Abstracts

Automatic Digital Method for Measuring the Permittivity of Thin Dielectric Films

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One of the most promising techniques for measuring the electric permittivity at microwave frequencies of thin dielectric materials of the order of 0.1 to 10 µm, is the cavity perturbation method. For thin films of this type, it is necessary to determine accurately and display small changes in the resonant frequency and Q factor of the cavity in the presence of the material sample. A circuit for the simultaneous measurement and digital readout of the resonant frequency and Q factor of microwave cavity is described. For the resonant frequency measurement, a very efficient automatic frequency circuit, with a homodyne modulation-detection bridge and frequency stabilization loop, is applied. Theoretical analysis and experiments results with this circuit show that an accuracy of 5x10/sup -7/can be achieved in the resonant frequency measurement. For measuring the Q factor, two similar circuits are described. The technique is based on measuring the phase shift of the envelope of an amplitude modulated microwave signal when this signal is transmitted through a resonant cavity at resonance. Although an accuracy of 0.5 percent in the Q factor can be achieved, it is shown that the main limiting factor in both circuits is the accuracy of phase shift determination at RF frequencies.

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