Handin 1: Extraction of extrinsic parameters.

Marcus Malmquist, marmalm, 941022

January 29, 2017

1 Task 1

In this section I describe the method I used to extract the values of the extrinsic components. This method was proposed by Dambrine and Gao.

1.1 Extrinsic resistances and inductances

The equations (proposed by Dambrine) used to extract the parasitic resistances and inductances at the gate, drain and source can be seen in (1). Some necessary values can be seen in Figure 1.

$$\mathbf{Z} = \begin{bmatrix} R_s + R_g + \frac{R_c}{3} + \frac{nkT}{qI_g} + j\omega(L_s + L_g) & R_s + \frac{R_c}{2} + j\omega L_s \\ R_s + \frac{R_c}{2} + j\omega L_s & R_s + R_d + j\omega(L_s + L_d) \end{bmatrix} \quad (1)$$

The matrix $\mathbf{Z}$ can be found by conversion from the scattering matrix $\mathbf{S}$. The values of R_g, R_d, R_s, L_g, L_d and L_s can be seen inductances Figure 1.

1.2 Extrinsic capacitances

The equations (proposed by Gao) used to extract the parasitic capacitances between gate and source, drain and source as well as gate and drain can be seen in (2). Some necessary values can be seen in Figure 2.

$$\mathbf{Y} = \begin{bmatrix} \omega(C_{pg} + C_{pgd} + W(C_{gspo} + C_{gdpo})) & -\omega(C_{pgd} + WC_{gdpo}) \\ -\omega(C_{pgd} + WC_{gdpo}) & \omega(C_{pd} + C_{pgd} + W(C_{dspo} + C_{gdpo})) \end{bmatrix} \quad (2)$$

The matrix $\mathbf{Y}$ can be found by conversion from the scattering matrix $\mathbf{S}$. The values of C_{pg}, C_{pgd} and C_{pgd} can be seen in Figure 2.
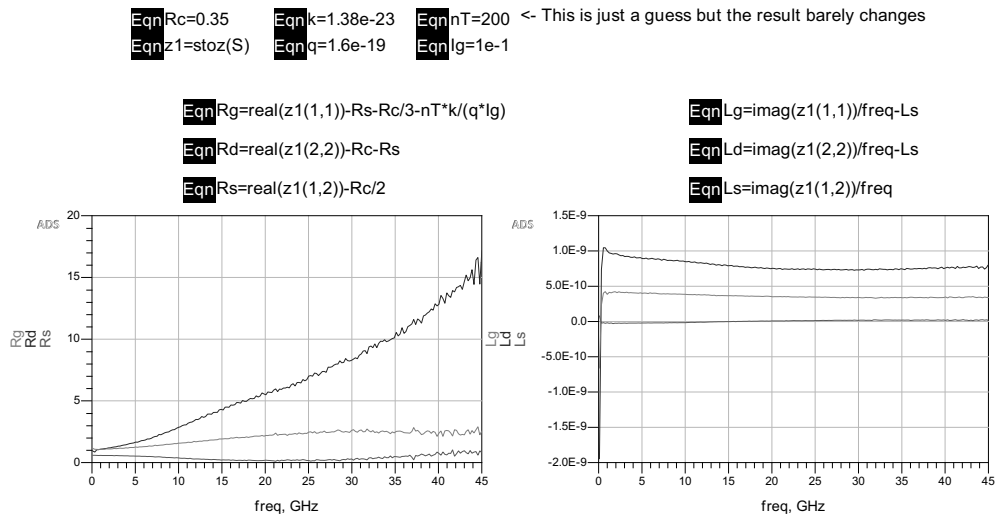
Eqn Rc=0.35   Eqn k=1.38e-23   Eqn nT=200   <- This is just a guess but the result barely changes
Eqn z1=stoz(S)   Eqn q=1.6e-19   Eqn lg=1e-1

Eqn Rg=real(z1(1,1))-Rs-Rc/3-nT*k/(q*lg)   Eqn Lg=imag(z1(1,1))/freq-Ls

Eqn Rd=real(z1(2,2))-Rc-Rs   Eqn Ld=imag(z1(2,2))/freq-Ls

Eqn Rs=real(z1(1,2))-Rc/2   Eqn Ls=imag(z1(1,2))/freq

Figure 1: The extrinsic resistances and inductances plotted versus the frequency.

W in mm; Cgspo, Cgdpo, Cdspo in fF/mm

Eqn W=1.000 Eqn Cgspo=228e-15 Eqn Cdspo=181e-15
Eqn y1=stoy(S) Eqn Cgdpo=155e-15

Eqn Cpg=imag(y1(1,1))/freq-W*(Cgspo+Cgdpo)-Cpgd
Eqn Cpd=imag(y1(2,2))/freq-W*(Cdspo+Cgdpo)-Cpgd
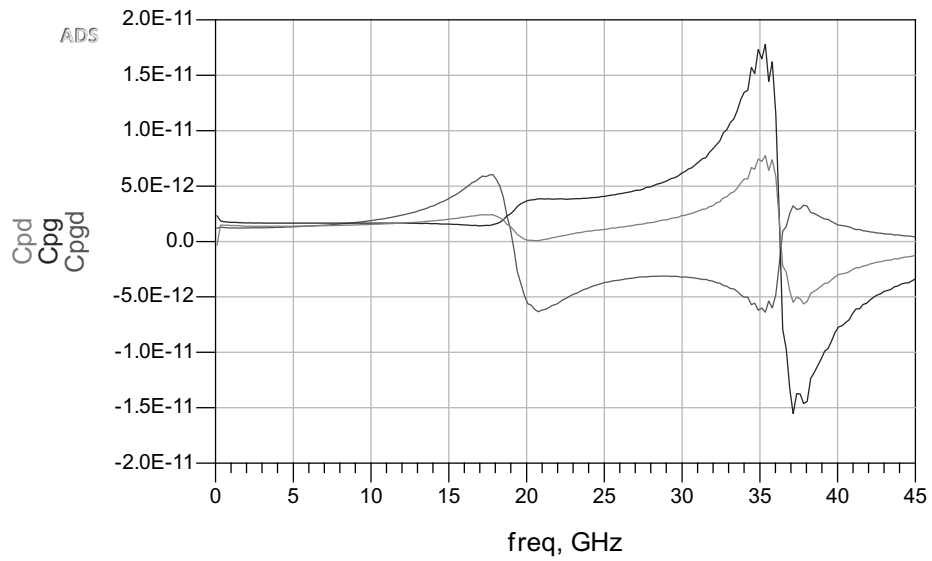Eqn Cpgd=-imag(y1(1,2))/freq-W*Cgdpo

Figure 2: The extrinsic resistances and inductances plotted versus the frequency.