

# Analysis and Design of Dual-Band Folded-Shorted Patch Antennas for Robust Wearable Applications

## **Abstract**

A flexible folded-shortened patch (FSP) antenna with dual-band functionality for wearable applications is presented. The proposed antenna is operational at 400 MHz and 2.4 GHz and can be considered compact for the lower operational frequency band ( $0.13\lambda_0 \times 0.13\lambda_0 \times 0.02\lambda_0$ ). Flexible polydimethylsiloxane (PDMS) is used as the substrate due to its relatively low-cost as well as its robustness for wearable applications. A comparison of the fields radiated by the FSP, in terms of the TM<sub>010</sub> and TM<sub>001</sub> modes are also presented considering the cavity model which is actually related to the two noted operating bands. Equations needed to calculate the beam pattern and directivity for these modes are also derived and their results are compared to commercial full-wave simulations and measurements of a wearable PDMS prototype. An analysis was also performed to characterize the relevant dimensions that are important for independently controlling or tuning the resonant frequencies for these two radiating modes. The proposed antenna can be suitable for robust wearable applications such as military search and rescue operations, emergency response team units, and medical services.

## **Keywords**

Folded-shortened patch (fsp) antenna; Tm modes; Wearable antennas