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TWO-PROBE MEASUREMENTS OF THE DISPLACEMENT OF AN OBJECT WITH ACCOUNT FOR THE ANTENNA REFLECTION COEFFICIENT

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This paper addresses the problem of displacement measurement by microwave interferometry at an unknown target reflection coefficient in the case where that reflection coefficient is comparable with the reflection coefficient of the antenna. The aim of this paper is to propose a two-probe displacement measurement method that would account for the antenna reflection coefficient. This aim is achieved by using expressions for the quadrature signals and an equation in the unknown magnitude of the target reflection coefficient written for the case of a nonzero antenna reflection coefficient. The unknown magnitude of the target reflection coefficient is taken to be equal to the smaller positive root of that equation. If the magnitude of the target reflection coefficient is smaller than a critical value, which depends on the antenna reflection coefficient, then, theoretically, the target displacement is determined exactly; otherwise, the displacement determination error does not exceed several percent of the free-space operating wavelength. Depending on the phase of the antenna reflection coefficient, the error may be greater or smaller than in the case of a zero antenna reflection coefficient where the worst-case error is about 4.4 % of the free-space operating wavelength. To verify the proposed method, the determination of the relative displacement of a target executing a harmonic vibratory motion was simulated. In doing so, variations of the detector currents from their theoretical values were modeled by random current noise. The simulation results show that ignoring the reflection coefficient of the antenna when it is comparable with that of the target may introduce a sizeable error. The two-probe displacement measurement method proposed in this paper may be used in the development of microwave displacement sensors.

Keywords: *complex reflection coefficient, displacement, electrical probe, microwave interferometry, semiconductor detector, waveguide section.*

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