Abstract

Microwave passive filters play major role in RF and microwave systems. Nevertheless, the periodic property generates spurious responses at the harmonic frequencies and degrades the performance of systems. This problem becomes especially serious in narrow band communications. Furthermore, the filter size is also an important factor to be concerned in the rapid developing wireless products. This thesis focus on the development of compact size and ultra wide stopband interdigital bandpass filters.

Common methods for spurious suppression are first addressed and the possibility to be applied in interdigital filters is explored. The sinusoidal modulation, defected ground structure and split ring resonators are investigated. The stepped impedance resonator (SIR) and spurline bandstop filter are then investigated to achieve size reduction and ultra wide rejection band objective. SIR is shown to have the property of resonance frequencies relocation. With the same physical length, the fundamental and first spurious resonance frequencies relocate lower- and higher- frequency bands respectively. Hence, simultaneous size reduction and stopband extension are obtained. The conventional uniform impedance resonator of interdigital bandpass filters is replaced by SIR to realize a size reduction of more than 22% and stopband extension by more than two harmonics.

Spurline are then applied to further extend the stopband. Two novel spurline filters are proposed, namely SIR spurline bandstop filter and dual spurline bandstop filter. It is shown that the first design gains size reduction and spurious free band extension at the same time while the second design attains additional zero. There are two ways to apply spurline for spurious passband suppression. The resonator embedded method does not require any penalty of size expansion, and the tapped line dual spurline gains double spurious passbands suppression. Third order and fifth order SIR interdigital bandpass filters at around 520 MHz with spurlines for size reduction and spurious responses suppression are designed and verified in both simulations and measurements. Excellent results have been obtained, and the embedded method demonstrates wide stopband till $7.2f_0$ while ultra wide rejection band up to $11.3f_0$ is achieved by the tapped line dual spurline method.