sary to use single-frequency data and a bilinear transformation to circumvent the problem of package and mounting geometry.

Finally, it should be noted that the method[1] does not separate out the circuit loss from the parasitic losses within the diode—indeed such a separation is not possible without substituting for the diode an equivalent susceptance of zero or known loss. Diode loss below breakdown is generally greater than that of good circuits; consequently, conclusions concerning circuit efficiency, given by the same authors in a similar paper [3], are liable to be erroneous.

It is also questionable whether an RF voltage, calculated by eliminating diode loss along with circuit loss [3],[1] can have any physical significance at the chip terminals.

REFERENCES

[1] N. D. Kenyon, "Equivalent circuit and tuning characteristics of 'resonant-cap' type Impatt diode oscillators," in *1973 Proc. European Microwave Conf.*, vol. 1, Paper A.1.1.
[2] I. S. Groves and N.D. Kenyon, "Measurement technique for large-signal admittance of Impatt diodes," *Electron. Lett.*, vol. 9, p. 331, July 26, 1973.
[3] R. C. Tozer, R. Charlton, and G. S. Hobson, "Circuit loss characterization with an Impatt diode," in *1974 Proc. European Microwave Conf.*, p. 464.

Authors' Reply[2]

G. S. HOBSON, R. C. TOZER, AND R. CHARLTON

Kenyon's objections are largely errors based on imperfect reading of our two papers [1],[2]. His comments about many identifiable circuit elements invalidating a simple equivalent circuit with two reactive components is incorrect. Foster's reactance theorem gives guidance on the form of the susceptance-frequency relationship of any circuit, however complicated, as its loss approaches zero (i.e., energy dissipated per cycle much less than energy stored). The only requirement for an equivalent circuit with two frequency independent susceptances is that the range of frequency encountered is small enough for a first-order Taylor expansion of the susceptance, B, to be sufficiently accurate in the form

$$B = B_0 + \left(\frac{\partial B}{\partial \omega}\right)_0 \Delta\omega.$$

The subscript 0 refers to the center frequency about which the expansion is taken. B_0 and $(\partial B/\partial\omega)_0$ are essentially constants of the expansion which may be expressed in terms of two constants: an inductance L, and a parallel capacity C of a simple equivalent circuit, i.e.,

$$B_0 = \omega_0 C - \frac{1}{\omega_0 L}$$

$$\left(\frac{\partial B}{\partial \omega}\right)_0 = C + \frac{1}{\omega_0^2 L}.$$

[2] Manuscript received January 22, 1975.
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Kenyon's misunderstanding appears to be of the nature of an equivalent circuit and its difference from an actual circuit. The actual circuit can contain any number of identifiable circuit elements.

Our experimental check of the validity of the first-order Taylor expansion was provided by the bias and frequency independence of the width of the resonant absorption [1]. The second check of the single tuned nature (this of course implies a two-constant description of B) is provided in the greater detail of the absorption line shape. If Kenyon had carried out experiments on multiple-tuned circuits he would have seen the vast changes in absorption line shape when a bias tunable resonance "passes through" a resonance controlled only by the inactive parts of the circuit. As additional evidence we have confirmed the shape of the absorption when multiple resonances do not overlap by calculating conductances corresponding to a given absorption line from measurements taken with several values of the ratio n[1]. These conductances were equal within a random experimental error of the same order as that shown in [2] (~15 percent) when our conditions for a simple resonance were satisfied.

The comments about package parasitics (presumably susceptive) are simply subjective and incorrect in reference to the equivalent circuit. The comments about diode parasitic losses have already been dealt with in [2], where we confined our measurements to those punched-through diodes whose loss below breakdown was independent of bias voltage.

REFERENCES

[1] R. C. Tozer, R. Charlton, and G. S. Hobson, "Characterization of microwave oscillator and amplifier circuits using an IMPATT diode biased below breakdown," *IEEE Trans. Microwave Theory Tech.* (Short Papers), vol. MTT-22, pp. 806–808, Aug. 1974.
[2] ——, "Circuit loss characterization with an IMPATT diode," in *Proc. 1974 European Microwave Conf.*, p. 464.

Correction to "The Numerical Solution of Some Important Transmission-Line Problems"

HARRY E. GREEN

In the above paper,[1] on pages 686 and 687, corrections are as follows.

1) Nowhere has the quantity called "gap ratio" been defined. In terms of Fig. 10(a) on page 686, it is the ratio s/b.

2) On page 687, (18) should read

$$C = \frac{\pi a^2 \epsilon}{2s} + 2a\epsilon \ln \frac{b-a}{s}. \tag{18}$$

3) On page 687, in the last column of Table VI (for diameter ratio 7:1) the entries in subcolumn C_1 for gap ratio 0.10 and 0.15 have been interchanged.

Manuscript received November 13, 1974.
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[1] H. E. Green, *IEEE Trans. Microwave Theory Tech.* (*Special Issue on Microwave Filters*), vol. MTT-13, pp. 676–692, Sept. 1965.