ABSTRACT

Nowadays, there is a significant increment in the use of wireless communications. Due to the growing needs for bandwidth, telecommunications increasingly move to the high frequency bands of the spectrum because of the largest available bandwidth, less interference, reduced component sizes, etc.

The potential commercial applications at high frequencies include satellite communications, vehicular radars, image and security systems, personal wireless devices, etc. As a result, an important research activity to understand different aspects of communications systems in the millimeter-wave frequency range is currently being done.

As the frequency increases, antennas present a higher directivity, so that, in order to transmit/receive with adequate levels to/from a certain direction a radiating system be capable of produce one or more beams in a wide angular range becomes necessary. The feeding system that performs some of these tasks is based in a Beam Forming Networks (BFNs). BFNs have been traditionally manufactured using different types of transmission lines, e.g. microstrip lines or metallic waveguides; however each of them has advantages and limitations depending upon the used technology.

Conversely, there are many technological and mechanical challenges when designing systems at high RF frequencies. Among the most important factors are: cost, small size requirements, need for higher system integration densities, low power consumption, low dissipation, etc. Currently, the planar technology has provided the ideal medium for the design and implementation of many circuits and systems in the microwave and millimeter-wave bands. However, this technology presents some disadvantages when used at high frequencies, so that, the search for other technologies that solve the current manufacturing problems becomes necessary.

For the above reasons, in this thesis, multibeam antennas fed by Rotman lens have been designed and manufactured in the microwave and millimeter-wave bands using Substrate Integrated Waveguide (SIW) and, the more recent, gap waveguide technology.

A prototype of a multibeam antenna system for tracking the POLITECH.1 pico-satellite has been designed and fabricated. This prototype will be useful as a test model for the design and manufacture of a much larger multibeam antenna system, which could be installed in the ground station located at UPV, as an alternative to current mechanical tracking systems.

A prototype of a multibeam antenna using the gap waveguide technology has been designed and manufactured. This antenna proves the validity of this technology for the manufacturing of complex devices in microwave and millimeter-wave frequencies.

Finally, a prototype of a Rotman lens in LTCC (Low Temperature Cofired Ceramic) technology, for use in the 60 GHz band has been designed. An important problem of the traditional planar-guiding technologies, such as microstrip or stripline, is the considerable amount of losses they have in the millimeter-wave range. The use of gap waveguide technology in the designed prototype allows the reduction of insertion losses at milimeter-wave frequencies.