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# Metamaterial Inspired Partial & Defected Ground based low profile Dual Band Printed Antenna for Vehicular Communication and Multi-standard Applications

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Abstract:

A low-profile novel metamaterial inspired hexagon shaped dual band microstrip patch antenna for vehicular communication as well as WLAN and Fixed Satellite Services is introduced in this article. The design process, parametric analysis to get the best result through optimization for the single element metamaterial antenna is also presented. The hexagonal shaped antenna is prototyped on a low cost easily available FR4 epoxy substrate having dimension of 22×25×1.6 mm3. From the simulated results there is a clear indication that the proposed antenna achieves a -10 dB return loss bandwidth in the ranges of (2.8–3) GHz and (4.2–9) GHz. These frequency bands encompass the Mid-Band 5G (n77/n78 extension area) S-Band Radar and Fixed/Mobile Services, the sub-6 GHz 5G bands utilized in Japan and China, LTE band, Band 46 (LTE-U / LAA) (5.15–5.925 GHz), various WLAN standards including IEEE 802.11 y/a/h/j/n/P, and Vehicular Communication (IEEE 802.11p) band around (5.85–5.925) GHz for DSRC/V2X applications. The antenna gain varies between 8.1 dBi to 9.9 dBi in the upper and lower frequency bands with radiation efficiency more than 95%.

Keyword: Dual band Metamaterial Antenna, Partial Ground, Defected Ground Structure I.

Introduction:

The rapid evolution of intelligent transportation systems (ITS) and the growing demand for high-speed, reliable in-vehicle and vehicle-to-everything (V2X) communication have necessitated the development of advanced antenna systems. Antennas designed for vehicular communication must meet stringent requirements such as low profile, broad impedance bandwidth, stable radiation performance, and robustness against environmental variations. Printed antennas, owing to their planar structure, ease of integration, and cost-effectiveness, have emerged as strong candidates for such applications.

To support simultaneous 3G, 4G, 5G, and WLAN applications, antennas must offer multiband functionality with wide operating bandwidth. Essential performance traits include good impedance matching and stable radiation patterns within the targeted frequency bands. Various design techniques have been explored to achieve multiband characteristics, including