MILLIMETER-WAVE INTEGRATED PHASED ARRAYS WITH FERRITE CONTROL

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Summary

A new class of scanning arrays will be described. The antenna is of a traveling wave type and consists of a waveguide with a magnetogyrotropic medium. The radiating discontinuities are placed periodically along the waveguide. The waveguide may consist of an open three-layer structure made up of ferrite-dielectric-ferrite materials. A set of microstrip dipoles is placed on top of the outer ferrite layer, spaced equidistantly (one half wavelength apart), perpendicular to the direction of wave propagation. The opposite side of the structure is covered with a metal screen and the ferrite plates are transversely magnetized using wires. The inner dielectric layer with a high dielectric constant consists of a number of rods, each of which is placed under a row of microstrip dipoles. Each dielectric rod with its row of dipoles forms a line-source antenna with negligible electromagnetic coupling to its nearest neighbors. This structure forms the planar scanning array.

Electrical scanning in the H-plane is controlled by the changing phase velocity of propagation in the waveguide due to the changing magnetization of the ferrite elements. Control of the electrical scanning in the E-plane is realized by controlling the phase shift between the individual line-source antennas using external phase shifters.

The antenna is excited using an E-plane horn or a standard rectangular slotted waveguide. Matching is performed with the help of a quarter-wave dielectric transformer.

This type of antenna has been implemented at millimeter-waves. The results show a wide scanning angle in both the E- and H-planes (approximately ± 40°) with losses of about 3 dB. A 75 GHz antenna has already been realized.

(Full text of paper not available at time of printing).

CH2870-4/91/0000-1269$01.00 © 1991 IEEE

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