

MOTION SENSING BY A TWO-PROBE IMPLEMENTATION OF MICROWAVE INTERFEROMETRY

This paper addresses the possibility of displacement measurement by microwave interferometry at an unknown reflection coefficient with the use of two probes mounted in a waveguide section. The aim of this paper is to show that the displacement measurement accuracy can be improved by using an interprobe distance other than its conventional value. The case of an arbitrary interprobe distance is considered. The measurement error as a function of the interprobe distance and the reflection coefficient is analyzed with the inclusion of variations of the currents of the semiconductor detectors connected to the probes from their theoretical values. The analysis has shown that as the interprobe distance decreases, 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 decreasing interprobe distance and/or 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. The interprobe distance is suggested to be one tenth of the guided operating wavelength λ_g . In comparison with the conventional interprobe distance of $\lambda_g/8$, the suggested value offers a marked reduction in the measurement error for reflection coefficients close to unity, while for smaller ones this error increases only negligibly. This is verified by experiment using both free-space and waveguide measurements. 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: vibration, displacement, interferometry, probe, incident wave, reflected wave, semiconductor detector, detector current.

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