

Study of Circularly-Polarized MACKEY with Two-Point Feed

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1. Introduction

The metasurface-inspired antenna chip developed by the KIT EOE Laboratory (MACKEY) [1] was devised as a robust antenna that is not affected by surrounding metals. In this report, we propose a new model, MACKEY CP type (hereinafter referred to as "MACKEY CP"). This proposition is based on MACKEY II [2], a thinner version of MACKEY that uses an inverted L element for unbalanced power supply, along with four grid plates and two parasitic elements to change the polarization from conventional linear to circular.

2. Proposal for MACKEY CP

Fig. 1 shows a model diagram of MACKEY CP. MACKEY CP combines MACKEY II orthogonally and feeds power with equal amplitude and a phase difference of 90° to the two feed points to radiate circularly polarized waves with an antenna size of approximately $(\lambda/2)^2$. In this study, we evaluate the relative bandwidth satisfying a VSWR (voltage standing wave ratio) of three or less and an axial ratio of 3 dB or less in free space and on metal when the center frequency is 2.45 GHz.

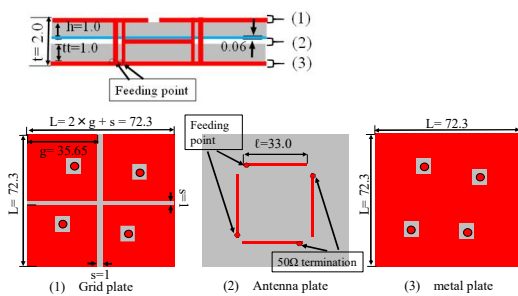


Fig. 1 MACKEY CP Model Diagram

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3. Analysis Results for MACKEY CP

In this study, to investigate the possibility of circular polarization by MACKEY, power feeding is performed under ideal conditions of equal amplitude and a phase difference of 0° and 90° respectively. The analysis is performed using an electromagnetic simulator (ANSYS, HFSS) based on the finite-element method. Fig. 2 shows VSWR and axis ratio in free space and on metal. It also shows that the bandwidth where VSWR is less than three is wider than the 2.4–2.5 GHz. The axial ratio is almost 0 dB. Fig. 3 shows that the realized gain in the frontal direction is 3.73 dB in free space and 4.86 dB on the metal.

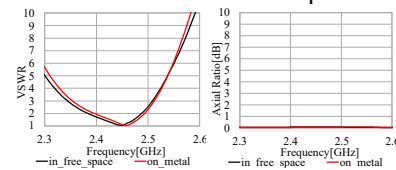


Fig. 2 VSWR and Axial Ratio

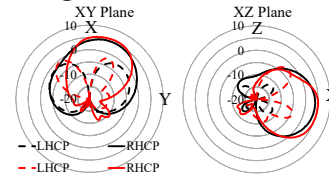


Fig. 3 Radiation Pattern

4. Conclusion

This study confirmed that MACKEY CP radiates circularly polarized waves with good axial ratio performance. In the future, we could investigate simpler ways to feed power, such as using one feeding point.

Acknowledgments

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References

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- [2] K. Miyashita, S. Makino, and K. Itoh, "Feasibility study of an unbalanced MACKEY type R with enhanced robustness on metal," in ISAP 2021, October 2021.J