Abstract

Microwave/RF passive devices are critical components for a variety of electronics systems that have a great impact on our society. With the rapid explosion of mobile and other wireless consumer products there is increasing demand for efficient spectrum utilization. More attention is now being given to device miniaturization with enhanced performance (e.g., ultra-wideband operation, notches in the ultra-wideband, multi-band operation, harmonic passband suppression, high selectivity, superior out-of-band rejection etc.) along with methodologies to embed (integrate) components for additional features, within the size of the component under operation. Moreover, the rising demand of wireless communication applications necessitates passive RF components for multiple band applications such as GSM, WCDMA mobile communications, and high-speed WLANs. A single component operating at multiple or dual-band frequencies is of great interest for the integration of the circuitry in multi-channel systems.

The objective of this PhD dissertation is to develop planar passive RF and microwave components, which are smaller in size, have superior characteristics for single or dual-band wireless applications and at the same time are easier to realize. Here, twenty novel designs of printed components, such as filters (bandstop, lowpass, bandpss), hybrid couplers and baluns, are presented which are comparable or superior in performance than those available in open literature. For all the RF components developed in this thesis, explicit design equations along with design graphs are analytically obtained using lossless transmission line model. For validation purposes and for microstrip implementation, full-wave electromagnetic (EM) simulations are carried out using a method of moment based IE3D simulator. The microstrip prototypes are fabricated on FR4 or on RT/Duriod 5880/5978 or on TFG substrates. Measurements are carried out using Agilent 8510C vector network analyzer. The measured, EM simulated and circuit computed performance characteristics are compared.

Keywords: Planar transmission lines, microstrip filters, hybrid couplers, baluns, transmission line model, S-parameters, fabrication, microwave measurements, vector network analyzer.