Arab Academy of Science, Technology and Maritime transport
Electronics and Communication Engineering dept.

Summary

Planar Miniature RFID Antennas

Radio Frequency Identification (RFID) technology allows users to identify, locate and exchange information with remote assets. Various kinds of data can be wireless transferred to a local querying system (reader) from a remote transponder (tag) that includes antenna and a microstrip transmitter or an integrated circuit chip which is capable of storing an identification number and other information. This technology is now used in many commercial applications such as access control, animal tracking, security and toll collection, etc. Applications abound in manufacturing retail, transportation, agriculture and environmental stewardship. A new frontier in this area is the wireless monitoring of people within mobile health care services. RFID devices operates at frequencies between 9 KHz and 24.125 GHz, operation within these bands offers superior diffraction around and penetration through obstacles. However, for RFID (tag and reader) antennas, many challenging features are required. For example small size, low profile, direct impedance matching to the microchip and suitability to low-cost mass production are crucial issues. Also, platform tolerance of the antenna is necessary in order to gain usability in different environments and applications.

The main objective of this thesis is to design and implement a tag antenna and a reader antenna that are suitable for RFID systems operating in the UHF band, and which satisfy the different standards and specifications required for RFID applications. During the research period and towards the RFID antennas development two antennas are proposed, designed and implemented.

A microstrip reader antenna of a planar square radiator with four circular unequal radii slots to obtain circular polarization was designed, simulated and implemented. In order to increase the bandwidth and reduce antenna size four rectangular slits are etched on the radiator edges and in the ground plane. The antenna was fabricated using photolithographic technique on the low cost FR4 dielectric substrate. The size of the fabricated prototype is 7.6×7.6 cm^2, which is the smallest reported RFID reader antenna producing circular polarization in the UHF range of frequency. The achieved -10 dB bandwidth is 28 MHz and the achieved 3 dB axial ratio bandwidth is 7 MHz. Good agreement is found between simulated and measured results.

A tag antenna that operates in the UHF range of frequency was also designed, simulated and implemented. The design is based on modifying the conventional printed dipole antenna. The modification includes meandering the dipole to decrease its length and using bow-tie to increase its bandwidth. This antenna was fabricated using photolithographic technique on Rogers ultralam 3000 series liquid crystal polymer (LCP) with ultrathin profile (thickness of 50 μm). The achieved bandwidth is 19 MHz and the achieved gain is 0.62 dBi. The total area of the antenna is 58mm ×11.5 mm which is only 16.5 % of the area of the conventional dipole. In order to increase the antenna gain, an array is constructed using two elements of the designed tag antenna with the same dimensions and a separation between elements of λ/20 (λ is the wavelength in free space). The final size of the array is 60mm ×30 mm. The gain of this two element array is about 1.17dBi.