

SIW Based Band Pass Filter In Ku-Band Using Rogers/RT duroid 5880 As Substrate With Circular Post

Rishi Nigam

Research scholar

*Department of Electronics and Communication Engineering
National Institute of Technology Agartala
Agartala, Tripura, India*

Prakash chaurasia

Research scholar

*Department of Electronics and Communication Engineering
National Institute of Technology Agartala
Agartala, Tripura, India*

Manik bhowmik

Assistant professor

*Department of Electronics and Communication Engineering
National Institute of Technology Agartala
Agartala, Tripura, India*

Abstract— In this paper novel bandpass filter is developed using substrate integrated waveguide cavity with circular post etched on waveguide surface. Siw is a arrangement of two parallel periodic row of vias which touches with upper and lower metallic layers of substrate. In this paper we have used Rogers/RT duroid 5880 as Substrate material with dielectric constant =2.2 and loss tangent = 0.009. In this minimum insertion losses is better than 1db and return losses is better than 25 db. The filter has been designed and simulated using HFSS 3D simulation software. The figure of SIW with inductive post resonates at 12.09 GHz. Return loss (s11) at 12.09 GHz is -24.2 dB, Bandwidth 230MHz, voltage standing wave ratio (VSWR) 1.13 and (s21) is above -10 db from 12GHz to 12.23GHz. The structure has excellent selectivity characteristics which make it useful for ku band .

Keywords—Microstrip antenna, frequency selective surface superstrate.

Introduction

In today's world if we have to draw any filter so it has many complex geometrical structure in such a way SIW(substrate integrated waveguide) has been very promising design. The SIW is synthesized in dielectric substrate with parallel periodic rows of metallic vias [1][2]. SIW components inherit the advantages of rectangular waveguide such as high factor,

low insertion loss, high power capability. This scheme is also feasible for designing ridged waveguides in low-temperature co-fired ceramic. The SIW components such as filters, multiplexers, antennas, and power dividers have been studied by researchers. Such immense research advancement shows that the SIW can be used in the design of microwave and millimeter-wave integrated circuits with very promising performance. In this paper SIW filter with circular inductive post is studied[3]. In this SIW filter with circular inductive post is influenced by lengths of cavities and diameter of circular post which delimit the cavities of filter[4].

Design technique and parameters

Circular post is represented by diagram consisting of two equivalent capacitance X_s and self X_p .

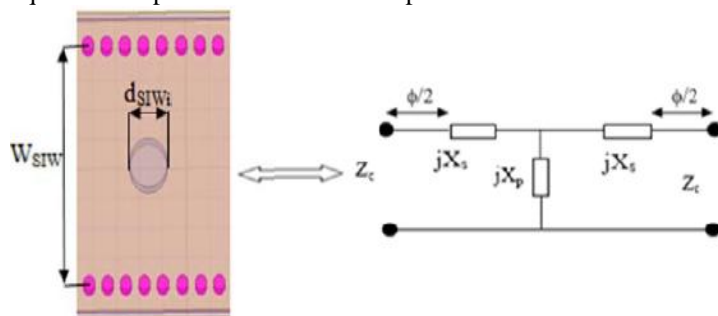


Figure 1 Equivalent ckt diagram of circular post

Where W_{siw} is the width of the waveguide d_{siw} is the diameter of circular post. The diameter of circular posts is determined by equation (2)[6] and abacus of estimated diameter in rectangular waveguide. The length l_{siw} the resonators are determined by equation (1)[5].

$$L_{siwi} = \frac{\lambda_{g0} \phi_i}{2\pi} \quad 1 \leq i \leq n \quad \dots 1$$

$$\left| \frac{X_{i,i+1}}{Z_0} \right| = \frac{K_{i,i+1}}{1 - \left(\frac{K_{i,i+1}}{Z_0} \right)^2} \quad \dots 2$$

In this design circular post also called as inductive post have been etched on the SIW surface with two ports on the either sides port1 and port2. Then this design is simulated in HFSS V-13.

Here d_{siw} is diameter of small circular post. D_{siw} is diameter of big circular post. W_{siw} is the width of waveguide. r is the radius of vias. h is the height of substrate. s is the spacing between two adjacent vias.

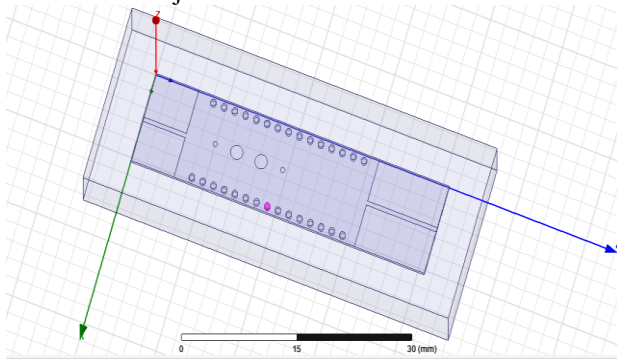


Figure 2. SIW filter with circular inductive post.

s	Spacing between two vias	1.5mm
---	--------------------------	-------

Results

S11 parameter

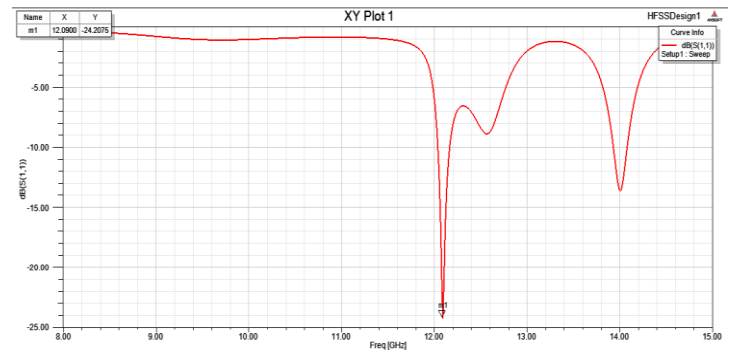


Figure 3 S11 parameter

Proposed structure resonates at 12.09 GHz. Return loss at 12.09 GHz is -24.20 dB. Bandwidth is 230MHz.

VSWR

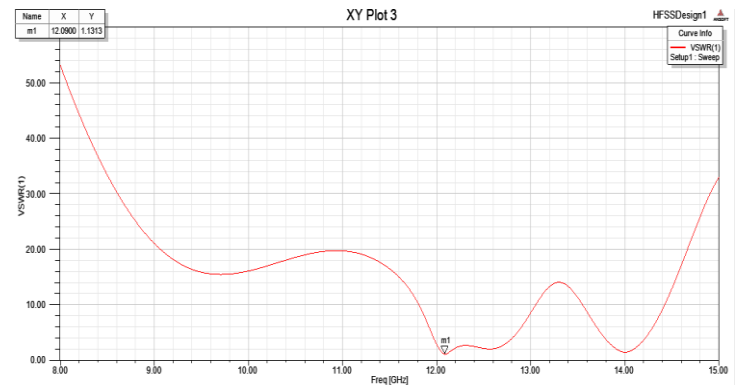


Figure 4 VSWR

From Figure 4. it can be seen that VSWR ratio is 1.13 at 12.09GHz.

d_{siw}	Diameter of small circular post	0.6mm
D_{siw}	Diameter of big circular post	1.64mm
W_{siw}	Width of waveguide	8.98mm
r	Radius of vias	0.375mm
h	Height of substrate	0.787mm

S21 Parameter

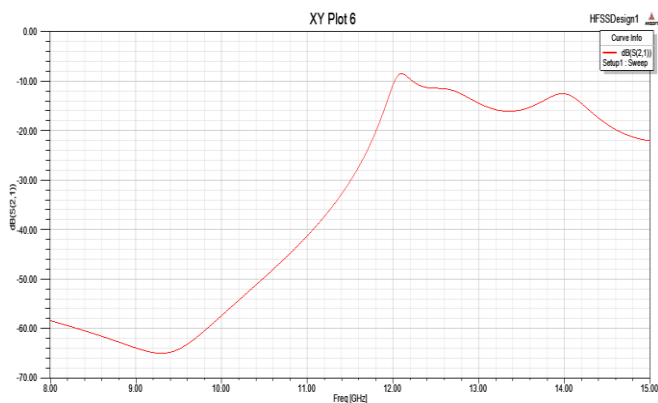


Figure 5 S21 parameter

It can be seen from fig.5 that S21 parameter is above -10dB from 12GHz to 12.23GHz.

Discussions

Based on the results it can be seen that bandwidth which we get by knowing the frequency at which S21 curve cuts the -10 db point Which is 12 GHz at the rising edge and 12.23GHz at the falling edge by which it can be seen that band pass SIW filter passes the frequency with bandpass range of 230 MHz.

Conclusion

It can be concluded that the bandpass filter which has been designed by SIW filter has bandwidth of 230 MHz. It is the pass band of the filter. This bandwidth can be concluded from the results that is S21 and S11 parameter. This pass band is in the Ku-band which is in the range of 12 -18 GHz.

References

1. Hsu, H. J., M. J. Hill, R. W. Ziolkowski, and J. Papapolymerou, \Aduroid-based planar EBG cavity resonator filter with improved quality factor," *IEEE Antennas Wireless Propag. Lett.*, Vol. 1, 67-70, 2002.
2. Simpson, J. J., A. Ta'ove, J. A. Mix, and H. Heck, \Computational and experimental study of a microwave electromagnetic bandgap structure with waveguiding defect for potential use as a bandpass wireless interconnect," *IEEE Microw. Wireless Comp. Lett.*, Vol. 14, No. 7, 343-345, Jul. 2004.
3. D.Li, C. Tong, J. Bao, P. Peng, and D. Yu," A novel bandpass filter of substrate integrated waveguide (siw) based on s shaped EBG", *Progress In Electromagnetics Research Letters*, Vol. 36, 191-200, 2013.
4. A. Rhbanou , S. Bri , "Design of Substrate Integrated Waveguide Pass Filter at [33-75] GHz Band", Ahmed

Rhbanou et al. / International Journal of Engineering and Technology (IJET)

5. D Zelenchuk, V Fusco," Low insertion loss substrate integrated waveguide quasi-elliptic filters for v-band wireless personal area network applications," *IET microwaves , Antennas and propagation*, vol-5 no.8, pp.921-927,2010.

6. W-Fi Yeo, T-yoon seo,tae w.lee and c.sikcho."H-plane sectoral filtering horn antennae in PCB substrate using via fences at millimeter -waves " *proceedings of the 37th European microwave conference* , PP 818-821,2007.