Design of a New Dual-Band Balun

A. Li Shen[(1)], M. Zhou[(1)], B. Arigong[(1)], J. Shao[(1)], H. Ren[(1)], J. Ding[(1)], and H. Zhang[*(1)]

(1) EE Department, University of North Texas, Denton, TX 76207, USA

In this paper, a novel dual-band balun with flexible frequency ratios will be presented. The proposed 3-port balun is based on a 4-port structure with the 4th port terminated as an open end. Baluns transform unbalanced input signals to balanced output signals or vice versa. They have become very useful and needed in various applications such as balanced mixers, frequency multipliers, push-pull amplifiers, and antennas.

So far, most of the existing baluns can only operate at a single frequency or frequency band. It is highly desired to design baluns with dual-band operations to meet the requirement of advanced wireless/wired communication systems. To address this issue, several dual-band baluns have been investigated [X. Gao et al., IEEE Trans. Microw. Theory Tech., 56, 1455-1460, 2008; C. Icheln et al., Electron. Lett., 36, 1760-1761, 2000]. However, the performance of these baluns is still limited. In this paper, a new dual-band balun is proposed. It features a simple and flexible structure. Due to the symmetry of the proposed structure, even-odd mode analysis is applied to analyze its performance. Based on the derived explicit design equations, an experimental prototype is designed to operate at 1.1 and 2 GHz. Numerical simulations have been conducted and the simulated return loss is better than 15dB at the design frequencies. The insertion losses at the two output ports are very close to 3dB at the two working frequencies. The simulated phase different between the two output ports is almost 180° at the working frequencies. To verify the theoretical and numerical results, the designed balun is fabricated on the FR4 Isola printed circuited board. The measurement results match well with the simulation results. Moreover, the realizable frequency ratio of the proposed dual-band balun has been studied. It is found that, assuming the realizable transmission line characteristic impedance is from 18Ω to 120Ω, a very wide range of frequency ratios (from 1.5 to 3.8 and even beyond) can be realized using the proposed balun. This is highly favorable for practical applications.