Abstract—A compact multiband planar antenna is proposed for several applications: DCS-1900/PCS/UMTS/WCDMA-2000/GPS, WLAN and WiMAX applications. A previous design was introduced in (2008) [4], which consists of a flared monopole with a sleeve for dual-band applications, it operates in two frequency bands 2.1 and 3.2 GHz covering DCS-1900/PCS/PHS, WCDMA/IMT-2000. This paper introduces a modified antenna consists of a single sided flared-slotted monopole with two “V”-shaped slotted sleeves for multiband applications. The proposed antenna is compact in size with overall dimensions 40mm×35mm. The modified antenna operates in four different bands: 1.58 GHz, 2 GHz, 2.5 GHz and 5 GHz covering DCS-1900/PCS/UMTS/WCDMA-2000/ GPS and 5.2/5.8 GHz WLAN bands and 2.5/3.5/5.5 GHz WiMAX bands. The antenna is fabricated on FR4 substrate with dielectric constant \(\varepsilon_r=4.4\) and thickness \(h=1.5\) mm with a Finite Ground CPW (FGCPW) feeding structure. The measured and simulated return loss have a good agreement with each other. The proposed antenna provides nearly omnidirectional radiation characteristics.

I. INTRODUCTION

Recently, multiband antennas have been introduced to support various applications as it can maintain reasonable gain and suitable radiation patterns. It is well known that multiband antennas represent a good trade-off among cost and performance in various applications. Despite the huge number of different designs that are already available in literature [3], [5], there is still a need for low-profile antennas for microwave communication systems. Therefore, for narrow band applications in multiple frequencies, multiband antenna is preferably a good selection. In 2008, Gijo Augustin, V.P. Sarin, P.Mohanan, C.K. Anandan, and K.Vasudevan presented a single layer, Finite Ground CPW (FGCPW) fed, dual-band with flared monopole with additional sleeves for DCS-1900/PCS/PHS, WCDMA/IMT-2000, and WLAN [4]. The resulting bandwidth of this design is still not covering the GPS/WiMAX applications. In this paper a modified design is proposed for the purpose of introducing more bands that are commonly used nowadays. As illustrated in Figure 1 the antenna is designed as a flared slotted monopole with two “V”-slotted shaped sleeves. All antenna elements are studied and analyzed for different values of antenna dimensions to achieve radiation in the desired frequency bands. The final proposed design is fabricated on FR4 material and the return loss is measured using the vector network analyzer. The comparisons between the measured results and the simulated ones are to be discussed in the following sections.

II. ANTENNA DESIGN

The structure of the proposed antenna shown in Figure 1 consists of a single sided flared slotted monopole to produce the first resonant frequency while the “V”-shaped sleeves
produce the second, third and fourth resonant frequencies. The feedline is a 50Ω CPW feeding structure, it is more flexible to reach the desired frequency band by tuning the antenna dimensions. First, many values of \( L_2 \) and \( t_1 \) were tried and the return loss is shown in Figure 2 and Figure 3 respectively. It is clear from the graph that varying the sleeve length causes shifting in the first, second and third resonant frequencies, while varying the slot sleeve size \( t_1 \) causes shifting in the first and second resonant frequencies without affecting the other two bands. Then \( L_g \) is changed to study its effect on the return loss as shown in Figure 4. It is clear also from Figure 4 that varying the ground length \( L_g \) affects the first and second resonant frequencies which causes shifting in their bands, while the third and fourth resonant frequencies remain constant. The last step is to change the value of \( W_g \) and sketch the return loss as shown in Figure 5. Finally, the appropriate dimensions are selected for the proposed antenna to operate in the required frequency bands and listed in Table 1.

### Table I

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**III. RESULTS AND DISCUSSION**

Based on the selected dimensions, the return loss was simulated introducing a four frequency bandwidths at 1.58 GHz, 2 GHz, 2.5 GHz and 5 GHz as shown in Figure 6 covering DCS-1900/PCS/UMTS/WCDMA-2000/GPS/5.2/5.8 GHz WLAN bands and 2.5/3.5/5.5 GHz WiMAX bands. The antenna is fabricated on FR4 substrate using ProtoMAT S62 with thickness 1.5 mm and shown in Figure 7. The return loss of the fabricated antenna is measured on the Vector.
Figure 7. The Compact fabricated prototype with dimensions 40mm × 35 mm

Figure 8. The verification of results using Vector Network Analyzer

Network Analyzer shown in Figure 8. The measured results and the simulated ones are found to be in a good agreement as shown in Figure 9. The radiation patterns behaves similarly to the typical printed monopoles, the patterns are almost omni-directional. This design is linearly polarized at all the frequency bands. The radiation patterns at 1.5 GHz and 2 GHz are shown in Figure 10 and 11 respectively. Also the radiation patterns at 2.5 GHz and 5GHz is shown in Figures 12 and 13 respectively. The surface current of the proposed antenna at 5 GHz is illustrated in figure 14. It is depicted from the current distribution figure that the lower pair of “V”-slotted sleeves has the dominant effect in the radiated fields at Frequency 5 GHz.

Figure 9. Measured and simulated Return loss of the modified antenna

Figure 10. Radiation patterns at 1.5 GHz (a) $\phi = 90^\circ$ (b) $\phi = 0^\circ$

Figure 11. Radiation patterns at 2 GHz (a) $\phi = 90^\circ$ (b) $\phi = 0^\circ$
In this paper, a compact multiband planar antenna is proposed for several applications: DCS-1900/PCS/UMTS/WCDMA-2000/GPS/WLAN and WiMAX applications. Various values of the antenna dimensions are optimized via simulations to obtain the dimensions suitable for the operations at the required frequency bands. A prototype has also been successfully fabricated. The measured results of the fabricated antenna and simulated results are in good agreement with each other. The proposed antenna radiation bands are: 1.58 GHz, 2 GHz, 2.5 GHz and 5 GHz. The proposed antenna provides almost omnidirectional radiation characteristics.

REFERENCES