A HIGH-SENSITIVITY, ULTRA-BROADBAND RADIATION PROBE

[redacted]

Abstract

The design, construction, and performance of an isotropic radiation probe with full-scale sensitivities ranging from 10uW/cm^2 to 10mW/cm^2 and covering the frequency range from 10 MHz to 20 GHz will be described.

1. Background

The present state of the art in the development of broadband microwave radiation probes utilizes the thermo-electric effect in one form or another. The advantages of this approach are well known, in spite of the extremely low conversion efficiency associated with the thermo-electric process. Recently, however, increasing demand is being placed on higher sensitivity probes. While this can be partially satisfied by employing improved dc amplifiers (7-10 dB), this approach suffers from increased costs, large battery drain, and reduced portability. Accordingly, the present development has been directed toward a 20-30 dB improvement in the basic sensitivity of the probe itself without any sacrifice in its broadband characteristics.

2. Approach

Based on an earlier paper by one of the authors, it was [1] recognized that the broadband coupling into free space should be accomplished by a resistive probe. It was also clear that further improvement of the thermo-electric design was not likely to yield the increase in sensitivity we were looking for. Hence, it was necessary to employ the much greater detection sensitivity achievable with barrier type devices, such as Schottky diodes, while maintaining the broadband features derived from the resistive coupling into free space. This is accomplished as shown in the equivalent circuit of Fig. 1. The new elements introduced in the figure are the diode and a shunt branch across it, which together form the detection circuit. At high frequencies, the shunt path across the diode is primarily resistive, providing a resistive divider network which keeps the RF voltage across the diode essentially constant with frequency. At lower frequencies, below 1 GHz, the gradual decrease in free space coupling is compensated for by the action of the shunt circuit. Calculations show that the circuit in Fig. 1, with appropriately chosen values for the circuit elements, has a flat characteristic from 10 MHz to 20 GHz and a sensitivity which, for presently available, low-barrier Schottky diodes, is well in excess of 23 dB above that of thermo-electric type probes.

A prototype isotropic probe has been constructed and is presently being evaluated. Initial measurements have confirmed the flat characteristic through 18 GHz as well as a 400-fold improvement in sensitivity.

REFERENCE

[1] S. Hopfer, "The Design of Broad-Band Resistive Radiation Probes," IEEE Trans. Instrum. Meas., vol IM-21, pp. 416-421, Nov. 1972.

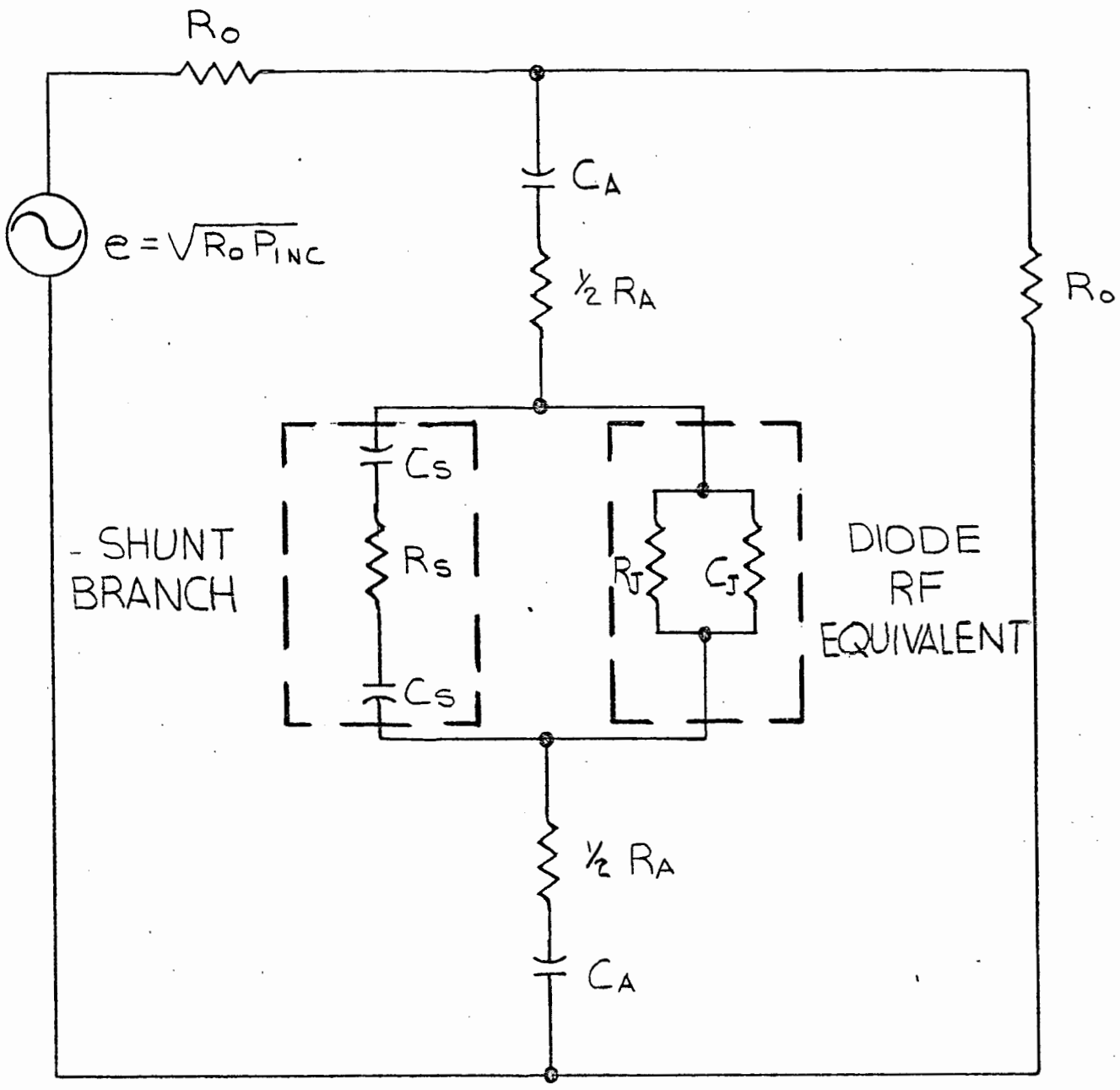

Fig. 1. Resistive Probe RF Schematic