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Design of a Compact Microstrip Tunable Dual-band Bandpass Filter

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Abstract

A novel microstrip tunable dual-band bandpass filter with high attenuation level in the upper stopband region is presented. The proposed structure comprises of T-shaped resonators and the coupled microstrip feeding lines. To reach a compact size, the feeding lines are bended. By altering the physical lengths, the characteristics of BPF can easily tune. So, the operational frequencies of the filter can be adjusted and has been fixed to 2.1 GHz and 2.63 GHz, which are applicative for 3G and 4G systems. The insertion-losses of the first and second pass-bands are only 0.68 dB and 1.08 dB, respectively. The undesired harmonics in the upper stopband, with an excellent attenuation level of -38 dB, are rejected up to 6.65 GHz. The results exhibit high return loss of 19.3 dB and 30.7 dB in the first and second pass-bands. The proposed circuit has been fabricated and tested that the obtained results are well close to the simulations results. The total size of the designed circuit is only $16.4 \times 13.4 \text{ mm}^2$.

Keywords: Bandpass filter, Dual-band, Feeding line, T-shaped, Resonator

1. Introduction

With develop the communication devices; more than ever the need for bandpass filters (BPFs) with flexible passbands, simple geometry and high rejection is felt. There are different methods to design BPFs, such as balance circuits, coupled structures and multi-layer circuits. By using a substrate integrated wave-guide, a dual-band BPF was reported in [1]. The spurious peaks in its stopband region are attenuated with -30 dB suppression level. Also, this filter has high insertion loss in passbands. A microstrip dual-band BPF using a hybrid structure was designed for WLANs applications [2]. Complex structure and enormous dimensions are undesirable properties of this circuit. The presented BPF in [3] was created using the stepped-impedance lines that the second passband is tuned by electrical length of high impedance lines. In [4], two dual-band BPFs with similar structures was introduced using the short/open ended stubs. Even though, the size of these BPFs are suitable, insertion losses of passbands are high. Based on the rectangular wave-guide structure, BPFs with high return losses in passbands were fabricated for X-band and Ku-band [5]. In [6], a triplex-layer

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