Letters

Comments on "GaAs Dual-Gate FET for Operation up to K-Band"

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In the above paper,[1] the authors have discussed some fundamental properties of dual-gate FET's valid from X-band up to K-band.

The resulting Y matrices for both FET parts and the overall FET are presented in table I of their paper. In their derivation it is assumed that the output impedance of the first FET is larger than the input impedance of the second FET with a low-impedance second gate termination. Based on the matrices in table I, the authors are able to algebraically present some important properties of the device in question.

I have rederived their expressions and found errors and algebraically inconsistent expressions compared with my expressions, even with the appropriate approximations taken into account.

First, let us correct some errors and secondly comment on their resulting Y matrices in general. Network equations are corrected and rewritten as they should appear from this author's point of view.

Consider table I in their paper in the column for the "first FET." The expression for Y_{d1} should read

$$Y_{d1} = Z_{\text{in1}}(1 + j\omega C_{dg1} Z_{\text{out1}})/[Z_{\text{out1}}(Z_{\text{in1}} - jR_{s1}B_1)]$$

In the column for the "second FET," the Y_{d2} expression subscript $(\ )_{dg1}$ should read $(\ )_{dg2}$.

In the Y_{mg2} expression, the subscript $(\ )_{dg1}$ should read $(\ )_{dg2}$.

Now, let us move to some numbered equations that appear in the above paper. Equation (10) should read

$$G_u \approx G_{us} \frac{B_2^2}{F_b} (R_{ds2}/R_{ds1}). \tag{10'}$$

Manuscript received October 22, 1987.

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IEEE Log Number 8821073.

[1] B. Kim, H. Q. Tserng, and P. Saunier, *IEEE Trans. Microwave Theory Tech.*, vol MTT-32, pp. 256–261, Mar. 1984.

Equation (11a) should read

$$G_{us} \approx \frac{1}{4} B_1^2 \left(\frac{R_{ds1}}{R_{i1} + R_{g1} + R_{s1}} \right). \tag{11'a}$$

Equation (14) should read

$$(k)_{\text{single}} \approx \frac{2(R_{i1} + R_{g1} + R_{s1})}{|Z_{\text{in1}} - jR_{s1}B_1| R_{ds2} g_{m1} (C_{dg1}/C_{gs1})}. \tag{14'}$$

Equation (15) should read

$$Y_{12} \approx (Y_{12})_{\text{single}} \left(\frac{Z_{\text{in2}}}{Z_{\text{out2}}(1 - jB_2)} + j\omega C_{dg2} Z_{rf} \right) - j\omega C_f. \tag{15'}$$

Equation (16) should read

$$MSG \approx \left| B_1 B_2 Y_{g1} \Big/ \left[j\omega C_f (1 - jB_2) + \left(j\omega C_{dg1} + \frac{R_{s1} Y_{g1}}{Z_{\text{out1}}} \right) \left(\frac{Z_{\text{in2}}}{Z_{\text{out2}}} + j\omega C_{dg2} Z_{\text{rf}} (1 - jB_2) \right) \right] \right|. \tag{16'}$$

If we go back to table I, we see that in the derivation of the first FET Y matrix, two different approximations are used.

The Y_{g1} and Y_{md1} expressions result from the use of one particular approximation. The Y_{d1} and Y_{mg1} expressions result from the use of a second (stronger) approximation; i.e., more terms are taken into account. In the Y_{mg1} expression, we should have a denominator with the term $-j\omega C_{dg1}$ not equal to one, as in the referenced paper.

In the derivation of the second FET Y matrix we see the use of —in principle—the same kind of approximations as mentioned above. However, the expressions for Y_{d2} and Y_{mg2} should read $(Y_{d2} - j\omega C_{ds})/D_{\text{tot}}^{\text{II}} + j\omega C_{ds}$ and $Y_{mg2}/D_{\text{tot}}^{\text{II}}$, respectively. Where

$$D_{\text{tot}}^{\text{II}} = 1 + R_{g2} Y_{11}^{\text{II}} + R_{d2} Y_{22}^{\text{II}} + R_{g2} R_{d2} \det Y^{\text{II}}.$$

The notation should be self-instructive for the authors.