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A Tri-elliptic Shaped Microstrip Patch UWB Antenna for Chipless RFID Tags

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Abstract
This article presents a tri-elliptic microstrip patch antenna for ultra-wide band (UWB) chipless RFID (CRFID) applications. The simple and compact structure consists of three elliptical patches that are optimized for bandwidth (BW) enhancement. The antenna is fabricated on a Rogers RT 5880 substrate with a compact size of 36.8×28 mm2 and has a partial ground plane (PGP) for wideband response. Both simulation and experimental results show a good agreement, hence confirming its high efficiency and omnidirectional radiation characteristics. It operates in the UWB frequency band from 3.67 to 10.5 GHz, showing a measured VSWR < 2 bandwidth of 6.83 GHz, a peak realized gain of 5.4 dBi, and a radiation efficiency greater than 94%. Further, the gain-to-aperture ratio (GAR) is calculated. It is found that the proposed antenna outperforms most of the existing CRFID tag antennas with 0.52 dBi/cm2. In addition, the antenna is tested in anechoic chamber and different multipath line of sight (LOS) scenarios for far field radiation pattern and wireless communication validation. Moreover, the antenna is attached with a 9-bit truncated-C multi-resonator (TCMR) to demonstrate its capabilities of encoding and decoding a wireless bit sequence of 'All Present' (111111111) even in the presence of path loss and attenuation. With proper implementation and adaptation to innovative and wearable technologies, this proposed design can become a foundational model for a suitable candidate in logistics, healthcare, and wearable applications, providing a reliable solution for next-generation UWB CRFID systems.

Author Keywords
Bit sequence; Chipless RFID; Multi-resonator; Partial ground plane; Realized gain; Ultra-wide band

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