A Review paper on Microstrip Bandpass Hairpin Filter

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Abstract- Band pass filters are essential part of any signal processing or communication systems, the integral part of superhetrodyne receivers which are currently employed in many RF/Microwave communication systems. At Microwave Frequencies the discrete components are replaced by transmission lines, for low power applications microstrip are used which provide cheaper and smaller solution of Band Pass Filter. This article is an effort to document the designing steps of a micro strip Band Pass Filter. The specific design discussed in the article in detail is know as Parallel Coupled Filter. In this article an example of a filter specs is given over which a filter is designed by using certain tools.

Keywords-ADS, Edge coupled, Microstrip filter, RF, Bandpass.

I. Introduction

RF filters operating in the microwave spectrum have a range of applications, including wireless handset and base stations, as well as satellite receivers and military applications. Recently published papers investigating RF filter design reveal a need for ongoing development. These filters operate in an increasingly crowded signal spectrum. They may operate in harsh environments subject to shock, vibration, and extreme temperatures. The industry experiences continuous pressure to improve performance while reducing the size and cost of the filters and their associated systems. Improvements in the electrical properties of available materials are helping meet these demands. PCB materials with higher dielectric constants yield smaller filter structures. More importantly, filters using materials with high quality factor will have proportionally less midband signal loss. As a result, smaller, higher performance filters are becoming easier to design.

II. Review

Jagdish shivhare and S.B.jain [1] Explained multi-fold hairpin filter at 1400 MHz communication system .This paper presents the design, simulation, optimization and test results of a new class of a 4-pole multi-fold hairpin line micro strip resonator filter. This design presents reduction in size and moderate selectivity compared to the conventional hairpin line resonator filters for L/S band communication systems. In this Paper they have not

fabricated their design so actual result may vary with simulated result also they did not give any information about the substrate they used in the design. Filter is designed on Agilent ADS software. The best part of there design is compactness.

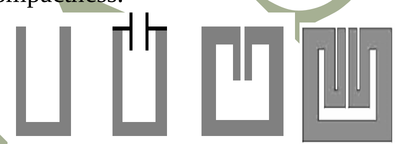


Fig.2.1 Compact hairpin configurations [1]

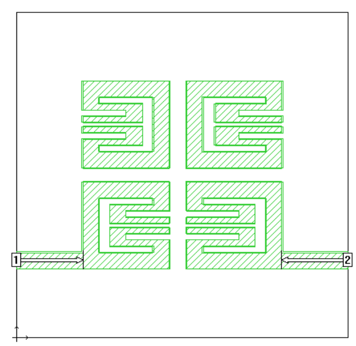


Fig 2.2: Multi-fold hairpin line band pass filter.

Due to multifold the size of the filter significantly reduces as in fig. 2 .The response of the filter is shown in fig.3.

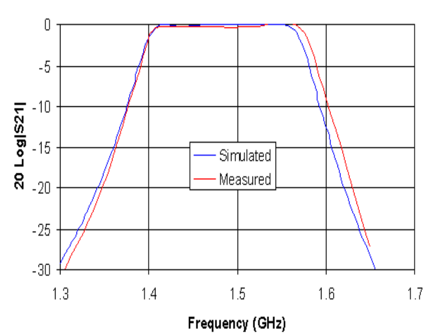


Fig. 2.3 Simulated and measured response of the multi-fold band pass filter [1]

Cheng-Yuan Kung [6] explained a compact dual-band band pass filter which is designed to operate at 2.4/5.2 GHz without any input/output impedance matching. Design is compact then conventional hairpin filters. Simulation is completed using IE3D.

K.vidhya and T. Jayanthi [2] Explained design of microstrip hairpin band pass filter using defected ground (DGS) structure and open stubs. In this design they explained 5 pole chebyshev hairpin BPF is designed using dumbbell shape DGS and open stubs. Two pairs of DGS structures are etched under the input and output feed lines of proposed filter to reduce the spurious frequencies. This filter is designed with ADS software. Authors introduce a new technique to suppress harmonics.

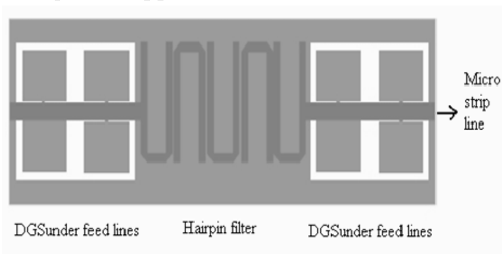


Fig 2.4 Layout DGS assisted microstrip B.P. Filter [2]

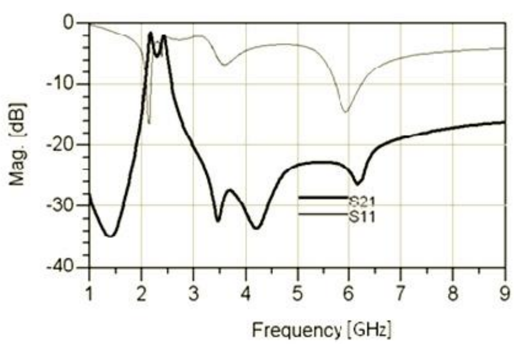


Fig 2.5 Simulated output of microstrip B.P.F using DGS [2]

The dumbbell shaped DGS gives wider stop band. This property of DGS is used for suppression of harmonics. The stop band can be widened by increasing the number of DGS units or cells.[2]

In Fig 4 Layout of band pass filter is given with DGS. Fig 5 shows results that by using DGS improved suppression is achieved at the third harmonic frequency.

Chih-Ming Tsai [7] proposed a method for tuning the transmission zeros of 0" feed structures by using impedance transformers. Transmission zeros can be adjusted to reject unwanted signals near the passband. In this paper second-order Butterworth hairpin filters with Different feed structures is designed.

S.I.Hong, S.W.Fok [3] and team explained a novel wiggly-line hairpin filter with 2nd spurious passband suppression. In this design wiggly-line filter based on the strip-width modulation reformulation is proposed to suppress the spurious passband at the second harmonics of the operating frequency. This wiggly-coupled line H-BPF equates the odd-mode and even-mode phase velocities such that the second spurious harmonics can be suppressed. In order to verify the practical performance of this novel filter structure, two prototype microstrip filters at 900MHz are designed and experimentally characterized. A small change in the design gives significant change in the results as we can see in Fig.7

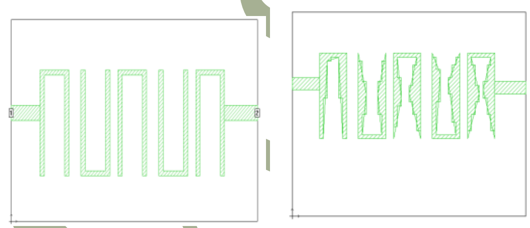
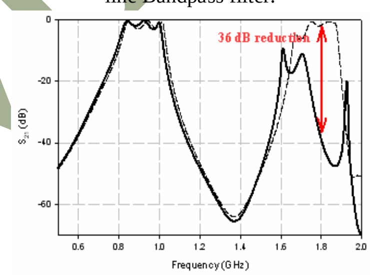
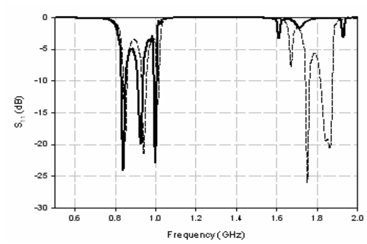


Fig 2.6 a) Conventional hairpin Bandpass filter, (b) hairpin wiggly-line Bandpass filter.



(a)



(b)

Fig. 2.7. (a) Simulated |S21| and (b) |S11| parameters for a Conventional hairpin Butterworth band pass Filter (dashed Line) and a "wiggly-line" H-BPF (thick solid line). [3]

Kamaljeet Singh, R. Ramasubramanian, and S. Pal [4] Explained Simple Methodologies for Improved Characteristics filters designed at 1.24 GHz with bandwidth of 10%. To improve insertion loss they used tapering .It also gives better alignment. The size of the hairpin cards is 50 mm by 32 mm. The harmonics are suppressed better than 20 dB in the proposed filters. Fig 8 shows layout and Fig 9 shows results of the proposed filter.

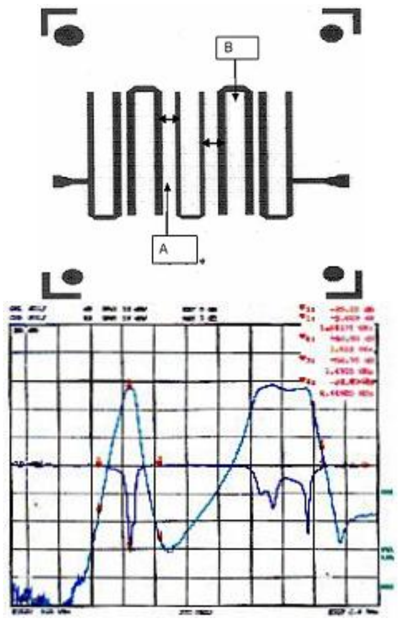


Fig 2.8 a) Hairpin Modified Topology [4] b) Measured Results[4]

Homayoon Oraizi [8] gives design of a microstrip hairpin filter providing harmonic suppression and impedance matching between source and load impedances. In this paper a multilayer structure is proposed for effective suppression of spurious response. 1.

A. A. Suleiman, M. F. Ain1, S. I. S. Hassan [5] and team Explained Design of Hairpin Band Pass Filters for K-Band Application. Filters are operated at K-Band frequency segment of 20 – 20.3 GHz. The filters were designed using Genesys software and implemented on Roger 5870 substrate. The results from simulation and measurement show that filter is operating at the desired specification. This paper provides simple method to design 3 and 4 element hairpin band pass filter. Fig 9 and Fig 10 shows layout and results of 4 element hairpin filter. 2.

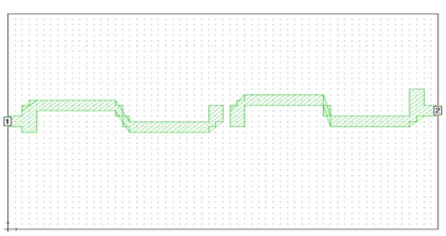


Fig 2.9 layout of Hairpin filter [5]

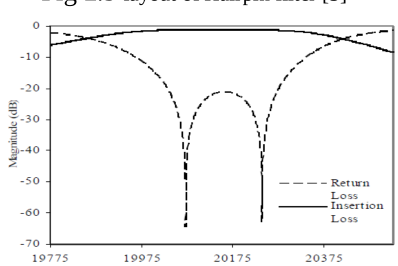


Fig 2.10 Responses of filter with four elements [5]

III. Conclusion

From this review, it is understood that efforts are going on to overcome some of the limitations of conventional microstrip hairpin Filters. This review work is done on some critical issues like compactness implemented through different techniques and spurious passband suppression. From this review it is observed that authors have either worked on compactness of the filter or either to suppress spurious losses or harmonics but no one include these two issues in one design hence, the author feels that further research is seriously needed in this area.

IV. References-

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Professor Rajeshwar Lal Dua a Fellow Life Member of IETE and also a Life member of: I.V.S & I.P.A former “Scientist F”(Deputy Director) of the Central Electronics Engineering Research Institute (CEERI), Pilani has been one of the most well known scientists in India in the field of Vacuum Electronic Devices for over three and half decades. His professional achievements span a wide area of vacuum

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He was awarded a degree of M.Sc (Physics) and M.Sc Tech (Electronics) from BITS Pilani. He started his professional carrier in1966 at Central Electronics Engineering Research Institute (CEERI), Pilani. During this period, indigenous know how was developed for several types of fixed frequency and tunable magnetrons of conventional and coaxial type. He headed the team for the production of specific Magnetrons for defense and transferred the know how to industries for further production. He also has several publications and a patent to his credit.

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