Experimental Study of a Circularly Polarized Circular Microstrip Antenna With Double Balanced Multiplier

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1 Introduction

In this paper, a circular microstrip antenna integrating a double balanced multiplier is proposed to achieve small and wideband circularly polarized antennas. A circular antenna element is employed to match the diagonal resonant frequency with the vertical and horizontal resonance frequencies.

2 Structure

Fig. 1 shows the structure of the proposed antenna. The proposed antenna is constructed with a circular microstrip antenna element and four diodes. As the diodes are connected in a star configuration, they form a double balanced multiplier which realizes the phase difference of 90° between two orthogonal modes by adjusting its bias voltage. This is a circularly polarized antenna based on a new principle.

3 Experimental Results

Fig. 2 shows the measured axial ratio when the bias voltage V_b=0.18 V. The minimum axial ratio of 0.40 dB is obtained at 7.16 GHz. This means that circular polarization is realized. The fractional bandwidth where the axial ratio is less than 3 dB is 8.74%. Much wider bandwidth is obtained when compared with conventional single-feed circularly polarized antennas. Furthermore, the obtained bandwidth is wider than previously reported multiplier integrated antennas which uses a square patch [1]. Same amplitude and 90° phase difference between two orthogonal modes are required to achieve circular polarization. Then, the amplitude and phase difference is separately examined.

Fig. 3 shows the measured phase difference between E_x and E_y for V_b=0.18 V. Phase difference of around 90° is obtained in a wide frequency band from 6.30 GHz to 7.80 GHz.

Fig. 4 shows the amplitude ratio E_x/E_y measured in the boresight direction of the antenna where the bias voltage is V_b=0.18 V. Two amplitudes are equal in the vicinity of 7 GHz. As the phase difference is also 90° around at this frequency too, much wider performance is expected if we could improve the amplitude ratio around the frequency.

4 Conclusion

We have proposed a circularly polarized circular microstrip antenna with a double balanced multiplier. A very wide axial ratio bandwidth of 8.74% is achieved.

References

[1] E. Nishiyama, A. Matsuo, and I. Toyoda, "Double balanced multiplier integrated circular polarization switchable microstrip antenna," 2015 IEEE AP-S Symp. on Antennas and Propag. and URSI CNC/USNC Joint Mtg. Dig. (AP-S/URSI 2015), WEP-A1.5A.9, pp. 2239-2240, Vancouver, BC, Canada, July 2015.

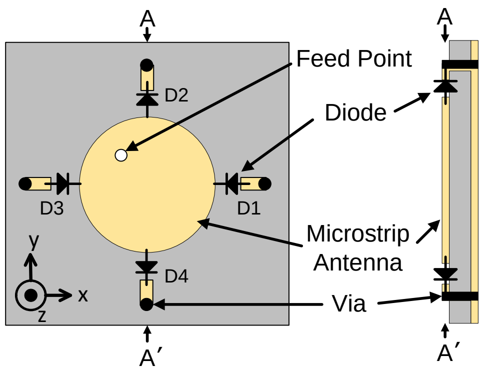

Fig. 1 Structures of the proposed antenna.

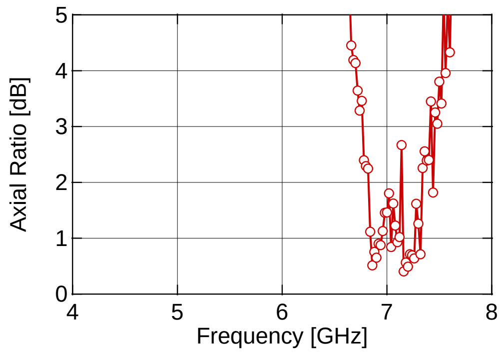

Fig. 2 Measured axial ratio.

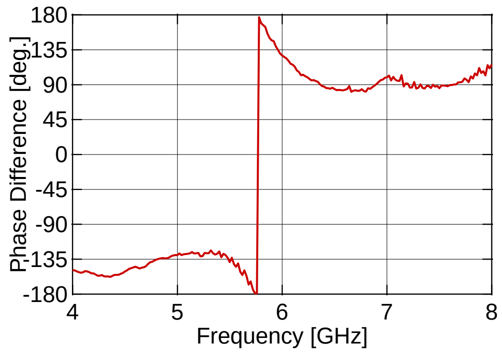

Fig. 3 Measured phase difference between E_x and E_y.

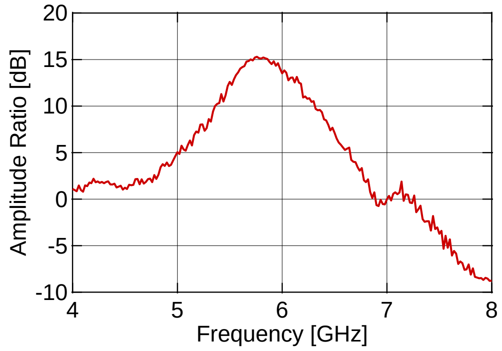

Fig. 4 Measured amplitude ratio E_x/ E_y.