

A Triple-Band mmWave Compact Antenna for Wearable Military Applications

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This paper presents the design and analysis of a triple-band millimeter-wave (mmWave) compact antenna for wearable military applications. The proposed antenna consists of a multi-slot microstrip patch structure, designed on a 0.5 mm thick flexible polyimide substrate. The antenna is fed through a side microstrip line, optimized to achieve an optimal 50-ohm impedance match. The antenna topology is illustrated in Fig. 1(a)-(c). A full copper ground plane is incorporated to enhance directionality and provide shielding, thus minimizing radiation exposure to the human body. The antenna operates across three frequency bands which are 24.8–25.1 GHz, 28–28.6 GHz, and 32–36 GHz, making it suitable for diverse mmWave military communication applications. Simulation results show a maximum gain of 7.6 dBi and a radiation efficiency of 90%. The antenna's performance is evaluated under various conditions, including free-space (normal), bending with a radius of 10 mm, and placement on the upper arm of a human model at a 1 mm distance. The results exhibit consistent performance with minimal variations, as demonstrated by the S11 parameters shown in Fig. 1(d). Furthermore, the radiation patterns at different frequencies are depicted in Fig. 1(e)-(g). The simulation results highlight the antenna's robustness and high-performance capabilities, which indicate its potential as a strong candidate for deployment in military and other demanding environments, following additional fabrication and measurements.

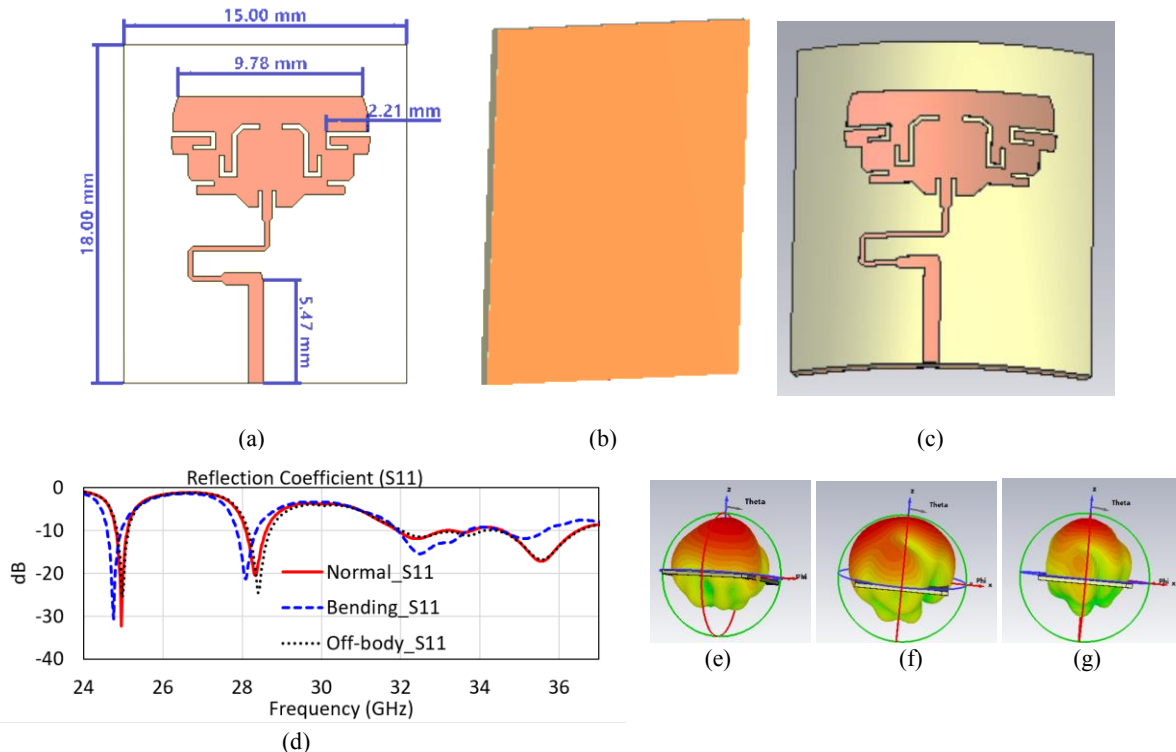


Fig. 1 Geometry of the proposed antenna and simulated results, (a) front view, (b) backside view, (c) front view under bending, (d) simulated S11, and (e-g) 3D radiation pattern at 25 GHz, 28 GHz, and 35.5 GHz.