

Fig. 1.

Reply² by J. Q. Howell³

The purpose of my short paper¹ was to present an alternate method of measuring the dielectric constant of MIC substrates to that suggested by Napoli and Hughes [1]. My new scheme appeared to be more accurate and yet as easily implemented. I did not intend to imply that the error in the Napoli-Hughes technique was resistive in origin, but only that the measured resonant frequencies were found to be affected by the strength of the coupling and by radiation losses. This could be demonstrated by observing the shift in resonant frequencies when changing the coupling coefficient or when moving an object in the vicinity of the substrate. Ladbroke *et al.* [2] did not

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TABLE I

Frequency	Mode	Permittivity
2.22	(2,1)	3.94
2.86	(2,2)	3.82
3.20	(3,1)	3.82
3.64	(3,2)	3.82

mention error due to the fringing fields along the open edge of the substrate and they implied that the dominant error was due to the perturbation of the fields in the vicinity of the feedpoint. Since the closed sidewall technique more closely approximates the theoretical model, I submit that this scheme is the more accurate of the two. At any rate, the solution to the question of whether the resistive loss or the field perturbation causes the largest error in the resonant frequency will depend on the properties of the sample and equipment being used. Either extensive theoretical analysis or comparison to some other accurate measuring scheme will be required to properly resolve this.

REFERENCES

- [1] L. S. Napoli and J. J. Hughes, "A simple technique for the accurate determination of the microwave dielectric constant for microwave integrated circuit substrates," *IEEE Trans. Microwave Theory Tech.* (Corresp.), vol. MTT-19, pp. 664-665, July 1971.
- [2] P. H. Ladbroke, M. H. N. Potok, and E. H. England, "Coupling errors in cavity resonance measurements on MIC dielectrics," this issue, pp. 560-562.

Contributors



Carlo Atzeni was born in Cagliari, Italy, on November 10, 1940. He received the Dr. degree in physics from the University of Florence, Florence, Italy, in 1965.

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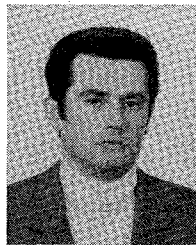


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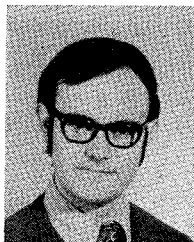
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Geoffrey O. Stone (S'67-M'73) was born in Melbourne, Australia on January 18, 1945. He received the B.E. and M.Eng.Sci. degrees in electrical engineering from the University of Melbourne, Parkville, Vic., Australia in 1967 and 1969, respectively.

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