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ANALYSIS AND DESIGN OF DIELECTRIC ROD MILLIMETRIC LEAKY-WAVE ANTENNAS

A Dissertation Submitted to the Electronics and Communications Department, Faculty Of Engineering, Ain Shams University

For the Degree of Doctor of Philosophy

By

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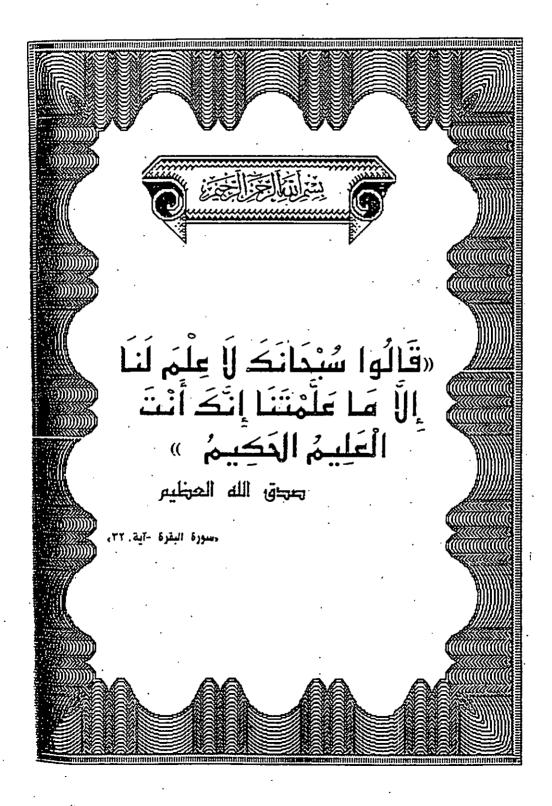
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ABSTRACT

Mohammed Assem Mohammed El-Muslimany, Analysis and Design of Dielectric Rod Millimeteric Leaky-Wave Antennas, A Dissertation Submitted to the Electronics and Communications Department, Faculty 0f Engineering, Ain Shams University For the Degree of Doctor of Philosophy, 1998.

Dielectric rod leaky-wave antennas may have applications in the millimeter wave band, for example as omni-directional antennas in the plane normal to the axis, as flush mounted antennas using its symmetry plane along the axis and as frequency scanning antennas with a cone shaped beam. TE, TM and hybrid leaky modes may provide radiation with ϕ -, θ -, linear, and circular polarization.

The present work is concerned with the analysis, design and measurement of the antenna consisting of a circular cylindrical dielectric rod covered with periodic circular conducting strips, for TE, TM and hybrid leaky modes. The method of analysis is based on expanding the mode fields in terms of Floquet's harmonics.

A moment method solution (Galerkin's method) is used to solve for the strip currents and/or the slot fields and the complex propagation constant. The choices of the unknown field or current components depends on the propagating mode to obtain numerical convergence. The radiated fields are obtained from fields on the rod surface using Kirchhoff-Huygens radiation formula.

The effects of the different parameters on the angle of the main beam and the attenuation constant are investigated. Such parameters include the frequency, the rod radius, the dielectric constant, the period length and the strip width.

At a certain frequency, the rod radius and the dielectric constant may be chosen such that the dielectric rod surface waves and the dielectric filled metal waveguide modes are above cut off. The period length may be used mainly to control the beam direction while the strip width may be used to control the attenuation constant, which in turn may be used to control the beam width and the side-lobe level.

The conventional radiation stop band at broadside radiation may be overcome by using double strips or slots

Verification of the results was made by comparison with published experimental results for the TE case and with laboratory measurements for the hybrid mode, and good agreement was found.