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CPW fed Inverted U-Shape Microstrip Patch Antenna for WLAN/WiMAX Applications

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Abstract: ***A coplanar waveguide (CPW)-fed planar monopole antenna for WiMAX and WLAN applications is presented. The antenna, which occupies a small size, is simply composed of an inverted U-shaped radiating patch with E-shape slot. By carefully selecting the positions of this slot, reasonable bandwidth of the antenna can be obtained so that operating bands covering 2.4/5.2/5.8 GHz WLAN bands and the 2.5/3.5/5.5 GHz WiMAX bands. The measured results also demonstrate that the proposed antenna has appreciable bandwidth and is thus suitable to be integrated within the portable devices for WiMAX/WLAN applications. The various characteristics parameters like S-parameter, VSWR and radiation pattern are studied. The proposed antenna is simulated by using ANSOFT HFSS software.***

Key words: Microstrip Antenna, WLAN, WiMAX, CPW feed

I. Introduction

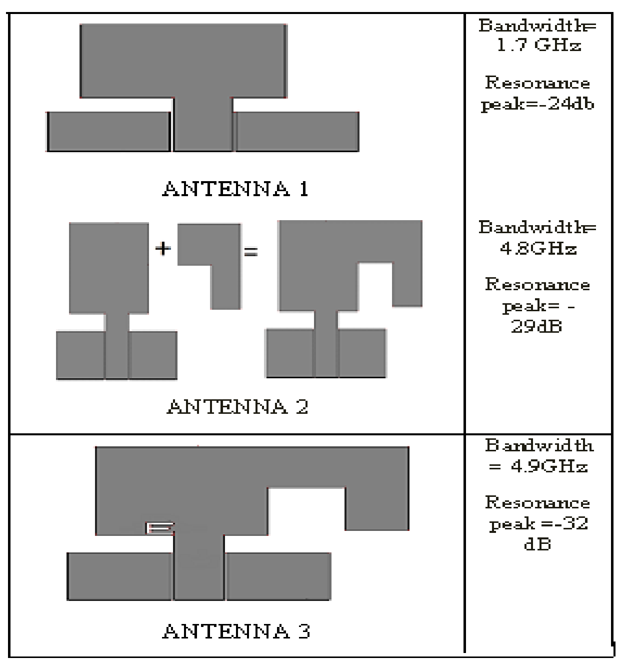
The technologies of wireless communication systems have been rapidly ever growing demands for broadband service and transmission speeds to support multimedia, image, speech, and data communication. In order to response the rapidly growing demands, an antenna should be responsible in many frequency bands. Accordingly, the multiband antenna is desired in many systems[I-VI] . Also, a modern antenna requires not only the function of providing a dual- or multiband operation, but also a simple structure, compact size, and easy integration with the system circuit[II]. Printed microstrip architectures have been widely investigated [III] and it is a good candidate for wireless communication[IV] because its offers a low profile, i.e. thin and easy manufacturability, easy to fabrication by using techniques like etching and photolithography , are easy to feed, easy to use in an array and moderate directivity, which provides a great advantage over traditional antennas [V].Different feed mechanisms, feed by probe and coupling through aperture, were used for high input isolation[VI].In addition, to simplify the feeding structure and save space, a coplanar waveguide (CPW) approach have been widely used for antenna feed system because its wide bandwidth, planar structures, and easy integration with monolithic microwave integrated circuits (MMIC)[VII] , which supports two orthogonal modes[6]

For short- and long-range wireless applications, number of antenna designs suitable for wireless local area network (WLAN: 2.4–2.483, 5.15–5.35, and 5.725–5.85 GHz) and worldwide interoperability for microwave access (WiMAX: 2.5–2.69, 3.3–3.8, and 5.25–5.85 GHz) operation have been studied and designed[I-X]. Antennas capable of reducing frequency collision and therefore enhancing system performance have been developed with slots embedments for WiMAX and WLAN operation As for practical applications, all these antenna designs have complicated structure that results in more cost for antenna fabrication.

In this article, we propose a new CPW-fed monopole antenna for WLAN/WiMAX operation. The antenna is originally designed as a U-shaped CPW-fed monopole with E-slot. This way, the antenna can achieve a reasonable bandwidth which simultaneously cover the most commonly used WLAN and WiMAX bands.

II. ANTENNA GEOMETRY

Fig. 1 exhibits the configuration of the proposed monopole antenna. The overall dimensions of the antenna are only 33.9 X 30.5 X 1.6 mm^3. This antenna, which is printed on a 1.6-mm-thick FR4 substrate with a relative permittivity of 4.4, is designed using a inverted U-shaped radiating patch with E-shape slots. The antenna was designed on a low-cost, durable FR4 substrate, which is reinforced with a woven fiberglass material. FR4 means flame retardant and type 4 indicates woven glass reinforced epoxy resin. The radiating patch is fed by a coplanar waveguide (CPW) transmission line with a width of 4.5 mm and a length of 14 mm. The main radiating elements of the antenna, which are etched on the ground plane, have E-Shape slot, which make the antenna to achieve better impedance.



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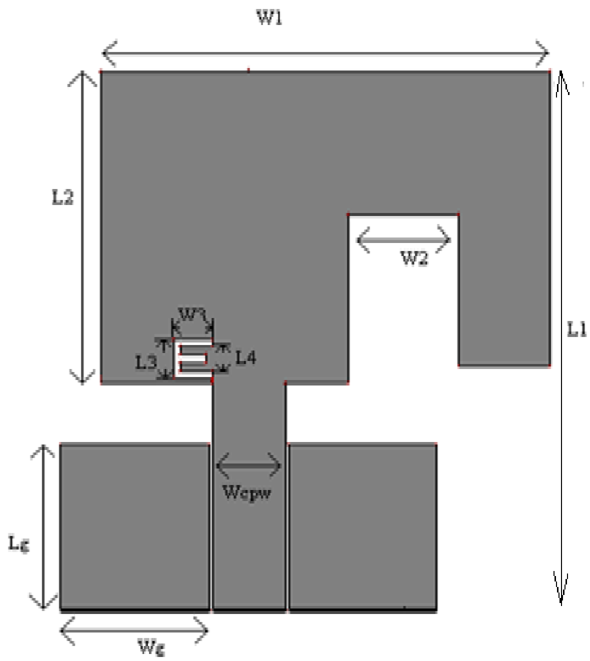

Figure 1 Geometry of proposed Antenna

The basis of this antenna structure is a rectangular patch , this incidentally makes the patch covers lower band of WLAN/WiMAX application. Further to cover both lower and upper band, proposed basic antenna is modified and inverted L-shape strip is joined with rectangular patch(shown in table 2) which results inverted U- shaped radiating. Such a design skill was found to be helpful for improving the antenna's bandwidth. An electromagnetic (EM) solver, Ansoft HFSS, has been employed to analyze the electrical properties and radiation performance of the antenna. The effects of the key structure parameters on the antenna performances are also analyzed and presented in next section.

Table 1 Parameters of the Proposed Multiband Antenna

Parameter	Size(mm)	Parameter	Size(mm)
L_g	10.475	W_g	9.25
L1	33.9	W_1	27.95
L_2	19.9	W_2	6.725
L_3	2.525	W_3	2.475
W_{cpw}	4.5	L4	1.475

III. SIMULATED RESULTS AND DISCUSSION

To validate the design, the parametric study and simulated return loss for the proposed antenna are obtained in this section. Simulated return loss of the optimized proposed antenna is shown in Fig 2. The simulated result has a -10 dB impedance bandwidth of 4.9 GHz in the band of 2.3GHz–7.2 GHz which cover both lower and upper frequency bands of WLAN/WiMAX application. The proposed monopole antenna has a broader bandwidth covering the required bandwidths of the IEEE 802.11 WLAN standard in the band at 2.4 GHz (2.4-2.48 GHz), 5.2 GHz (5.15- 5.35 GHz) and 5.8 GHz (5.72-5.82 GHz) and WIMAX standard in the band at 2.5 GHz (2.5-2.69 GHz), 3.5 GHz (3.4-3.69 GHz) and 5.5 GHz (5.25-5.85 GHz).

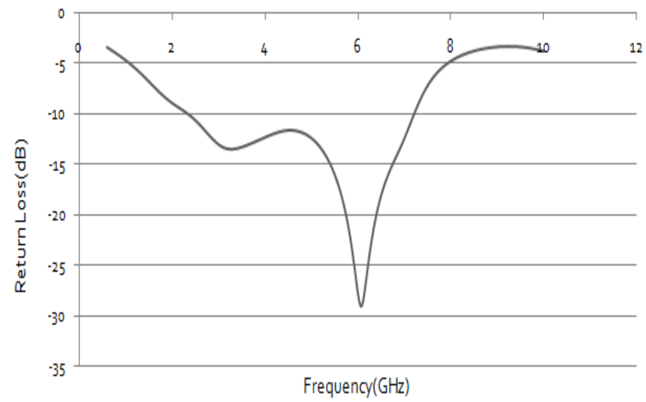

Figure 2 Return loss of proposed multiband antenna

Table 2 Geometry of Antenna1, Antenna 2 and Antenna 3

Figure 3 illustrate the effect of inverted L-Strip on the frequency response of the proposed antenna. The result shows that only 1.7 GHz bandwidth is obtained with primitive antenna (antenna 1 shown in Table 2) which cover only lower bands of WLAN/WiMAX application.

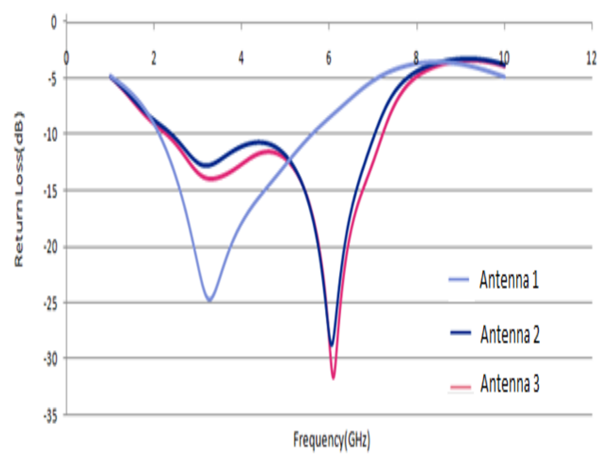

Figure 3 Return losses of antenna 1, antenna 2, antenna 3

Hence, to improve the bandwidth and performance of overall antenna , inverted L-shape Strip is designed to cover both upper and lower bands. With Antenna 2, 4.8 GHz bandwidth and -29 dB return losses peak obtained. The return loss of the antenna3 embedded with E-shape slot is also analysed. The better lower frequency band matching condition is obtained and impedance bandwidth (-10 dB return loss) of 4.9 GHz having return loss peak with -32 dB are obtained. The bandwidth of antenna3 is 4.9GHz which is better than anteena2. This clearly reveals that by using E-shape slot much better bandwidth and return losses can be obtained. Hence a wideband antenna is presented in this work , which has higher bandwidth and small in size. This way it achieves good impedance matching with working bands for WLAN/ WiMAX applications.

3.1 Voltage Standing Wave Ratio (VSWR)

There should be maximum power transfer between the transmitter and the antenna to perform efficiently for any application. The VSWR plot for CPW fed antenna is shown in Figure 4. Ideally, VSWR must lie in the range of 1-2 near the operating frequency value.

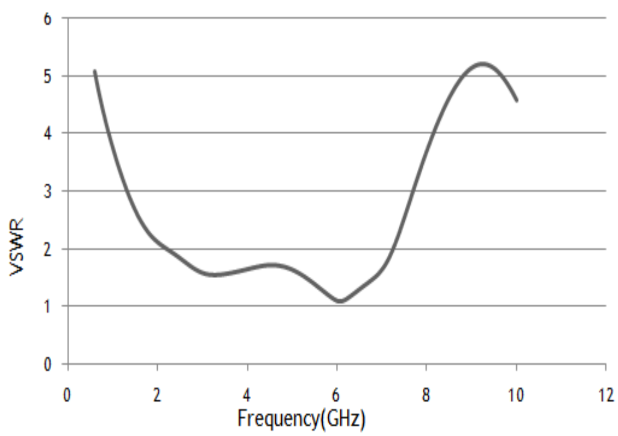

Figure 4 VSWR of proposed antenna

3.2 Radiation pattern

Radiation pattern shown in below figures presents the graphical representation of radiation properties of antenna as a function of space co-ordinates. Simulated 2D and 3D radiation pattern respectively is shown in Figure 5 and Figure 6. These patterns are desirable for WLAN/WiMAX applications.

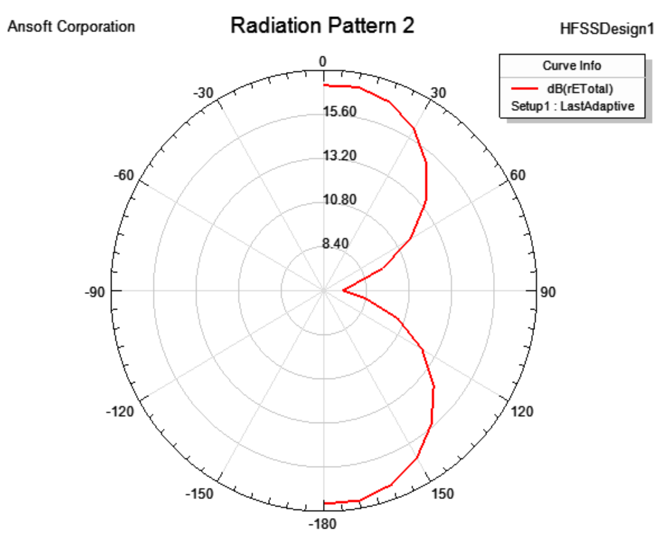

Figure 5: Radiation of Total E-field

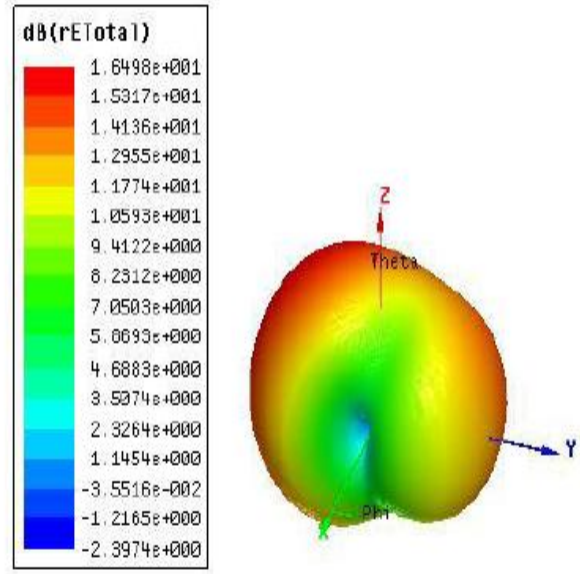

Figure 6: Radiations of Total E-field in 3D configuration

IV. CONCLUSION

A CPW fed inverted U-Shape microstrip patch monopole antenna suitable for WLAN/WiMAX applications is presented. To improve the performance of conventional antenna and widen its bandwidth the patch is loaded with slots. The simulated result has a -10 dB impedance bandwidth of 4.9 GHzin the band of 2.3-7.2GHz which covers of WLAN/WiMAX. Effects of varying dimensions of key structure parameters on the antenna and various parameters like VSWR, radiation pattern and their performance are also studied. The parametric studies show significant effects on the impedance bandwidth of the proposed antenna. Moreover, the proposed antenna has several advantages, such as small size, excellent radiation patterns, good efficiency. These characteristics are very attractive for some wireless communication systems.

REFERENCES:

i. C. Mahatthanajatuphat and P. Akkaraekthalin, S. Saleekaw , M. Krairiksh, " A Bidirectional multiband antenna with modified fractal slot fed by CPW," Progress In Electromagnetics Research, PIER 95, 59{72, 2009

ii. Wen-Chung Liu, Chao-Ming Wu, and Nien-Chang Chu, "A Compact CPW-Fed Slotted Patch Antenna for Dual-Band Operation," IEEE Antennas and wireless propagation letters, VOL. 9, 2010

iii. X. Li, L. Yang, S.-X. Gong, and Y.-J. Yang, " Bidrectional high gain antenna for WLAN applications," Progress In Electromagnetics Research Letters, Vol. 6, 99–106, 2009

iv. Y.-Y. Cui, Y.-Q. Sun, H.-C. Yang, C.-L. Ruan, " A new triple-band CPW-fed monopole antenna for WLAN and WiMAX Applications," Progress In Electromagnetics Research M, Vol. 2, 141–151, 2008

v. Ritika Saini, Davinder Parkash, " CPW fed Rectangular Shape Microstrip Patch Antenna with DGS for WLAN/WiMAX Application," International Journal of Advanced Research in Computer Science, Volume 4, No. 11, Nov-Dec 2013

vi. Yue Li, Zhijun Zhang, Wenhua Chen, Zhenghe Feng, and Magdy F. Iskander, "A Dual-Polarization Slot Antenna Using a

Compact CPW Feeding Structure," IEEE Antennas and wireless propagation letters, VOL. 9, 2010

vii. *L.-M. Si and X. Lv, "CPW-Fed multiband omni-directional planar microstrip antenna using composite metamaterial resonators for wireless communications," Progress In Electromagnetics Research, PIER 83, 133–146, 2008*

viii. *T. Wang, Y.-Z. Yin, J. Yang, Y.-L. Zhang, and J.-J. Xie "Compact triple-band antenna using defected ground structure for WLAN/WIMAX application," Progress In Electromagnetics Research Letters, Vol. 35, 155-164, 2012*

ix. *Islam, F. ,Ali, M. , Majlis, B.Y. , Misran, N. "Design, simulation and fabrication of a microstrip patch antenna for dual band application," International Conference on Electrical and Computer Engineering, pp 799 – 802, Dec. 2008*

x. *Liu, H., Li, Z., Sun, X., "Compact defected ground structure in microstrip technology," IEE Electronics Lett., 2005, vol. 41, no. 3, p. 132 - 134.*