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Design a Substrate Integrated Waveguide IRIS Band Pass Filter in CST Software

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Abstract:-*A rectangular waveguide is known as a property handling low loss and low energy waveguide. However, since the structure is large, it is difficult to manufacture at low cost with a flat structure.So we invent a new technique which is called Substrate Integrated Waveguide (SIW) is introducing. In line with these limitations in the design of microwave components, a rectangular waveguide was incorporated into the microstrip substrate. SIW is one of the most common and complicated techniques so far because it is easy to incorporate a conventional rectangular waveguide into a conventional printed circuit board (PCB). The SIW rectangular waveguide consists of a dielectric substrate by placing two separate metal walls designed with metal bars. The ground level and the substrate layer are also metal, and the traditional metal rectangle leaves most of the waveguide advantages.Many types of filters are using to design SIW structure. In this paper, we propose an improve X and K band pass IRIS filter designed in CST and simulated for satellite communication environment.*

Key word: SIW, IRIS, Band pass filter, CST, K band

1. INTRODUCTION

Substrate Integrated waveguide (SIW) has a waveguide structure have two parallel metal panels are connected by two layers of integrated metal conductors. The rows of metal tracks form side walls. This relatively new architecture features microstrip and waveguide properties. Its manufacturing process is similar to other printing structures. A typical geometric shape is shown in Fig. 1 (ie, a passage through a lateral hole), the diameter of the hole in d and the length of the step (p) are the most important in the design of the SIW. Next section, It should be noted that the dominant pattern is TE10 as a rectangular waveguide. Substrate Integrated waveguide (SIW) designed with SWI is an integrated waveguide structure, and two parallel metal plates are connected by two rows of buried metal buffer paths. The rows of metal tracks form side walls. This relatively new architecture features microstrip and waveguide properties. Its manufacturing process is similar to other printing structures. The SIW is shown in Figure 1, where the width (i.e. the lateral as pacing), the diameter of the hole through and the length of the step are more important in the SIW design. The relationship between fc frequency and size a and b of AFWG and DFWG is the starting point of SIW. For AFWG (see Figure 1), the pattern cut frequency is given by the following formula

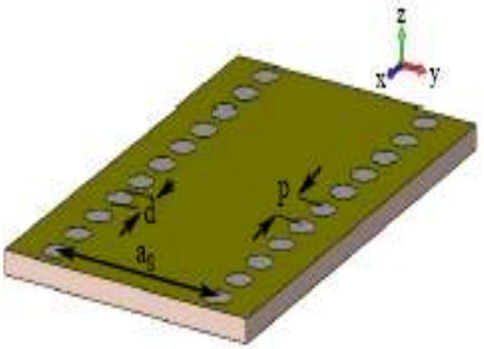


Fig 1. Basic Design of SIW

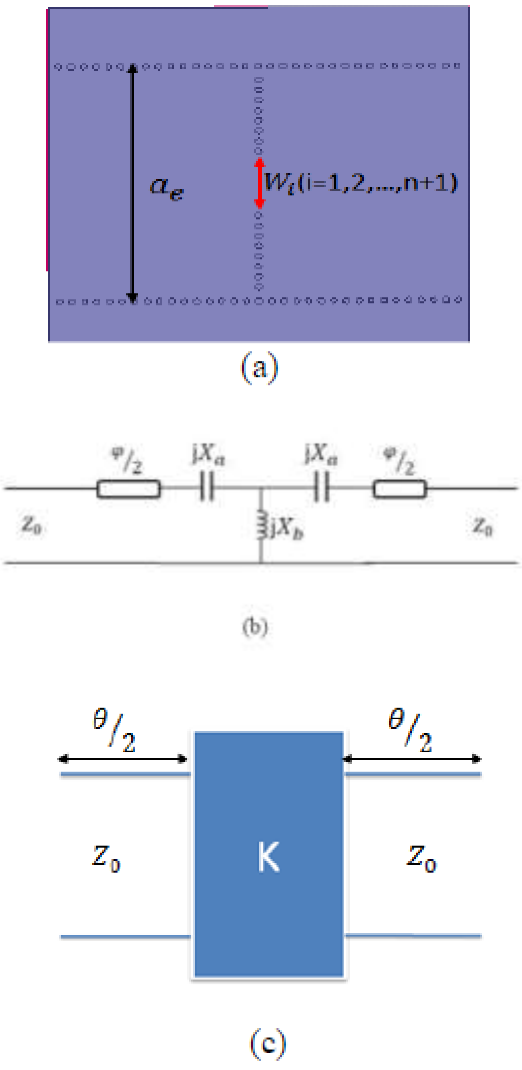
$$f_C = \frac{C}{2\pi}\sqrt{\left(\frac{m\pi}{a}\right)2+\left(\frac{n\pi}{b}\right)2}\text{………………}(1)$$

Where c is the speed of light in free space, m and n are state numbers, a is the higher and b is the lesser dimension of this waveguide. Equation 1 is simplified because it needs to operate in dominant TE10 mode

$f_c = \frac{c}{2a}$ for AFWG

2. IRIS BANDPASS FILTER

The SIW structure is achieved by two metal methods that are periodically incorporated in an insulating substrate. Because of these metal layers surrounding the SIW, the pattern spreads only to this structure. The most important landmark is the distance between the adjacent road and its diameter. For these unique values of p, λ ,c and λ or c is the structure of the integrated wave substrate that has the equivalent behavior as a rectangular waveguide, and its radiation loss is almost negligible. Breakouts are generally applied to the guide structure of the router and waveguide filters can be applied. However, due to manufacturing process limitations, the only way to manufacture SIW interactive components is to create fully empty cavities and padded metal sheets, or to form models of upper and lower metal planes. Therefore, capacitive blocking can not be generated with a single layer SIW structure. Figure 1 - a shows one of the interoperable breaks in the SIW structure. This filter is called an iris filter. Iris illumination in the symmetric display sensor window (= 1, 2, ...) and longitudinal resonance (= 1, 2, ..., + 1) is integrated during these interruptions. The relationship between resonances is controlled by the viewing distance of the iris cutting.



(a)

(b)

(c)

Fig 2. (a) Illumination of SIW structure, (b) Equivalent circuit of iris diaphragm in SIW structure, (c) Iris deflection equation circuit using SIW structure

According to the number (1-c), these tariff functions interconnecting SIWs function as resistors. Thus, the process of designing SIW filters using Iris interrupts reduces the detection of the characteristic impedance of inverters and the width of the display between symmetrical metal walls. The measured impedance impedance characteristics of a band pass filter with a Chebyshev frequency response is

$$\Delta = \frac{\grave{A}g1-\grave{A}g2}{\grave{A}g0}$$

$$\frac{K_{D,1}}{Z0} = \sqrt{\frac{\pi}{2}\frac{\Delta}{g0g1\Omega}}$$

$$\frac{K_{f,f+1}}{Zo}\ \mathrm{I\ i{=}1to\ n{-}1} = \frac{m\Delta}{2\prod}\frac{1}{\sqrt{g1g2+1}}$$

$$\frac{K_{m,n+1}}{Z0} = \sqrt{\frac{\pi}{2}\frac{\Delta}{g0g+1\Omega}}$$

$$\grave{A}_{go} = \frac{\grave{A}g1+\grave{A}g2}{2}\ldots\ldots\ldots\ldots\ldots\ldots(2)$$

In (2), g_i's is the value of the low pass filter component. By Chebyshev's reaction, Δ is the relative bandwidth. The waveform wavelength is the measured low-pass frequency, and the characteristic impedance of the transmission line and is the wavelength that is directed to the upper and lower ways of the frequency band filter. Once the characteristic impedance value of the resistance impedance is determined, the physical length of the lumen resonance can be calculated as described below.

$$\frac{X_{j,j+1}}{z_0} = \frac{\frac{ki,j+1}{z_0}}{1-\left(\frac{k_{i,j+1}}{z_0}\right)2}$$

$$\emptyset_t = \prod-\frac{1}{2}\left[\tan^{-1}\left(\frac{2x_{j-1j}}{z_e}\right)+\tan^{-1}\left(\frac{zx_{i,j+1}}{z_e}\right)\right]\mathrm{Li} = \frac{\emptyset,\grave{A}go}{2x}\ldots\ldots(3)$$

Fig 2(b) shows the equivalent T circuit of this interrupt. Their component values are dependent on frequency, magnitude, and the position of the iris. The parameters of the T circuit are derived from the following equation .

$$\emptyset = -\tan^{-1}(2X_P+X_x)-\tan^{-1}(X_x)$$

$$jX_x = \frac{1-5_{22}+5_{31}}{1-5_{33}+5_{32}}$$

$$jX_p = \frac{2S_{12}}{(1-S_{11})2-S_{12}S_{12}}\ldots\ldots\ldots\ldots\ldots\ldots(3)$$

After determining the physical parameters of the iris wave filter by the equations (2) - (3), the equivalent SIW parameter is calculated as .

$$L_{sjw}=L+\frac{d^2}{0.95p}$$

$$a_{sjw}=a_e+\frac{d^2}{0.95p}\ldots\ldots\ldots\ldots\ldots\ldots(4)$$

3. Proposed IRIS Bandpass Filter

SIW bandpass filter iris design (one X band, the other in the K band), which εr = 9.8, the loss tangent of 0.002 and have a thickness of 0.254. Steep dielectric constant material is used to obtain small size filters. Figure 3 illustrates the K-band filter. Once the waveguide has been inflated, filter waveguide iris parameters (using the design equations) are determined. dimensions of the waveguide SIW to scale with the size, and the scale factor used to modify the width and length of the window between the iris of the iris, the iris can be performed in such a way that the SIW implementation filter. Then, the final value of the key parameter (for example, window width iris (indicated by Fig. 3 along the length of the longitudinal direction between the iris SIW Optimized for optimal performance with CST MWS. Figures 3 show the K band filter CST MWS model. Li and filter parameters and wi game and key parameters wt and Lg.

The final parameters of the manufactured filter are listed in Table 1, for the K band filters. In addition to these parameters, the width of line 50 is 22 thousandths of an inch, each having of metal of diameter 16 thousand and the separation between the 28 thousandths of an inch through holes. It must be taken into account that these parameters are measured from the center of the through hole. Both filters have 5 sections of cavity (between 6 sections of iris), so they are 5th order filters. Finally, the southwestern microwave has a 2.92 mm final emitter connector.

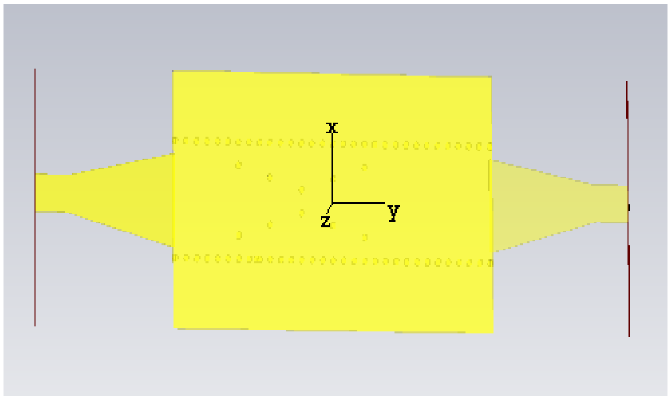


Figure (3). CST MWS model for the SIW iris filter at K band

Table (1). Dimension of the K-band iris filter

Parameter	Length	Parameter	Length
MetalThick	0.035	width	5
diaThick	0.254	y	Pitch*30
dia	0.3	x	Width+6
Pitch	0.6		
p	1.5		

The measurement and simulated s11 graph of the designed filter is obtained by CST as illustrated in Figure (4).

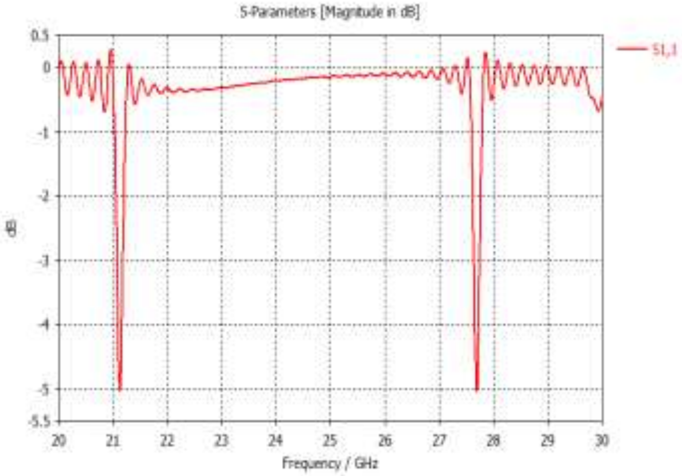


Figure 4. S11 graph of SIW band pass filter

4. Discussion and Conclusion

Purposed Waveguide iris bandpass Filter structure is designed with SIW technology and designed at K-bands. Measurement and simulation s11 and s12 results are draw in CST Software. Then, using IRIS based bandpass Filters that are available in the literature are investigated and similar results with the ones reported in the literature are obtained. Having investigated these filter structures in the literature, a novel SIW bandpass filter topology is proposed by replacing the resonators in reverse geometry that has named interdigital structure of the configuration. Simulation and fabrication results agree well with each other and it shows that this filter can be successfully used in microwave applications for satellite communication.

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