Abstract

One of the miniaturized RF front-end design approaches is to integrate the passive circuitries, such as antenna, bandpass filter, balun, matching network, and interconnects. An integrated balun-bandpass filter (balun-BPF) is one of these examples. The combination of a balun and a bandpass filter not only permits the realization of conversion from the balanced signal to an unbalance one but also bandpass filtering. With increasing demands for ever smaller circuitry dimension, the miniaturization for distributed balun-BPF is necessary at low gigahertz frequency regime. To realize a miniature circuit, capacitive loading can be applied. But the sacrifice of the miniaturization is akin to shrink the bandwidth due to the group delay change if the filter is studied. It is also a lingering doubt for miniaturized balun-BPF. The discussion of differential performance of balun-BPF due to the miniaturization is still rare however. Against this background, a miniaturized balun-BPF, which possesses the capacitive loading miniaturization onto the circuitry, will be presented in this thesis. With the focus on differential performance investigation, an attempt was made to study the imbalance of the amplitude and phase due to the capacitive loading.

The phase and amplitude imbalances due to the loaded resonator are analyzed and verified by a prototype balun-BPF with loaded resonator designed at 1.7 GHz with 5.5% fractional bandwidth. The experimental results reveal that size reduction of 16% and spurious suppression up to 4.5 GHz are achieved as compared to that of a conventional structure. The phase and amplitude imbalances of the prototype balun-BPF are recorded as 8° and 0.6 dB respectively.

Moreover, a tunable square-loop dual-mode balun-BPF configuration is designed based on the proposed balun-BPF. The tunable square-loop dual-mode balun-BPF uses varactor diode as the capacitive loading, thus a tuning range of 100 MHz is realized. This tunable square-loop dual-mode balun-BPF displays the amplitude and phase imbalance within the range of 2 - 7 dB and 165° - 185°, respectively.