

A Compact Dual-Band Bowtie Antenna for RF and ISM bands Operation

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Traditionally, bowtie antennas have been known to exhibit wide impedance characteristics, omnidirectional radiation patterns, and linear polarization. There is a broad range of applications from medical imaging, archaeological survey, and Ground Penetrating Radar (GPR) to trackers and sensor networks where wideband bowtie antenna designs are required for their operations. Broadening the bandwidth of bowtie antenna requires widening the flare angle of the bowtie arms, which consequently results in a large surface area that may not be suitable for space-constrained applications. Moreover, drawback attributes of the wideband bowtie designs feature inconsistent radiation pattern across the bandwidth and low signal-to-noise (SNR) ratios. As it is known, the SNR would be improved in dual- or multi-band antennas due to their reduced bandwidth. To this end, dual-band/multi-band antennas are preferred over wideband antennas in applications where more than a single frequency of interest is present. Previously, a two-port double-dipole elements was reported, whose arms were orthogonally interleaved to facilitate operation in both the standard WLAN frequency bands (J. M. Steyn and et. al, *Progress in Electromagnetic Research, Vol. – 10 pp. 151-161*). Even though the antenna is not very compact it does exhibit good cross-polarization, moderate gain in both frequency bands. Another dual-band bowtie antenna which excites two bands using a single transmission line was reported (Wen Chao Zheng and et. al, *IEEE Trans. Antennas propag., 2014*). The design was compact and did not need multi-port feeding network.

In this paper, a dual-band compact bowtie antenna operating at 900 MHz (RF band) and 2.45 GHz (ISM band) using a single excitation port is introduced. It is printed on a 1.54mm thick dielectric substrate ($\epsilon_r = 3.38$). The antenna consists of two sets of bowtie arms, a microstrip transmission line to feed the bowtie arms, and a ground plane acting as a reflector to partially reduce the back radiation. One of the bowtie arms of each frequency is printed on the top layer and the other arm, which is mirror imaged, is printed on the bottom layer of the substrate. The length of the bowtie controls the resonance frequency of the antenna and the flare angle controls the bandwidth of the antenna. The microstrip transmission line, connected to a 50 Ω SMA probe, feeds the bowtie antenna. The compact antenna can be used for both RF and ISM band applications. The bowtie arms at the lower frequency band are miniaturized by elongating their electrical lengths. The influence of miniaturizing the bowtie arms and the supporting partial ground plane is observed in the reduced peak gain and degraded front-to-back ratio. These are partly neutralized using four quarter-wave choke-slots in the ground plane with two on each side of the feeding transmission line. The proposed antenna is numerically investigated and finalized by the finite-element based full-wave EM solver, ANSYS HFSS. The miniaturization has reduced the ground plane size by ~45% and the arms size by ~41%. In addition to the size reduction benefits, the antenna shows reasonable peak gain and front-to-back ratio in both the bands. The corresponding results will be presented and discussed at the conference.