A Dual-Band Coupled line Microstrip Band-Pass Filter

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Outline

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Previous works [1]

A filter is a device that permits the signal transmission within area of pass band and attenuates the signal at the remaining area. Due to the recent advancement in mobile communication, low profile, lighter weight and low cost devices like microstrip patch antenna and filters are required.

Previous works [2]

Systems with ultra-band width make use in wireless scenario which enables information transmission over long range of frequency of small distances with a minimum power and high information rates. An ultra-wide band filter is an important requirement for high-quality signal transmission and reception.

Previous works [3]

Microwave bandstop filters (BSFs) are being widely used in telecommunication systems. Various techniques have been developed to design and synthesis BSFs [1]. Conventionally, by cascading more open stubs onto a microstrip, a wider rejection bandwidth and a deeper rejection can be obtained. The side effects of this method are the high insertion loss in the passband and increased circuit size [2-3].

Previous works [4]

A conventional open-stub BSF can be formed by mounting two open stubs onto a microstrip. The length of the two stubs and the separation between the two stubs are a quarter of the wavelength at the midband frequency [2-3]. Embedded open-circuit stub was proposed by Shaman and Hong to generate a band notch on an ultra wide band bandpass filter [4].

Previous works [5]

A size reduction technique based on meander-lines for microwave filters is presented for designs employing Signal Interference Techniques. These filters exhibit low insertion loss, high selectivity and sharp rejection. Also, these are suitable for microstrip structure with fractional bandwidths ranging from 10 to 45%. Absence of any form of coupling structures render the filters suitable for meandering technique.

Introduction

- The subject of this paper is a microstrip coupled-line bandpass filter with a simulation performed in the range of 7-10 GHz. The filter has two bands with center frequencies of 7.4 and 9.3 GHz and insertion losses are almost zero dBs and input matches are -45 and -49 dBs respectively.
- The microstrip filter can be used in C-band microwave applications.

Design Steps & Simulation Results

- Figure 1 has the top view of the filter. The filter is built on a 1.55mm thick FR4 substrate. The dielectric constant is $\varepsilon_r = 4.4$ for this material.

- The box size of the filter is 28 x 15 mm. The dimensions of the feeding line of the filter is 1 x 8 mm.

Design Steps & Simulation Results

The simulated filter response can be seen in Figure 2. The passband covers bands from 7.3 to 7.5 GHz and from 9.2 to 9.4 GHz with an insertion loss between 0–0.015 dB. The simulated input matches are -45 dB and -49 dB, respectively, in most of the passband.

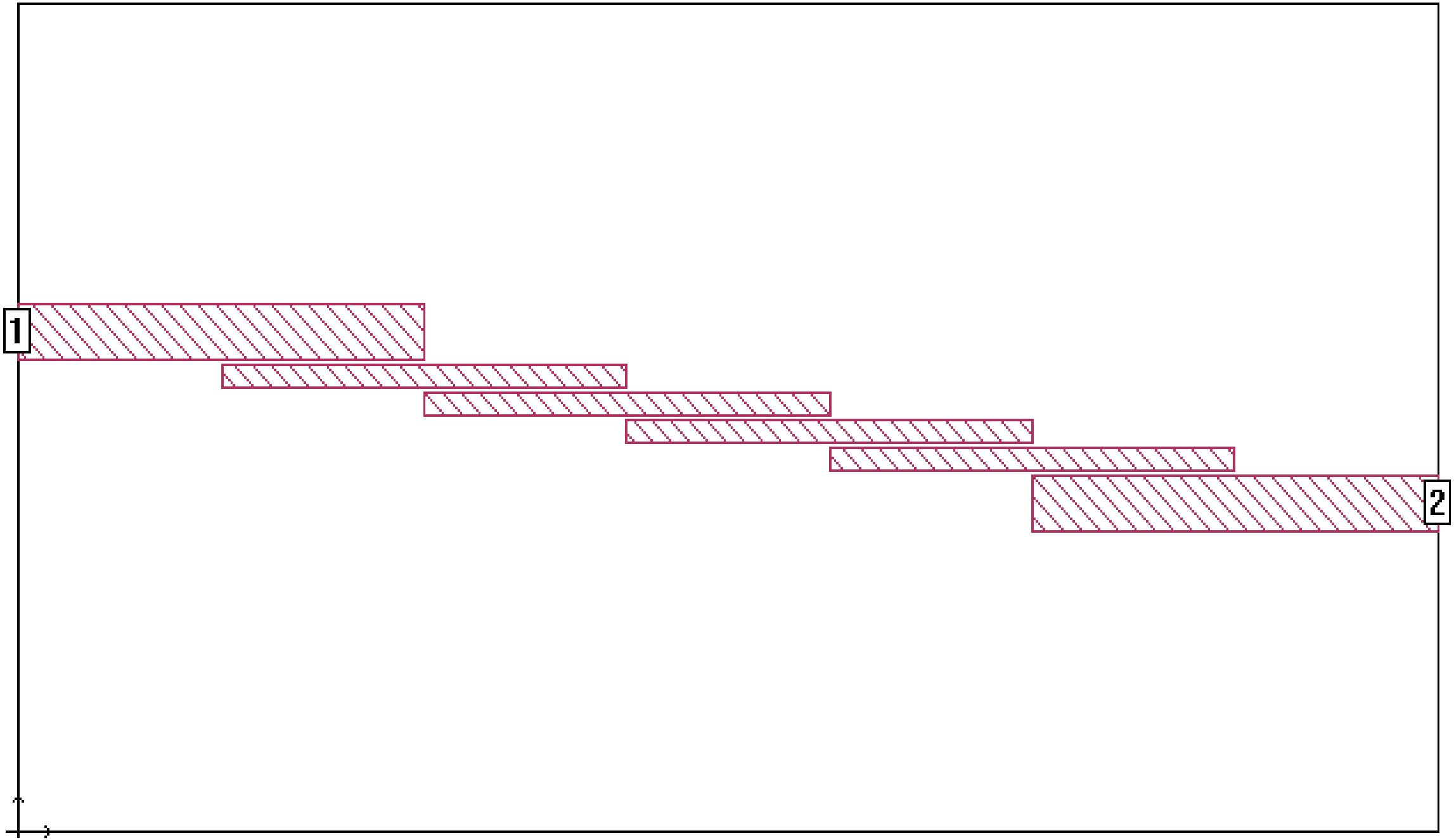

Fig. 1. Top view of the filter

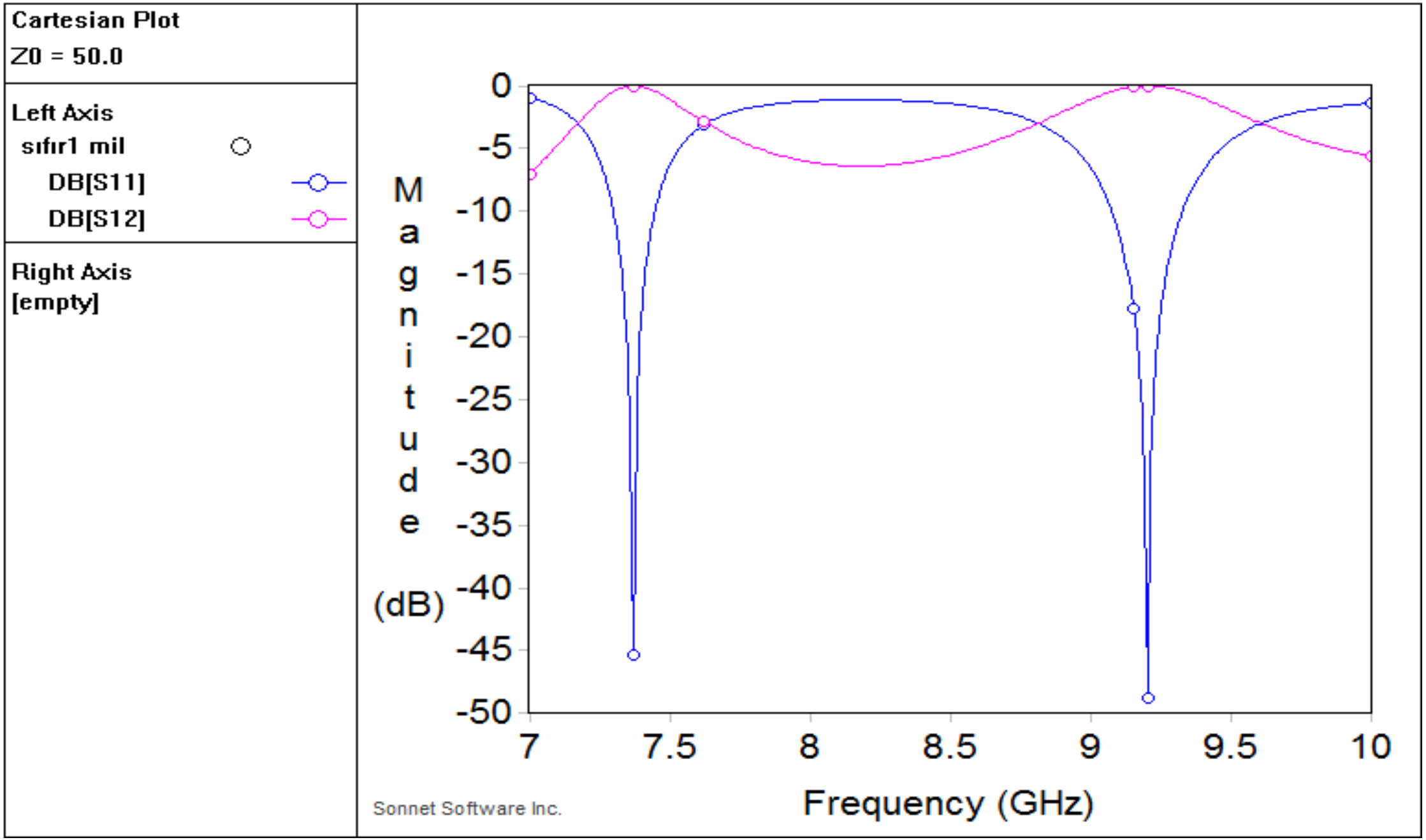

Fig. 2. Bandpass filter response

Parametric Study

In order to see the fabrication tolerances of the filter, a parametric study is conducted by changing the separation of the coupled lines in the middle section and the linewidths of the metals attached to the ports.

TABLE I. CHANGING THE SEPERATION

Mid separation with 1 mm port metal width (mm)	S12-freq. (dB-GHz)		Freq. [BW1-(MHz)]	Freq. [BW2-(MHz)]
0.3	-0.01 7.72	-0.01 8.00	52	78
0.2	-0.01 7.54	-0.01 9.15	47	76
0.1	-0.01 7.38	-0.01 9.18	45	79

TABLE II. CHANGING THE PORT WIDTHS

Port metal width with 0.2 mm mid separation (mm)	S12 - freq. (dB-GHz)		Freq. [BW1-(MHz)]	Freq. [BW2-(MHz)]
0.6	-0.01 7.59	-0.01 9.16	52	68
0.8	-0.01 7.54	-0.01 9.17	46	73
1	-0.01 7.54	-0.01 9.15	47	76
1.2	-0.01 7.49	-0.01 9.08	48	82
1.4	-0.03 7.46	-0.01 9.1	49	137

CONCLUSION

In this paper, a microstrip coupled line bandpass filter was designed, simulated and tested. Simulations were performed in the range of 7-10 GHz. The filter has two bands with center frequencies of 7.4 and 9.3 GHz and insertion losses are almost zero dBs and input matches are -45 and -49 dBs respectively.

CONCLUSION

When slight changes are applied to the geometry such as changing the separation of the coupled lines and port widths, no significant changes occur in the parametric studies. Therefore, the next step is to fabricate the filter.

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AUDIENCE QUESTIONS

THANK YOU