A Review Paper on Compact Micro Strip Filters Design to an Advanced Wireless Communications for Smart Cities

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Abstract— The main purpose of the proposed work is to design and implementation of L and S-band compact reconfigurable dual-mode band-pass filters using Hybrid Microwave Integrated Circuits HMIC which is useful in advanced wireless communication for the smart city. The advanced wireless communication systems require cost effective, high Q, and compact blocks with high performance. Microwave filters are the basic building blocks with frequency-selective or filtering functionality in the development of various wireless systems that operate at frequency ranges above 300 MHz, Filter block play a key role in effectively transmitting the desired signals in certain pass-band regions while attenuating all the undesired signals in the remaining band-stop regions.

Key words: Compact Micro Strip Filters, Wireless Communications

I. INTRODUCTION

Recent advances in modern wide-band radar and wireless communication applications demand high performance, reconfigurable, and compact RF subsystems. Therefore, much attention has been devoted for compact reconfigurable microwave devices. These trends impose stringent requirements on the passive and active filters directed at these applications. Specifically, the development of efficient methods for tunning both the center frequency and bandwidth of the filter response should be one of the main goals. Tunable-bandwidth microwave filters are especially useful for the design of high-frequency multifunction receivers supporting multiple information signals with different frequency-bands.The dual-mode micro strip filters are attractive due to high selectivity characteristics and can be used as a doubly tuned circuit and, therefore, the number of resonators required for an n-degree filter is reduced by half resulting in a compact filter configuration. Selected shapes of the existence dual-mode filters that could be electronically reconfigured will be studied through this research.

Micro strip is a type of electrical transmission line which can be fabricated using printed circuit board technology, and is used to convey microwave-frequency signals. It consists of a conducting strip separated from a ground plane by a dielectric layer known as the substrate as shown in the fig 1.1. Microwave components such as antennas, couplers, filters, power dividers etc. can be formed from micro strip. Micro strip transmission line consists of a single ground plane and a thin strip conductor on a low loss dielectric substrate above the ground plate. Micro strip is predominantly used in printed circuit board. It is used as frequency selective devices at higher frequency.

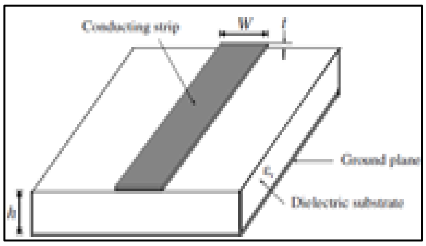

Fig. 1.1: Micro Strip Structure

At radio frequency the reactance of the lumped component filter varies with respect to frequency. So, lumped component filter is replaced with equivalent micro strip filters. It can operate in wide range of frequency, lightweight, ease of fabrication and integration and cost effective. The importance of the micro strip filters can be seen by the graph shown below in fig 1.2;

A. *Micro Strip Filters Publications*

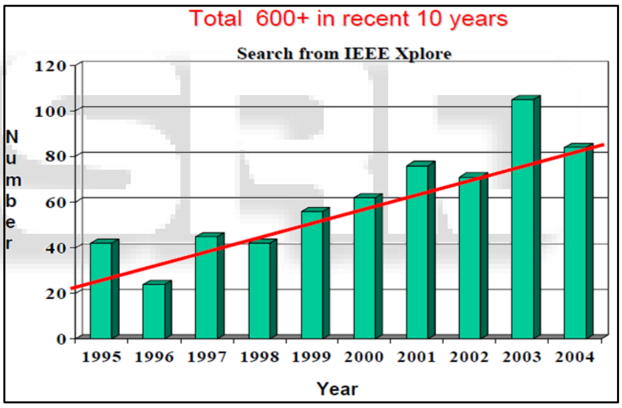

Fig. 1.2: Survey on Micro Strip Filters

II. RELATED WORKS

In [1] a miniaturized 7.35 GHz BPF is designed and tested and the size: substrate thickness (0.508 mm) and micro strip size (19.7 µm2), respectively. EM simulations are used and the designed BPF is fabricated on Rogers 5880 with a substrate thickness of 0.508 mm. The limitations of [1] is, it is not cost effective because of the Rogers 5880 material, this technique is not going to reduce the size of the filter at lower frequency range, the Band width is around 250MHz which is not satisfactory. The size and shape is as show in the fig.2.1

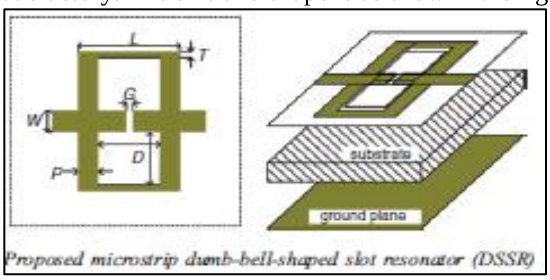

Fig. 2.1:

In [2] a compact micro strip wideband band pass filter with BW of about 1000MHz has been designed and size is of 20 mm×16.55mm, this is a compact structure when the length of the feed lines is ignored. Electromagnetic simulation software is utilized and the wideband band pass filter was fabricated on the Rogers RT/duroid 5880 substrate. Limitations of [2] is, It is not cost effective similar to the [1], Size is not reduced much, Even though this is giving 1000MHz Bandwidth this structure is not suitable for handheld communication systems or high power systems. The shape of micro strip is as shown below in fig 2.2.

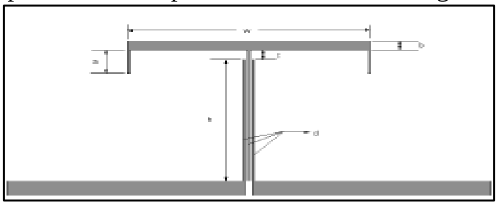

Fig. 2.2:

In [3] the is Size: 33.8mm x 2l.1mm, operating at 250MHZ at central frequency 6.45GHz and EM Simulation tool and network analyzer are used as shown in the fig.2.3. Limitations: bandwidth is very less for wireless Communication systems.

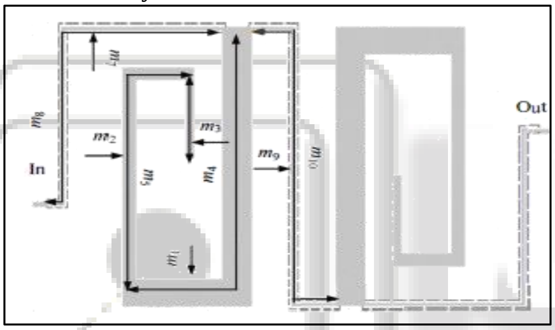

Fig. 2.3:

In [4] the size is 15.3mm x 9.9mm I.e. 64% more compact compared to regular open loop filter Which is 37% more than “Dual mode micro strip open loop resonators and filters” by J.S. Hong, Shaman in 2007.MAT Lab program, EM simulation, fabrication on RT duroid 5880 are used and 3db Bandwidth is ≈ 380MHz as shown in the fig.2.4 Limitations are similar to [1] and [2] i.e., it’s not Cost effective because of the Rogers 5880 Material, this technique is not going to reduce the size of the filter at lower frequency range and is not satisfactory.

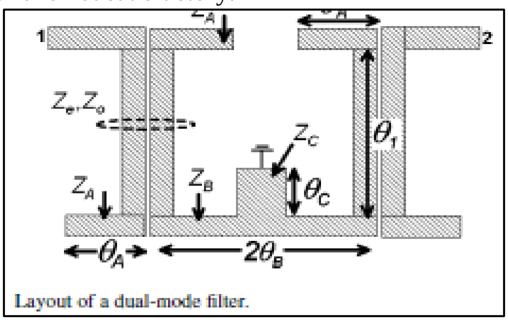

Fig. 2.4:

In [5] is Based on a unique E-shape micro strip structure and it is a compact and highly selective seventh-order UWB band pass filter which is developed for small wireless communication systems as shown in the fig. 2.5. This highly selective UWB band pass filters offers ultra-wide stop band attenuation. This filter composes of six grounded middle stub E-shape micro strip structures connected in cascade using short sections of the micro strip line as shown in the fig 7. The filter structure boosts reduced number of vias achieved by folding back the consecutive middle stubs in opposite direction. The proposed filter is smaller than 4.3 mm × 10 mm × 0.4 mm excluding the feeding ports. The theoretical and measured responses of the filter show excellent agreement.

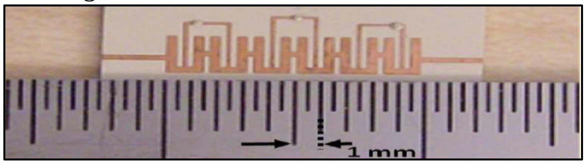

Fig. 2.5:

The [6] is a novel technique to synthesize microwave filters by inverse scattering. It provides an exact solution for the synthesis problem, by means of a closed-form expression, with very low computational cost. This technique is valid when the target frequency response can be expressed as a rational function. The coupled-mode theory is used to model microwave propagation along the filter, and therefore, the synthesis technique is applicable to filters implemented in a wide range of technologies, such as planar and non-planar transmission lines, and many waveguides. The synthesis method is exact for all the frequency range of interest, preventing the degradation of the frequency response that can be troublesome for wideband applications or to satisfy the out-of-band requirements of the filter. The resulting synthesized filter is, in general, a non-uniform transmission line or waveguide that features a continuously varying smooth profile, avoiding the presence of sharp discontinuities and their detrimental effects.

The [7] presents the design of low pass filter by taking into account the transverse resonance phenomena. It is an excellent method for the design of filters with stringent requirements like sharp cut off frequency and wide rejection bandwidth. Cut off frequencies of the designed low pass filters have been selected between 2.5 GHz and 5GHz to cover the most of the wireless communication bands. Sharper LPF can be designed by choosing the transverse resonance near the cut off and wide rejection stop band can be achieved by selecting the transverse resonance around 2 times of cut off. Proposed design method gives both sharper and wide stop band LPF.

In [8] presents a design methodology of compact composite low pass filter using defected ground structure (DGS). Performance of the composite LPF using DGS is compared with the micro strip line LPF. DGS based composite LPF is much sharper than the micro strip line LPF, while the rejection bandwidth of the micro strip line based LPF is larger than the DGS based LPF. Size of DGS based LPF is 40% smaller than the micro strip line LPF. A composite LPF has been designed using micro strip line and DGS. The sharpness of cut-off of the DGS based composite LPF is large as compared to the micro strip line LPF. The rejection bandwidth of the micro strip line based LPF is more. Size of the DGS based composite LPF is 40% smaller than the micro strip line LPF.

In [9] A novel, broadband, via less, and vertical micro strip- to-micro strip transition is proposed. The transition consists of two open-circuited micro strip resonators and a U-shaped resonant-slot on the common ground plane as shown in the fig.2.6. A physics-based equivalent-circuit model is developed for interpreting its working mechanism and facilitating the design process. The transition is analogous to a three-pole resonator filter. Based on the equivalent-circuit model, the coupling coefficients of the physical circuit can be calculated from the group delay information of two segregated electromagnetic models. To effectively control the couplings, a modified configuration is also proposed. A prototype transition is designed using the proposed design formulas. The fabricated circuit is measured to validate the proposed transition and the equivalent-circuit model. Good agreement is obtained between not only the measured and the simulated performance, but also the designed and the extracted-circuit model. In addition to the wide bandwidth, the features of via less and easy fabrication make the novel transition very attractive for system-on-package applications.

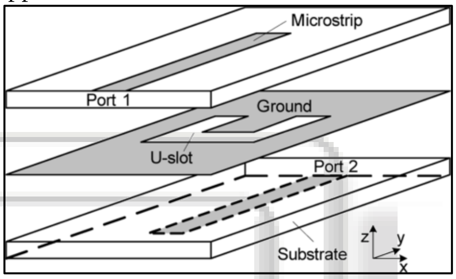

Fig. 2.6: Basic Physical Structure of the Proposed Transition

In [10] inter digital micro strip coupled-line band pass filter is proposed for millimetre-wave application. A quadruple-mode micro strip-line resonator is designed to constitute the pass band. Inter digital coupled-line sections are designed as the input/output network of the resonator. Meanwhile, sharp selectivity of the pass band is achieved. As design examples, the in-band and out-of-band performances of a filter prototype using low-cost single-layer micro strip-lines has been designed and experimentally examined. The measured results show that the filter achieves a pass band insertion loss of 1.07 dB at 40 GHz, the lower- and upper-stop band rejections are larger than 18 dB and 3 dB fractional bandwidth is 20%. The filter is fabricated on a single layer PCB using low-cost micro strip-line technology. Measured results show 1.13 dB insertion loss at 40 GHz, which is very small at such high frequency and the fractional bandwidth achieved is 21%.

III. METHODOLOGY

Steps followed to achieve the proposed work as follows:

1) Step 1: Analysis of the compact band-pass filters based on dual mode resonators.
2) Step 2.Selection of appropriate configurations that could be reconfigured.
3) Step 3: Analysis and design of the selected configurations.
4) Step 4: Simulation of the designed band-pass filters using ADS/ IE3D simulator.
5) Step 5: Implementation of the designed band-Pass filters & Experimental characterization using HP Network Analyzer.
6) Step 6: Comparison between theoretical and Experimental results.

A complete design flow of ADS software is shown below in the fig 3.1;

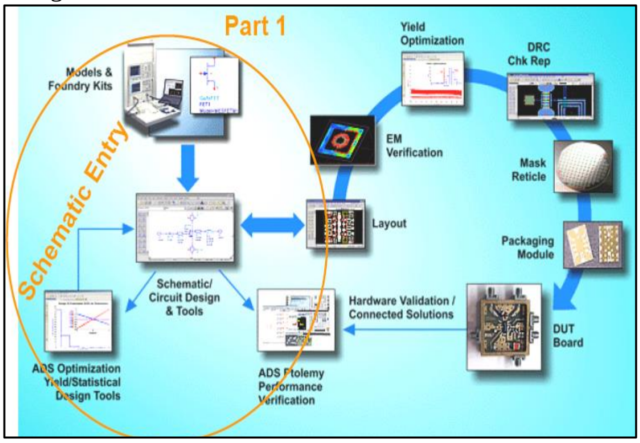

Fig. 3.1: Advanced Design Software (ADS)

A. *Design Flow*

1) *Possible Outcome*

A Compact size micro strip filters are developed for hand held communication systems one of the examples as shown in the diagram below Fig 3.2.

Fig. 3.2: Example of usage of Compact Filter

IV. CONCLUSION

In case of handheld communication systems, space is the most important parameter. For this purpose compact filters are required, hence the proposed work is to reduce the size of the micro strip filters without affecting the original parameters of the experimental filters. The dual mode micro strip filters are attractive due to high selectivity characteristics and can be used as a doubly tuned circuit; therefore the number of resonators required for an n-degree filter is reduced by half resulting in a compact filter configuration which can be used for advanced wireless communications in the smart cities.

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