Letters

Comments on "Analysis of Nonreciprocal Coupled Image Lines"

CHRISTIAN SCHIEBLICH

In the paper in question,[1] nonreciprocal effects are predicated to a homogeneous waveguiding structure containing a gyromagnetic medium biased in the direction of propagation. In [1], the thesis was derived that any longitudinally biased structure showing reflection symmetry with respect to its midplane is reciprocal. The structure in the paper in question falls into this category, because a homogeneous structure is symmetrical with respect to any plane perpendicular to the direction of propagation.

Part A of the paper treats the problem of wave propagation in an infinite, homogeneous, gyrotropic medium. The resulting propagation constants are given in Eq. (8). The interpretation of this equation is, however, incomplete. As is known from literature (e.g. [2]), there are two eigenwaves propagating in the direction of bias field, as well as two eigenwaves in the opposite direction. They are circularly polarized, and the propagation constants depend on their sense of polarization with respect to the bias field, not to the direction of propagation. Thus the right-handed polarized wave travelling in the direction of the bias field is degenerated with the left-handed wave in the opposite direction, and vice versa. Hence it is possible to build nonreciprocal components by a structure sensitive to the sense of circular polarisation, e.g. a twisted waveguide, as is used for Faraday isolators.

A correct treatment of the structure in the paper in question would have to take into account a superposition of both senses of circular polarization in the ferrite medium. As the plane boundaries force the eigenwaves to be linearly polarized in the transversal plane (a rotation of fields, as caused by circular polarization, is not compatible with a constant transversal field distribution along the direction of propagation), both components are excited with equal amplitudes. Due to the above-mentioned degeneration, this results in the same characteristic equation for both directions.

Reply[2] by D. B. Sillars and L. E. Davis[3]

We should like to thank the author for his interest in, and comments on our paper.

The background to our paper is that nonreciprocal effects have been observed experimentally on coupled image lines loaded with a ferrite slab which is magnetized longitudinally just above saturation (reference [8] cited therein). Since the applied magnetic field was small, the behavior has been analyzed using approximations which include only the E^y_{mn} modes and a perturbed propagation constant. The characteristic equation (eq. (4) in our paper) was developed assuming all six field components since the ferrite can support a hybrid mode in which the field components are coupled through the tensor permeability. However, at this stage the possibilities of higher order modes and mode conversion have deliberately been neglected. Our approximate approach has yielded dimensions that are similar to those used experimentally, but we would accept the implication in the author's comments that a full-wave analysis of the open coupled structure is required to obtain a more precise description of the behavior and design information.

References

[1] E. Jensen and Ch. Schieblich, "Comments on 'Millimetric nonreciprocal coupled-Slot finline components'," *IEEE Trans. Microwave Theory Tech.*, vol MTT-35, p 470–471, Apr. 1987.
[2] B. Lax and K. J. Button, *Microwave Ferrites and Ferrimagnetics*. New York: McGraw-Hill, 1962.

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The author is with the European Laboratory for Particle Physics, CERN, CH-1211, Geneva 23, Switzerland.
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[1]D. B. Sillars and L. E. Davis, *IEEE Trans Microwave Theory Tech.*, vol. MTT-35, pp. 629–635, July 1987.

[2]Manuscript received November 21, 1987.

[3]D. B. Sillars is with MACom Ltd, Dunstable, Bedfordshire, LU5 4SX, U.K. L. E. Davis is with the University of Manchester Institute of Science and Technology, Manchester M60 1QD, United Kingdom.
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Corrections to "A Study of Electric-Field Breakdown in *E*-Plane Lines at Centimeter and Millimeter Wavelengths

M. M. NEY, S. R. VALLURI, W. YUE, G. I. COSTACHE, AND W. J. R. HOEFER

In the above paper,[1] the sentence on p. 507, right column, "Diagrams of Fig. 8 were established..." should read: "Diagrams of Fig. 7 were established...." In addition, the next sentence: "Corrections due to the geometry and the frequency can be made by using..." should read: "Then, corrections due to the geometry and the frequency have been made by using...."

Also, values in Table II and curves in Fig. 7 are not appropriate. The modified figures and table are given here.

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M. M. Ney, W. Yue, G. I. Costache, and W. J. R. Hoefer are with the Department of Electrical Engineering, University of Ottawa, Canada K1N 6N5.
S. R. Valluri is with the Department of Applied Mathematics, University of Western Ontario, London, Canada N6A 5B9.
IEEE Log Number 8719194.

[1]M. M. Ney, S. R. Valluri, W. Yue, G. I. Costache, and W. J. R. Hoefer, *IEEE Trans. Microwave Theory Tech*, vol MTT-35, pp 502–509, May 1987.

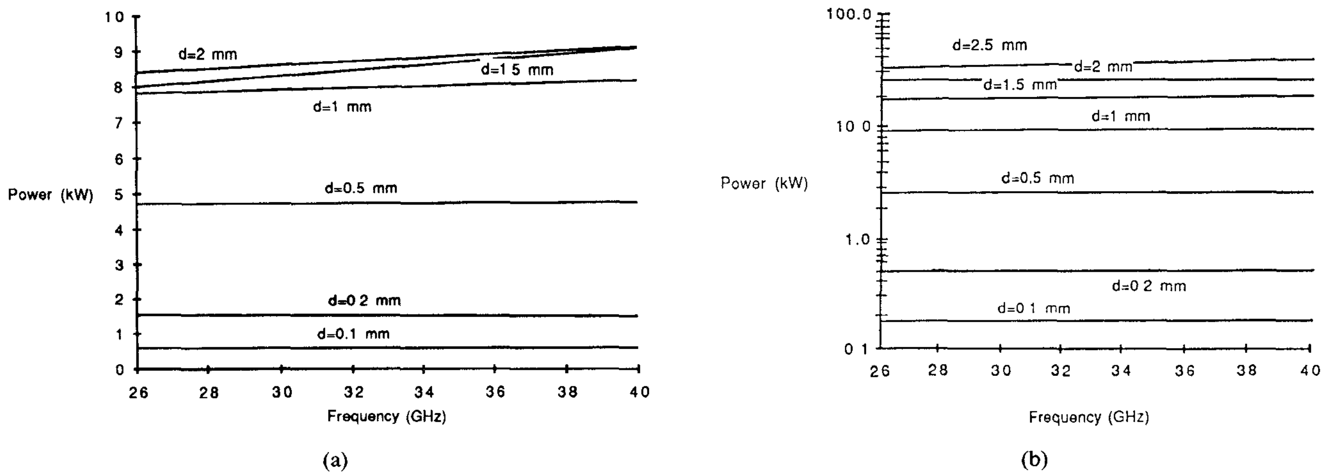

Fig. 7. Peak power-handling capability of (a) unilateral and (b) bilateral finline structures in WR-28 enclosures for different gap widths, evaluated with the finite element method; $g = 17\ \mu$m, and $\epsilon_r = 2.22$.

TABLE II
COMPARISON BETWEEN THE MAXIMUM PEAK POWER-HANDLING CAPABILITIES OF FINLINES AND OF CORRESPONDING WAVEGUIDE STRUCTURES

Maximum power (kW)	Unilateral Finline	Bilateral Finline	Empty waveguide
WR-28	7 82	10 2	128 2
WR-90	15 30	15 30	1160

Gap width = 1 mm. Finline dimensions as in Table I ($\epsilon_r = 2.22$).