

Roof-Mounted Triple-Band Stacked Patch Antenna for V2X Communications

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With the advancement of mobile communication systems, both the number of communication modes that vehicles must simultaneously support and the required number of antennas are increasing. The vehicle roof can serve as a symmetrical radiator to minimize pattern distortion[1], allowing the installation of many antennas; however, due to limited space, it is becoming increasingly difficult to accommodate multiple communication bands with separate antennas. Therefore, this study proposes a triple-band multi-layer patch antenna capable of transmitting and receiving LTE and 5G signals on the vehicle roof.

Fig. 1(a) shows the side view of the proposed antenna implemented on a Taconic RF-30 substrate. The antenna is fed using an Aperture-Coupled Feeding method and is composed of four metal layers. Fig. 1(b) shows the layout of each layer. Layer 1 radiates the 2.1 GHz LTE band, while Layer 2 radiates the 1.8 GHz LTE band and the 3.5 GHz 5G band.

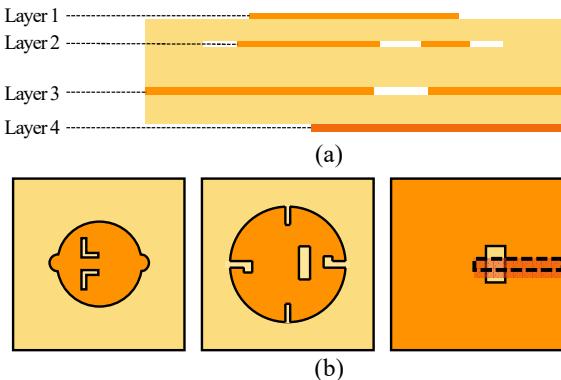


Fig. 1. (a) Cross-sectional view and (b) top view of the proposed antenna

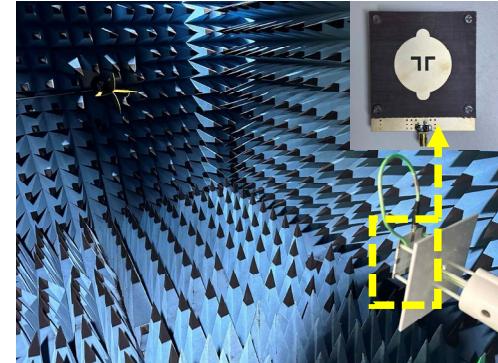


Fig. 2 Testing environment and prototype photo of the proposed antenna

Fig. 2 presents the fabricated proposed antenna and the test environment in the anechoic chamber. The simulated and measured reflection coefficients are shown in Fig. 3(a), while the radiation patterns in the E-plane and H-plane are presented in Fig. 3(b) and Fig. 3(c), respectively. It is designed to be applicable to the vehicle roof and can cover both LTE and 5G bands.

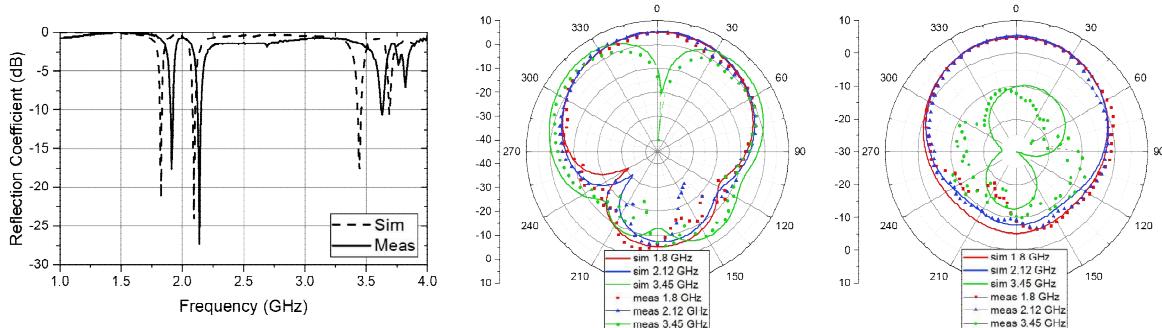


Fig. 3. Measured and simulated (a) reflection coefficient, (b) E-Plane and (c) H-Plane radiation pattern of the proposed antenna

This paper designs a triple-band stacked antenna to alleviate the space constraints of vehicular antennas. The first layer supports the 1.8 GHz and 3.45 GHz bands, while the second layer supports the 2.12 GHz band, and the design enables both LTE and 5G signal transmission and reception. The proposed antenna satisfies three target frequencies with a single element, making it suitable for vehicular applications.

REFERENCES

[1] R. L. Jesch, "Measured vehicular antenna performance," in IEEE Transactions on Vehicular Technology, vol. 34, no. 2, pp. 97-107, May 1985