Design of Dual-Band Bandpass Filter with Controllable Bandwidth

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***Abstract*—A microstrip dual-band bandpass filter (DBPF) with controllable bandwith is designed and simulated at 3.08 GHz and 7.05 GHz. A step impedance resonator (SIR) with open stubs and the shunt open stub is employed that consists in a pair has advantage of having a compact and excellent transmission characteristics. The 3 dB bandwidth of a first band is 950 MHz with the insertion loss (S21) of -0.2dB and the second bandwidth is 1400 MHz with the insertion loss (S21) of -0.7dB. This bandpass filter can be applied to the domestic and international fixed and mobile satellite telecommunications, fixed meteorological satellite, ultra-wideband(UWB), and broadcast relay, The overall size of bandpass filter is 15 mm × 20 mm.**

Keywords— Microstrip open stub; dual-band filter; transmission zero

I. INTRODUCTION

With the rapid development of modern wireless communications, antennas, [1] dual-band RF / microwave amplifier components, [2] and the filter [3-6] has been developed. The dual-band bandpass filter (DBPF) as one of the most important components of a dual-band radio systems which is getting a lot of attention in the literature references [3-6]. Miyake et al. [3] suggested to connect two other parallel to the BPF, and application methods were designed to achieve a dual-band BPF. In the same wahy, Hsue [4] reported a broadband BPF and bandstop filter constructed the same length by combining a dual-band filter. Since the circuit configuration in the references 3 and 4 are relatively bigger in terms of size of the filter that constitutes two different filters. The dual-band BPF basically realized by using a micro-resonant mode spurious half-wave resonator [5, 6].

The BPF of the proposed dual-band based on the synthesis method and circuit conversion [7], but it was difficult to obtain continuous frequency convertion with a separate control. Therefore, the bandwidth of the dual-band dual-pass filter is proposed with different configuration.

the dual bandwidth control and BPF. Dual-band characteristic of the micro-resonator using a shunt open stub, multiple transmission zero, insulation and a large pass-band between the two sharp attenuation near the pass band. The admittance inverter designed to facilitate dual-band, dual-bandwidth control. Bipolar dual-band central frequency of the BPF designed and measured at 3.8 and 7.05 GHz. Simulation It is confirmed the filter's frequency response to the measurement result.system.

II. DESIGN AND SIMULATION

The simulation of DBPF is performed on the basis of FR4 substrate with a thickness of 1.6 mm and the dielectric constant of 4.5. The filter is designed at 3.8 GHz and 7.05 GHz as its center freuqency of the dual band bandpass filter (DBPF). We have designed a dual-band resonator with the configuration of the two-pole dual-band as shown in Figure 1 which are connected by the admittance inverters. Each resonator is arranged to controllably open the bandwidth based on the shunt stub.

Schematic layout design is shown in Figure 1. The design is simulated by using SONNET EM simulator and its equivalent circuit of DBPF is depicted in Figure 2. The equivalent circuit is composed of series LC (Lt and Ct) components with parallel parasitic capacitances (Cp1 and Cp2) as shown in the Figure. The transmission characteristics and the reflection coefficient of the DBPF is shown in Figure 3 as the simulation results. The first center frequency of the filter is 3.8 GHz and the transmission characteristic that shows insertion loss (S21) is 0.2 dB. The 3 dB bandwidth of DBPF in this frequency is 950 MHz, and the second center frequency is 7.05GHz and the transmission characteristic that shows the insertion loss (S21) is - 0.7 dB. In the same manner, the 3dB bandwidth of DBPF is 1400 MHz and its input reflection coefficient (S11) that represents a very wide bandwidth which is close to the other to zero.

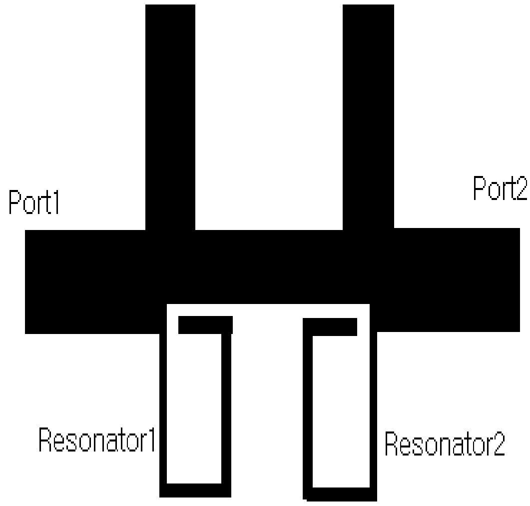

Fig. 1. Designed hairpin structure based SIRBSF.

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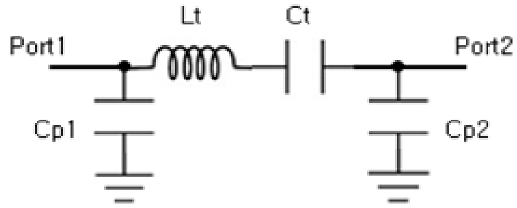


Fig. 2. The simplified equivalent circuit of the designed SIRBSF.

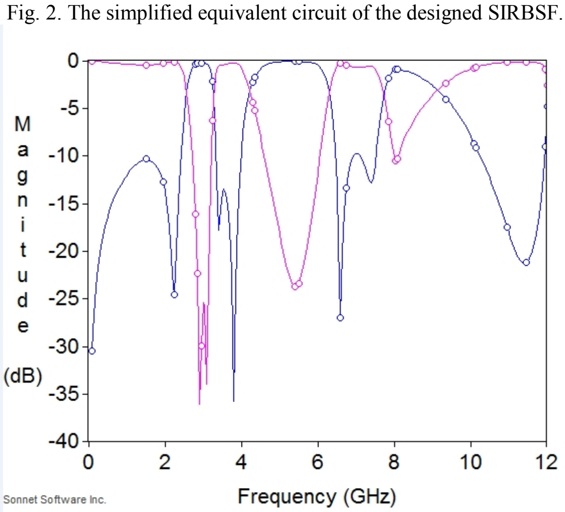
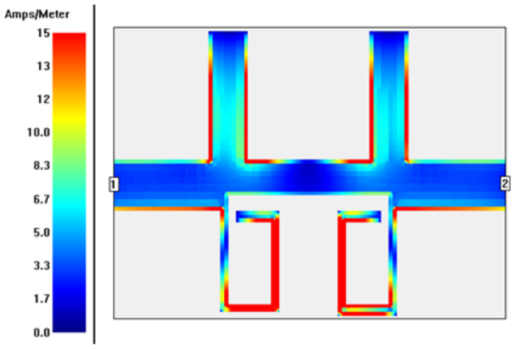
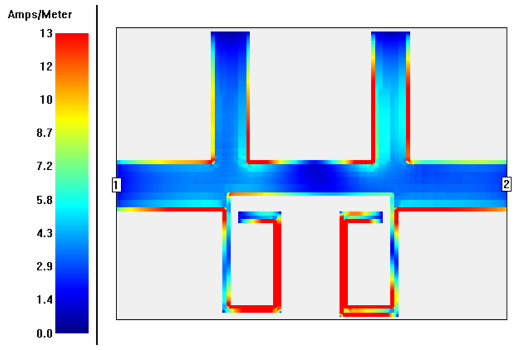


Fig. 3. The simulation result of the designed SIRBSF.



a) at 3.8 GHz.



a) at 7.0 GHz.

Fig. 4. The current density distribution in the SIRBSF.

The simulation of the current density distribution of DBPF is shown in Figure 4. The current density distribution in the both bands of DBPF is shown clearly in the Figure. The random simulaiton of current distribuiont in the first band is at 3.8 GHz, and the second band is at 7.05 GHz are entirely passed (showing in pink color) and blocked the remaining frequencies (showing in dark blue color) as showin in Figure 4 a) and b) respectively. So, the maximum distribution of current density is shown input and output parts fo the DBPF. The total size of DBPF is 15 mm × 20 mm.

III. CONCLUSION

In this paper, DBPF resonator having a controllable open stub impedance bandwidth wtih parallel open stub is presented. Sonnet simulation EM simulator is used for the design and simulation on FR4 substrate. As a results, 3 dB bandwidth of the first band is 950 MHz with 0.2 dB insertion loss at 3.8 GHz and a 3 dB bandwidth of a second band is 1400 MHz with 0.7 dB insertion loss at 7.05GHz. The well distribution of current density is also shown in both bands. The designed DBPF can be applied to both domestic and international fixed satellite communications systems and experiments station, a fixed M / W relay and meteorological satellite, broadcasting, ultra-wideband (UWB).

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