DESIGN AND PERFORMANCE OF COPLANAR WAVEGUIDE SLOTLINE BANDPASS FILTER

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ABSTRACT

This paper describes the work involved in designing a coplanar waveguide - slotline bandpass filter. The filter designed to achieve at least -30dB insertion loss ($S_{21}$) in the stopband (8 to 8.5; 9.3 to 10 GHz) and less than -0.2 dB in the passband (8.75 to 9.05 GHz), with a centre frequency of 8.9 GHz. The filter and transition were fabricated on 1.27 mm thick RT-Duriod 6010.2 substrate and S-parameters were tested using standard SMA connectors with an HP-8510A network analyser.

INTRODUCTION

Many authors have dealt with the problem of developing a broad band transition from microstrip to slotline [1]-[3]. Some intuitive approaches to this problem have been presented with a reported bandwidth in the frequency range from 1 to 10 GHz. Coplanar waveguide (CPW) is an alternative transmission line that is truly planar and allows easy series and shunt device mounting. The radiation loss in the CPW odd mode is low for an open transmission line. These characteristics make CPW important for millimetre wave range and have aroused considerable interest microwave and millimetre wave integrated circuit design [4]-[5].
Previously end-coupled resonator bandpass filters have been realised in many guiding structures including conventional waveguide and coaxial lines, microstrip, stripline and finline. End-coupled resonant CPW filters were realised by cutting gaps in the inner conductor of the guide, by creating capacitively coupled resonant sections [6].

Low-loss wide band microstrip to slotline transitions have been reported in the literature. Schuppert [7], demonstrated that the transition from microstrip to slot line can be described by simple equivalent circuits even when dealing with broadband transitions incorporating nonuniform lines. These transitions offer good performance and are widely used for circuit design.

**DESIGN STRATEGY**

CPW allows the easy integration of series and shunt devices on a planar transmission line. Previous CPW bandpass filter [4] have used end coupled resonators. Although these circuits showed good performance, device mounting and biasing are difficult to incorporate. So that CPW resonators coupled via slotlines to create a CPW slotline bandpass filter.

The most basic design element of bandpass filter is the resonator. Resonator can be designed with a combination of open and short terminations. Due to the ease of device integration CPW resonators used with an open and a shorted end interconnected via slotline. Fig.1 shows the novel CPW slotline bandpass filter configuration. The microstrip to slotline transition used to test the filter.

The CAD package Touchstone used to develop the equivalent circuit and then to analyse and optimise the filters performance in order to meet the desired specifications. To minimise optimisation variables and form a symmetrical configuration, the lengths of the first and third resonators were made equal to each other. So the optimisation variables would now be \( L_{c1} \), \( L_{c2} \), \( L_{c3} \), \( L_{c4} \), \( L_{s1} \), and \( L_{s2} \), respectively.