Letters

Comments on "Microstrip Characteristic Impedance"

B. BIANCO, M. PARODI, AND S. RIDELLA

In a recent paper [1] Getsinger considers some definitions of microstrip characteristic impedance which are usual in literature and which have been analyzed by us in order to show their different behavior with the frequency [2]. In particular, Getsinger states that only one of these definitions is correct, that is, the one based on the wave-impedance concept, while the others must be neglected.

We agree with Getsinger where he says that such a definition is the most widely accepted today, and there is no doubt that it is related to the dc behavior of the microstrip in the simplest way with respect to the others. In our opinion such arguments make this definition to appear, in some sense, the most natural to be assumed, but we cannot find a good reason to state that it is the "right one". The theory developed by Schelkunoff [3] makes possible the application of the wave-impedance concept to transmission lines, but it can be shown that this leads to the obtaining of a result which is not the same at every point of the cross section of the microstrip, except for the dc case (in which all the definitions considered by us give the very same result), or when appropriate but approximate field expressions are assumed. It must be stressed that such indeterminateness does not affect most of the experimental results. In a previous paper [4] we have shown that changing the characteristic impedance by any real or complex factor leads to a change in the model of the coaxial terminations in such a way that the effects of varying the former cannot be distinguished from the effects of varying the latter when S-parameter measurements are made.

For these reasons, we were not concerned with giving a definition of the microstrip characteristic impedance, but we considered fairly important to find why different research workers [5]–[9] give results on the microstrip characteristic impedance which are in sharp contradiction with regard to its dependence on frequency. Our work [2], which does not side with any of the definitions examinated, shows that the contradictions above are strictly consequent with the definition assumed.

References

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B. Bianco and S. Ridella are with C.N.R. Laboratory for Electronic Circuits, 16145 via all'Opera Piall, Genova, Italy.

M. Parodi is with the Department of Electrical Engineering, University of Genova, viale F. Causa 13, 16145 Genova, Italy.

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Response to Comments on "Microstrip Characteristic Impedance"

W. J. GETSINGER

Bianco *et al.* [1] have performed a service in pointing out that microstrip characteristic impedance definitions employing voltage–current–power ratios can be functionally inconsistent. The purpose of my note was to show that such definitions are also inconsistent (with one coincidental exception) with the unifying concept of wave impedance [2], which embraces the impedances of the modes of TEM lines, hollow waveguides, and other structures.

With this approach, wave impedance is the only definition used, while characteristic impedance is a derived quantity. Thus if wave impedance has the same value over the entire cross section of the structure, there can be no confusion of definitions or functional forms for characteristic impedance; the resulting expression is unique.

The problem of coupling microstrip to coax [3] or other transmission lines mentioned by Bianco *et al.* is interesting but not directly related to the question of a unique functional form to describe microstrip characteristic impedance.

References

[1] B. Bianco *et al.*, "Some considerations about the frequency dependence of the characteristic impedance of uniform microstrips," *IEEE Trans. Microwave Theory Tech.*, vol. MTT-26, pp. 182–185, Mar. 1978.

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The author is with COMSAT Laboratories, Clarksburg, MD 20734.