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Tri-Band Circularly Polarized Monopole Antenna for Wireless Communication Application

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Abstract—A circularly polarized (CP) CPW-fed (CoPlanar Waveguide) with two asymmetric U-shaped strips, patch antenna is described in this paper. The antenna consists of a radiating patch composed of a hexagonal-ring connected with two annular rings on the two corners, which provide wide CP. The CPW-fed antenna was constructed by etching out two L-shaped slots and adding two asymmetric U-shaped strips to the ground, which greatly enhanced both the impedance bandwidth (IBW) and axial ratio bandwidth (ARBW). The proposed antenna design yields a measured wide IBW = 5.637 GHz (4.484–10.121 GHz), which is about 80.53% with respect to the center frequency f_c = 7.3 GHz. The simulated 3-dB axial ratio (AR) bandwidth for tri bands includes 95 MHz (1.37%), 186 MHz (2.35%) and 149 MHz (1.67%) resonating at 6.95, 7.93, and 8.91 GHz, respectively. The radiation characteristics of the implemented antenna have been analyzed and discussed in this paper. The maximum simulated peak gain is 5.968 dBi at 6.063 GHz. The proposed antenna can be suitable for C- and X-band wireless communication applications.

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1. INTRODUCTION

Multiband, miniaturized antennas are essential for rapidly developing modern communication systems. In some mobile satellite communications and most of the wireless communications, circularly polarized (CP) antennas are used. In recent times, single feed circularly polarized microstrip antennas have been developed to make the systems more compact.

In general, the single feed mechanism yields very small CP band. In order to increase the CP band, perturbation techniques are being used. In that case, two orthogonal degenerated modes having equal amplitudes with a 90° phase difference are generated that yields wide CP.

A printed, circular polarized monopole antenna excited by a shorting sleeve-strip and fed using coplanar waveguide (CPW) transmission line has been reported in [1]. Here, the sleeve and the gap between monopole and sleeve, generate the CP and impedance characteristics in this antenna. The measured impedance bandwidth (IBW) of the designed antenna cover the range 1.24–1.96 GHz, which is 720 MHz and 45% with respect to center frequency f_c = 1.6 GHz, whereas ARBW is 5%, and the size of antenna is too large.

For circular polarization using single-feed, a novel arrowhead-shaped slotted microstrip antenna has been proposed in [2]. The measured IBW and 3-dB ARBW are quite low at 35 MHz (888–923 MHz) and 8 MHz (908–916 MHz), respectively. The proposed antenna dimensions are also very large (87×87×4.572 mm^3).

A wide-band H-shaped patch antenna has been designed for circular polarization [3]. This antenna measured IBW of 2.21–2.77 GHz (22.5%), with wide 3-dB ARBW equal to 2.28–2.77 GHz (19.4%). A circularly polarized equilateral-triangular microstrip antenna with a slotted ground plane was fabricated for gain enhancement [4]. The simulated and measured values of the center frequency, axial ratio, and gain for the said antenna, were 2611 MHz, 1.1%, 4.7 dBi and 2655 MHz, 1.3%, 4.7 dBi, respectively.

A circularly polarized patch antenna has used a half of E-shaped structure [5] giving measured IBW and ARBW of 35% and 5.3%, respectively, with respect to center frequency 2.45 GHz. A novel dual-band dual-sense, CPW-fed monopole antenna (63×75×1.6 mm) with two rectangular parasitic elements and an

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

SUPPLEMENTARY MATERIALS

Supplementary materials are available for this article at 10.3103/S0735272720040044 and are accessible for authorized users.

ADDITIONAL INFORMATION

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