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STUDY OF A CIRCULARLY POLARIZED CPW-FED INDUCTIVE SQUARE SLOT ANTENNA

I-Chung Deng,[1] Ren-Jie Lin,[2] Kow-Ming Chang,[2] and Jin-Bo Chen[1]
[1] Department of Electronics Engineering
Northern Taiwan Institute of Science and Technology
Taipei, Taiwan 112, R.O.C.
[2] Department of Electronics Engineering and Institute of Electronics
National Chiao Tung University
Hsinchu, Taiwan 30050, R.O.C.

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ABSTRACT: *A novel design of circularly polarized (CP) CPW-fed inductive square-slot antenna is proposed. A right-hand circularly polarized (RHCP) radiation is achieved by an inductive square patch with two adjusted slots and cuts. This experimental results show that the bandwidth of 3 dB axial ratio is about 320 MHz (or 13.15%). Prototypes of this proposed antenna is designed for solution of IEEE 802.11 b/g (2.4 GHz). Details of the experimental results are presented and discussed.* © 2006 Wiley Periodicals, Inc. Microwave Opt Technol Lett 48: 1665–1667, 2006; Published online in Wiley InterScience (www.interscience.wiley.com). DOI 10.1002/mop.21711

Key words: *circularly polarized; coplanar waveguides; inductive slot antennas*

1. INTRODUCTION

Coplanar waveguide (CPW), compatible with the monolithic microwave integrated circuits (MMIC) and active devices applications [1–4], has been widely studied as an alternate to microstripline for feeding printed square slot antenna in the past few years. In addition, the CPW-fed printed slot antenna, having enough bandwidth to support modern wireless communication, have relatively much wider impedance bandwidth than the conventional microstrip one [5, 6]. Thus, it has recently received much attention, especially for the circularly polarized CPW-fed printed slot antenna. The advantage of a circularly polarized antenna over a linearly polarized one is that nearly constant signal can be achieved even if the received-antenna's rotation angle changes. In order to obtain wider 3-dB axial-ratio bandwidth of circular polarization radiation, many kinds of CPW antennas were designed [7]. However, the conventional circularly polarized CPW-fed antennas are capacitively coupled in the feeding network. A new circularly polarized CPW-fed inductive slot antenna is proposed and exhibits several advantages such as axial-ratio profile over a wide frequency range, good antenna operation gain, and broad impedance bandwidth. The experimental results of antenna are presented and in good agreement with the simulated results.

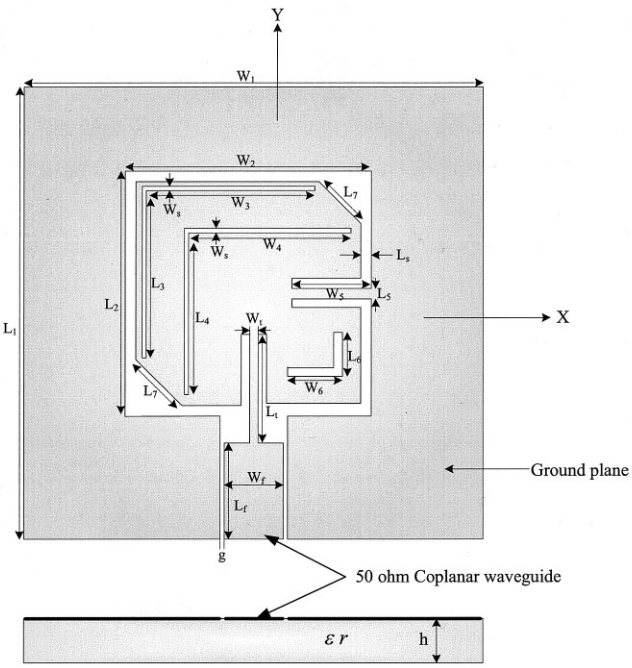


Figure 1 Geometry of the proposed circularly polarized CPW-fed inductive slot antenna

2. ANTENNA CONFIGURATIONS

The geometry of the circularly polarized CPW-fed inductive slot antenna is depicted in Figure 1. The inexpensive FR4 dielectric substrate, a thickness of 1.6 mm (h) and a relative permittivity of 4.4 (ε_r) is used. In this suggested antenna, the lengths of L_1, L_2, L_3, L_4, L_5, L_6, L_7, and L_f are fixed to be 48, 26, 18, 17.5, 1, 5, 6.6, and 10 mm, respectively, and the widths of W_1, W_2, W_3, W_4, W_5, W_6, and W_S are fixed to be 50, 26, 18, 17.5, 8.6, 6, and 0.5 mm, respectively. A 50Ω CPW transmission line, having a protruded single strip of width $W_f = 6.37$ mm and a gap of distance $g = 0.5$ mm between the signal strip and the ground plane, is used to feed the antenna. By adjusting the length of protruded strip L_t, the impedance matching of slot antenna can be easily controlled, and its width W_t is fixed to be 1 mm. Moreover, along the direction of 90° to the signal strip, a metallic strip with 1-mm width is protruded and connected to the center patch at the right side. Including the both sides of protruded strip, the slots around the center patch are all 1 mm.

3. EXPERIMENTAL RESULTS AND DISCUSSION

The length of the protruded signal strip (L_t) in proposed antenna is varied and the effect on the impedance matching is investigated. Figure 2 shows the simulation results of the return ratio against frequency for the proposed antenna with different signal strip length of $L_t = 11.5$, 12, 12.5 mm. It is apparent that as the length of L_t increases, the fundamental resonant frequency decreases, and the return loss increases and then decreases. When signal strip length of L_t is 12 mm, the resonant frequency of 2.453 GHz and the minimum return ratio of −45 dB are obtained and in good agreement with the measurement result (square solid line). Figure 2 also shows that it has a resonant frequency of 2.48 GHz and the return loss of −42 dB. The impedance bandwidth of the proposed antenna is about 0.17 GHz for measurement, and 0.165 GHz for simulation, the different bandwidth is due to the fabricated loading effect [8], the measurement error, and the environment inference.

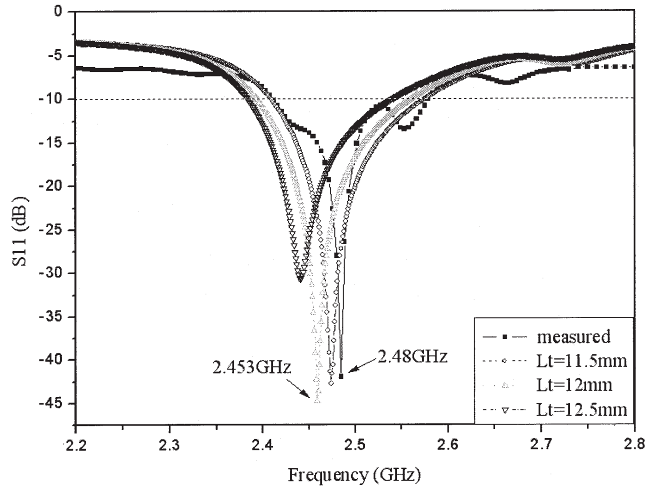
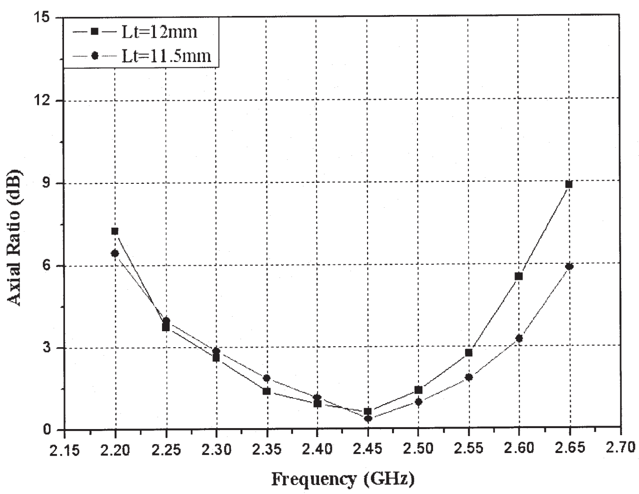
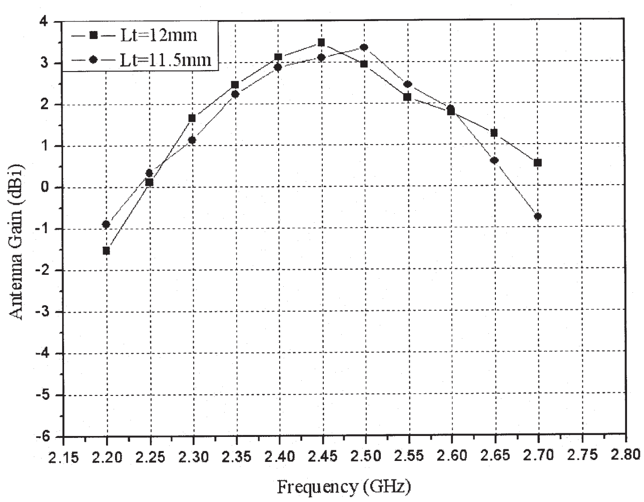


Figure 2 Simulated return loss vs. frequency for the antenna which has with different signal strip lengths of L_t = 11.5, 12, 12.5 mm and measured return loss against frequency for the antenna which has L_t = 12 mm

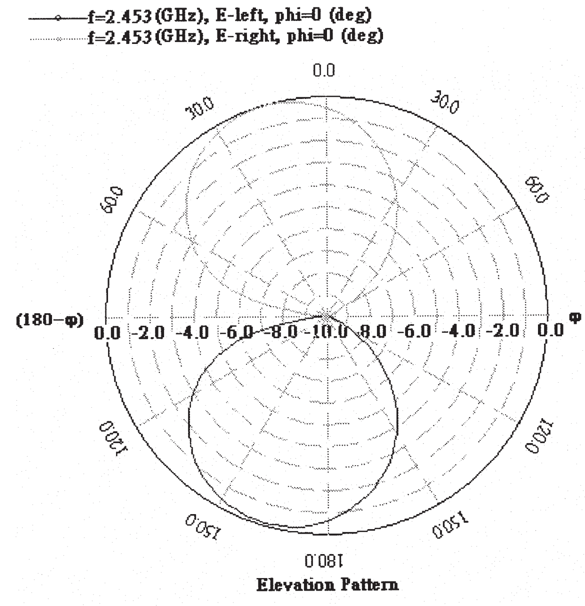


(a)

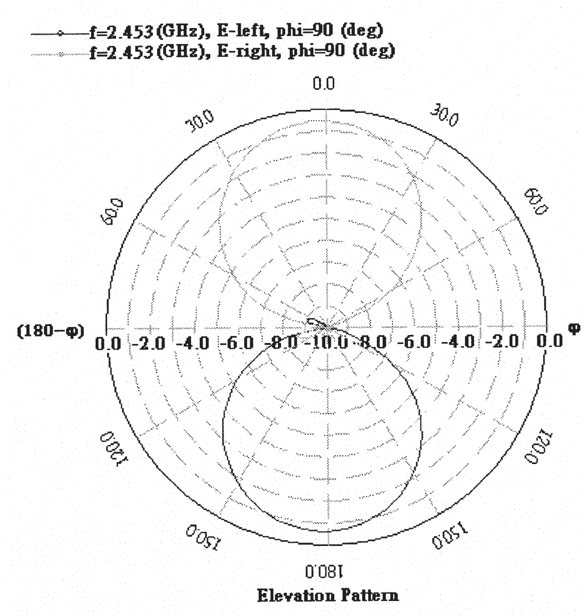


(b)

Figure 3 Measured (a) axial ratio and (b) antenna gain against frequency for L_t = 12 mm



(a)

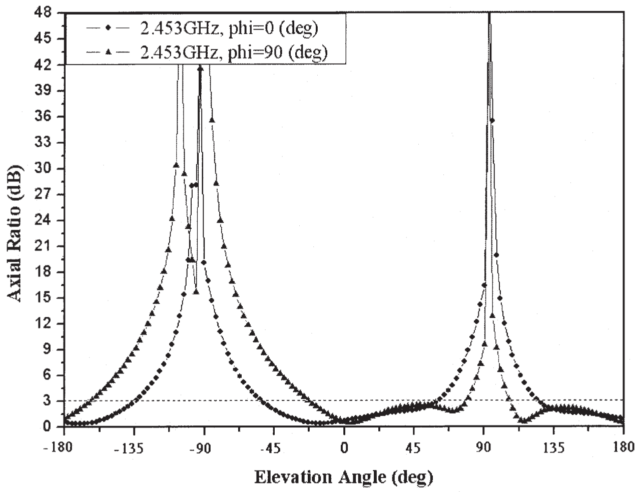


(b)

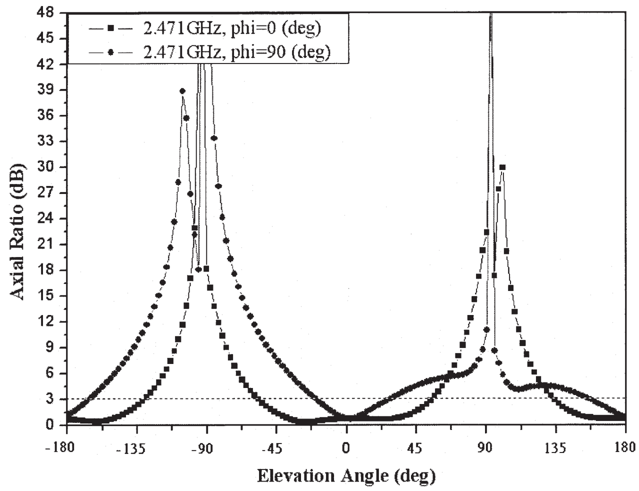
Figure 4 Measured radiation patterns of proposed at two orthogonal planes at 2.453 GHz

The measured axial ratio and antenna gain for different L_t are shown in Figure 3. The CP bandwidth, determined by the 3-dB axial ratio, is about 300 MHz or 12.2% (2.29–2.59 GHz) and 260 MHz or 10.6% (2.29–2.56 GHz), respectively, for L_t = 11.5 mm and L_t = 12 mm. It is also observed that, within the 3-dB AR bandwidth, a peak of antenna gain is about 3.4 dBi at 2.45 GHz (L_t = 11.5 mm) and 3.3 dBi at 2.5 GHz (L_t = 11.5 mm). The radiation patterns for proposed antenna is plotted in Figure 4, and good RHCP radiation with broadside radiation patterns is seen.

Figure 5 shows the simulated axial ratio (AR) of different L_t. It is observed that the different length of L_t affects the value of AR



(a)



(b)

Figure 5 Simulated axial ratio vs. elevation angle (θ) for (a) $L_t = 12$ mm at the resonant frequency of 2.453 GHz and (b) $L_t = 11.5$ mm at the resonant frequency of 2.71 GHz with different azimuthal angles of $\phi = 0°$ and 90°

at different angles. Figure 5(a) shows the AR value of 2.434 GHz with $L_t = 12$ mm against the elevation angle (θ) with different azimuthal angles of $\phi = 0°$ and 90°. It can be noted that the range of elevation angles from −55° to 62° has a smaller 3-dB AR value at $\phi = 0°$. Correspondingly, in Figure 5(b), as the ϕ is at the angle of 90°, the elevation angle range of AR value less than 3 dB is from −23° to 80°. Compared to antenna with $L_t = 12$ mm, the $L_t = 11.5$ mm seems to have a narrower angle range of −21° to 26° at $\phi = 90°$. Thus, the antenna with $L_t = 11.5$ mm has better measured return loss (not shown here) and CP bandwidth; even so, we chose 12 mm as the length of L_t to fabricate a broadside CP CPW-fed inductive slot antenna.

4. CONCLUSION

A novel design of CPW-fed inductive square slot antenna has been investigated and successfully implemented. The impedance return loss of −42 dB is measured at the resonant frequency of 2.48 GHz. The 3-dB AR bandwidth is 260 MHz or 10.6% and maximum gain is about 3.5 dBi at 2.45 GHz. The simulation and measurement results match reasonably well. This antenna has excellent performances and is very suitable for wireless communication applications.

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STUDY OF THE BAND-NOTCH FUNCTION FOR A UWB CIRCULAR DISC MONOPOLE ANTENNA

Xinan Qu,[1] Shun-Shi Zhong,[1] and Wei Wang[2]
[1] School of Communication and Information Engineering
Shanghai University
Shanghai, 200072, P. R. China
[2] East China Research Institution of Electronic Engineering
Hefei, 230031, P. R. China

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ABSTRACT: *A UWB circular disc monopole antenna fed by a coplanar waveguide (CPW) is introduced with a band-notch function. An arched slot is inserted on the disc to obtain the band-notch function and its parameters are studied in detail. It is shown that the band-notched function can be controlled by the location of the arched slot and the notched band can be changed by adjusting the length and width of the slot. Experimental results show that the ultra-wideband (UWB) antenna has an obvious rejected band in the WLAN frequencies.* © 2006 Wiley Periodicals, Inc. Microwave Opt Technol Lett 48: 1667–1670, 2006; Published online in Wiley InterScience (www.interscience.wiley.com). DOI 10.1002/mop.21710

Key words: *ultra-wideband (UWB); monopole antenna; band-notch; coplanar waveguide (CPW)*

1. INTRODUCTION

Since the Federal Communication Commission (FCC) allocates the frequency band 3.1–10.6-GHz for commercial use [1], the UWB systems have been in the spotlight worldwide. Various forms of antennas with wide bandwidth have been proposed in recent years. Due to their attractive features of wide bandwidth and simple fabrication, the planar monopole antennas are the most frequently used antennas for UWB applications [2–4]. Taking the