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High-Selectivity UWB Bandpass Filter With a Notched Band Using Stub-Loaded Multi-Mode Resonator

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Abstract: **In this paper, a novel type of stub-loaded multiple-mode resonator (MMR) with electrical coupling is developed for exploration of a single band-notch UWB Bandpass Filter (BPF) with high selectivity. Based on even and odd mode theory, five resonant modes, including two odd modes, three even modes, and a notched band can be properly designed to form the UWB passband. The odd-mode resonant frequencies can be controlled by tuning the coupling strength between two open stubs with no impact on the even modes, which provides a high design freedom of the UWB filter. Moreover, a pair of transmission zeros (TZs) can be also generated at either side of the passbands for sharp skirts and a TZ is also created within the passband for interference signal rejection. The simulated and measured results show that a notched band is obtained at 8.0 GHz, which can be controlled by arranging the parameters of the MMR, sharp attenuation slops at the lower and upper bands can be simultaneously realized, which validates the proposed design flow well.**

Keywords: UWB bandpass filter, notched band, multiple-mode resonator, sharp roll-off, electrical coupling

1 1. Introduction

In recent years, ultra-wideband (UWB) wireless communication systems have been widely developed since the release of UWB frequency spectrum for commercial applications [1]. As essential component for the system, UWB bandpass filters (BPFs) with high performance, like sharp selectivity and compact size, have attracted great attention among researchers. It is observed that, various type of MMRs have been widely implemented to realize UWB filters [2-4].

In addition, to avoid interference signals from other wireless systems like WLAN (2.4/5.8 GHz), WiMax (3.5 GHz), RFID (6.8 GHz) and satellite communication systems (8 GHz), UWB filters with notch capabilities have been in great demand [5-12]. In [5], a controlled defected ground structure realized by a complementary folded split-ring resonator is utilized to achieve negative permittivity in the field of metamaterials for band notch. However, the selectivity of the filter is moderated. In [6], two electromagnetic bandgap structures are placed near the feed lines to introduce two rejected notched bands. By combining a low-pass and a high-pass filter, a UWB filter is realized in [7] with a notch band implemented by using step impedance resonators coupled to the high-pass section. However, this filter suffers from large size and high design complexity. In [8], a UWB filter with wide notch-band around 5-6 GHz is implemented using a stub-loaded ring resonator. For size reduction, slow-wave CPW MMR is employed in [9] to realize UWB filter characteristic, and a bridge structure is used to create a notch in the passband. In [10], a UWB filter with a notched band is reported, which is realised utilizing a step-impedance stub loaded ring resonator. However, this filter has poor harmonic suppression. In [11], a UWB BPF with a wide stopband rejection characteristic is proposed based on radial loaded stub resonators. In addition, a compact UWB BPF with a tri-notch-band feature is realized using a ring-stub multimode resonator.

In this paper, a novel high-selectivity UWB filter with a notched band based on new type of MMR is proposed. The MMR consists of a uniform-impedance resonator with one centrally loaded open stub and two bent stubs with electric coupling effect loaded at the symmetrical side locations. Based on even and odd mode theory, five resonant modes, including three even modes and two odd modes, and a notched band can be designed within the UWB band. And a pair of transmission zeros can be generated at either side of the passbands for sharp roll-off. Moreover, the coupling strength between the two stubs

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