Letters

Comments on "Frequencies of a Truncated Circular Waveguide—Method of Internal Matching"

Harry E. Green

In the above paper,[1] Wang makes a useful addition to the literature on truncated circular waveguides, which have important practical applications in polarizers. Wang references several prior contributions to the theory of this particular kind of waveguide [1]–[3] and commenting collectively on this body of literature, goes on to state "the results, however, differ considerably." This is, at best, only partly true, and results in a greater degree from the author's failure to find other available references, i.e., [4] and [5].

In their original attempt at the problem, Pyle and Angley [1] model the guide cross section as a series of steps cut off by planes drawn parallel to the principal axis for the mode in question. The analysis proceeds from that point by treating the whole as a cascade of parallel plate lines for which it is possible to set up an equation for transverse resonance.

Implicit in the procedure ought to be an assumption that, as the number of steps is made large, the cutoff so determined will converge to the correct result. However, the result of continuing in this way is to constrain all the electric lines of force to be parallel to the principal axis and to each other when, in fact, they are curved. The outcome is an irreducible minimum error that cannot be eliminated simply by adding more steps.

Pyle and Angley show this by using their method to also determine cutoff of the H_{11} mode in circular waveguide, a problem for which an analytic solution is available for comparison purposes. They then proceed to adjust the previously determined results on the assumption that the error so determined continues to apply in the supposedly closely similar circumstances of the truncated guide.

The validity of this last step is questioned in [4], where a finite-difference solution to the problem, not referenced in the above paper, is presented. The result is data with similar trends, but deviating markedly in numerical value from that in [1], particularly for large cross-sectional truncations.

A number of years later, this problem was also investigated by Levy [3] using a perturbation approach quite different from either of the two previously cited references. He compared his results with those in [1], showing useful correlation, but with a divergence in numerical values for large truncations too big to be regarded as satisfactory. When [4], also missed by Levy, was drawn to his attention, he undertook a further comparison of his with these new results. The outcome was now close agreement for the $E_{\|}$ case, but an even worse result than previously in the $E_{\perp}$ case. This led Levy to check his analysis, resulting in discovery of a factor of two error, which, when corrected, produces almost exact agreement in both instances between Levy and [4]. This is reported by Levy in [5], which is also not referenced by Wang.

The true situation in relation to this problem is, therefore, that two independent solutions showing close agreement have been published, and to this literature, Wang's contribution makes a useful addition, especially in its treatment of higher order modes not included in [3] and [4].

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[1]C. Y. Wang, *IEEE Trans. Microwave Theory Tech.*, vol. 48, no. 10, pp. 1763–1765, Oct. 2000.

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Author's Reply

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H. E. Green's comments on the above paper[1] are appreciated for expanding and discussing the literature on the truncated circular waveguide. I would like to add a recent reference. Using a Rayleigh–Ritz method, Lin *et al.* [1] confirms the results of the above paper for several lower modes.

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[1]C. Y. Wang, *IEEE Trans. Microwave Theory Tech.*, vol. 48, no. 10, pp. 1763–1765, Oct. 2000.

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