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TWO-PROBE MEASUREMENTS OF THE DISPLACEMENT OF MECHANICAL OBJECTS OVER A WIDE RANGE OF THE REFLECTION COEFFICIENT

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This paper addresses a two-probe implementation of microwave interferometry for measurement of the displacement of a target with an unknown reflection coefficient. The aim of this paper is to improve the measurement accuracy over a wide range of the target reflection coefficient. The measurement error as a function of the interprobe distance, the free-space operating wavelength, the width of the broad wall of the waveguide section with the probes, and the target reflection coefficient is analyzed with the inclusion of variations of the currents of the semiconductor detectors connected to the probes from their theoretical values. As the free-space operating wavelength increases, the measurement error passes through a minimum for reflection coefficients close to unity and increases monotonically for smaller reflection coefficients. This behavior of the error is due to the fact that with increasing free-space operating wavelength and/or decreasing reflection coefficient the inherent error of two-probe measurements decreases, while the error caused by variations of the detector currents from their theoretical values increases. A measurement error reduction technique is proposed. The technique consists in changing the free-space operating wavelength in accordance with the measured reflection coefficient. In comparison with the conventional operating mode, in which the interprobe distance is equal to the one eighth of the guided wavelength, the proposed technique offers a significant reduction in the measurement error for reflection coefficients close to unity. As distinct from an existing technique that uses a fixed value of the interprobe distance to guided wavelength ratio smaller than 1/8, the proposed technique is free from such a drawback as a marked increase in the measurement error at rather small reflection coefficients. The results reported in this paper may be used in the development of microwave displacement sensors for various classes of vibration protection and workflow control systems.

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

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