

Compact ultra-wideband monopole antenna loaded with metamaterial

Abstract

A printed compact monopole antenna based on a single negative (SNG) metamaterial is proposed for ultra-wideband (UWB) applications. A low-profile, key-shaped structure forms the radiating monopole and is loaded with metamaterial unit cells with negative permittivity and more than 1.5 GHz bandwidth of near-zero refractive index (NZRI) property. The antenna offers a wide bandwidth from 3.08 to 14.1 GHz and an average gain of 4.54 dBi, with a peak gain of 6.12 dBi; this is in contrast to the poor performance when metamaterial is not used. Moreover, the maximum obtained radiation efficiency is 97%. A reasonable agreement between simulation and experiments is realized, demonstrating that the proposed antenna can operate over a wide bandwidth with symmetric split-ring resonator (SSRR) metamaterial structures and compact size of $14.5 \times 22 \text{ mm}^2$ ($0.148 \lambda_0 \times 0.226 \lambda_0$) with respect to the lowest operating frequency.

Keywords

ENG metamaterial; Monopole antenna; Near-zero refractive index (NZRI); Ultra-wideband (UWB); Wideband