

EKV Extracted Parameters to EKV SPICE Model

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EKV Extracted Parameters

You can get physical parameters out of the reduced EKV model with IV sweeps of transistors

Gate Sweep

1. Weak Inversion: $\kappa, I_0, I_{th}, V_{th}$
2. Strong Inversion: $K\kappa, I_{th}, V_{th}$

Drain Sweep

1. Weak Inversion: σ
2. Strong Inversion: V_A

Source Sweep

1. Weak Inversion: U_T
2. Strong Inversion: $\frac{K}{\kappa}$

EKV SPICE Model

The LTSPICE EKV Model [1] uses the EKV model from a group in Switzerland [2]. In LTSPICE it seems that the main parameters used are γ , V_{t0} , ϕ , and K_p . Each of these has analogs to what was extracted from the IV curves.

GAMMA (γ)

In [3], a more simplified version of the EKV model is presented that makes approximations to ease extraction parameters. From this I get

$$\begin{aligned}\gamma &= \frac{\sqrt{2p\epsilon_s 10^6}}{C_{ox}} \\ C_d &= \frac{\sqrt{p\epsilon_s 10^6}}{\sqrt{2\phi_s}} \\ \kappa &= \frac{C_{ox}}{C_{ox} + C_{dep}} \\ \phi_{s,max} &= 2\phi_f\end{aligned}$$

If we rearrange all the variables and solve, we can get the following expression

$$\gamma = 2\sqrt{2\phi_f} \left(\frac{1}{\kappa} - 1 \right)$$

Threshold Voltage (V_{t0})

This is directly extracted from a gate sweep.

$$V_{t0} = V_{th}$$

PHI (ϕ)

The bulk surface potential is coupled to the expression for γ we derived. Probably best to just iterate on this one, starting with default values you can get from [1-3].

KP (K_p)

In [2] K_p is defined as

$$K_p = C_{ox} U_0 10^{-4}$$

We know that

$$K = \mu C_{ox} \frac{W}{L}$$

so its just scaled by the transistor dimensions

$$K \approx K_p$$

References

1. https://ltwiki.org/LTspiceHelp/LTspiceHelp/M_MOSFET.htm
2. Bucher, Matthias, Christophe Lallement, Christian C. Enz, Fabien Théodoloz and François Krummenacher. "The EPFL-EKV MOSFET Model Equations for Simulation." (1998).
3. Godfrey, Michael and Lazzaro, John. (1997). A Device Model for Analog VLSI Circuits.