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Bandstop Filter based on Inter-digital Capacitor

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Abstract

We presnt a microstrip bandstop filter (BSF) using interdigital capacitor. For purpowse, we used two λ / 4 lengths to make an interdigital capacito and we added one shunt open circuit resonator with λ / 4 length. The open stub resonator is meandered in order to get much more coupling effect. The layout pattern was was simulated using the SONNET simulator tool. In experimental results, we achieved 4.2 GHz bandwidth at 6.3 GHz as its center frequency. The 3 dB bandwidth is much more wider and it can be implemented to the ultra-wideband application. The simulated insertion loss (S21) and return loss (S11) were found to be 35.0 dB and 0.43 dB, respectively with good device performance. The physical size of the designed BSF is comparatively reduced..

Keywords: *Bandstop filter, Interdigital Capacitor, microstrip BSF, wideband bandstop filter, UWB BSF.*

1. INTRODUCTION

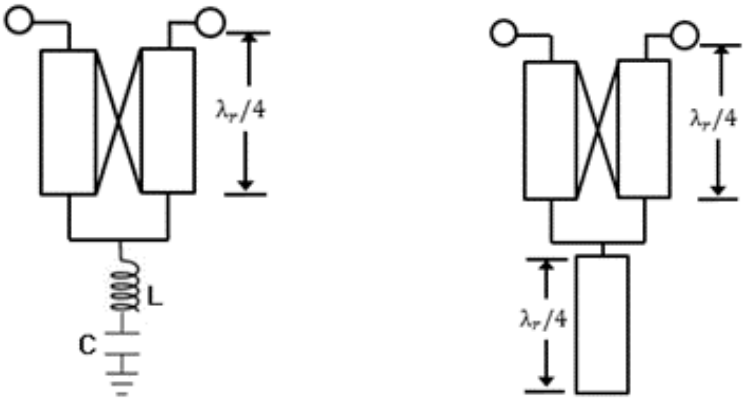
Ultra-wideband (UWB) communication is being popular for long term evolution (LTE) version of smart devices, local area network (LAN), and satellite communication system of both satellite and earth stations. The interference occurs during the transmitting and receiving the radio signals in the communicating unit. In order to reject those interference occurred the system, we can use various kinds of RF bandstop filters. In this work, we used wideband bandstop filter (BSF) with high selectivity for rejecting those noises or interferences [1]. In this work, we develop a compact wide bandstop filter using interdigital capacitor symmetrically in both sides. These interdigital capacitors were embedded in quarter-wavelength stubs that controls the bandwidth of the bandstop filte and assists to improve the device performance as well [2-5]. In order to improve the transmission zero, we used open stub meander line with quarter-wavelength meander line. The performance of BSF is greatly improved, and it is compact and easy to realize. Several techniques have been used to reduce the size of the BSF including quadband technique [6-8]. After setting up the specifications and design concept, we have built design layout pattern using electromagnetic simulator, SONNET based on transmission theory.

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3. DESIGN AND SIMULATION

The wideband bandstop filter is designed by combining two electrically coupled frequency selective (FSCS) and a meander line. The electrical length of FSCS and meander line is designed using λ / 4. The equivalent circuit of the part of the resonator design is shown in Figure 1 which shows an LC resonator with quarter-wavelength and open circuit quarter-wavelength resonator. It is simulated using SONNET simulator tool.



(a) **(b)**

Figure 1. a) LC resonator with quarter-wavelength, and b) Open circuit quarter-wavelength resonator

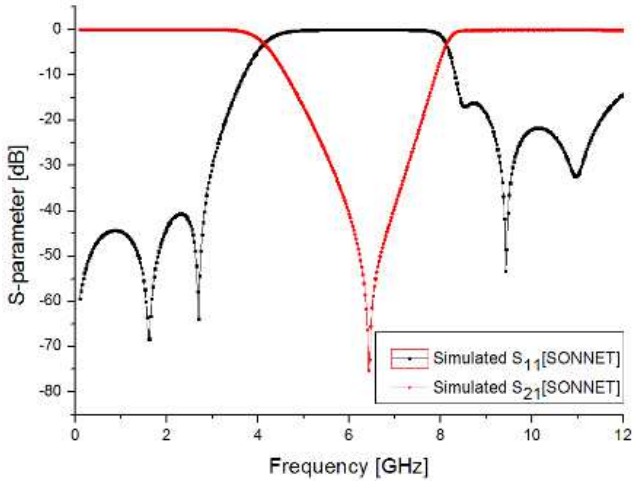


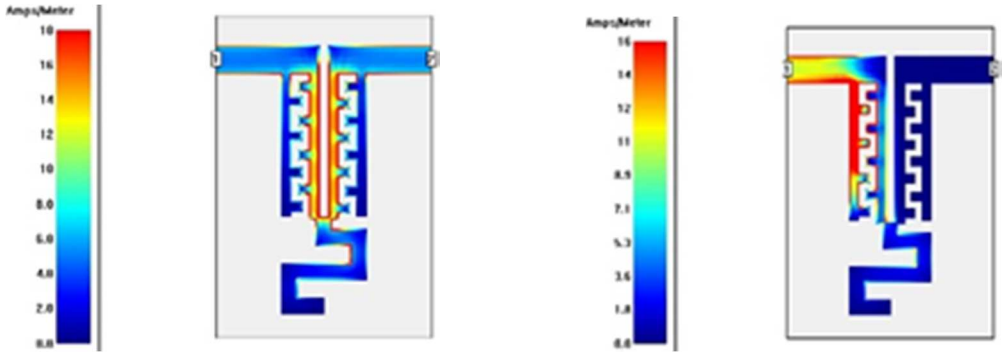
Figure 2. Simulated result of wideband BSF

The quarter-wave length meander line was built at the lower side of the BSF and built interdigital capacitor symmetrically in both sides represented by series inductance, L and capacitance. The meander line in the lower side causes the widening the stopband and sharpening the slop. When the length of the meander line becomes longer, the lower side of the center frequency and the lowering frequency is further lowered, and when the length becomes shorter, the upper side of the center frequency and the lowering frequency moves upward. These cause the shifting of the center frequency as well.

On the basis of the theoretical background as in Figure 1, we designed layout pattern and the set the physical dimensions as follows. L1 = 4.8 mm, L2 = 7.4 mm, L3 = 4.0 mm, L4 = 2.4 mm, L5 = 2.0 mm, L6 = 2.4 mm, W1 = 1.4 mm, W2 = 0.5 mm, W3 = 0.8 mm and G = 0.4 mm. The Teflon substrate is used for our purpose which has a thickness of 0.54 mm and a relative permittivity of 2.54 with a loss tangent of 0.002 while terminating the input and output terminal in to 50Ω. The layout pattern is optimized in to 10.0 × 12.57 ㎟.

And then we simulated the pattern of wideband bandstop filter. The simulated result is shown in Figure 2. The simulated maximum insertion loss (S21) of the BSF was 72.9 dB and return loss (S11) was 0.044 dB at 6.0 GHz as its center frequency. The lower and upper side of the 3 dB stopband were 4 GHz and 8 GHz respectively. The results showed the sharp rejection at 6 GHz.

The current density distribution is shown in Figure 2 in which the random simulation have done at 2.5 and 6.4 GHz. Figure 3 shows current density of DIDC FSCS filter. This simulation uses a SONNET simulator at 2.5 GHz and 6.4 GHz. In both simulation results, the current distribution is totally stopped in the relevant regime of frequencies.



(a) **(b)**

Figure 3. Current density distribution in the designed BSF at a) 2.5 GHz and b) 6.4 GHz

5. CONCLUSION

A double interdigial resonator were used with an open stub meander line to realize the wideband bandstop filter based on Teflon substrate with a thickness of 0.54 mm and a relative permittivity of 2.54. The layout pattern of the BSF was simulated using SONNET that results good insertion loss (S21) and return loss (S11) characteristics at center frequency of 6.0 GHz. The wide bandwidth was achieved during the simulation as well which was wide-enough for system application. The size of the BSF was also reduced.

REFERENCES

[1] Ren, S. W., Wu, L. S., Peng, H. L., & Mao, J. F. (2015). Quasi-elliptic wideband bandstop filter using stepped-impedance coupled line. IEEE Microw Wirel Lett, 25(6), 364-366.

[2] Shrestha, B., & Kim, N. Y. (2015). Microstrip wideband bandstop filter with open stubs for UWB applications. Microwave and Optical Technology Letters, 57(4), 1003-1006.

[3] Sánchez-Soriano, M. Á., Torregrosa-Penalva, G., & Bronchalo, E. (2010). Compact wideband bandstop filter with four transmission zeros. IEEE Microwave and Wireless Components Letters, 20(6), 313-315.

[4] Hsieh, M. Y., & Wang, S. M. (2005). Compact and wideband microstrip bandstop filter. IEEE Microwave and Wireless Components Letters, 15(7), 472-474.

[5] Kim, C., Hyeon Lee, T., Shrestha, B., & Chul Son, K. (2017). Miniaturized dual band bandpass filter

based on stepped impedance resonators. Microwave and Optical Technology Letters, 59(5), 1116-1119.

[6] Kumar, J., & Chauhan, R. K. (2016). Microstrip Wideband Band Stop Filter with IDC Loaded Open-Loop Resonator. International Journal of Science Technology & Engineering, 3(4), 167-169.

[7] Sánchez-Soriano, M. Á., Torregrosa-Penalva, G., & Bronchalo, E. (2010). Compact wideband bandstop filter with four transmission zeros. IEEE Microwave and Wireless Components Letters, 20(6), 313-315.

[8] Dhakal, R., Cho, S., Shrestha, B., & Seo, C. (2018). Quad-band bandstop filter modeled by comprising quad-section stepped-impedance resonator. Analog Integrated Circuits and Signal Processing, 1-7.