



EBG Structure based UWB Band pass filter

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ABSTRACT: In this paper two microstrip bandpass filter as been proposed for UWB application using uniplanar compact–electromagnetic bandgap (UC–EBG) and the Periodic UC–EBG (PUC–EBG) structures. The UC–EBG and PUC–EBG cell are used here to improve passband obtained in UWB region,also to improve the good out-of-band performances and the EBG structure to reduce the overall size of the filter.

KEYWORDS: Bandpass filter, electromagnetic bandgap (EBG), ultra wideband (UWB), wideband filter.

I.INTRODUCTION

The Ultra-wideband (UWB) technology is being reinvented recently with many promising modern applications. In particular, the UWB radio system has been receiving great attention from both academy and industry since the Federal Communications Commission (FCC) release of the frequency band from 3.1 to 10.6 GHz for commercial communication on applications in February 2002[1]. In an UWB system, an UWB band pass filter (BPF) is one of the key passive components to keep the spectrum of the signals to meet the FCC limits, or used in the UWB pulse generation and reshaping.

In such a system, an UWB filter is one of the key components, which should exhibit a wide bandwidth with low insertion loss over the whole band. In order to meet the FCC limit, good selectivity at both lower and higher frequency ends and flat group-delay response over the whole band are required .Over the last years, the design of wide and ultra-wide Bandpass filters is generating a great interest due to the fast development of broadband wireless communication systems. Traditional methods to implement ultra-wide bandpass filters usually introduce spurious bands .These undesired bands become an important drawback for ultra-wide bandpass filters performance due to their proximity to the pass-band of interest.

The recent research and development practical applications of EBG structures have improved realizing compact EBG structures filters. EBG structure recently is developed rapidly due to its unique properties to suppress the propagation of surface wave in microstrip filters. EBG structure is also known as a high impedance surface due to its ability to suppress the propagation of surface wave at the certain operational frequency. This structure is also has ability to block the effect of mutual coupling effect in array application.

II.FILTER THEORY

In designing a filter, the following important parameters are generally considered.

- Pass bandwidth
- Stop band attenuation and frequencies
- Input and output impedances
- Return loss
- Insertion loss
- Group delay

The most important parameters among the above is the amplitude response given in terms of the insertion loss Vs frequency characteristics. Let P_i be the incident power at the filter input, P_r is the reflected power, P_L is the power passed on to the load.

The insertion loss of the filter is defined by,

$$IL \text{ (dB)} = 10 \log (P_i/P_L) = -10 \log (1-|\Gamma|^2)$$

Where $P_L = P_i - P_r$, if the filter is lossless

and Γ is the voltage

reflection coefficient given by $|\Gamma|^2 = P_r/P_i$

The return loss of the filter is defined by

$$RL \text{ (dB)} = 10 \log (P_i/P_r) = -10 \log |\Gamma|^2$$

which quantifies the amount of impedance matching at the input port.

The group delay is important for the multi-frequency or pulsed signals to determine the frequency dispersion or deviation from constant group delay over a given frequency band and is defined by

$$T_d = [1/2\pi] * [d\Phi/d\omega]$$

Where Φ is the transmission phase.

III. PROPOSED EBG STRUCTURE.

The conventional EBG structure has a wide band-gap and compact nature. The inductor L results from the current flowing through the connecting via. The gap between the conductor edges of two adjacent cells introduces equivalent capacitance C . Thus a two dimensional periodic LC network is realized which results in the frequency band-gap and the center frequency of the band-gap is determined by the formula

$$\omega = 1/\sqrt{LC}$$

From above equation it can be seen that in order to achieve an even more compact EBG structure, the equivalent capacitance C and inductance L should be increased. But in the EBG design procedure, if the dielectric material and its thickness have been chosen, the inductance L cannot be altered. Therefore, only the capacitance C can be enlarged.

Below fig.1 shows the proposed EBG structures for filter design.

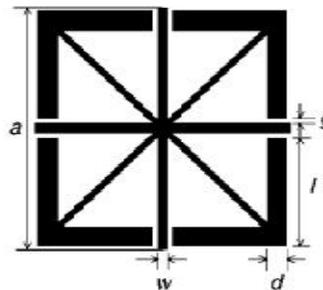


Fig 1. Proposed EBG structures

IV. DESIGN OF PROPOSED UWB FILTERS

In this proposed model two uwb band pass filter are designed and simulated also compared with performance of EBG Embedded Multi Mode Resonator BPF. All BPFs are fabricated with thickness of 0.635 mm on an RT/Duroid substrate

with a dielectric constant of 10.2 . The schematics of uniplanar compact–EBG (UC–EBG) structure and a periodic UC–EBG (PUC–EBG) structure are shown in fig 2. The inter digital coupled lines used in all BPFs have a coupling peak at the center frequency of 6.85 GHz. Simple EBG Embedded Multi Mode Resonator UWB BPF is also shown in fig 2. There simulation as been done using ADS Momentum simulator

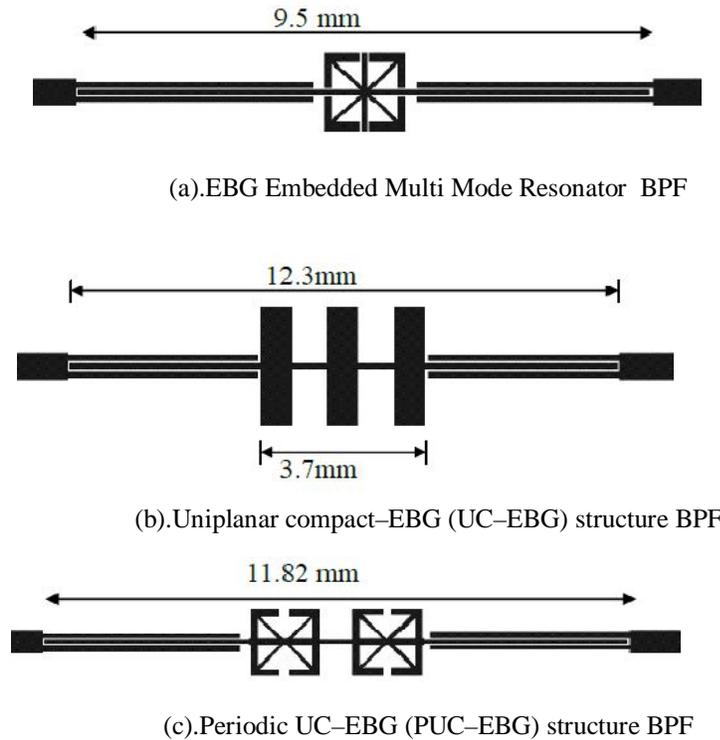


Fig 2. Schematics of proposed UWB filter.

V.SIMULATION RESULTS

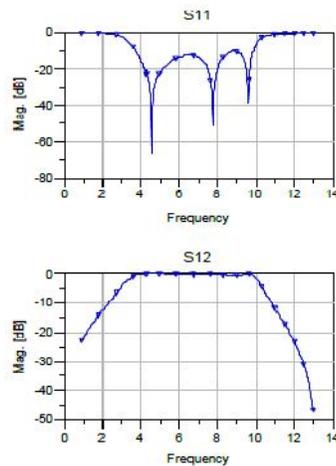
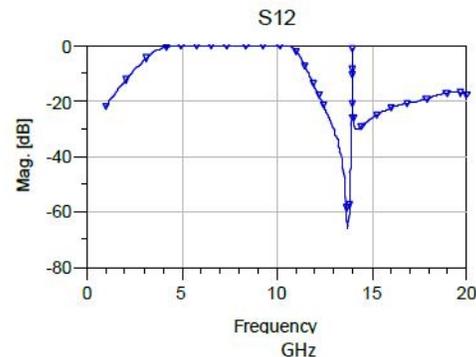
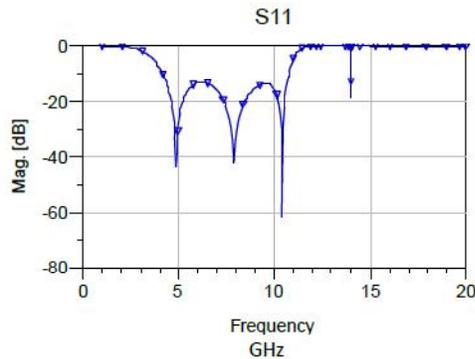


Fig 3(a).EBG Embedded Multi Mode Resonator BPF return loss and insertion loss



VII.CONCLUSION

In this, EBG structures are investigated and applied to UWB BPFs. The UC–EBG cell ,used here as improved passband obtained in UWB region,also improving the good out-of-band performances and the EBG structure to reduce the overall size of the filter. Compared with a simple EBG Embedded Multi Mode Resonator UWB BPF. There results have been compared by simulated using ADS Momentum simulator.

REFERENCES

- [1]FCC, Revision of Part 15 of the Commission’s Rules Regarding Ultra-Wideband Transmission Systems Federal Communications Commission, Tech. Rep. ET-Docket 98-153, FCC02-48, Apr. 2002.
- [2] H. Ishida and K. Araki, “Design and analysis of UWB bandpass filter,” in *Proc. IEEE Top. Conf. Wireless Comm. Tech.*, Oct. 2003, pp.457–458.
- [3] C.-L. Hsu, F.-C. Hsu, and J.-T. Kuo, “Microstrip bandpass filters for ultra-wideband (UWB) wireless communications,” in *IEEE MTT-S Int.Dig.*, Jun. 2005, pp. 679–682.
- [4] W. Menzel, M. S. R. Tito, and L. Zhu, “Low-loss ultra-wideband (UWB) filters using suspended stripline,” in *Proc. Asia-Pacific Microw.Conf.*, Dec. 2005, vol. 4, pp. 2148–2151.
- [5] K. Li, D. Kurita, and T. Matsui, “An ultra-wideband bandpass filter using broadside-coupled microstrip-coplanar waveguide structure,” in *IEEE MTT-S Int. Dig.*, Jun. 2005, pp. 675–678.
- [6] J.-S. Hong and H. Shaman, “An optimum ultra-wideband microstrip filter,” *Microw. Opt. Technol. Lett.*, vol. 47, no. 3, pp. 230–233, Nov.2005.
- [7] L. Zhu, S. Sun, and W. Menzel, “Ultra-wideband (UWB) bandpass filters using multiple-mode resonator,” *IEEE Microw. Wireless Compon.Lett.*, vol. 15, no. 11, pp. 796–798, Nov. 2005.
- [8]F.-R. Yang, K.-P. Ma, Y. Qian, and T. Itoh, “A uniplanar compact photonic-bandgap (UC-PBG) structure and its applications for microwave circuit,” *IEEE Trans. Microw. Theory Tech.*, vol. 47, no. 8,pp. 1509–1514, Aug. 1999.
- [9]Microstrip Filters for RF/Microwave Applications JIA-SHENG HONG,M. J. LANCASTER ,JOHN WILEY & SONS, INC 29
- [10]Application of Electromagnetic Bandgaps to the Design of Ultra-Wide Bandpass Filters With Good Out-of-Band Performance. IEEE TRANSACTIONS ON MICROWAVE THEORY AND TECHNIQUES, DECEMBER 2006
- [11]Recent Development of Ultra-Wideband (UWB) Filters IEEE 2007 International Symposium on Microwave, Antenna, Propagation, and EMC Technologies.
- [12] Electromagnetic Band Gap Structures in Antenna Engineering . FAN YANG,YAHYA RAHMAT-SAMII