Analysis of Spiral Resonator Filters

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Abstract

Increasing demand for more advanced wireless systems requires the development of novel designs that are capable of simultaneously fulfilling multiple operating and performance criteria. The implementation of high data rate transmission systems requires the development of innovative designs for microwave filters that must fit within a reduced volume that allows the integration of multiple filters into more compact wireless systems. In addition, the filter's specific passband frequencies and quality factors must be achieved within the system's geometrical and topological constraints. Spiral resonator filters offer one option for significantly reduced size compared to conventional ring resonators.

The performance of two alternative designs ofspiral resonators have been analyzed using COMSOL Multiphysics®: a compact spiral microstrip line filter and a fractal spiral resonator filter. A compact microstrip based spiral resonator filter with a resonant frequency of 7.2 GHz shows low insertion losses with a high level of performance and sharp cut off over the specified frequency range. Analysis of a fractal spiral resonator consisting of two unit cells of magnetic meta-materials operating at a resonant frequency of ~1.3 GHz also shows a high level of selectivity at 100 dB/GHz. The results of these analyses are in excellent agreement with experimental data.