Abstracts

Some Effects of Field Perturbation Upon Cavity-Resonance and Dispersion Measurements on MIC Dielectrics

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An analysis is presented of field perturbations in MIC resonators in order to examine the errors which occur in permittivity measurements made by cavity-resonance methods: Q factor, coupling effects, fringing fields, crystal misalignment (for anisotropic materials), changes in ambient temperature are all considered. Analysis of a cavity with mixed boundary conditions shows that the resonant-mode frequencies depend to the first order on that part of Q/sub 0/ associated with imperfect electric (metal) walls, but to the second order on that part associated with imperfect magnetic (open-circuit) walls. A new expression is given for the Q of an open-ended microstrip resonator when surface waves are excited in the dielectric, and it is shown that the unloaded Q (Q/sub 0/) can be dominated by this phenomenon. It is further shown that these Q-related effects, together with reactive perturbations arising from fringing, coupling structures, are the principal source of error in measurements for epsilon or epsilon/sub eff/. Such reactive effects may be treated semiquantitatively by applying Slater's perturbation theorem to the affected region. These procedures lead to the following revised values for the crystal permittivity of sapphire (monocrystalline Al/sub 2/0/sub 3/) in the microwave region: epsilon/sub ||/ (parallel to the c axis) = 11.6; epsilon/sub /spl perp// (base-plane) = 9.4.

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