

Substrate Integrated Hard Horn Antenna

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The horn antennas are probably the simplest and widely used microwave antennas. They are basically a device which provides a transition between waves propagating in a transmission line and wave disseminating in an unbounded medium such as free space. The bulky geometry of traditional horns has always been a limitation for these antennas to be used in compact form at high frequencies. In recent years, the invention of substrate integrated waveguide (SIW) technology has revolutionized the employment of planar horn antennas integrated into microwave and millimeter-wave circuits.

From the family of horn antennas, an H-plane sectoral horn that is formed by flaring a waveguide in the plane normal to the electric field can be accomplished by using SIW technique. Numerous studies and researches have been conducted to make improvement in the performance of SIW H-plane horn antennas. Generally, the ideal design for a horn antenna is to have more uniform amplitude and phase distribution in the aperture so that higher directivity and narrower beam width can be achieved.

For horn antennas, maximum directivity can be achieved if the horn designed to have uniform amplitude and phase distribution over its aperture. In recent years, such horns are called “hard” horns and they are just the simple horns with modified walls to have hard boundary conditions. The concept of artificially soft and hard surfaces have been introduced in the context of hybrid mode horns. In fact, the definition of soft and hard horn antennas includes the balanced hybrid conditions at the design frequency.

In order to have a horn antenna with maximum possible gain while keeping side lobes below a given level, a finite wall impedance is needed. Such a horn can be realized by dielectric filled horn with inverse-graded index behavior, which spreads the field away from the symmetry axis. In this work, the hard boundary conditions have been applied for SIW H-plane horn antenna in order to achieve uniform field distribution in its aperture and finally to get higher directivity. These conditions only applied to E-wall of the antenna since H-walls are already hard for dominant mode inside the SIW H-plane horn. The simulation results show a considerable improvement in antenna directivity at the design frequency. In other words, by using hard conditions, aperture efficiency can be maximized which is very important for antennas of this type.