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Ring Based Planar Crossover for Beamforming Networks

Jayakrishnan V M[a,*],Sreedevi K. Menon[b]

[a]*Amrita Center for Wireless Networks and Applications, Amrita School of Engineering, Amritapuri campus, Amrita Vishwa Vidyapeetham University, Kerala, India*
[b]*Department of Electronics and Communication,Amrita School of Engineering, Amrita Vishwa Vidyapeetham University, Amritapuri, India*

Abstract

A crossover maintains signal integrity when transmission lines overlap. In this paper, a microstrip patch is used to design the overlapping region thus providing desired isolation and transmission between desired ports. Square and Circular patch configurations for crossovers are analysed using ANSYS HFSS. The basic microstrip patch is further modified by introducing fractals enhancing the electrical length and improving the crossover characteristics.

*Keywords:*crossover;isolation;fractals;microstrip patch

1. Introduction

Microwave crossovers are passive devices that helps in maintaining the signal purity when transmission lines overlap. Crossovers are traditionally designed using wire bond or air bridges which are difficult to fabricate [1, 2]. Planar crossovers are highly preferred when there is importance in packaging, multichip circuits, and other planar subsystems. Planar crossovers were designed using microstrip lines with ring resonators or patch resonators [3, 4].

A typical crossover when two transmission lines overlap is shown in Fig 1. For signal purity, the overlapped region has to be modified thus providing isolation between adjacent ports and transmission between opposite ports.

* Corresponding author. Tel.: 9745303211;
E-mail address: aliaskrishna@gmail.com

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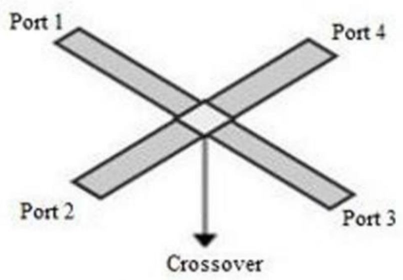


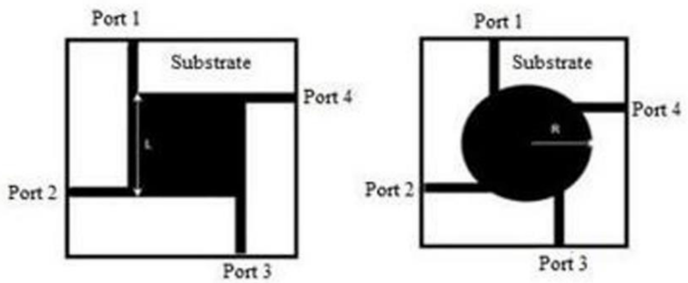
Fig. 1. Crossover.

A simple planar symmetric crossover with square patch is presented in [5]. This crossover can be designed using conventional patch antenna design. For improvement of characteristics Sierpinski gasket is found to enhance the crossover properties [6].

In this paper, the overlapped region is modified as microstrip patch. Both square and circular patches are analysed for crossover characteristics and is presented in following sections.

2. Design of Microstrip Patch Based Crossover

In the present study the overlapped region of the transmission lines is modified as microstrip patch - square and circular in geometry to provide desired isolation between the adjacent ports and transmission between opposite ports as shown in Fig. 2.The position of microstrip feed line decides the isolation provided by the patch based crossover. The feed location is selected in such a way that the adjacent ports transmits or receives orthogonal polarization, thus providing isolation between the ports. The opposite ports being in same polarization will transmit/ receive the signal between them. The designed crossover is symmetric and reciprocal and the feed lines are designed for 50Ω. So transmission is observed as $S_{13} = S_{31}$ and $S_{24} = S_{42}$ while isolation is observed as $S_{12} = S_{21}$, $S_{14} = S_{41}$, $S_{23} = S_{32}$, $S_{34} = S_{43}$.



(a) (b)

Fig. 2. Microstrip patch based crossover. (a)Square patch crossover (b) Circular patch crossover

The patches are designed using standard equations in [7] on RT Duroid 6010 with dielectric constant ε_r =10.2 and thickness, h = 0.64 mm. For square patch crossover, length, L and for circular patch crossover, radius R is designed for 2.45 GHz. The isolation obtained for both the designs presented in Fig 2 is -12 dB and -15 dB for square and circular patch respectively offering a transmission of 0.7 dB between opposite ports.

For further enhancement of isolation between adjacent ports, a ring shaped slot is introduced at the centre of the