Circularly polarized antennas with degenerate separation

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1. Introduction

The meta-surface-inspired antenna chip developed by the KIT EOE Laboratory (MACKEY) is a small antenna that remains unaffected by surrounding metals [1]. The MACKEY Q-type was developed based on the MACKEY [2]. It was miniaturized to a square with a side length of λ/4, using two shorting plates. In this study, it is proposed an antenna that radiates circularly polarized waves with a single point feeding by using degenerate separation.

2. Proposal for circularly polarized MACKEY Q type

Fig. 1 shows the model diagram of circularly polarized MACKEY Q-type designed for Wi-Fi 2-GHz band. The model consists of three layers: metal, antenna, and grid plates, with a dielectric filling the gap between the plates. The grid and metal plates act as artificial magnetic conductor substrates for working on the metal, and the grid and antenna plates act as antenna substrates for radiation. In order to radiate circularly polarized waves, orthogonal polarizations must have equal amplitude and a phase difference of 90°. Therefore, by changing the vertical slit width ssx and horizontal slit width ssy, the propagation constant is changed, and as a result, a phase difference can be added to this antenna.

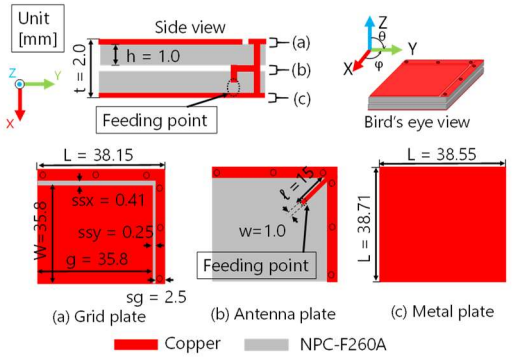

Fig. 1 Model diagram of circularly polarized MACKEY Q-type

3. Analysis results of Unbalanced Type Inverted F

Fig. 2 shows the VSWR and axial ratio characteristics in free space and on the metal. Here, the axial ratio characteristic shows characteristic in the Z direction. Fig. 3 shows the radiation patterns at 2.45 GHz for the cut planes φ = 0° and φ = 90°. From Fig. 2, it was found that the axial ratio characteristic could not satisfy less than 3 at 2.45 GHz on the metal, although it operated at 2.45 GHz in free space. Fig. 3 shows that in free space, the main polarization, LHCP was 5.01 dBi in the frontal direction. On metal, the frontal gain of the LHCP was 6.42 dBi, which is sufficient to radiate in the frontal direction, but the RHCP was reflected by the metal and radiated in the frontal direction.

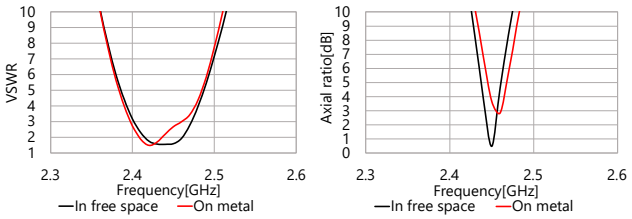

Fig.2 VSWR and axial ratio characteristics

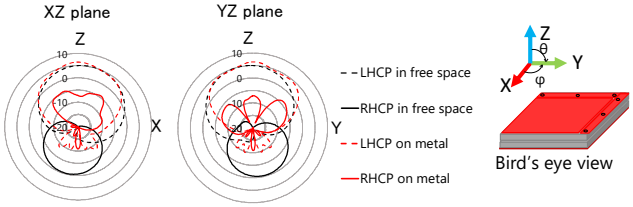

Fig.3 Radiation pattern

4. Conclusion

In this study, the authors proposed an antenna that radiates circularly polarized waves by varying the width of the vertical and horizontal slit lines and by varying the propagation constant. In free space, it operated at 2.45 GHz, but on metal, the axial ratio no longer satisfied the bandwidth due to backlobe reflection.

Acknowledgments

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References

[1] S. Makino, T. Moroya, M. Kotaka, K. Itoh, K. Noguchi, and T. Hirota, "A proposal of AMC inspired small antenna MACKEY," 2015 IEEE-APS Topical Conference on Antennas and Propagation in Wireless Communications (APWC), Sep. 2015.

[2] Iijima et al., "MACKEY Q-Type Miniaturized Using Two Shorting Plates," in IEEE AP-S/URSI 2022, (to be presented)

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