

## From Behzad Razavi: "Design of Analog CMOS Integrated Circuits"

pp.13..14

In weak inversion,  $n$  is approximately 1.4–1.5 for typical bulk CMOS processes, but can be as low as 1.1 [4] for fully depleted (FD) silicon-on-insulator (SOI) CMOS processes where there is little substrate effect.  $n$  drops slightly with increasing inversion level (increasing  $V_{EFF} = V_{GS} - V_T$ ) and is approximately 1.35 in moderate inversion and 1.3 in strong inversion for typical bulk CMOS processes.

From David M. Binkley: "Tradeoffs and Optimization in Analog CMOS Design"  
p. 14

In weak inversion,  $n$  is the weak inversion slope factor that describes the degradation of exponential MOS drain current compared to bipolar transistor collector current where the equivalent value of  $n$ , the emitter injection efficiency, is very close to unity. Often the MOS weak inversion slope factor is expressed by the weak inversion or subthreshold swing given by

$$S = \ln(10)nU_T = 2.303 \cdot nU_T \quad (\text{mV/decade}) \quad (2.7)$$

This is the required increase in gate–source voltage for a factor-of-10 increase in drain current. The weak inversion swing is approximately 90 mV/decade for bulk CMOS processes at room temperature, assuming  $n = 1.5$  and  $U_T = 25.9$  mV.

pp. 42..43      PROCESS PARAMETERS FOR EXAMPLE PROCESSES

Parameter	Description	nMOS	pMOS
$n$	Substrate factor (average moderate inversion value, $V_{sb}=0$ )		
	0.5 $\mu\text{m}$	1.4	1.35
	0.35 $\mu\text{m}$ , PD SOI	1.4	1.35
	0.18 $\mu\text{m}$	1.35	1.35

pp. 89, 115 & 121

... the substrate factor,  $n$ , which has typical values of 1.4, 1.35, and 1.3 in weak, moderate, and strong inversion for typical bulk CMOS processes.