Abstracts

Limitations on the Size of Miniature Electric-Field Probes

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The miniature dipole probe is a useful tool for measuring the electric field at high radio and microwave frequencies. A common design for the probe consists of an electically-short antenna with a diode across its terminaly a resistive, parallel-wire transmission line transmits the detected signal from the diode to the monitoring instrumentation. Small dipoles are desirable because they provide high spatial resolution of the field, and because they permit a frequency-independent response at higher microwave frequencies. Recent efforts have produced probes with dipole half lengths h less than one millimeter. With the advances occuring in microelectronics and thin-film technology, the construction of even smaller probes may be possible. In this paper, the limitations imposed on the sensitivity of the probe by a reduction in its physical size are determined. A model that contains noise sources for the diode and the resistive transmission life is used to obtain the signal-to-noise ratio for the probe, and this is examined as a function of the parameters that describe the dipole, diode, resistive transmission line, and amplifier. When the physical dimensions of the probe are reduced by the scale factor k/sub l/ (k/sub l/ < 1), the signal-to-noise ratio is found to decrease by approximately the factor k/sup 4//sub l/, and the minimum-detectable incident electric field for a fixed signal-to-noise ratio is found to increase by approximately the factor k/sub l//sup -2/. A numerical estimate is made for the sensitivity of miniature probes with dipole half lengths in the range 10 µm <= h <= 1 cm.

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