

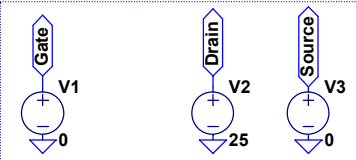
Angelov Model Equivalent Circuit

(with charge implementation)

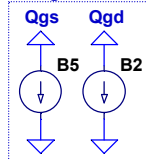
Simulation Command

```
.dc V1 -15 15 .1 V2 5 50 5
.step param Vds list 10 20 30 40 50
```

Sources



Charge Calculation



Rc Function

```
.func calcRc (Rcmin, R_c, tau) {Rcmin + R_c / (1 + tanh(tau))}
```

Igs/Igd Functions

```
.func Igs (Vgsc) {Ij * ( exp(Pg * tanh(Vgsc - Vjg) ) - exp(-Pg * Vjg) )}
.func Igd (Vgdc) {Ij * ( exp(Pg * tanh(Vgdc - Vjg) ) - exp(-Pg * Vjg) )}
```

Charge Implementation Functions Pt. 1

```
.func Phi1 (Vgsc, Vds) {P10 + P11 * Vgsc + P111 * Vds}
.func Phi2 (Vds) {P20 + P21 * Vds}
.func Phi3 (Vds) {P30 - P31 * Vds}
.func Phi4 (Vgdc, Vds) {P40 + P41 * Vgdc - P111 * Vds}
```

Ids Functions

```
.func Vpkm (Vds) {Vpks - Dvpks + Dvpks * tanh(Alphas*Vds)}
.func Psi (Vgs,Vds) {P1 * (Vgs - (Vpks - Dvpks + Dvpks * tanh(Alphas*Vds)))}
.func Alpha (Vgs,Vds) {Alpha + Alphas * (1 + tanh(P1 * (Vgs - (Vpks - Dvpks + Dvpks * tanh(Alphas*Vds)))))}
.func Ids (Vgs,Vds,Vdg) {Ipk0*(1+tanh(P1*(Vgs-(Vpks-Dvpks+Dvpks*tanh(As*Vds))))*tanh((Ar+As*(1+tanh( P1*(Vgs-(Vpks-Dvpks+Dvpks*tanh(As*Vds)))))**Vds)*(1+Lambda*Vds+Psi(Vgs,Vds))))}
```

Charge Implementation Functions Pt. 2/2

```
.func Lc1 (x_Phi1) {ln(cosh(x_Phi1))}
.func Lc10 (Vds) {ln(cosh(P10 + P111 * Vds))}
.func Qgs0 (Vds, x_Lc10) {P10 + P111 * Vds + x_Lc10}
.func Qgs (Vgsc, x_Phi1, x_Lc1, x_Qgs0, x_Phi2) {Cgspi * Vgsc + Cgs0 * ( (x_Phi1 + x_Lc1 - x_Qgs0) * (1 - P111 + tanh(x_Phi2)) / P11 + 2 * P111 * Vgsc )}
.func Lc4 (x_Phi4) {ln(cosh(x_Phi4))}
.func Lc40 (Vds) {ln(cosh(P40 - P111 * Vds))}
.func Qgd0 (Vds, x_Lc40) {P40 - P111 * Vds + x_Lc40}
.func Qgd (Vgdc, x_Phi4, x_Lc4, x_Qgd0, x_Phi3) {Cgdpi * Vgdc + Cgd0 * ( (x_Phi4 + x_Lc4 + x_Qgd0) * (1 - P111 + tanh(x_Phi3)) / P41 + 2 * P111 * Vgdc)}
```

Parameters from MDIF

```
.param Sample={28} Idsmod={0} Igmod={1} Capmod={2} Ipk0={0.514349} Vpks={-1.53444} Dvpks={0.294994} P1={0.56757} P2={-0.0586053} P3={0.296868} Alpha={0.997126} Alp
.param Lambda={0.00879765} B1={0} B2={3} Lsb0={0.007} Vtr={200} Cds={7.65344e-13} Cgspi={1.689e-12} Cgs0={3.20166e-13} Cgdpi={1.127e-13} Cgd0={3.49431e-13} Cgdpe={0}
.param P11={1.71715} P20={1.43116} P21={3.58465} P30={1.57127} P31={2.25911} P40={1.79639} P41={0.103924} P111={0.0928397} Ij={0.0713869} Pg={18.4065} Vjg={1.48915} Rg
.param Rd={3.001} Rs={0.5035} Ri={2.13233} Rgd={52.1222} Lg={8.8542e-11} Ld={8.388e-11} Ls={0} Tau={2.40378e-12} Rcmin={233.77} Rc={2.08053} Crf={1.5e-08} Rth={9.5}
.param Cth={0.001} Tc1pk0={-0.00272725} Tc1p1={-0.00171529} Tccgs0={0} Tccgd0={0} Tccrf={0} Tnom={25} Selft={1} Cpg={1.766e-13} Cpd={1.714e-13}
.param Ar={Alpha} As={Alphas}
```

