Paper ID: 13871
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SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2)
Mobile Satellite Communications and Navigation Technology (5)

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DESIGN AND REALIZATION OF TM11 WAVEGUIDE MODE COUPLER

Abstract

Electromagnetic wave propagation in waveguides normally refers to the propagation of dominant mode as is evident from its applications, most of which use only the dominant modes and higher order modes by and large remained an academic curiosity. Recently however; interest in applications for higher order propagation modes has increased, chief among them being monopulse tracking. Monopulse tracking uses a squinted beam pattern to continuously home in on its target, and it is in the generation of this beam pattern that higher order waveguide modes come into play. Monopulse tracking requires a radiation pattern that has an off-center peak with a null along boresight, yet symmetric about the boresight axis or plane. Classically, a multihorn configuration was used to generate the desired patterns, but it usually required more than four horns which caused aperture blockage and a complex feed network. The use of higher order modes generates the desired patterns while overcoming the aperture blockage.

The TM11 mode in circular waveguide has a field distribution and radiation pattern that makes it suitable for use in monopulse systems. Usually this mode is produced through mode conversion where some of the energy in the dominant mode (TE11) is converted to TM11 mode through the use of step discontinuities (in the aperture or dielectric), slots, and passive conductors etc. These methods offer a sub-optimal solution; ideally it is desirable to have independent control of the sum and difference patterns. Even more so for applications such as satellite tracking antennas since it needs to transmit only in the TE11 mode, while tracking is done solely on the receive side. A power split on the uplink can be a major drawback for mobile systems that are already operating on a tight budget. The solution lies in the TM11 mode coupler, which can independently generate or extract the TM11 mode in a circular waveguide.

This paper presents a coupler design for generating and extracting TM11 mode in a circular waveguide. The coaxial to waveguide coupler is easy to design and manufacture. The design was simulated and then verified via measurement. Radiation pattern measurements have been done in a planar nearfield facility on a hardware prototype, and the results are presented.