SHODH SANGAM -- A RKDF University Journal of Science and Engineering

A Comprehensive Analysis of Microstrip Filter:-Review

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Abstract - Wireless transceivers and other wireless communication facilities have become more and more important in the field of microwave and radio frequency communication in recent years. The microwave filter is one of the most crucial components in wireless communication systems. In communication systems, microwave filters are essential for allowing desired frequency bands to flow through while blocking undesirable ones, such as noise interference signals. The locations of the wireless transceiver system's microwave filters in general. It is desirable to design high-performance multi-standard filters with small sizes, low in-band insertion loss, and high out-of-band rejection skirts. Due to their innately higher order resonant modes, high-order BPFs like dual band, triple band, and quad band BPFs have the advantages of smaller size, low loss, and good design feasibility.

Keywords- Microstrip Filter, wireless communication and Band Pass Filter.

I INTRODUCTION

Bidirectional frequency conversion is possible. A low-pass, high-pass, band-pass, or band-stop filter might be a useful filter. Frequency conversion can be used to convert it into a low-pass prototype. It can obtain the normalized component values of the low-pass filter via complete designs, and the practical filter's normalized component values through a second time frequency conversion. Under the assumption of equal attenuation, this transform is a frequency transform since only the horizontal ordinate, which represents the frequency value, is converted and the vertical ordinate, which describes the attenuation value, is not.

Frequency conversion between the low-pass prototype and low-pass filter Figure 1 illustrates the attenuation characteristics of the practical and prototype low-pass filters, with frequency variables ω' and ω, respectively. In order to do frequency transforming, the attenuation must stay constant and the points at frequencies ω=0, ω, ωs, ∞ must match to the points at frequencies ω' =0, 1, ωs', ∞. The formula for the frequency transform is:

$$\omega' = \omega / \omega c \qquad (1)$$

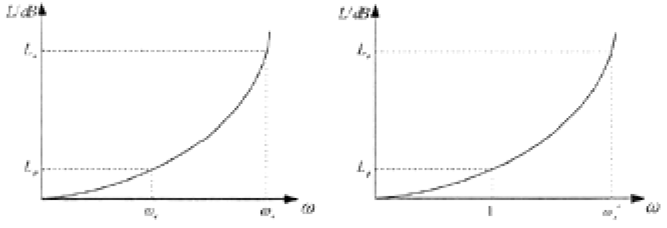

Figure 1. Practical/prototype low-pass filter frequency response curve

The actual values of the components are [1] when equal attenuation circumstances and the signal source's inversely normalized internal resistance Rg are used.

$$\begin{cases} L_k = L_k' R_g = \dfrac{g_k}{\omega_c} R_g \\ C_i = \dfrac{C_i'}{R_g} = \dfrac{g_i}{\omega_c R_g} \end{cases}$$

An inductive input low-pass prototype filter and its matching real-world low-pass filter are depicted in Figure 2. Analyses of capacitive input circuits may likewise be conducted using the aforementioned techniques.

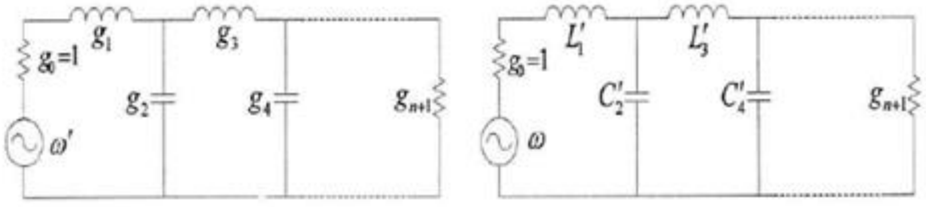

Figure 3. A prototype low-pass filter with inductive input and the matching low-pass filter in practice

II TRANSFORMATION OF FREQUENCY Over THE LOW-PASS With HIGH-PASS FILTER

Assuming that the prototype low-pass filter's frequency variable is ω and the practical high-pass filter's frequency variable is ω', Figure 4 depicts the attenuation characteristics of both filters.In order to do a frequency transform, the points at frequencies ω =0, ωc, ωs, and ∞ must match the points at frequencies ω' =-∞,-1, -ωs, and 0 with equal attenuations. The formula for the frequency transform is:

$$\omega' = -\omega_c / \omega \quad (3.24)$$

Utilize inversely normalized internal resistance Rg of the signal source and equal attenuation circumstances; the actual values of the components are:

$$\begin{cases} C_k = \dfrac{1}{\omega_c g_k R_g} \\ L_i = \dfrac{R_g}{\omega_c g_i} \end{cases}$$

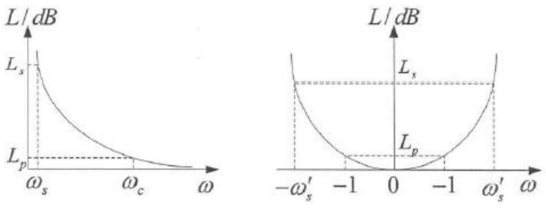

Figure 4 Realistic/prototype frequency response curve for a high-pass filter

Figure 5 demonstrates a high-pass prototype filter for inductive input and the matching practical high-pass filter. The studies described above may also be used to analyze circuits with capacitive input.

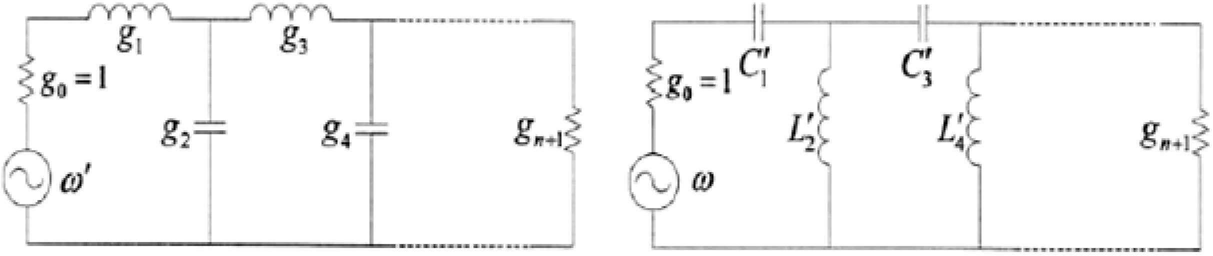

Figure 5. A prototype low-pass filter with inductive input and a matching high-pass filter that is useful.

III. LITERATURE REVIEW

An enhanced equivalent circuit parameters extraction technique for the dumbbell-shaped defective ground structure was presented in a work by Y.C. Guo [1]. S11 and S21 are contained in closed-form formulae that provide the new extraction parameter equations. When compared to traditional techniques, the suggested method yields frequency response curves that are more accurate and may be applied broadly to DGS design and analysis.

A study titled Combined Shaped Microstrip Line and DGS Techniques for Compact Low-pass Filter Design was published in 2013 by Abdalla Abdulhadi [2]. The filter properties are improved by the employment of stub matching and inset feed methods. The suggested filter is made up of a shaped microstrip line on top and two U-shaped DGS units at the ground plane.

Abdalla Abdulhadi also published "Combined Shaped Microstrip Line and DGS" [3] in the same year. Figure 6 illustrates the paper's structure. Two equilateral U-shaped DGS units and one inverted U-shaped DGS unit make up the DGS, which has a stronger attenuation for high frequency harmonics. In order to provide more attenuation in the stopband, the shaped microstrip line is composed of three parallel double stub sections with varying widths and two sections of microstrip line with varying widths. These portions also enable impedance matching control for the input and output ports.

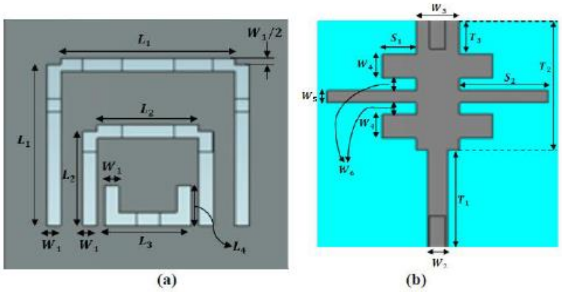

Fig 6. An explanation of the transmission line's size (b) and the DGS unit (a) in [3].

Due to the similarities between substrate integrated waveguide (SIW) structures and traditional rectangular waveguides, SIW technology uses the majority of planar (H-plane) waveguide components. Comparing this method to traditional waveguides, it is often possible to achieve significant component weight and size reductions. Additionally, SIW components have no packaging or radiation issues and have losses that are lower than those of similar microstrip devices. A nice middle ground between microstrip lines and air-filled rectangular waveguides is provided by SIW components.

SIW technology has been thoroughly investigated in recent years as a potential solution. In 2003, Ke Wu unveiled the substrate integrated circuit, a novel idea in optoelectronics and high frequency electronics [3]. This approach also includes Substrate Integrated Non Radiating Dielectric (SINRD) and Substrate Integrated Slab Waveguide (SISW) guide circuits in addition to SIW. The foundation of the SIW structure consists of planar dielectric substrates that have arrays of metalized via holes punched through their top and bottom layers. SIW uses conventional printed circuit board (PCB) technologies to offer affordable waveguide filters [4]–[6]. Comparing SIW to traditional waveguides, SIW is smaller and easier to combine with other microwave and millimeter-wave circuits on the same substrate. The top and bottom metal planes of a substrate and two parallel arrays of via holes, often referred to as via fences, in the substrate make up the construction.

Researchers have presented a number of SIW band-pass filter designs for X-band applications in recent years, each based on a distinct technique. Y. L. Zhang created the SIW triangular cavity compact band-pass filter in 2005 [7]. With a 2.4 GHz center frequency, the design filter was based on the coupling matrix synthesis technique. Based on the discretization of a structure's border, Shahvirdi (2010) designed a four pole Chebyshev X-band dual inductive post SIW filter using the contour integral approach [8]. Compared to the full wave approach, it requires less memory. Square vias were used in favor of circular ones to shorten the computation time. These square vias have the same centers as the circulars.

X.Zou (2011) proposes the conversion of a band-pass filter to its standard rectangular wave guide band-pass filter equivalent [9]. The waveguide filter design features a distinct skirt characteristic.

The symmetric window SIW filter has a 5% bandwidth of 3 dB between 9.77 and 10.27 GHz in its design. About 1.4 dB is lost during insertion, and more than 20 dB is lost on return.

IV. CONCLUSION

In the stream of microwave and radio frequency communication, wireless transceivers and other wireless communication facilities have grown in importance in recent years. One of the most important parts of wireless communication systems is the microwave filter. Microwave filters are crucial to communication systems because they let desired frequency bands pass through while obstructing unwanted ones, such noise interference signals. The basic placements of the microwave filters in the wireless transceiver system. strong-performance multi-standard filters with strong out-of-band rejection skirts, low in-band insertion loss, and compact sizes are preferred. High-order BPFs, such as dual band, triple band, and quad band BPFs, offer the benefits of reduced size, low loss, and superior design feasibility because of their naturally higher order resonant modes.

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