

Elliptical Top-Hat Monopole Antennas on a Dielectric Substrate for V-Band Operations

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This paper presents low-profile, end-fire, wide bandwidth and vertical polarization top-hat monopole antennas designed for use around 60 GHz. Hu et al. reported circular top-hat monopole antennas operating at the UHF band (500 – 600 MHz range) with no dielectric substrate (Z. Hu, Z. Shen, W. Wu, and J. Lu, IEEE Trans. Antennas Propag., vol. 63, No. 7, pp. 2851-2857, July 2015). The proposed monopole configuration in this paper employs elliptical top hats on a dielectric substrate, and same height for all monopole elements as shown in Figure 1. A semi flexible dielectric substrate instead of air is used in order to maintain mechanically robust structure because slight changes of geometrical factors degrades antenna performance around 60 GHz. We designed elliptical top hat for Yagi-Uda array in order to secure a gap distance between the driven element and the reflector because circular top-hat monopole antennas do not allow enough gap under the given physical conditions with a dielectric substrate.

We used HFSS and CST Microwave Studio for analyses and design of the top-hat monopole antennas. Effects on the top-hat monopole antenna's input impedance changes by implementing elliptical top hats and dielectric substrate will be described. We performed analyses of near-field propagations, current densities on the metal hat, far-field radiation pattern characteristics, and impedance bandwidth when the top-hat configuration changes from a circle to an ellipse. We studied the effect of the ground size, and its effect on the radiation patterns will be presented. A prototype was fabricated and both measured data and simulation results will be presented. One of the fabricated prototype (4-element Yagi-Uda array) antennas shows ~5.65 GHz impedance bandwidth around 60 GHz.

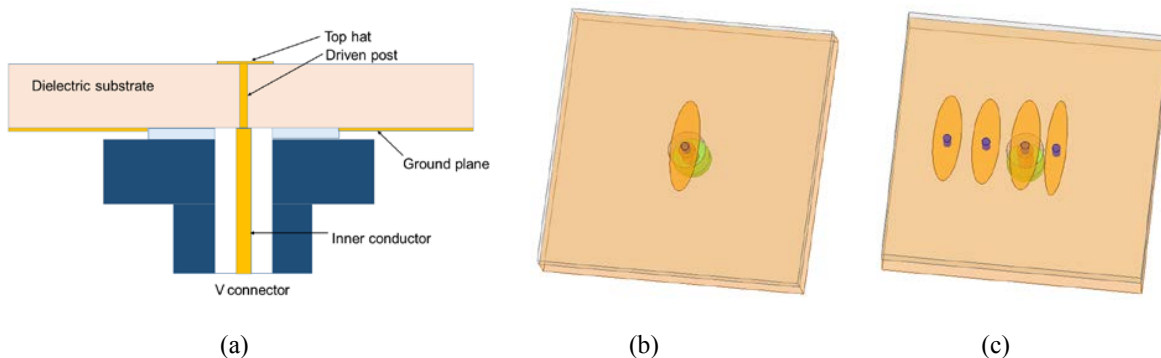


Figure 1. Configurations of elliptical top-hat monopole antennas. (a) Side view of a single element. (b) Single element. (c) 4-element Yagi-Uda array.