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Design and Development of Multi-Port Switchable Power Dividers

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Abstract

Microstrip line based two switchable power dividers are presented in this paper and these models are capable of power division control at four output ports. Here, power switching is implemented with terminating some open-ended stub-lines using varactor diodes and corresponding mathematical equations are derived. Proper DC voltages are applied for biasing the activator diodes and consequently to have appropriate stub-line terminations. For designing these power dividers, CST Microwave Studio is used here as the EM tool. The characteristics such as return loss, insertion loss and isolation have been explored from the simulation results followed by it's fabrication and measurement. Quite good agreement is achieved between the simulation and the experimental results. Much better performance characteristics make this proposed power divider a good candidate for various microwave systems where switchable power dividers are required.

Keywords:
switchable power divider, stub-line, varactor diode, junction capacitance, return loss, insertion loss

1. Introduction

Over the years, feeding networks or power dividers are one of the fundamental devices for microwave systems. Various novel designs have been implemented to solve certain design constraints in different applications. Frequency agile and controllable power division are features of modern power dividers [1, 2]. From literatures, it has been studied that reconfigurability in power dividers can be incorporated using various switches like PIN diodes [3, 4, 5], varactor diodes [6, 7], RF switches [8] and MEMS switches [9, 10].

For a dual state 2-way power divider, 1:0 power division is the first state while 1:1 [3], 1:3 [4] and 1:5 [5] are achieved in the second state. The model can operate at both states. In the first state, power division ratio is fixed and power is routed from the input port to one of the two sets of output ports in the second state. PIN diode switch is used to make that reconfigurable power divider. Again, based on adjusting the bias voltage, varactor diodes are utilized in a power divider for achieving power division [6]. In [7], another 1:2 switchable power divider is proposed where one varactor diode is used to tune the return loss of the input port and the other diode is utilized to tune the return loss of the two output ports and the isolation between those ports. A bi-directional power divider is designed for four operating modes using single pole double throw RF switches [8]. A five states power divider has been constructed where MEMS switches are used to reconfigure the model [9]. In that literature, a reflection-line phase shifter and two hybrid couplers are implemented for the power divider. Furthermore, the power division ratio of 6:1 is proposed for a state where the model is performed well with respect to port isolation and matching. A MEMS reconfigurable power divider is described in [10], where left/right-handed composite transmission lines are used to implement a T-shaped junction. The network shows dual-band nature and switching can be performed for achieving 1:1, 2:1, and 3:2 power division for both the operating bands.

Reconfigurable power dividers can be also utilized in antenna arrays [11, 12]. One reconfigurable 1x4 power divider having three states is used for beamforming in an antenna array [11]. Another such kind of reconfigurable power divider is discussed in [12]. In planar multiport power dividers, random power division ratio is possible with

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