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Optimal Positioning of an Embedded Inverted-F Antenna

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1 Introduction

An embedded antenna (EA) is any antenna that lies completely within the device housing. Because of this, this antenna will strongly interact with the entire device chassis which creates a complex situation where the antenna impedance, quality factor, radiation efficiency, and radiation pattern depend strongly on the position of the EA. The bandwidth requirement of EA for M2M application were historically rather small, because of the use of the free industry-scientific-medical (ISM) bands. However, there is also a drive to use cellular licensed bands for IoT devices, which imply to work over a larger bandwidth such as LTE-M or LTE-NB standards [1]. The objective of this study is to determine the optimal position to minimize the quality factor of an embedded antenna within the terminal chassis.

2 Position of an Embedded Inverted-F Antenna

The inverted-F antenna (IFA) is the most common embedded antenna in use today in wireless devices in the 700 MHz to 6 GHz frequency range [2]. In its most basic form, the inverted-F is a quarter-wave long conductor parallel to and within a few mm of the RF ground plane, grounded at one end, and has a 50-Ohm feed point close to the grounded end. A classical solution to reduce the IFA dimension is to meander the conductor trace. A 50mm×50mm terminal size is selected for this study. First, the antenna geometry is automatically generated by a matlab code to fill the space available, then a electro-magnetic simulation is performed with HFSS, finally the structure parameters are updated and optimized to obtain self-resonance (with $|S_{11}|$ <-20 dB) and a minimal quality factor (Q_z). On Fig. 1(a), a 20mm×20mm meander IFA is optimized at 860 MHz and matched on 50 Ohm, for different x position ranging from 10 mm to 40 mm. The simulation results presented on Fig. 1(b) show that the corners are the optimal position in term of Q_z. It is interesting to observe a difference of performance between the two corners which is explained by the asymmetry of the structure. More cases will be presented at the conference.

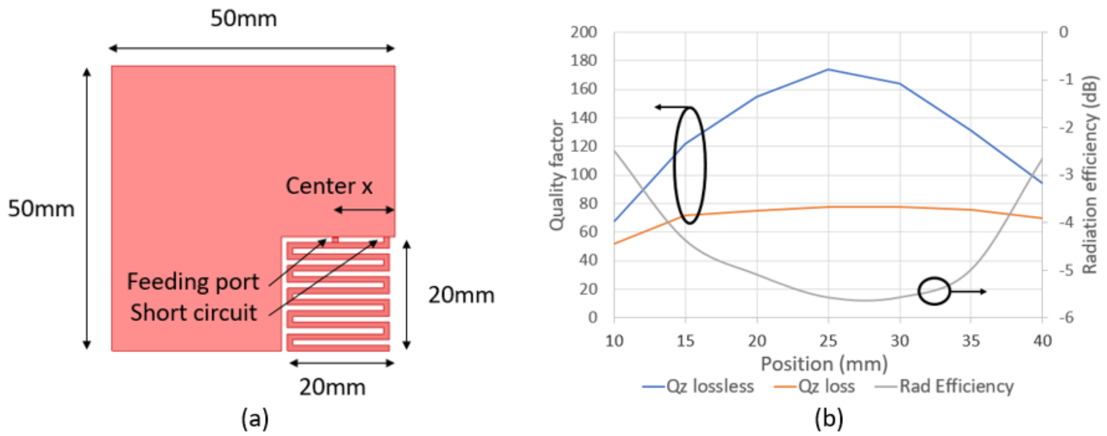

Figure 1. (a) Geometry of the simulated model, (b) Quality factor versus position of the embedded IFA.

References

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