MILLIMETER WAVE INTEGRATED CIRCUITS

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New applications for millimeter waves have been developed and will be described. These include: high data rate communications, secure communications, low altitude radar, obstacle avoidance, imaging and fog penetration, radiometry and radiometric imaging.

With the increased need for millimeter wave devices and components, costs will be a significant problem. In order to attack this problem, new approaches to millimeter wave integrated circuits are being sought, while at the same time improving the quality of the equipment.

Several of these approaches will be compared on the basis of electrical performance and manufacturing technology. These will include the following major family categories, which are grouped by common technology. First, there is the family of waveguide integration including standard waveguide, machined metal blocks, "fin line" guide, dielectric filled waveguide, trough guide, and others. Second, there is the planar family including microstrip, stripline, microguide, inverted microstrip, suspended microstrip. Third, we shall consider the family of transmission lines such as dielectric waveguides, image lines, and Goubau lines which are related to optical integrated circuits, Figs. 1 and 2.

In addition, new information will be furnished on active devices imbedded in dielectric waveguide. GUNN and IMPATT devices have been inserted in a high resistivity silicon guide. These have been characterized and give performances comparable with metal waveguide cavities (see Figs. 3 and 4).

The following aspects will be compared for each specific type of transmission line: wave impedance, guide wavelength and dispersion properties, conductor attenuation, dielectric attenuation, compatibility with active devices, technology problems, size and power considerations, and specific applications to particular systems.

In addition, costs or projected cost comparisons will be made with competing technological approaches (i.e., microwaves, lasers, and infrared).

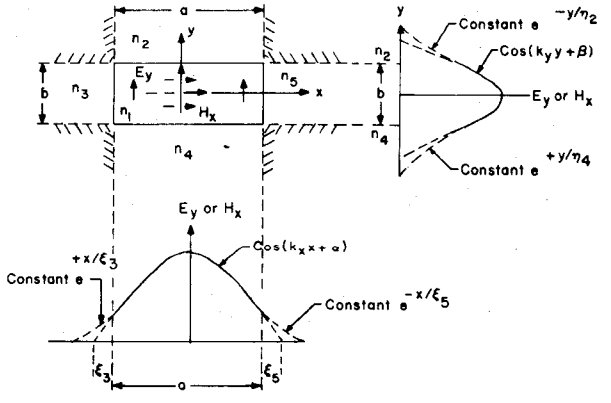

FIG. 1. E_{11}^{y} mode of propagation in a dielectric.

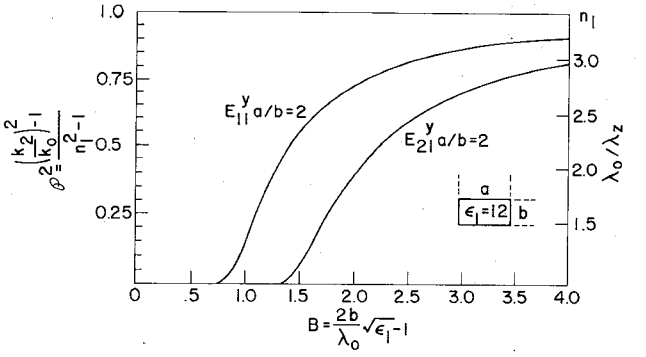

FIG. 2. Dispersion for electromagnetic waves in silicon.

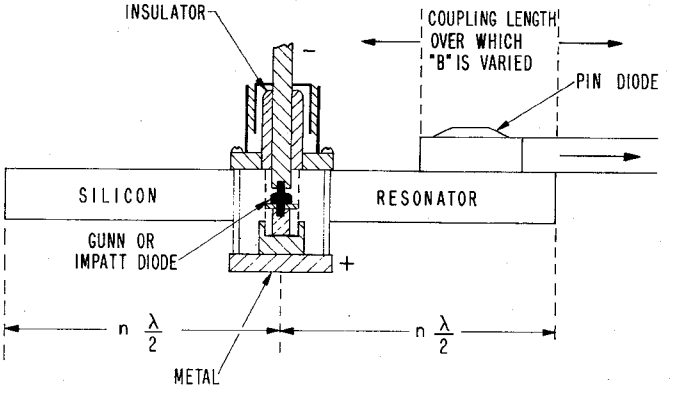

FIG. 3. Oscillator diode in dielectric structure.

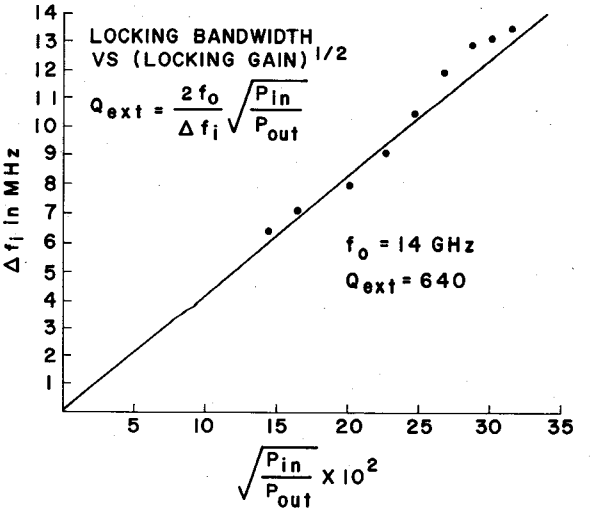

FIG. 4. Data on circuit Q for metal-dielectric resonator.

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