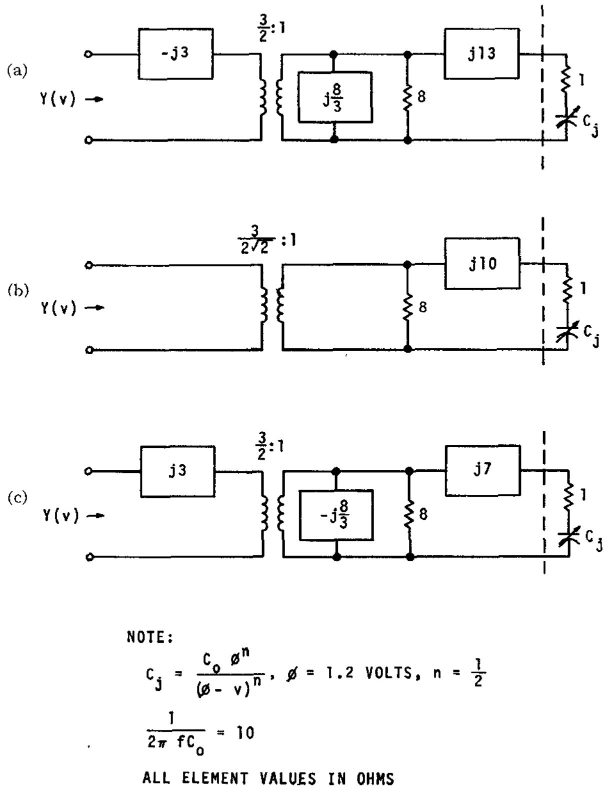

Fig. 1. Varactor coupling networks, (a) $\alpha=3$. (b) $\alpha=0$. (c) $\alpha=-3$.

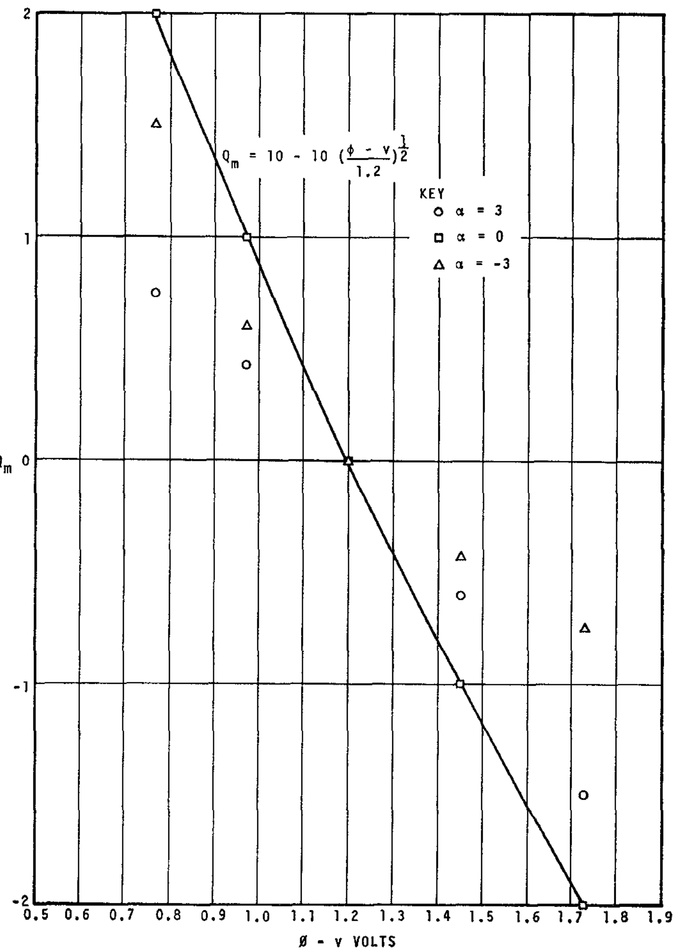

Fig. 2. Q_m versus $\phi - v$.

TABLE I

CALCULATION OF Q_m

v (volts)	ø-v (volts)	Co/Cj	Y (v) = G (v) + jB (v) α = 3	α = 0	α = -3	$Q_m = \frac{B(v)}{1/9 - G(v)}$ α = 3	α = 0	α = -3
+0.432	0.768	0.8	(51-j32)/75	(13-j16)/45	(15-j16)/39	3/4	2	3/2
+0.228	0.972	0.9	(75-j28)/87	(5-j4)/9	(39-j20)/51	3/7	1	3/5
0	1.2	1	1	1	1	0	0	0
-0.252	1.452	1.1	(39+j20)/51	(5+j4)/9	(75+j28)/87	-3/5	-1	-3/7
-0.528	1.728	1.2	(15+j16)/39	(13+j16)/45	(51+j32)/75	-3/2	-2	-3/4

varactor law, *as observed at the operating frequency*. If the observed law differs from one derived at a lower frequency, it only suggests to me that the model should contain frequency-dependent terms, whether they are associated with the junction or the inherent mounting structures. Houlding has pointed out [1] that the inclusion of a constant capacitance parallel to $C_j(v)$ is sufficient to cause an effective change in the varactor law. Shunt capacitance is a very common property of physical structures when observed at microwave frequencies.

Notice that Sard's viewpoint and mine are not incompatible. If the varactor law is constant with frequency, both methods should explain the same observed data. One could derive why the varactor *acts* differently by studying how the measured data vary with mounting, tuning, and frequency. Perhaps an optimum mounting and tuning procedure can be identified from such studies.

REFERENCES

[1] N. Houlding, "Comment on 'A new procedure for calculating varactor Q from impedance versus bias measurements,'" *IEEE Trans. Microwave Theory Tech.* (Corresp.), vol MTT-18, pp. 229–230, Apr. 1970.

[2] E. W. Sard, "A new procedure for calculating varactor Q from impedance versus bias measurements," *IEEE Trans. Microwave Theory Tech.*, vol. MTT-16, pp. 849–860, Oct. 1968.

Comments on Papers Dealing with Dielectric-Loaded Rectangular Waveguides

VAN RE BUI AND R. R. J. GAGNÉ

We have read with interest the paper of Tsandoulas, Temme, and Willwerth [1] and that of Chatterjee and Chatterjee [3], dealing with rectangular waveguides loaded with dielectric. For the scientific accuracy, however, we believe a few errors have unfortunately occurred in them, and, therefore, we would like to submit the following remarks. The symbols in original sources are kept for easy comparison.

A. Reference [1]

1) Page 88, second column, first paragraph, the last sentence seems to imply that, for $n=0$ (no y dependence), the LSM_{m0} modes become identical with the conventional TM_{m0} ones. This is not correct since the LSM_{m0} or TM_{m0} modes do not exist in inhomogeneous and homogeneous rectangular waveguides. In fact, when there is no y dependence, the electric Hertzian potential from which the field components of these modes can be derived disappears [2].

It is interesting to note that the characteristic equation for the nonexisting LSM_{m0} modes having only E_y and H_z field components, and that for the LSE_{m0} modes having E_y, H_x, and H_z components, give the same results on cutoff frequency and on phase constant. However, these modes should not be confused.

2) In Fig. 10, "$a=0.0800$" should read "$a=0.800$."

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B. Reference [3]

1) Page 149, equations (27a) and (27b) for the $(LSE)_{mn}$ and $(LSM)_{mn}$ modes should read, respectively,

$$(\psi_h)_{mn} = f(x) \cos \frac{n\pi y}{b} \exp(-\gamma z)$$

$$(\psi_e)_{mn} = g(x) \sin \frac{n\pi y}{b} \exp(-\gamma z)$$

since $f(x) \neq \sin m\pi x/a$ and $g(x) \neq \cos m\pi x/a$ [2].

2) Page 149, there are some errors in the statement "It is to be noted that the waves $(LSM)_{0n}$ and $(LSE)_{m0}$ correspond to H_{0n} and E_{m0} waves of a homogeneous guide." We think the authors would like to mean "$\cdots E_{0n}$ and $H_{m0} \cdots$." As pointed out previously the waves $(LSM)_{0n}$ and E_{0n} do not exist in a rectangular waveguide. The $(LSE)_{m0}$ or H_{m0} exist, not only in a homogeneous guide, but also in an inhomogeneous one.

3) Page 198, equations (82) and (84) should read, respectively,

$$Y_{in} = Y_0^{(2)} \frac{-jY_0^{(1)} \cot\left(x_1 \frac{a-d}{2}\right) + jY_0^{(2)} \tan\left(x_2 \frac{d}{2}\right)}{Y_0^{(2)} + Y_0^{(1)} \cot\left(x_1 \frac{a-d}{a}\right) \tan\left(x_2 \frac{d}{2}\right)}$$

$$x_1 \cot\left(x_1 \frac{a-d}{2}\right) = x_2 \tan\left(x_2 \frac{d}{2}\right).$$

C. Reference [2]

Note the missing of a minus sign in equation (9a).

REFERENCES

[1] G. N. Tsandoulas, D. H. Temme, and F. G. Willwerth, "Longitudinal section mode analysis of dielectrically loaded rectangular waveguides with application to phase shifter design," *IEEE Trans. Microwave Theory Tech.*, vol. MTT-18, pp. 88–95, Feb. 1970.
[2] R. E. Collin, *Field Theory of Guided Waves.* New York: McGraw-Hill, 1960, pp. 224–229, and p. 190.
[3] S. K. Chatterjee and R. Chatterjee, "Dielectric loaded waveguides—A review of theoretical solutions," *Radio Electron. Eng.*, vol. 30, pp. 145–160, Sept. 1965; and pp. 195–205, Oct. 1965.

Computer Program Descriptions

Eigenmodes for Straight Circular Cylinder Microwave Resonators Containing a Coaxial Dielectric Sample

PURPOSE: This program gives, from an exact analytic theory, either a characteristic parameter of the sample or resonance frequency for all eigenmodes which may exist in the loaded cavity.

LANGUAGE: Fortran IV. Program deck length 101 cards.

AUTHORS: J. C. Joly and A. Poinsot, Microwave Laboratory, University of Dijon, Dijon, France.

SPONSOR: Prof. J. Bouchard, Faculté des Sciences, Laboratoire de Radioélectricité, 6 Boulevard Gabriel, 21 Dijon, France.

AVAILABILITY: ASIS–NAPS Document No. NAPS–01759. Subprograms used for calculation of Bessel's functions come from IBM 1130 scientific subroutine package. Detailed explanations of the method used for calculation and of the program structure are joined with the listing.

DESCRIPTION: Perturbation of a circular microwave resonator by a dielectric sample of the same symmetry (see Fig. deposited with NAPS) is often used to measure the relative permitivity of the material under test. When the frequency shift becomes important, the theory of local perturbation is no longer valid and an exact analytic theory must be used for calculation. In the theory, ϵ appears as the root of a transcendental equation whose numerical solving must be done by means of a computer. This program deals with all eigenmodes which may exist in the loaded cavity, and it can be used for three kinds of calculation: 1) calculation of ϵ from a frequency measurement; 2) calculation of eigenmode frequencies; 3) calculation of the diameter which a sample of a given material must have to obtain a determined frequency of resonance for the loaded cavity. Program size has been reduced as much as possible and permits loading onto small laboratory computers. For example, using a Digital PDP 15/8 computer, our compiled program requires a 2420/8 word storage (5521/8 with BESJ and BESY subroutines).

Manuscript received October 4, 1971; revised January 17, 1972.
For program listing, order NAPS-01759 from ASIS National Auxiliary Publications Service, c/o CCM Information Corporation, 909 Third Avenue, New York, N. Y. 10022; remitting $2.00 per microfiche or $5.00 per photocopy.