TABLE II
TRANSFORMATION FROM $\varepsilon_{r1} = 9$ TO $\varepsilon_{r2} = 6$

(a) For Z_{oe}

W/H	S/H	Z_{oe1} (exact from ref.2) Ohms	Z_{oe2} (approximate from eq.(1)) Ohms	Z_{oe2} (exact from ref.2) Ohms	Percentage error
	0.05	110	132.4	134	1.1
0.4	0.5	95	114.4	115	0.5
	2.0	80	96.3	98	1.7
	0.05	56	67.9	68	0.1
1.4	0.5	52	63.1	63	0.1
	2.0	46	55.8	56	0.2

(b) For Z_{oo}

W/H	S/H	Z_{oo1} (exact from ref.2) Ohms	Z_{oo2} (approximate from eq.(1)) Ohms	Z_{oo2} (exact from ref.2) Ohms	Percentage error
	0.05	33	39.7	39	2.0
0.4	0.5	56	67.4	67	0.6
	2.0	71	85.5	85	0.6
	0.05	23	27.7	28	1.0
1.4	0.5	34	40.9	41	0.3
	2.0	41	49.4	49	1.0

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The Resonant Frequency of a Narrow-Gap Cylindrical Cavity

HARRY E. GREEN

***Abstract*—A recently proposed method for computing the resonant frequency of a narrow-gap reentrant cylindrical cavity is discussed. It is shown that provided that the cavity does not have too low a height-to-diameter ratio, its resonant frequency may also be computed with expectation of reasonable accuracy from numerical data which have been available in the literature for some time.**

INTRODUCTION

In a recent paper Williamson [1] has proposed a new method for computing the resonant frequency of the reentrant narrow-gap cylindrical cavity shown in Fig. 1, which is claimed to be simple and reasonably accurate. In the case of very squat

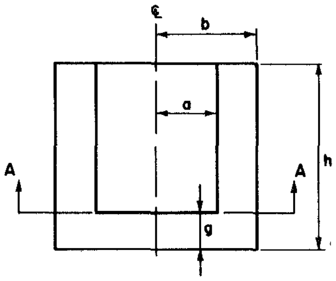

Fig. 1. Cross section of the reentrant cylindrical cavity.

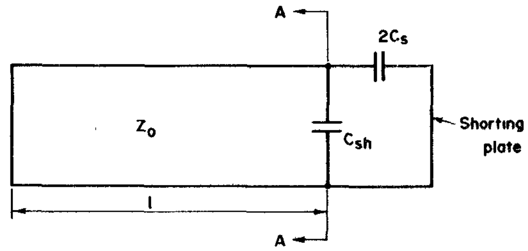

Fig. 2. Equivalent circuit of resonator.

cavities (low $h/2b$ ratio) it would seem that Williamson's method is a valuable contribution. However, when this is not the case, other methods, also fairly simple and potentially capable of good accuracy, are also possible.

THEORY

A gap in the inner conductor of a coaxial line may be modeled with good accuracy by an equivalent symmetrical π network of capacitors, provided that the gap is small compared with the wavelength in the line. Furthermore, under this condition, the values of the capacitances in the network can be computed from a quasi-static approximation. This has been done by Green [2], [3].

When a short-circuiting plane is introduced through the middle of the gap, the π network is bisected and the equivalent circuit of the resonator, the resonant frequency of which we wish to determine, is as given in Fig. 2. In this figure Z_o is the characteristic impedance of a coaxial line having inner conductor radius a and outer conductor radius b. C_s and C_{sh} are the series and shunt capacitances of the equivalent π network corresponding to a gap width of $2g$. They may be found from [2, table VI] by entering it with a gap ratio g/b and a diameter ratio b/a, finally multiplying the results extracted by $2\pi b$. In addition to the restrictions already cited, the value obtained for the gap capacitance will be valid only when the evanescent fields associated with the gap cannot interact with the short circuit. In practice, this means that the cavity should be so proportioned that $(h - g) > 2(b - a)$, and hence excludes some of the very squat cavities treated by Williamson.

At resonance the admittance seen at the plane AA must be zero. Hence the condition for resonance is

$$\cot \frac{\omega_r l}{c} - Z_o C_{eq} \omega_r = 0 \qquad (1)$$

where

ω_r resonant angular frequency;
l $= h - g$;
c velocity of propagation in the coaxial line (3×10^8 m/s);
C_{eq} $= 2C_s + C_{sh}$.

Manuscript received June 28, 1976; revised August 9, 1976.
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Since it is easily differentiated, this equation is simply solved iteratively by the rapidly convergent Newton's method. A suitable initial trial solution is one lying in the range

$$\omega_o\left(1 - \frac{C_{eq}}{C_o l}\right) < \omega_r < \omega_o \qquad (2)$$

where

$\omega_o = \pi c/2l$;
C_o capacitance per unit length of the coaxial line.

Results

In an attempt to provide some basis for comparison with Williamson's results, this method has been used to compute the resonant frequency of his cavity no. 4 which has dimensions (in millimeters) $h = 28.019$, $g = 7.999$, $a = 5.999$, $b = 29.988$. By simple linear interpolation in [2, table VI], we deduce that for this case $C_{eq} = 0.4426$ pF, giving a resonant frequency of 2.387 GHz. This is in error from Williamson's value of 2.216 GHz by about 7.5 percent. In the circumstances this is rather good as this cavity is so squat that it violates the suggested criterion for valid application of this method by more than a factor of 2, and there should be significant distortion of the gap field by the presence of the shorting plate.

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Evaluation of MTT Transactions (1976)

M. E. HINES

***Editor's Note:* Marion Hines was one of three individuals asked by the IEEE Publications Board to review recent volumes of the MTT Transactions and to provide an objective evaluation. Printed below is his evaluation in its entirety.**

I have been asked by you, on behalf of the IEEE, to review recent volumes of the IEEE Transactions on Microwave Theory and Techniques to evaluate them objectively, and to prepare a report on this subject for the IEEE. This letter constitutes that report. This is a personal document which is subjective to a large degree, no matter how objective I try to be. In the following, I will discuss a number of topics on this subject which occur to me, and make a number of suggestions for improvement of the Transactions.

I. General Quality of Papers

I am impressed by the average high technical level of the published papers in the Transactions. Within the framework of IEEE and S-MTT policy, the traditions of the MTT Society, and the limitations imposed by the unavoidable fallibility of volunteer reviewers, the MTT Transactions have maintained high standards. I feel that we have had outstanding service and good management by our editors and that nothing said here should be construed as criticism of their performance in this demanding and somewhat thankless task.

Manuscript received August 30, 1976.
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II. Some Philosophical Comments

In my opinion, the primary function of the MTT Transactions is the communication of microwave *engineering* information among the membership so that new and *useful* knowledge is made available to the profession as a whole. I have stressed the words engineering and useful. We are an engineering society, devoted to applications of science and technology. The chief criticisms of the MTT Transactions which I have heard in recent years and my own chief criticism is that much of the published theoretical material is written with obscure jargon and unfamiliar mathematical symbolism so that for a majority of the membership it is difficult to read and understand. There also appears to be a singular lack of usefulness in much of what is published. Often there is insufficient effort to explain the results and to present the data in graphs, tables, or other directly interpretable form. These are serious charges and the problems they present do not seem to have simple answers.

We have a tradition in the MTT of taking our theoretical work seriously. We believe that good microwave engineering requires a sound theoretical foundation, and that we prefer to *design* our microwave components and systems with theory and precise computations. I have no desire to change this tradition. I believe, however, that no worthwhile theoretical paper need be so obscure that its purpose, its basic method of approach, and the meaning and general character of the results cannot be understood by a majority of the subscribers to the Transactions. Likewise, no experimental paper need be so meager or disorganized in its information content that other experienced workers in the same field with similar availability of components and technology cannot duplicate the results from the data presented.

I have an impression that many of our contributors of theoretical work are directing their work to an elite group of specialists and seem to believe that mathematical "elegance" is the chief virtue of a good paper. In this context, elegance seems to require a minimization of explanatory English text, no repetition of previously published material (even when necessary to understand the paper), elimination of all unnecessary steps in the development, the use of specialized jargon familiar only to the specialists, use of mathematical symbolism requiring the minimum amount of space for equations, and expression of the results in the most compact equations possible. Graphs of key data may be eliminated as unnecessary. This kind of "elegant" paper is, as a result, directly useful only for that limited group of specialists. It must be recognized that the IEEE and S-MTT encourages some of this by editorial policies regarding shortness, and the the "page charge" policy.

In recent years, the digital computer has become an indispensable tool for microwave engineers who use theory to design their devices and systems. A large number of our member engineers are now adept at writing their own programs and make much use of time-shared computer services. Many of these engineers have developed libraries of software for their personal use and for use by others in their own organizations. A number of software service companies have developed and offer the use of