A COMPACT MICROSTRIP ANTENNA FOR WIMAX APPLICATIONS

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ABSTRACT
In wireless communication, there are several types of microstrip antennas; the most common is microstrip patch antenna. In this paper, we present a new design of a compact, lightweight, low-cost, multi standard antenna for WiMAX applications. Measured and simulated results of the resonant frequency, return loss, radiation patterns, gain and efficiency are presented using IE3D software. Two L slits are introduced at the edge of the patch to reduce the resonant frequency. For the proposed antenna four resonant frequencies are obtained at 2.54 GHz, 4.2 GHz, 5.58 GHz and 7.4 GHz with bandwidth of 12 MHz, 22 MHz, 78.63 MHz, 116 MHz & return loss –21.81 dB, –12.06 dB, –15.56 dB & –19.68 dB respectively. The size of the antenna has been reduced by 75% when compared to a conventional microstrip patch.

Keywords: Compact, slit, Conventional, patch.

1. INTRODUCTION
The explosive growth of wireless system and booming demand for a variety of new wireless application [1-3], it is important to design broadband antennas to cover a wide frequency range. Design of WiMax [4-5] antennas also got popularity with the advancement of microstrip [6-9] antennas. WiMax stands for Worldwide Interoperability for Microwave access and established by the IEEE 802.16 working group. It has three operating bands, the lower band (2.5-2.69 GHz), the middle band (3.2-3.8 GHz) and the upper band (5.2-5.8 GHz). The proposed quad band antenna (substrate with $\varepsilon_r = 4.4$) is simulated for the WiMax frequency ranges of 2.5-2.69 GHz and 5.2-5.8 GHz. The work to be presented in this paper is a compact microstrip antenna design obtained by cutting L slit on the patch. Our aim is to reduce the size of the antenna as well as increase the operating bandwidth. The proposed antenna presents a size reduction of 75% when compared to a conventional microstrip patch with a maximum bandwidth of 116 MHz. The simulation has been carried out by IE3D [10] software which uses the MOM method. Due to the Small size, low cost and low weight this antenna is a good candidate for the application of WiMax applications.

2. ANTENNA DESIGN
The geometry of the proposed rectangular patch is shown in Figure 1 which is 18 mm × 14 mm. The antenna is fabricated on a substrate of FR4 epoxy with dielectric constant ($\varepsilon_r$) = 4.4 and substrate height ($h$) =1.6 mm.

3. SIMULATED RESULTS & DISCUSSION
The simulated return loss of the conventional antenna (antenna 1) and the proposed antenna (antenna 2) is shown in Fig. 2 which is done by IE3D [10] software.
In Conventional antenna only one frequency is obtained below -10 dB which is 5.08 GHz & return loss is found about -44.5 dB with 23.6 MHz bandwidth. For the proposed antenna resonant frequencies are 2.54 GHz, 4.2 GHz, 5.58 GHz, 7.4 GHz and their corresponding return losses are -21.81 dB, -12.06 dB, -15.56 dB & -19.68 dB respectively. Simulated 10 dB bandwidths are 12 MHz, 22 MHz, 78.63 MHz, & 116 MHz respectively.

3.1. Simulated Radiation pattern
The simulated E & H plane radiation patterns for proposed antenna are shown in Figure 3-6.

Figure 3: (a) E Plane Radiation Pattern of the Antenna 2 at 2.54 GHz (b) H Plane Radiation Pattern of the Antenna 2 at 2.54 GHz

Figure 4: (a) E Plane Radiation Pattern of the Antenna 2 at 4.2 GHz (b) H Plane Radiation Pattern of the Antenna 2 at 4.2 GHz

Figure 5: (a) E Plane Radiation Pattern of the Antenna 2 at 5.58 GHz (b) H Plane Radiation Pattern of the Antenna 2 at 5.58 GHz

Figure 6: (a) E Plane Radiation Pattern of the Antenna 2 at 7.4 GHz (b) H Plane Radiation Pattern of the Antenna 2 at 7.4 GHz

Figure 7 shows the Gain versus frequency plot for the antenna 2. It is observed that gain is about 5.21 dBi for 4.2 GHz, 5.9 dBi for 5.58 GHz & 5.04 dBi for 7.4 GHz.

Figure 7: Gain Versus Frequency Plot for the Antenna 2

Efficiency of the antenna 2 with the variation of frequency is shown in Figure 8. It is found that antenna efficiency is about 22 % for 2.54 GHz, 76 % for 4.2 GHz, 84 % for 5.58 GHz & 58% for 7.4 GHz.
Comparisons between the measured return losses with the simulated ones are shown in Fig. 9 and 10. 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.

5. CONCLUSION

A single feed single layer L slit 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 116 MHz with a return loss of -19.68 dB, absolute gain about 5.04 dBi. Efficiency of antenna has been achieved 84%. An optimization between size reduction and bandwidth enhancement is maintained in this work.

REFERENCES


