Metal Cap with Two Slots covering an Edge of a Mobile Device Substrate for 60GHz Band

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***Abstract* – This paper presents the measured results of a metal cap with two slots covering an edge of a mobile device substrate for 60 GHz band. The size of the metal cap is 6.9 × 3.8 × 1.1 mm^3. The bandwidth for reflection less than −10 dB is 13.6%. The measured gain is higher than 9 dBi over 59.2 – 63.6 GHz.**

***Index Terms* — wireless personal area network (WPAN), module, slot array antenna.**

I. INTRODUCTION

Wireless personal area network (WPAN) is expected as high-speed wireless file transfer systems for mobile device [1]. We propose a metal cap with slots to realize gain of about 9 dBi with a simple structure to integrate WPAN system in a mobile device. The designed metal cap is expected to have 19.5% bandwidth for reflection less than -10dB and more than 9 dBi realized gain over 57–66 GHz [2]. In this paper, we present the measured results of the fabricated metal cap.

II. STRUCTURE OF THE FABRICATED ANTENNA

Fig. 1 shows the structure of the metal cap with two slots. The metal cap is excited by a microstrip line (MSL). A mobile device substrate is inserted to an aperture on the back side of the metal cap and the MSL is converted to a waveguide. The upper and the lower slots are excited by equal power divided by a T-junction. In measurement, the MSL is fed by a standard waveguide through another waveguide-MSL transition [3]. Fig. 2 shows the fabricated metal cap. The size of fabricated metal cap is 6.9 (width) × 3.8 (height) × 1.1 (thickness) mm^3. Fig. 3 shows the metal cap connected to the waveguide-MSL transition. To reduce the effect of the transition on the directivity of the metal cap, the MSL is extended to 16 mm. The entire length of the structure for experiment is 21.2 mm including the transition.

III. MEASURED RESULT

Fig.4 shows the measured reflection of the metal cap. The frequency characteristic of the measured reflection is similar to the designed one. The measured reflection is less than −10 dB above 58.6 GHz. The radiation patterns in the E- and H-planes are shown in Fig. 5. Although a ripple is observed at +45deg. in the E-plane due to an E-bend shown in Fig.3, the measured radiation patterns show good agreement with the designed ones. The 3dB down−beamwidth in the both planes is 47 deg. The realized gain of the metal cap is shown in Fig. 6. The measured gain exceeds 9 dBi from 59.2 to 63.6 GHz and the peak is 9.6 dBi at 60.0 GHz. The realized gain is lower than the designed one. The loss of the measured metal cap may come from the fabrication error of the transition and the small backside aperture.

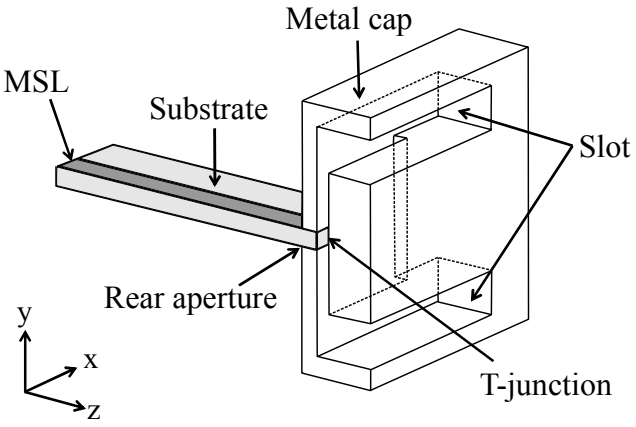

Fig.1: Structure of the metal cap
(divided into a half to show the internal structure)

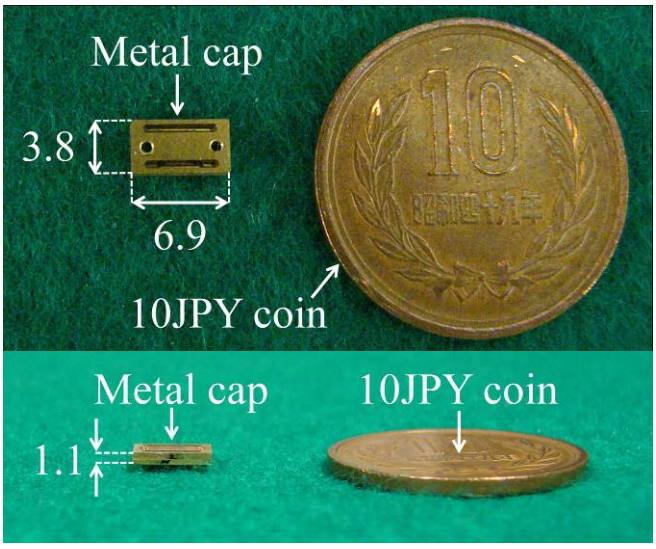

Fig.2: Fabricated metal cap (Unit: mm)

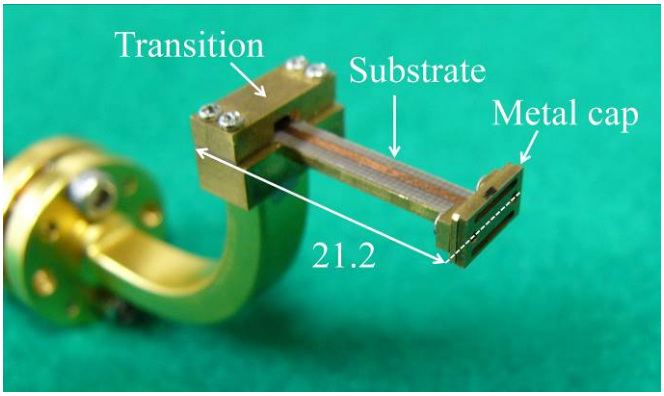

Fig.3: The metal cap connected to transition (Unit: mm)

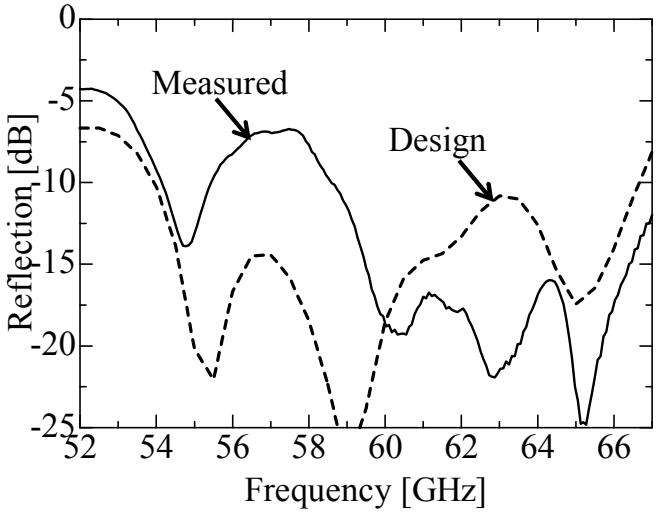

Fig.4: Reflection of the metal cap

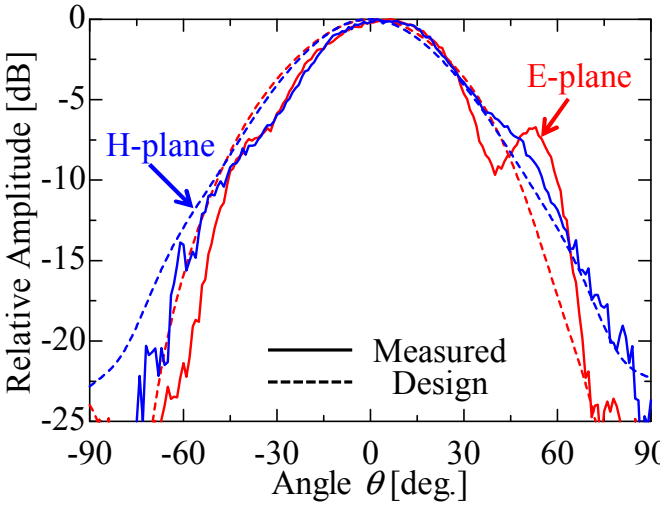

Fig.5: Radiation pattern of the metal cap at 61.5 GHz

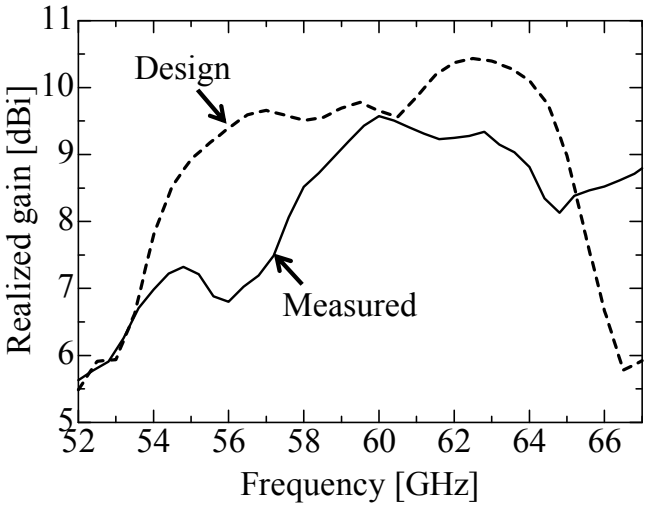

Fig.6: Realized gain of the metal cap

IV. CONCLUSION

We have presented the measured results of the metal cap with two slots covering an edge of a mobile device substrate for 60GHz band. The measured bandwidth of reflection less than -10 dB is 13.6% and the measured radiation patterns in the E- and H- planes show good agreement with the designed ones. The measured gain is lower than the design, which may come from the fabrication error of the metal cap.

REFERENCES

[1] http://www.ieee802.org/15/pub/TG3c.html

[2] K. Ito, J. Hirokawa, K. Sakurai and M. Ando, "Design of a metal cap with two slots covering the tip of a module substrate for 60-GHz," IEEE iWEM Aug. 2014.

[3] Y. Deguchi, K. Sakakibara, N. Kikuma, H. Hirayama, " Design And Optimization of Millimeter-Wave Microstrip- to-Waveguide Transition Operating over Broad Frequency Bandwidth," IEICE Trans. on Electron., vol.E90-C, no.1, pp.157-164, Jan.2007.