Split-Ring Resonators (SRR)-based antenna for WLAN applications

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The edge-coupled split-ring resonator (EC-SRR) is a well-known electrically small resonator which has been largely applied to the design of metamaterial-inspired devices such as filters, power dividers, and couplers, among others. The SRR has also been used in antennas, but mainly in ultrawide band antennas in order to inhibit some frequency bands, rather than as radiator. However, the radiation properties of these resonators working at the first resonance (where the particle behaves as an electrically small current loop) and at the second resonance (where the resonator behavior can be approximated to that of a dipole) were recently explored and analyzed. Both works demonstrated the suitability of the SRR to be used as a radiating element. However, due to the intrinsic electrically small size of the resonator at the fundamental resonance, the narrow bandwidth is a critical issue for some applications, as in the case of WLAN (802.11b/g/n).

The goal of this work is to take advantage of the SRR working at the second resonance to enhance its bandwidth in order to cover the WLAN band (from 2.4 GHz to 2.48 GHz). Adjusting the SRR topology to increase the effective area enclosed by the particle and tailoring the distance between the ring splits, which is not usually considered as a design parameter, are some of the approaches carried out to design the antenna layout. The SRR was designed on a low-cost *FR4* substrate and the overall size was slightly lower than 22 x 22 mm^2 ($0.18\lambda_0$ x $0.18\lambda_0$). The electromagnetic simulation was carried out by means of *Keysight Momentum*, providing good impedance matching (-17 dB at 2.45 GHz) and nearly 5% of fractional bandwidth (118 MHz). The simulated radiation pattern showed a toroidal behavior with linear polarization, similar to the half-wave dipole. The radiation efficiency was found to be η_{rad} = 70 % and the maximum gain was G = 1.4 dB. In order to validate the simulations, the antenna was fabricated by means of a drilling machine. The measured power reflection coefficient is in good agreement with simulations. The radiation pattern was also measured by means of the gain transfer method, obtaining the copolar and crosspolar components for the electric and magnetic planes. The experimental results are in good agreement with simulations and prove that the SRR-based antenna fulfills the WLAN requirements.