Comparison of UWB Band pass filter and EBG embedded UWB Band pass filter

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ABSTRACT— The main objective of this project is compare UWB Bandpass filter and another UWB Bandpass filter based on electromagnetic bandgap (EBG) structures .Mainly the focus is on the compactness and performance of the filter design which will be compared with conventional wideband filter .In this EBG structure is investigated and applied to UWB BPFs. The UC–EBG cell is divided in four sectors with the cross line, and added with parallel coupled line to obtain a simple bandpass filter ..The performance of filter is compared by there insertion loss and return loss.

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

I. INTRODUCTION

Recently , there is an increased interest in ultra-wideband (UWB) technology for use in several present and future applications. UWB technology received a major boost especially in 2002 since the US Federal Communication Commission (FCC) permitted the authorization of using the unlicensed frequency band starting from 3.1 to 10.6 GHz for commercial communication applications [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 .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. OVERVIEW OF EBG STRUCTURES

Periodic structures are abundant in nature, which have fascinated artists and scientists alike. When they interact with electromagnetic waves, exciting phenomena appear and amazing features result. In particular, characteristics such as frequency stop bands, passbands, and band gaps could be identified.
Electromagnetic band gap structures are defined as artificial periodic (or sometimes non-periodic) objects that prevent/assist the propagation of electromagnetic waves in a specified band of frequency for all incident angles and all polarization states.
Electromagnetic band-gap (EBG) structures are periodic structures which can prohibit the propagation of electromagnetic wave in certain band of frequency. They can be embedded in the dielectric substrate or etched on the metal layers. The EBG structures are always used to help suppress the surface waves to gain good pass band or stop band.
There are two types of EBG structure to be discussed. Firstly is Perforated dielectric and the second one is Metallodielectric structures. Perforated dielectric is defined as effectively suppress unwanted substrate mode. This structure designed by drill periodic holes on dielectric subtracts to introduce another dielectric but in practical, this structure is difficult to implement. Metallodielectric structure is exhibits an attractive reflection phase future where the reflected field change continuously from 180 degrees to -180 degrees versus frequency.

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III.FILTER THEORY

Filter are two-port, reciprocal, passive, linear devices which attenuate heavily the unwanted signal frequencies while permitting transmission of unwanted frequencies. The practical filters have a small non-zero attenuation in the pass band and a small signal output in the attenuation or the stop band due to the presence of resistive losses in reactive elements and propagating medium.

FILTER PARAMETERS.
     In filter designing following important parameters are considered.
   1. Pass bandwidth
   2. Stop band attenuation and frequencies
   3. Input and output impedances
   4. Return loss
   5. Insertion loss
   6. Group delay.

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

IL (dB) $=10\log (Pi/PL)$ $= -10 \log(1-|\Gamma|^2)$
Where PL=Pi - Pr, if the filter is lossless
and Γ is the voltage
reflection coefficient given by $|\Gamma|^2 = Pr/Pi$
The return loss of the filter is defined by

RL (dB) $=10\log (Pi/Pr) = -10\log|\Gamma|^2)$
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
 $Td= [1/2\pi]*[d\Phi t/df]$
Where Φt is the transmission phase.

MULTIMODE RESONATOR FILTER
   A microstrip-line multiple-mode resonator (MMR) is used design UWB bandpass filter. At the central frequency of the UWB passband, i.e., 6.85 GHz, the MMR consists of one half-wavelength low-impedance line section in the center and two identical λ/4 high-impedance line sections at the two sides as shown below.
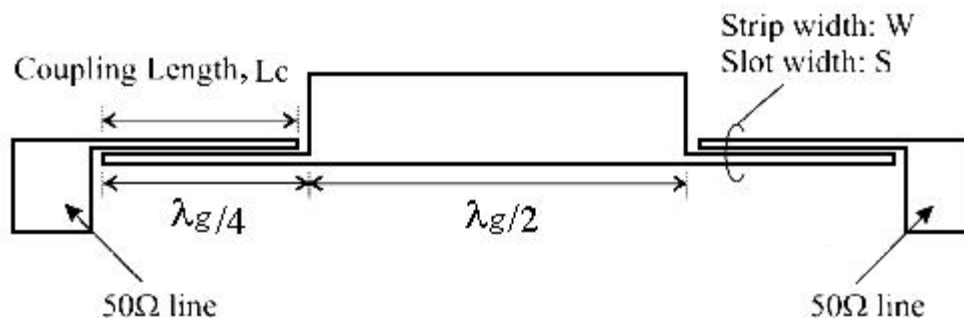

FIG 1

The MMR in the filter generates first and third resonant mode at the edges of the UWB pass band. The parallel-coupled lines are modified to obtain the ultra-wide pass band. This could be done by adjusting the coupling length, Lc.

Result obtained Within the UWB passband, the measured insertion and return losses are lower than 2.0 dB and higher than 10.0 dB, respectively.

In recent years conventional microstrip band pass filters such as stepped-impedance filters, open-stub filters, semi lumped element filters, end- and parallel-coupled half-wavelength resonator filters, hairpin-line filters, interdigital and combine filters, pseudo combine filters, and stub-line filters are widely used in this parallel-coupled half-wavelength resonator filters are taken in consideration along with EBG structure based filter.

IV. 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 .
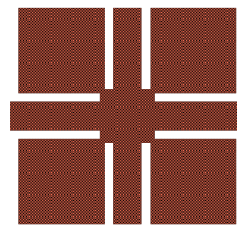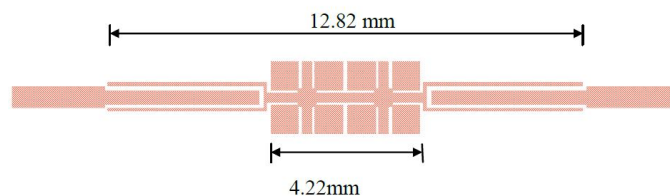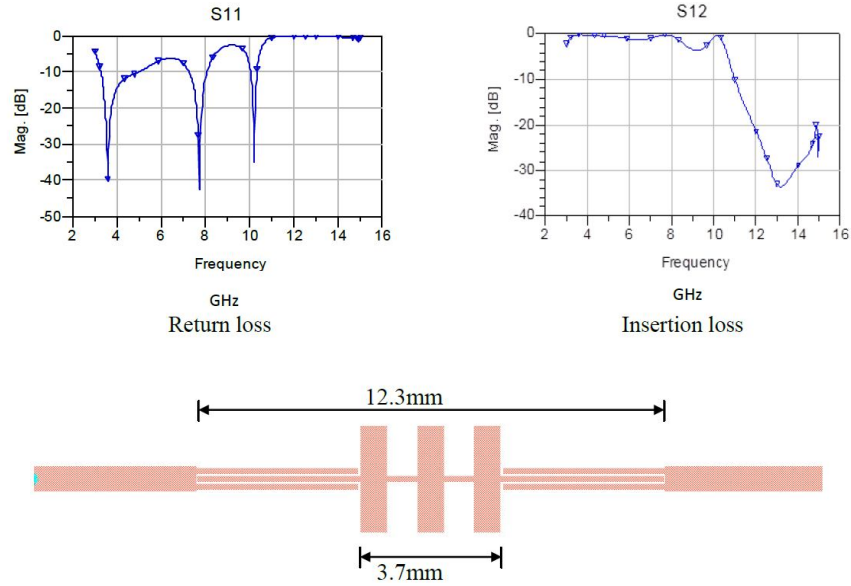Below fig.2 shows the proposed EBG structures for filter design.

Fig.2. **UC- EBG**

V. SIMULATION & RESULTS

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 BPF. All BPFs are fabricated with thickness of 1.27 mm mm on an RT/Duroid substrate with a dielectric constant of 10.2 . The schematics of uniplanar compact–EBG (UC–EBG) structure shown in fig 3. The inter digital coupled lines used in all BPFs have a coupling peak at the center frequency of 6.85 GHz. There simulation as been done using ADS Momentum simulator

Uniplanar compact–EBG (UC–EBG) structure BPF

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S11 Return loss

S12 Insertion loss

EBG Embedded Multi Mode Resonator and result.

12.3mm

3.7mm

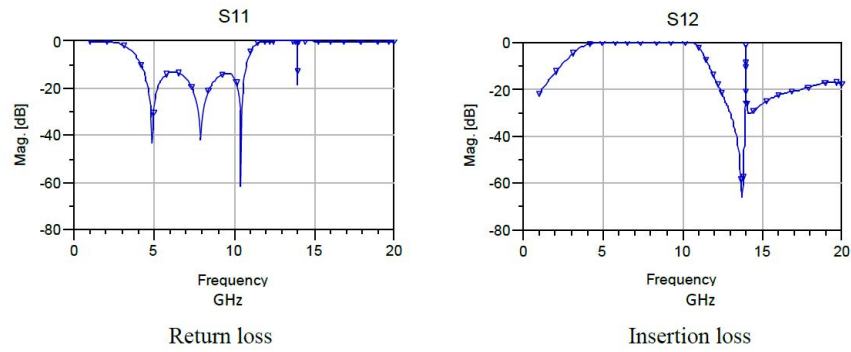S11 Return loss

S12 Insertion loss

Fig-3

VI. PERFORMANCE COMPARSION OF DIFFERENT EBG STRUCTURE FILTER:

For Frequency range between 3.1 to 10.6GHz

EBG structures	Insertion loss dB	Return loss dB	Length of the filter mm
UC-EBG	Less than 2dB	More than 7dB	12.82mm
EBG-Embedded MMR	0dB	More than 13dB	12.3mm

Table 1

VII. CONCLUSION & FUTURE WORK

In this, two UWB BPFs with EBG structures are investigated and simulated.. There results have been compared by simulated using ADS Momentum simulator .The future work is towards improving the good out-of-band performances

and other EBG structure to reduce the overall size of the filter. Also to improve the performances of EBG by using defected ground plane.

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