

# Development of MACKEY II type H miniaturized using slits

Kota HAKAMATA<sup>†a)</sup>, Student member, Keisuke MIYASHITA<sup>†</sup>, Student member, Keito YOKOE<sup>†</sup>, Student member, Shigeru MAKINO<sup>†</sup>, Fellow Member, and Kenji Itoh<sup>†</sup>, Fellow Member

## 1. Introduction

The meta-material antenna chip developed by the KIT EOE Laboratory (MACKEY), which is sufficiently robust to metal objects, was developed in a previous work [1]. One of the problems with this antenna was its width ( $L$ ), which could be as large as half wavelength (such as 200 mm) at 920 MHz. Therefore, in this study a compact type H MACKEY with a slit in the grid plate has been developed to extend the current path [2]. This study aims to miniaturize the type H MACKEY in the 920 MHz band to the size of a card ( $L = 80$  mm).

## 2. Consideration of Miniaturization

In the type H shown in Fig. 1,  $L$  was fixed to 80 mm, and thus the dielectric width ( $tg$ ) could be obtained by determining the metal width ( $g_m$ ). Fig. 2 shows the relationship between  $g_m$  and the resonant frequency. The type H chip exhibits two resonance points at 920 MHz and the lowest resonant frequency is 880 MHz.

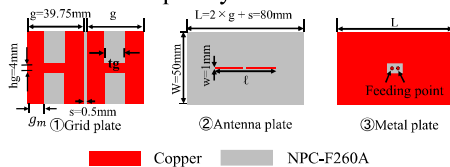


Fig. 1 Model diagram of MACKEY II type H

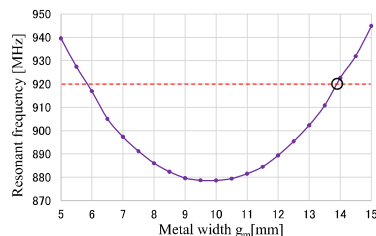


Fig. 2 Relationship between  $g_m$  and resonant frequency at  $L = 80$  mm

## 3. Analyzed and Measured Results for the Type H

Results from analysis and measurement results were obtained at the resonance frequency of 920 MHz and  $g_m =$

13.65 mm (black circle in Fig. 2). The voltage standing wave ratio (VSWR) characteristics and the radiation patterns are shown in Figs. 3 and 4, respectively. The black lines represent the measured values, whereas the red lines represent the analysis values. The radiation pattern appears at the frequency where the VSWR has the lowest value. The measured results in free space as well as on metal are observed to be shifted to the lower frequency side compared to the analysis results. The radiation pattern is observed to be almost identical between the measured and analysis results. The gain in the frontal direction is generally consistent between the measurement and the analysis results.

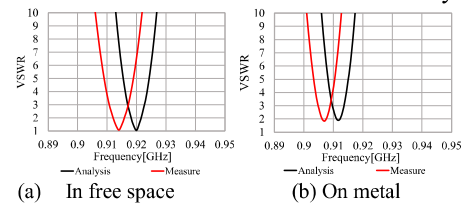


Fig. 3 VSWR characteristics

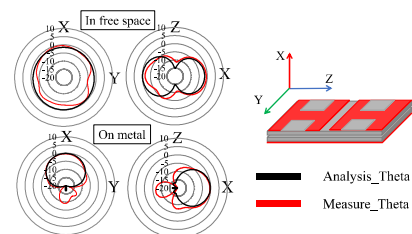


Fig. 4 Radiation patterns

## 4. Conclusion

MACKEY II type H was modeled and measured. The card size was achieved by optimizing the metal width of the type H.

## Acknowledgments

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## References

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- [2] K. HAKAMATA et al., "Feasible study of MACKEY the grid board into a letter H," Society Convention, AP2020, B1-55 (2020).

<sup>†</sup>The author is with Kanazawa Institute of Technology ...

<sup>a)</sup> E-mail: b1745887@planet.kanazawa-it.ac.jp