

Electrically small spiral PIFA for deep implantable devices

Abstract

In this paper, a miniaturized implantable circularly polarized spiral Planar Inverted-F Antenna (SPIFA) in the UHF (600-800 MHz) band is presented. This antenna is intended for deep implantable devices such as leadless pacemakers and deep brain stimulation (DBS), which facilitates the reception of RF power from an external transmitter. The antenna is electrically small, with a volume of $\pi \times 5 \text{ mm} \times 5 \text{ mm} \times 3.2 \text{ mm}$ and a diameter of 0.022λ . The performance of the proposed antenna in terms of reflection coefficient, realized gain and axial ratio are assessed when accounting for the effects of operating in different types of human body tissues, different biocompatible materials and different thicknesses and depths of the implanted antenna. Finally, the antenna is prototyped and measured in free space, a phantom model, in a cow's fat and muscle tissues to validate the simulation results, indicating good agreements. A realized gain around -20 dBm is achieved when operating in 50 mm depth in cow's muscle tissue while having electrically very small dimensions compared to implantable antennas reported in the literature.

Keywords

Circular polarization; Equivalent circuits; Implantable antennas; PIFAs; Spiral antennas