

Antennas for W/V Band Applications

Firas Ayoub

Abstract

This dissertation focuses on designing, fabricating and testing antennas that are suitable for operation within the V/W bands. In particular, this work focuses on the design of slotted rectangular waveguide antenna arrays and cross slotted waveguide fed horn antennas. These structures are known for their high efficiency and high circularly polarized gain that can be implemented in satellite and terrestrial communication links. In addition, such designs can be implemented in radar applications that operate within the 72 GHz or 84 GHz bands. Such antenna structures are inexpensive to fabricate since they can simply be mechanically and laser milled using high precision milling tools.

The work in this dissertation, discusses the design of an array of cross slotted rectangular waveguide antennas exhibiting radiation beams with Left Hand or Right Hand circular polarization. The array is composed of 8x16 elements and generates a circularly polarized gain of 25 dB over the frequency range 84.2 – 85.7 GHz. The array also exhibits a cross polarization discrimination of more than 20 dB and an isolation of more than 20 dB between the feeding ports. A new type of z-arm shaped cross slots is introduced that fits on the broad-wall of a conventional rectangular waveguide. The feeding network is also optimized to regulate the power and the phase of each rectangular waveguide element in order to increase the gain of the antenna array.

This dissertation also presents the theoretical analysis of a cross slotted waveguide polarizer. The polarizer achieves a RHCP or LHCP by altering the feeding ports. The polarizer feeds different conical horns or pyramidal horns without affecting their characteristics. The efficiency of the polarizer is improved by combining the power of different crossed slots using square waveguide combiners. Other modes of use and operation of the cross slot polarizer are investigated for multiband operation and an antenna system operating at 72 GHz and 84 GHz simultaneously is designed.