Correction to "Microstrip Discontinuity Capacitances for Right-Angle Bends, T Junctions, and Crossings"

P. SILVESTER AND P. BENEDEK

In the above paper,[1] due to a programming error, Fig. 7 on page 345 for bend capacitance is incorrect and should appear as shown in the following. The other curves are not affected. Stephenson and Easter's [1] measured result, marked on the figure, is $C_{\text{bend}}/W = 159.79 \pm 6.37$ pF/m (for a 50-Ω microstrip line on $\epsilon_r = 9.9$ substrate, $w/h = 1$). This compares well with the calculated $C_{\text{bend}}/W = 155.5$ pF/m.

For $w/h > 1$, the bend capacitance was also checked using

$$C_{\text{bend}} = C_{\text{total}} - 2^*C_{OC} - 2^*C_l \quad (1)$$

with reference to Fig. 1 on page 342.[1] C_{total} was calculated using PARCAP [2], a new program for calculating the capacitance of a planar N-conductor system. The agreement was to better than 5 percent.

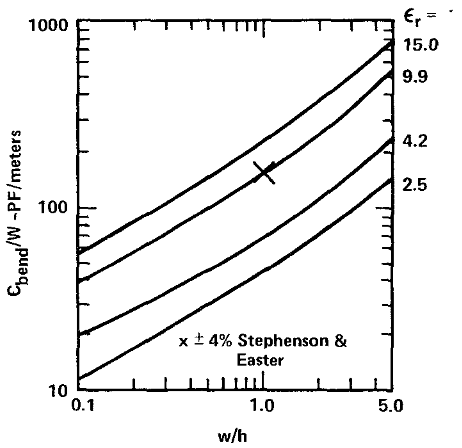

Fig. 7. Microstrip bend capacitance, normalized to strip width, as a function of width-to-height ratio and substrate permittivity.

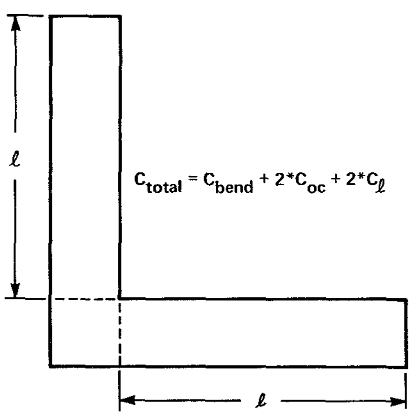

Fig. 1. Microstrip bend ($l \gg h$).

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[1] P. Silvester and P. Benedek, *IEEE Trans. Microwave Theory Tech.*, vol. MTT-21, pp. 341–346, May 1973.

REFERENCES

[1] I. M. Stephenson and B. Easter, "Resonant techniques for establishing the equivalent circuits of small discontinuities in microstrip," *Electron. Lett.*, vol. 7, pp. 582–584, Sept. 23, 1971.

[2] P. Benedek, "Capacitances of a planar multiconductor configuration on a dielectric substrate by a mixed-order finite-element method," in *Proc. IEEE Int. Symp. Circuits and Systems*, to be published.

Comments on "An S-Band Radiometer Design with High Absolute Precision"

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In the above paper,[1] a highly stable noise-balancing radiometer at 2.7 GHz for satellite applications, with a claimed absolute measurement precision of 0.1 K, is reported. The purpose of this letter is to indicate a source of calibration error which can be seriously underestimated.

The radiometer of Hardy *et al.* has a bidirectional coupler, which therefore injects $(T_0 - T_c)$ out of the antenna, as well as into the receiver. Although $(T_0 - T_c)$ is the correct noise level to balance the receiver with the antenna looking at free space, a voltage reflection coefficient Γ in front of the antenna results in the injected noise being modified by the feedback loop. For a narrow-band system ($l \cdot \Delta f \ll$ velocity of propagation) with $|\Gamma| \ll 1$, the new level of injected noise is

$$(T_0 - T_c) \cdot [1 + 2 \mid \Gamma \mid \cos (4\pi l/\lambda_0)]$$

to a very close approximation, where l is the probe-cryoload separation. Hardy [1] quotes $|\Gamma| = 0.01$ for the cryoload used, and $(T_0 - T_c) \approx 220$ K. Hence the calibration error could have maximum possible values of ± 4.4 K, although for the radiometer of Hardy *et al.*, $l \cdot \Delta f = 0.56 \times$ velocity of propagation, so that the maximum noise error is reduced by

$$\frac{\sin 1.12\pi}{1.12\pi} \approx 0.1.$$

This reduces the maximum possible error to ± 0.44 K. The preceding considerations are for a radiometer with single input; for reception of circular polarization, the situation is improved since circular polarization directions are reversed on reflection. Ideally, this should reduce the effect to a negligible magnitude; experimentally, the cross polarization of the cryogenic load and the limited bandwidth of the quarter-wave plate will somewhat limit this improvement. The preceding expression is, of course, a simplification, since the horn and transducer have significant fixed reflection coefficients;

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[1] W. N. Hardy, K. W. Gray, and A. W. Love, *IEEE Trans. Microwave Theory Tech.*, vol. MTT-22, pp. 382–390, Apr. 1974.