Letters

Corrections to "The Scattering Parameters and Directional Coupler Analysis of Characteristically Terminated Asymmetric Coupled Transmission Lines in an Inhomogeneous Medium"

Krzysztof Sachse

Haste in preparing the above paper[1] unfortunately entailed certain errors in equations (3), (6), (10a), (11), and (12). These consist in either a change of sign or index or omission of terms in the expressions. Equations (3), (6), (9), (10a), and (11) should be written as follows:

$$\delta_r(v_r) = (\beta_1 + \beta_r)(\beta_{2(1)} - \beta_r)(\beta_2 + \beta_r) - \beta_1\beta_2(\beta_{2(1)} + \beta_r)s^2 - \beta_1\beta_2(\beta_{2(1)} - \beta_r)d^2 \tag{3}$$

$$q = \frac{\sqrt{\beta_1\beta_2}\,s}{\beta_2 + \beta_c} = \frac{\beta_2 - \beta_\pi}{\sqrt{\beta_1\beta_2}\,s} \tag{6}$$

$$T_{23} = -T_{14}^* \tag{9}$$

$$S_{24} = S_{42} = S_{13}e^{j2\theta u} \tag{10a}$$

$$b_3 = 2\sqrt{\beta_1\beta_2}\,s\beta_2/b \qquad b_4 = 2\sqrt{\beta_1\beta_2}\,s\beta_1/b$$

$$a = (\beta_1 + \beta_c)(\beta_2 - \beta_c) - \beta_1\beta_2 s^2$$

$$b = (\beta_2 + \beta_\pi)(\beta_1 - \beta_\pi) - \beta_1\beta_2 s^2. \tag{11}$$

The pq^2 factor in the expressions (12) for the parameters $d_{21}, \cdots, d_{34}$ should be replaced with $(pq)^2$. Moreover, the parameters d_{12}, d_{42}, and d_{13} in (12) should be written as follows:

$$d_{12} = (pq)^2\left(c_{12} + \frac{1}{q}c_{43} - qc_{42} - \frac{1}{q^2}c_{13}\right)e^{j\theta_c}(d/s)$$

$$d_{42} = (pq)^2\left(-q^2c_{12} - \frac{1}{q}c_{43} + c_{13} + qc_{42}\right)e^{-j\theta_\pi}(d/s)$$

$$d_{13} = (pq)^2\left(-\frac{1}{q}c_{12} - c_{43} + c_{42} + \frac{1}{q}c_{13}\right)e^{j\theta_c}(d/s). \tag{12}$$

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The author is with the Institute of Telecommunication and Acoustics, Wroclaw Technical University, Wyb. Wyspianskiego 27, 50-370 Wroclaw, Poland.

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[1] K. Sachse, *IEEE Trans. Microwave Theory Tech.*, vol. 38, pp. 417–425, Apr. 1990.

Comments on "Formulas Useful for the Synthesis and Optimization of General, Uniform Contradirectional Couplers"

Krzysztof Sachse

In the above paper[1] explicit formulas that allow the evaluation and optimization of a very general class of contradirectional couplers are derived using a Y-parameter matrix given by Tripathi [1, eq. (22)]. An asymmetric, lossless, uniformly coupled line 4-port with line length l, lumped equalizing capacitors C_p, a source with admittance Y_G at port 1, and loading admittances Y_{1T} at port 4 and Y_{2T} at ports 2 and 3 is considered. Certain useful relations between the 4-port S parameters and these external loads assumed as real entities are determined in order to optimize conditions for contradirectional coupler operation. The optimization is carried out—using the proposed iterational procedure—by choosing C_p, Y_G, Y_{1T}, Y_{2T}, and length l in such a way that the coupler is perfectly matched and isolated at any chosen frequency. Specialized cases of a homogeneous coupler, a symmetric coupler, and couplers optimized with and without using capacitors are discussed, but there is nothing about the ideal asymmetric inhomogeneous coupled line coupler [2], [3] perfectly matched and isolated at all frequencies.

The S parameters of the couplers are expressed by admittances Y_G, Y_{1T}, and Y_{2T} and normal-mode parameters of asymmetric coupled lines (voltage mode numbers R_c and R_π and mode admittances Y_{c1} and $Y_{\pi 1}$). Some of the formulas contain square roots of the expressions $(-R_cR_\pi)$ and $Y_{c1}Y_{\pi 1}$, which, as noted by the author of the paper in question, can be negative. Those formulas can always be used because they are always combined in such a way that no complication arises. There are no references which could confirm that the mentioned case of unusual behavior of normal-mode parameters exists, and there is no analysis of the coupler which has $(-R_cR_\pi) < 0$ together with $Y_{c1}Y_{\pi 1} < 0$. Usually $(-R_cR_\pi) > 0$ and mode admittances Y_{c1} and $Y_{\pi 1}$ are positive. In the literature there are many papers presenting the characteristics of normal-mode parameters for several structures of asymmetric coupled lines. Only in [2]–[4], to our knowledge, has this unusual behavior of coupled line parameters been numerically revealed. The first of them, [4], gave rise to considerable discussion and controversy.

Limiting the discussion to the cases of a homogeneous coupler, a symmetric coupler, and couplers with and without equalizing capacitors in the paper dealing with general, uniform contradirectional couplers makes it possible to restate the principles of the new coupler [2], [3] whose ideal properties do not

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The author is with the Institute of Telecommunication and Acoustics, Wroclaw Technical University, Wyb. Wyspianskiego 27, 50-370 Wroclaw, Poland.

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[1] F. Sellberg, *IEEE Trans. Microwave Theory Tech.*, vol. 38, pp. 1000–1010, Aug. 1990.