Broadband Circularly Polarized Patch Antenna for WLAN System Application

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***Abstract* - A broadband circularly polarized patch antenna is proposed for WLAN system application. Seven identical curved branches extended from the circular patch are designed to generate circular polarization. Simultaneously, seven identical slots are symmetrically etched on the junction of each curved branch and the circular patch. The dimension of the antenna is reduced by 17.8% compared with no slots. The proposed antenna can produce a 10 dB impedance bandwidth of nearly 21% (2.30-2.85 GHz), a 3-dB axial-ratio bandwidth of nearly 19% (2.34-2.82 GHz) to cover 2.4 GHz WLAN band. The antenna also has the advantages of compact dimension and easy feeding structure.**

***Index Terms* — Broadband, Circular polarization, shorting vias, Patch Antenna.**

Introduction

Nowadays, microstrip antenna with circular polarization has been widely used in wireless communications. CP antennas have the advantages of alleviating polarization mismatch losses and multipath distortion, but the inherent defect of microstrip antenna is narrow band, so widening the bandwidth and miniaturization are meaningful.

In [1], a single-band probe-fed CP antenna has been proposed. Though the 10-dB impedance bandwidth is 18.03%, the 3-dB axial-ratio bandwidth is only 5.06%. In [2], a broadband circularly polarized microstrip antenna with coplanar parasitic ring slot patch has been designed. The impedance bandwidth is nearly 27%, and 3-dB axial-ratio bandwidth is nearly 16%. But the structure of the feed network is so complicated. In [3], a wideband circularly polarized patch antenna is proposed based on vortex slots and shorting vias. A 10-dB impedance bandwidth of 51.7% and a 3-dB axial ratio bandwidth of 57.8% are achieved. The performance of the antenna is fine. However, the shortcoming of the antenna is the high profile.

In this letter, a broadband circularly polarized patch antenna is proposed. Curved branches extended from the circular patch are designed to generate circular polarization. Shorting vias can excite another mode to broaden the impendence bandwidth. Identical slots are used to achieve miniaturization. Compared to no slots, the size of the proposed antenna can be reduced by 17.8%. However, the impendence bandwidth is almost the same. The antenna is centrally fed by a probe, making the feeding structure simpler than the one in [2]. The characteristics of the proposed antenna have been simulated by HFSS. The results show that antenna can produce a 10 dB impedance bandwidth of nearly 21%, and a 3-dB axial-ratio bandwidth of nearly 19% in the whole WLAN band.

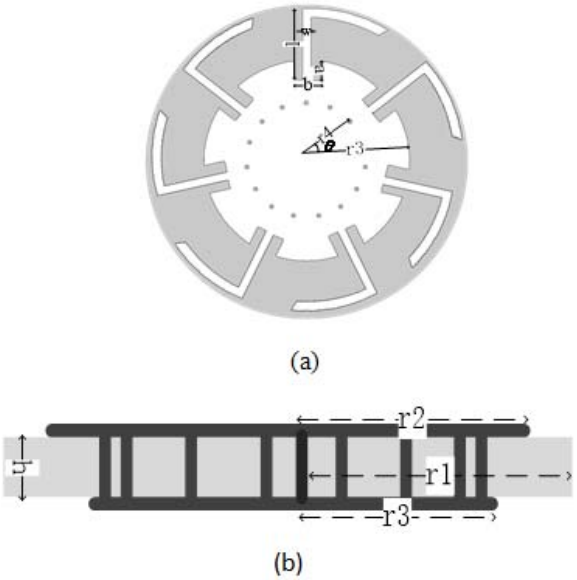


Fig.1 Geometry of the proposed antenna

TABLE I
Optimal dimensions of the proposed antenna

Parameter	mm	Parameter	mm	Parameter	mm
r1	74	r4	30.2	l	33.8
r2	46	a	4	w	2.8
r3	42.5	b	8	h	3

Design considerations:

Fig.1 shows the structure of the proposed antenna and the dimensions of the proposed antenna are listed in Table I. It

is fabricated on a Rogers-Duroid 5880 substrate of thichness 3 mm, permittivity 2.2 and loss tangent 0.0009. The upper surface of the antenna is a circular patch. The under surface of the antenna is a modified circular patch extending seven identical curved branches. Seven identical slots are etched on the junction of each curved branch and the circular patch. Shorting vias are located symmetrically about the center of the patch. LHCP can easily be achieved when the branches are oriented in a clockwise direction, RHCP can be obtained when the branches are oriented in an anticlockwise direction.

Results and analysis

The simulated and measured S-parameters of the proposed antenna is shown in Fig.2. The simulated 10 dB impendence bandwidth is 550 MHz (2.30-2.85 GHz). Fig.3 shows the simulated axial radio value of the proposed antenna. The 3-dB axial-ratio bandwidth is 480 MHz (2.34-2.82 GHz). The simulated radiation patterns are shown in Fig.4. As it is shown, the peak gain is obtained with an up obliquitous angle of 30 deg. The cross polarization (RHCP) is about 20 dB below the co polarization (LHCP).

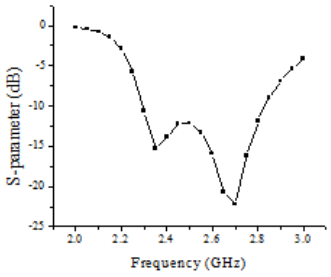


Fig. 2. Reflection coefficients of the proposed antenna

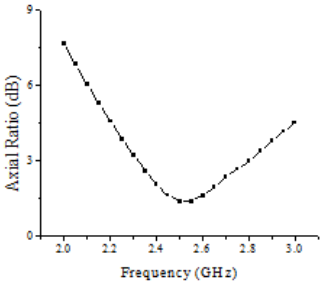
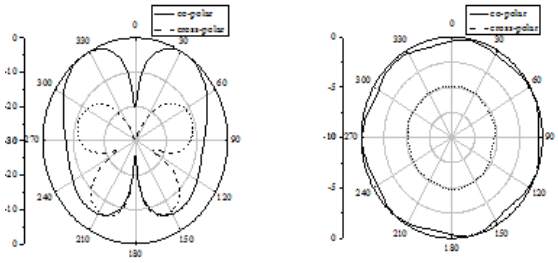


Fig. 3. Axial radio value of the proposed antenna



(a) (b)

Fig.4. Radiation patterns of the proposed antenna at 2.5 GHz: (a) *xz* plane and (b) *xy* plane

Conclusion

A wideband patch antenna with circular polarization is proposed in this letter. Identical slots are designed to accomplish miniaturization. The dimension of the antenna is reduced by 17.8% compared to no slots. The antenna also has the advantages of compact dimension and easy feeding structure. These good performances make it a good candidate for WLAN system application.

References

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