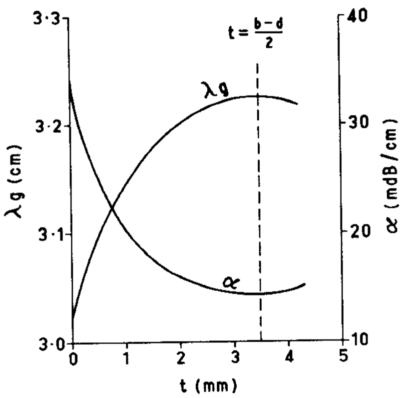

Fig. 2. The effects on α and λ_g of the composite guide of separating the sample from the broad wall by distance t, for a typical sample of $\epsilon = 3 - j0.02$, 1/8 in. thick, measured at 10 GHz, in WG 16 guide.

The computer program, written in Basic, is not claimed to have been optimized for the speed of approach to the root (Newton's method is used to approach the solution along the direction of the steepest descent). This program is available on request.

REFERENCES

[1] P. Bhartia and M. A. K. Hamid, "Dielectric measurements of sheet materials," *IEEE Trans. Instrum. Meas.* (Short Papers), vol. IM-22, pp. 94–95, Mar. 1973.
[2] V. R. Bui and R. R. J. Gagne, "Dielectric losses in an H-plane-loaded rectangular waveguide," *IEEE Trans. Microwave Theory Tech.*, vol. MTT-20, pp. 621–623, Sept. 1972.

The Impedance and Scattering Properties of a Perfectly Conducting Strip Above a Plane Surface-Wave System

JOHN BROWN

***Abstract*—Gillespie and Kilburg have postulated that the fraction of the incident surface-wave power radiated by a conducting strip does not exceed 0.5. This result is shown to be a consequence of the representation of the strip by a shunt impedance.**

With the notation used by Gillespie and Kilburg [1], the fraction of the incident power radiated by the strip is

$$P_{\text{rad}} = \text{Re}\,|1+\Gamma|^2/\bar{Z}.$$

From [1, eq. (4)],

$$\Gamma = -1/(1+2\bar{Z}) = -\bar{Y}/(2+\bar{Y})$$

where $\bar{Y} = 1/\bar{Z}$. Hence

$$P_{\text{rad}} = \text{Re}\,4\bar{Y}/|2+\bar{Y}|^2 = \frac{4g}{(2+g)^2+b^2}$$

when $\bar{Y} = g + jb$.

The maximum value of P_{rad} is seen to occur when $g = 2$ and $b = 0$ and to have the value

$$P_{\text{rad,max}} = 0.5$$

as postulated.

REFERENCES

[1] E. S. Gillespie and F. J. Kilburg, "The impedance and scattering properties of a perfectly conducting strip above a plane surface-wave system," *IEEE Trans. Microwave Theory Tech.* (Short Papers), vol. MTT-21, pp. 413–419, June 1973.

Manuscript received September 4, 1973.
The author is with the Department of Electrical Engineering, Imperial College of Science and Technology, London, England.

Comments on "Measured Noise Temperature Versus Theoretical Electron Temperature for Gas Discharge Noise Sources"

RONALD E. GUENTZLER

***Abstract*—Previously published microwave noise temperatures from wall-contained argon discharges at 200 mA dc are compared with the electron temperatures predicted by von Engel and Steenbeck. A good agreement between data and theory results if the ionization efficiency is modified to account for stepwise ionization.**

In the above paper,[1] Olson presented a comprehensive study of measured microwave noise temperatures of commercial-gas discharge noise sources. A poor correlation existed between the theoretical electron temperatures as predicted by von Engel and Steenbeck [1, p. 242] and most of the measured noise temperatures. The data were from both wall-contained and constricted discharges.

While studying Olson's figure 2,[1] it became apparent that there was a definite trend in the data from the wall-contained discharges (points 1, 7, and 11–16). This trend was reinforced when the wall-contained data published by Denson and Halford [2, fig. 2] were plotted along with Olson's data. Although all the wall-contained data disagreed with the theoretical curve, they yielded a least squares fit with $\sigma = 1.25$ percent (0.05 dB).

Further investigation of the wall-contained data revealed that if the von Engel and Steenbeck constant c were multiplied by 2, the measured noise temperatures would fit the modified von Engel and Steenbeck curve with $\sigma = 1.75$ percent (0.07 dB), with the furthest point being only 3.5 percent (0.14 dB) in error. This is shown in Fig. 1. (Although the original Olson data points 8 and 9 fall in the area covered in Fig. 1 they are from constricted discharges and are not shown here.)

The von Engel and Steenbeck constant c is obtained from the formula [1, p. 242]

$$c = [aV_i^{1/2}/k^+p]^{1/2}$$

where a is the ionization efficiency, V_i is the ionization potential, k^+ is the positive ion mobility, and p is the pressure.

Traditionally, c (and thus the theoretical electron temperature) was calculated using a value of a appropriate for *direct ionization* by electron impact; however, *stepwise ionization* takes place at the pressures and currents used in the tubes studied [1, p. 244], [3, p. 29]. The excited atoms have a larger ionization cross section than ground-state atoms and can be ionized by the more numerous lower energy electrons; therefore, the ionization efficiency a can be 4 times greater than the value used under the assumption of direct ioniza-

Manuscript received July 18, 1973; revised October 10, 1973.
The author is with the Department of Electrical Engineering, Ohio Northern University, Ada, Ohio 45810.
[1] K. W. Olson, *IEEE Trans. Microwave Theory Tech.* (*Special Issue on Noise*), vol. MTT-16, pp. 640–645, Sept. 1968.