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On-Chip Ku-Band Bandpass Filter with Compact Size and Wide Stopband

Authors : Jyh Sheen, Yang-Hung Cheng

Abstract : This paper presents a design of a microstrip bandpass filter with a compact size and wide stopband by using 0.15-μm GaAs pHEMT process. The wide stop band is achieved by suppressing the first and second harmonic resonance frequencies. The slow-wave coupling stepped impedance resonator with cross coupled structure is adopted to design the bandpass filter. A two-resonator filter was fabricated with 13.5GHz center frequency and 11% bandwidth was achieved. The devices are simulated using the ADS design software. This device has shown a compact size and very low insertion loss of 2.6 dB. Microstrip planar bandpass filters have been widely adopted in various communication applications due to the attractive features of compact size and ease of fabricating. Various planar resonator structures have been suggested. In order to reach a wide stopband to reduce the interference outside the passing band, various designs of planar resonators have also been submitted to suppress the higher order harmonic frequencies of the designed center frequency. Various modifications to the traditional hairpin structure have been introduced to reduce large design area of hairpin designs. The stepped-impedance, slow-wave open-loop, and cross-coupled resonator structures have been studied to miniaturize the hairpin resonators. In this study, to suppress the spurious harmonic bands and further reduce the filter size, a modified hairpin-line bandpass filter with cross coupled structure is suggested by introducing the stepped impedance resonator design as well as the slow-wave open-loop resonator structure. In this way, very compact circuit size as well as very wide upper stopband can be achieved and realized in a Roger 4003C substrate. On the other hand, filters constructed with integrated circuit technology become more attractive for enabling the integration of the microwave system on a single chip (SOC). To examine the performance of this design structure at the integrated circuit, the filter is fabricated by the 0.15 μm pHEMT GaAs integrated circuit process. This pHEMT process can also provide a much better circuit performance for high frequency designs than those made on a PCB board. The design example was implemented in GaAs with center frequency at 13.5 GHz to examine the performance in higher frequency in detail. The occupied area is only about 1.09×0.97 mm2. The ADS software is used to design those modified filters to suppress the first and second harmonics.

Keywords : microstrip resonator, bandpass filter, harmonic suppression, GaAs
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