Design And Analysis of Coplanar Waveguide Resonators using Short ended and Open Ended series stub

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ABSTRACT
This research proposed and simulated the coplanar waveguide (CPW) which is serially connected short circuit series stub resonator (SCSSS) and serially connected short circuit and open circuit series stub resonator (SCSOSS). The CPW is an alternative to microstrip and stripline. The Coplanar waveguide has ground and the signal on a same layer. The single layer is divided into three parts like two ground layer and center layer. The CPW resonator is placed on the center layer of the design, which helps to reduce the radiation loss. Series stubs are connected to the center layer based on the higher order butterworth filter. The simulation results gives the sharp repeated attenuation pole and minimum transmission zeros.

Keywords: CPW resonator, Series and shunt stub, ADS software

I. Introduction.
Coplanar waveguide is a type of planar transmission line used in Microwave integrated Circuits(MICs) as well as millimeter wave circuits. The Unique feature of this transmission line is that it is uniplanar in construction, which gives that all of the conductors are on the single side substration. This unique features simplifies production and allows fast and inexpensive characterization using on wafer techniques. The CPW has the advantages over the micstrip line (1) easy to fabricate (2) It makes easy shunt and series surface mounting of active and passive devices[2] – [6]. (3) It eliminates the need for wraparound and via holes[2] – [7]. (4) Low radiation losses[2]. The first coplanar waveguide was fabricated on a dielectric substrate in 1969 by C.P.Wen[1]. So the coplanar waveguide is an alternative to microstrip and stripline.

CPW resonator proposes a series of short and open ended stub with transmission zeros near the resonant frequency. This would improves the performance in the design of uniplanar filter structures. By designing the combination of the more series stub which are directly etched within the strip and/or ground would give the resonance with transmission zeros. One more advantage of connecting the series stub is capable of adjusting the reactance slope parameter that is needed for filter. The CPW resonators is implemented in Full Ground Coplanar waveguide to obtain the desired frequency response. This resonators will be useful in the future enhancement.

II CONVENTIONAL CPW SERIES STUB RESONATOR

Fig 1.(a – d) demonstrates the transmission line models of the conventional short- ended λ/2 and open- ended λ/4 series stub resonator and its realization in coplanar waveguide. The reactance – slope parameters of two kind of resonators are ...

\[ X = \frac{\pi Z_s}{2} \]  \hspace{1cm} (1)

And \[ Z_s, \]

\[ X = \frac{\pi Z_s}{4} \]  \hspace{1cm} (2)

Here \[ Z_s \] is the characteristic impedance of the stub line. To achieve a greater external Q-value, \[ Z_s \] is required to have a greater value. Though, the high impedance limit is controlled by the width of the slot. It can be etched in the strip and also the radiation loss occurred. So the bandwidth of the designed filter is constrained.
The stub resonator, the proposed resonator results shows that the resonator design is more compact. The parasitic radiation losses. While designing the series stub resonator, the parasitic radiation losses should be minimized. The stub resonator design should optimize the geometry configuration in order to minimize the radiation losses. The optimization occurs only when the slots etched in the two conductors are electrically in phase. To measure the radiation efficiency, connect 50Ω load in one port and simulate with full wave simulator. The results shows that the serially connected stub resonator has 20% radiation efficiency at resonant frequency with large radiation loss in half wavelength. The proposed design shown in fig. 2(b) reduces the radiation loss into 1%. This is achieved only because of the lengthy resonators has been folded. And also passband insertion loss has been reduced. The resonator design is more compact.

The proposed resonator is designed and simulated using ADS software. The design is having the dimension of 18.4mm x 16.5 mm. The substrate used is FR4 having thickness of 1.6mm
and its dielectric constant is 4.4. The simulated results are shown in fig 3(a) and(b). In fig. 3(a) shows the passband for serially connected short circuit series stub resonator ranging from 3.3GHz to 4.3GHz. And the return loss is 24dB. Similarly, the passband for serially connected open circuit series stub resonator is forming between 1.3GHz to 4.1GHz, and the return loss is 23dB

Fig. 2 (a)-(b) Possible CPW implementations of proposed resonators

Fig. 3(a) simulated results of SCSSS resonator

Fig. 3(b) simulated result of SCOSS

V CONCLUSION

CPW resonators using serially connected short circuit and open ended circuit series stub are designed and analysed using ADS software. This kind of resonator is very much helpful for further development of bandpass filter for good selectivity. By using the reactance slope parameter, the resonator can adjust the bandwidth for any desired applications. The CPW resonators are getting periodic passbands with repeated attenuation poles and minimum number of transmission zeros. Without the complexity of the structure, the attenuation poles can be obtained. This resonator structure will have more application in bandpass filters.

References