Abstract

This thesis presents a study of some novel Substrate Integrated Waveguide (SIW)-Inspired planar and 3D based geometries. The advantages of SIW have been efficiently used to model structures, both in the lower IEEE designated WLAN and WiMAX frequency bands; and higher bands such as the Ka band.

Miniaturization techniques such as those involving the use of quasi-magnetic wall for segmentation have been incorporated. The effect of fractal geometries and Complimentary Split Ring Resonators (CSRR) on such geometries have been investigated and further miniaturization and frequency tunability have been observed. Certain limitations associated with rectangular based geometries have been overcomed by the use of cylindrical shaped geometries, which has been shown to operate upto the 64^{th} mode geometry (structurally occupying 1/64 times the area of a Full Mode cavity), while operating at the same frequency. The ground plane has been engineered to achieve quasi-omnidirectional radiation characteristics from the antenna, while maintaining its modal fields, which has been validated by Eigen-modes as well. Subsequently, mode switchability has been incorporated by the use of active devices within the structure. Some variants involving the use of alternately etched slots of varied thickness and amalgamation of 32^{nd} and 64^{th} mode geometries have promised wideband response from the antenna.

An investigation has been carried out to mitigate the issues involved with radiation from planar SIW based horn geometries. To alleviate such concerns, a 3D based pyramidal horn antenna is proposed, which can be manufactured using the standard Printed Circuit technology. Such design modifications could accomplish directive radiations along both the principal radiation planes for a wide operating bandwidth. An ingenious method has been applied to incorporate profiled ridging within the stacked structure to further increase its operating bandwidth. An examination has also been successfully carried out by which a single embodiment could imitate the three standard horns, viz. E- plane sectoral, H-plane sectoral and pyramidal horns, in terms of its radiation. The structure being a two port embodiment can switch its radiation based on the port at which the power is fed, hence minimising the use of three separate horn antenna geometries.

Keywords: Complementary Split Ring Resonator, multi-horn, pyramidal horn, quasi-magnetic walls, Substrate Integrated Waveguide, Sierpinski fractal, wideband