot for the proposed antenna.

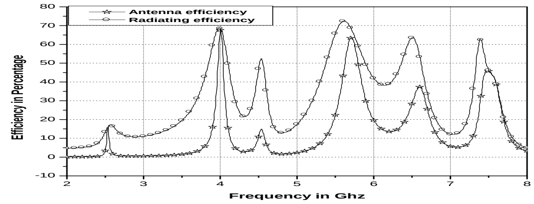

Fig14. Antenna efficiency versus frequency plot for the proposed antenna.

4. Experimental results: Comparisons between the measured return losses with the simulated ones are shown in Fig. 15 & Fig.16. 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.

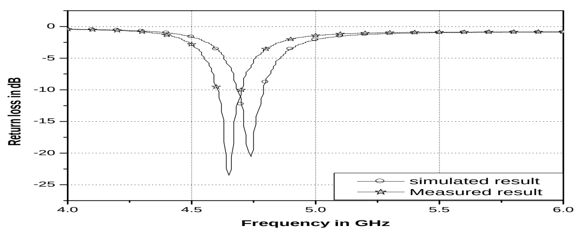

Fig 15. Comparison between measured and simulated conventional antenna.

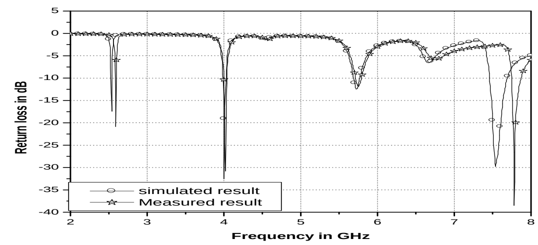

Fig 16. Comparison between measured and return losses for simulated return losses for proposed antenna.

5. Conclusions: A single feed single layer microstrip antenna has been proposed in this paper. It is shown that the proposed antenna can operate in four frequency bands. The slits reduced the size of the antenna by 75 % and increase the bandwidth up to 230.67 MHz with a return loss of -29.7 dB, absolute gain about 3.49 dBi. Efficiency of antenna has been achieved 67.52 %. An optimization between size reduction and bandwidth enhancement is maintained in this work.

6. References:

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