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Miniaturized broadside 3-dB quadrature coupler using slow-wave effect

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ABSTRACT— A novel slow-wave broadside quadrature 3-dB coupler is presented. The proposed coupler miniaturises the effective occupied area to 73.54 % of the conventional coupler of its type. Operational bandwidth is 470-862 MHz for DVB-T applications. A good agreement between simulation and measurement results is shown.

KEYWORDS: Hybrid Coupler, Slow wave, DVB-T.

I. INTRODUCTION

A quadrature 3-dB coupler is a four port passive structure which is broadly used in microwave systems for dividing the incoming signal into two signals, equal in amplitude but having 90° relative phase difference. It could be used for combining signals as well. Different designs for improving the performance of quadrature couplers have been reported [1-4]. Basically all of the designs occupy a large area, because they normally use a λ/4 transmission line and therefore a lot of effort to miniaturize them recently.

In this letter, to miniaturize the effective area of the coupler an idea of using a slow-wave artificial transmission line (ATL) is proposed. In contrast to the conventional quadrature couplers presented in [1-4], the proposed coupler has a significantly shorter effective electrical length, while keeping the performance very good. Compared to other miniaturized designs using metamaterial, meander, and folded transmission lines [5, 6], which have some fabrication complexities, our design has a very simple topology and adds no complexity to the fabrication procedure.

In the following we present the design concept, the simulation and measurement results, and finally we conclude them.

II. CONCEPTUAL DESIGN

The structure of the proposed quadrature 3-dB coupler is shown in Fig. 1. It is fabricated on a two-layer printed circuit board. AD PIM 250 substrate with relative dielectric permittivity of 2.55, thickness of 1.575 mm, and the loss tangent of 0.0018 is used.

It comprises of a broadside coupled line with electrical length of much less than λ/4 due to slow-wave technique applied to structure, and four ports connected to the four ends of the broadside coupled lines. The longitudinal slot located at the centre of the broadside coupled