Metal Cap Antenna with Two Slots Fed by the Post-wall Waveguide

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We proposed a thin dielectric-slab antenna for mobile devices for 60 GHz-band WPAN system (R. Suga, et al., IEEE Trans. Microw. Theory Tech., 58, 3989–3995, 2010). The radiation of the antenna is affected very much by surrounding parts in the mobile device, because the dielectric slab is one of open waveguides. This paper presents a metal cap antenna with two slots fed by the post-wall waveguide (PWW) as shown in Fig.1, of which the radiation is not affected by surrounding parts in the mobile device, because the PPW is one of closed waveguides.

Fig. 1 shows the half section view of the antenna to show the internal structure. The metal cap is fed by a PWW converted from a microstrip line (MSL). The PWW is made near the edge of a mobile device substrate, and the metal cap is attached on the edge. The PWW is converted to a T-junction of hollow waveguide inside the metal cap. The two slots are excited with same phase and equal amplitude. A matching post is placed inside the PWW. The reflections from the T-junction, slots and the matching post are cancelled by each other. The minimum processable interval of posts is 0.6 mm, which is larger than twice of the post diameter (0.25 mm). The matching post changes the form of TE_{10} mode. These factors cause the leakage from gaps between posts. To reduce the leakage, the PWW consists of two rows of posts. The antenna is designed to have about 60-degree 3dB-down beamwidth and to minimize the reflection from 57 to 66 GHz. The thickness of the substrate is 0.20 mm. The necessary size of the metal cap is $W \times H \times L = 8.01 \times 4.45 \times 0.52$ mm^3.

In the simulation, the conductivity is set to be 5.8×10^7 S/m in the metal cap and the MSL. The complex dielectric constant of the substrate is set to be $\varepsilon_r = 4.1$ and $\tan\delta = 3.5 \times 10^{-3}$. The reflection is lower than −13 dB, and the realized gain exceeds 9.4 dBi over 57 to 66 GHz. The simulated radiation patterns in the E- and H-planes are shown in Fig. 2. The 3dB-down beamwidths in the E- and H-planes are 62.9° and 56.9° at 61.5GHz, respectively. The antenna will be fabricated and the measured results will be shown in the conference.

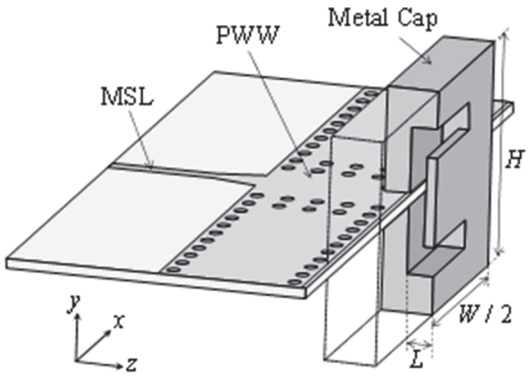

Figure 1. Half section view of the proposed antenna.

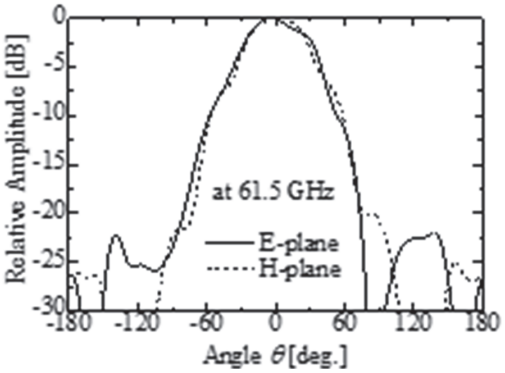

Figure 2. Simulated radiation patterns.