Astract

112

# DOSIMETRIC USE OF SCHOTTKY DIODES

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The use of electric and magnetic field probes for dosimetric measurements has relied heavily on the use of microwave diodes. In this paper the performance of such diodes is examined at length with particular emphasis on Schottky barrier or hot-carrier diodes.

The basic characteristics of diodes in these applications are examined including physical mechanisms and equivalent microwave circuits. Analytic expressions are developed that illuminate the existence of linear, square-law, and other regions of operation. The effects of load-resistance, bias-current, and temperature are explored.

The analysis is employed in the evaluation of one E-field probe model which has been designed and used for dosimetric purposes. For this probe-type, measurement and theory are compared. Practical limitations on such probes are discussed, and means of selecting diode-parameters for maximum probe performance are presented.

In current biological research, there is considerable use of electric and magnetic field probes to complement thermographic and thermometric measurement techniques. Such probes are often used to quantify both external and internal fields. Because of its small size, ruggedness, and high impedance, the microwave diode has been the overwhelming detector of choice in these applications. Yet the performance characteristics of such diodes and their limitations and strengths have been little analyzed for this application.

The basic operational model of the diode is examined in this paper from the dosimetric standpoint. Its physical operation is used to generate an equivalent circuit. This, in turn is used to generate analytic expressions describing the behavior of the diode probe. The resulting expressions are used to reveal the presence of linear, square-law, and other operating regions. Because of its common use, the Schottky barrier or hot-carrier diode is especially discussed. Quantitative limitations on probe performance are shown to be specific functions of load impedance (including high resistance leads), bias current and temperature, as well as reverse saturation current.

The analysis thus developed is actually applied in an example which shows computations for a diode probe which was designed and employed for dosimetric use. The performance of the probe type is explained in terms of the model, and a comparison of actual and predicted values is presented.

A more general discussion of dosimetric diode probes is employed to suggest ways to use diode characteristics to maximize probe performance, and to predict limitations in this measurement approach.