International Journal of Engineering and Technical Research (IJETR)
ISSN: 2321-0869, Volume-2, Issue-2, February 2014

A Compact Dual-Band CPW Fed Slot Antenna for PCS/WLAN Application

Yatendra Kumar Tiwari, Ravi Mohan, Sumit Sharma

***Abstract*— In this article a novel wide dual-band design of a coplanar waveguide (CPW) fed antenna for PCS/WLAN is presented. By using a double C-shaped metallic strip embedded in a rectangular slot and an inserted tuning strip, the dual-band resonances of the antenna can be generated. Good impedance matching condition at the two separated wide frequency bands is achieved by using two pairs of tuning strips at the double C-shaped strips and a pair of symmetrical slots. The measured result provides good dual-band operation, with -10 dB impedance bandwidths of 900 MHz (1.96–2.86 GHz) and 3.22 GHz (4.87–8.01 GHz) at the two frequency bands, and average antenna gains of 3.2 and 4 dBi, respectively. The observations will be Monopole-like radiations with small cross-polarisation pattern can be seen for the operating bands.**

***Index Terms*— Compact antennas, dual-band operation, Slot antenna, Wireless applications, WLAN.**

I. INTRODUCTION

In modern wireless communication systems, there has been much interest in utilization of dual band or multiband antennas are increased as compare to single band antennas. Numerous designs of dual-band antenna have been presented in the recent literature, including A dual band S-shaped slot antenna have been proposed as in [1]. A fork-shaped dual band antenna has been reported for Bluetooth and ultra wide band application. In this design structure FR-4 substrate contains fork like patch on top surface, while rectangular ground plane is located on bottom surface. Central longer element and U-shaped element is responsible for Bluetooth and UWB application respectively [2], a K-shaped dual-band antenna with a shorting pin [3] and a p-shaped dual-band antenna [4]. But their impedance bandwidth cannot fulfil the reception of the 2.4 GHz WLAN band. It is also noted that most of them are designed with complicated structures. Some are printed on both sides of the substrate and a via-hole connection is provided for feeding the signal, which increases manufacturing difficulty and cost. The CPW-fed antenna offers many attractive features. Also, the coplanar waveguide (CPW)-fed antenna has become very popular owing to the simplest structure of a single metallic layer, wide bandwidth and easy integration with active devices or MMICs. Thus, the designs of the CPW-fed antennas have recently received much attention. However, for all the antenna designs mentioned they can satisfy at most one wide band in their two bands. Matching two separated frequency bands is very difficult, especially when both of them are very wide. In this Letter, a novel and simple design of a wideband dual-band CPW-fed slot antenna with a single layer substrate is proposed, which operates at (1.96–2.86 GHz) and (4.78–8.01 GHz). This CPW-fed monopole antenna covers the PCS band (1.85–1.99 GHz) and the difficulty of matching this antenna at two separated wide frequency bands has been overcome by using two pairs of tuning strips at the inner and outer C-shaped strips and a pair of symmetrical rectangular slots etched on each side of the feed line. The measurement results show this antenna has wide impedance bandwidths of 900 MHz and 3.22 GHz in the lower and upper bands, respectively. Good radiation performance suitable for wireless communication such as WLAN systems is obtained and details of the antenna design as well as the experimental results are presented and discussed.

Manuscript received Feb. 20, 2014.

Yatendra Kumar Tiwari, Elactronics & communication Engineering, Sri Ram Institute Of Technology, Jabalpur, India, 09696574095.
Ravi Mohan, Electronics & Communication Engineering Department, Sri Ram Institute Of Technology, Jabalpur, India .
Sumit Sharma, Electronics & Communication Engineering Department, Sri Ram Institute Of Technology, Jabalpur, India .

II. ANTENNA CONFIGURATION

The geometry of the proposed CPW-fed slot antenna for dual-band operation is shown in Fig. 1. The antenna has a single-layer metallic structure and is etched on a side of an inexpensive FR4 substrate with a dielectric constant of 4.4 and substrate thickness of 1.6 mm. The overall ground size of the antenna is 60 × 62 mm. A CPW transmission line of strip width, wc, and gap 0.5 mm is used for feeding the antenna. The basis of the antenna structure is a rectangular slot antenna, which has dimensions of length, l, and width,w.

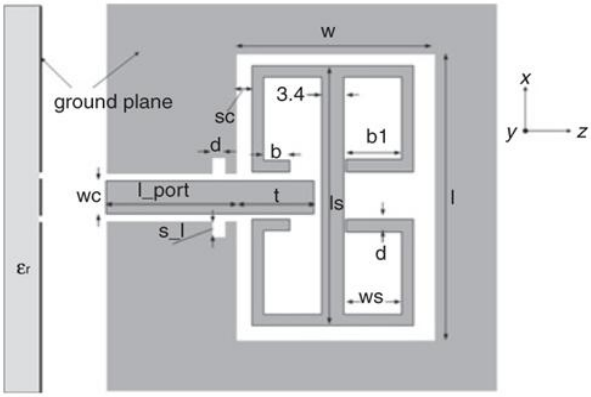

Fig. 1 Geometry of proposed CPW fed slot antenna.

A double-C-shaped metallic strip embedded in the large rectangle slot and a special tuning strip with length, t, inserted into the inner C-shaped strip are employed to create dual-band characteristics. Both bands are sensitive to the pair of symmetrical strips with length, b, and the tuning strip with length, t. The slot surrounded by the double-C shaped strip is responsible for the upper band while the rectangle slot is responsible for the lower band. The pair of strips with length, b1, at the outer C-shaped strip can be adjusted to obtain good impedance matching of the lower band without noticeably

affecting the upper band. By adding two equal rectangular slots symmetrically on each side of the CPW feed line, the impedance matching condition for the upper band is much easier and significantly improved. Finally, the other dimensions of the proposed antenna are adjusted as follows: l = 45 mm, w =33.8 mm, ws = 10.5 mm, wc = 6.37 mm, ls = 37.3 mm, sc = 0.5 mm, s_l = 5 mm, l_port = 18 mm, t = 12.2 mm, d = 1.8 mm, b1 = 8.57 mm, b = 4 mm.

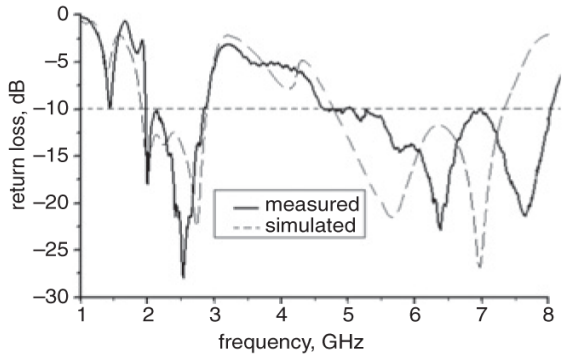

Fig. 2 Measured and simulated return loss for proposed antenna

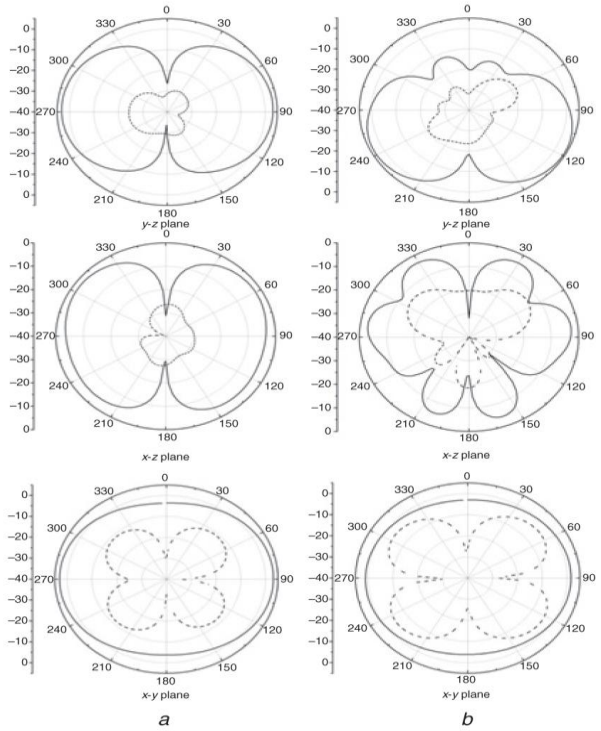

Fig. 3 Measured far-field radiation patterns of proposed CPW fed antenna.

a 2.45 GHz
b 5.8 GHz
—— Eθ
– – – Eϕ

III. RESULT AND DISCUSSION

In Fig. 2 the simulated and measured input return loss is being shown. Good agreement between simulation and measurement results is achieved. The measured -10 dB return loss bandwidths are very wide, which are 900 MHz (1.97–2.87 GHz) and 3.22 GHz (4.78–8 GHz) in the lower band and the upper band, respectively. Figs. 3a and b show the measured radiation patterns including the vertical (Eθ) and the horizontal (Eϕ) polarisation in the elevation cuts (x-y and x-z plane) and the azimuth cut (x-y plane) when operating at 2.45 and 5.8 GHz. The measured patterns, in the x-y plane, are all nearly omni-directional, and those in the x-z and y-z planes are all monopole like. It is emphasised that the cross-polarisation levels are very small for the measured patterns in x-z and y-z plane, which is significantly suppressed down to the level below 15 dB in the x-z plane and especially down to the level below 20 dB in the y-z plane. Finally, the measured antenna gain against frequency for the proposed antenna across the two bands is shown in Fig. 4. For the lower band, the antenna has a maximum radiation gain of about 3.68 dBi and the gain variation is less than 1 dBi. The antenna gain is within a range of 2.3–4.37 dBi in the frequency band 4.7–6 GHz.

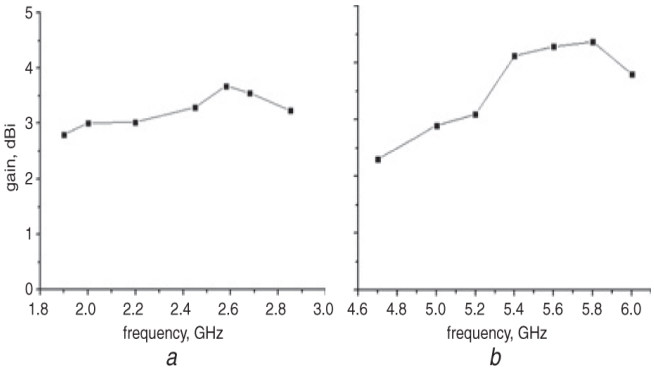

Fig. 4 Measured gain spectrum of proposed antenna

a 1.8–3 GHz
b 4.6–6 GHz

IV. CONCLUSION

A novel wide dual-band operation CPW-fed antenna has been designed and successfully implemented. Experimental results reveal it has wide impedance bandwidths of 900 MHz (1.96–2.86 GHz) and 3.22 GHz (4.87–8.01 GHz) at the lower and upper bands, with antenna gains within the range of 2.8–3.68 and 2.3-4.37 dBi in the two frequency bands, respectively. The cross-polarisation is suppressed down to the level below 15 dB in the x-z and y-z planes. The proposed antenna, with a simple structure, can provide sufficient impedance bandwidths and suitable radiation characteristics to be applied in the 2.4/5.2/5.8 GHz for PCS/WLAN systems.

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