UNAMBIGUOUS EXTRACTION OF THE THRESHOLD VOLTAGE BASED ON THE ACM MODEL

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ABSTRACT

THIS WORK PRESENTS A VERY SIMPLE METHODOLOGY FOR DETERMINING THE MOSFET THRESHOLD VOLTAGE WITH NEGLIGIBLE INFLUENCE OF PARASITIC RESISTANCES, TRANSVERSAL FIELD DEGRADATION AND SHORT-CHANNEL EFFECTS.

ACM MODEL

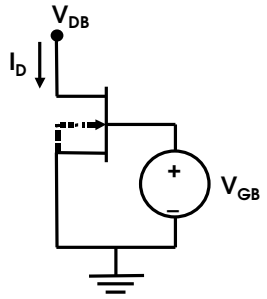
$$I_D = I_S(i_f - i_r) \qquad I \quad C \quad n\frac{2}{2}\frac{W}{L}$$

$$V_P - V_{S(D)B} = \phi_t\left[\sqrt{1+i_{f(r)}} - 2 + \ln\left(\sqrt{1+i_{f(r)}} - 1\right)\right]$$

$$V_P = \frac{V_{GB} - V_{T0}}{n}$$

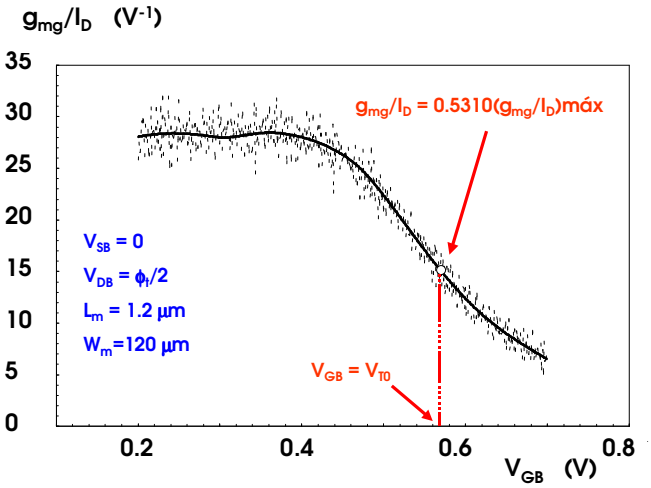
$$\frac{g_{mg}}{I_D} = \left(\frac{g_{mg}}{I_D}\right)_{max}\frac{2}{\left(\sqrt{1+i_f} + \sqrt{1+i_r}\right)}$$

EXTRACTION OF THE THRESHOLD VOLTAGE:



Linear region

moderate and weak inversion



For $i_f = 3$ and $V_{DS} = \phi_t/2$:

$$\sqrt{1+i_r} + \ln\left(\sqrt{1+i_r} - 1\right) = 1.5 \Rightarrow i_r = 2.11196$$

$$\frac{g_{mg}}{I_D} = 0.5310\left(\frac{g_{mg}}{I_D}\right)$$

EXPERIMENTAL RESULTS

L_m(μm)	V_{T0} (V) - NMOSFET			V_{T0} (V) - PMOSFET		
	ELR	SDL	Proposed method	ELR	SDL	Proposed method
0.4	0.567	0.559	0.590	-0.703	-0.679	-0.729
0.6	0.567	0.562	0.600	-0.713	-0.730	-0.745
0.8	0.561	0.542	0.584	-0.711	-0.694	-0.740
1.2	0.553	0.526	0.570	-0.709	-0.673	-0.720
1.6	0.546	0.524	0.564	-0.705	-0.670	-0.722
4.0	0.532	0.505	0.545	-0.692	-0.657	-0.706