Chapter 10
The Design of Ku Band SIW Slot Antenna Array Used for IoT Applications

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ABSTRACT

This chapter presents a brief description on the design of 1x1 rectangular slot antenna array at 30 GHz. The rectangular slots are etched off in the top layer of substrate-integrated waveguide (SIW) cavity. Antenna is designed in Ku band frequency for 5G IOT application. A prototype working at 30 GHz band was designed and simulated. Simulated results show that the prototype achieves a-16-dB impedance bandwidth from 29 to 31 GHz. The peak gain at broadside is 14.3 dBi at 30 GHz. The radiation pattern is stable within the operating bandwidth. Simulation is done in HFSS software tool.

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INTRODUCTION

Substrate Integrated Waveguide (SIW) technology has proven to be a promising alternative to conventional waveguide for the design of microwave and millimetre-wave circuits. In this technology, relatively low-loss and high-Q waveguide structures are realized in compact size, low-cost, and highly integrated planar structures. As the field pattern inside the SIW is similar to that of rectangular waveguide structures, the design of any SIW structure starts with specifying the waveguide width for the desired frequency band and substrate material. Longitudinal slots on the top metallic surface of the substrate integrated waveguide (SIW) is designed with 4 X 4 slots which acts as an antenna to radiate the power feed is M.S power divider return loss of the antenna is 9-11GHz (Yan & Hong, 2004). Single-layer SIW interconnects, including their transitions to micro strip lines. Design equation includes effective width is easily calculated here with d and p consideration. Tapper edge is used to feed this model (Rayas-Sanchez, 1998). The structure consists of an array of various shape slots antenna designed to operate in C and X band applications. The basic structures have been designed over a Rtduroid substrate with dielectric constant of 2.2 and with and thickness of 0.508mm Gain more than 9dB and return loss better than −10dB(Kachhia, 2015).The proposed work discusses SIW Slotted array antenna in Ku-BAND. Also, a comparative analysis between the corresponding S-Parameters is performed.

DESIGN OF SUBSTRATE INTEGRATED WAVEGUIDE

The proposed work uses Rogger 5880 substrate with dielectric constant 2.2 with a thickness of about 1.6mm. The fundamental parameters to design the SIW waveguide antenna are given below. The substrate integrated waveguide (SIW) is sort of a guided transmission line just like a dielectric filled rectangular waveguide. Its dominant mode cut-off frequency is same as TE_{10} mode of rectangular waveguide. The only difference is that the metallic walls are replaced by two parallel arrays of conductive via holes. The key parameters of SIW design are spacing between the vias “P” also called pitch, diameter of vias “D”, central distance between via arrays “A_r” also called integrated waveguide width, and the equivalent SIW width “A_e”.

The SIW parameters should be designed carefully. The pitch “P” and diameter “D” control the radiation loss and return loss, while the integrated waveguide width “Ar” determine the cut-off frequency and propagation constant of the fundamental mode (Kachhia, 2015). There are two design rules related to the pitch and via diameter as given by (Deslandes & Wu, 2003):