RTL inverters

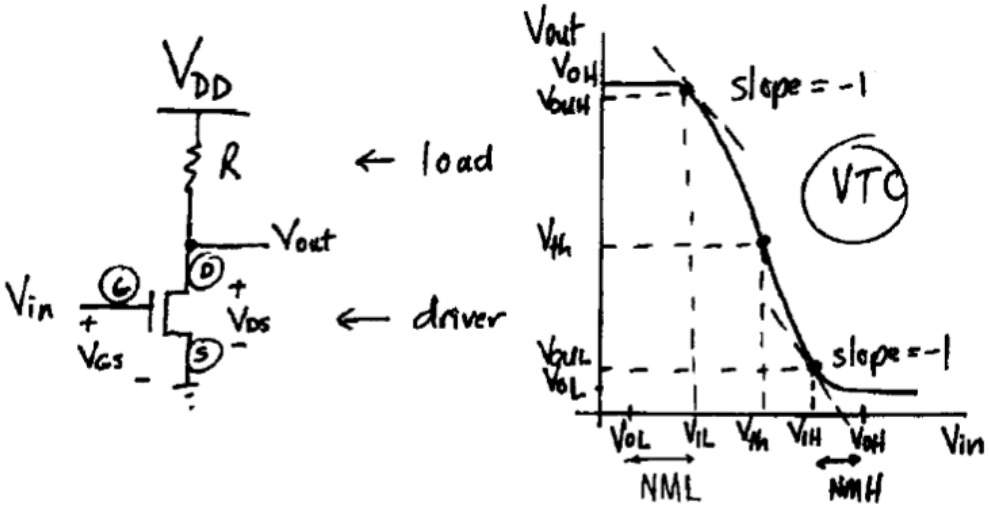

Figure 1: RTL VTC

$$\frac{V_{DD} - V_{out}}{R} = \frac{k_n}{2}(E_{CN}L_N)\frac{(V_{th} - V_{TN})^2}{V_{th} - V_{TN} + E_{CN}L_N} \tag{1}$$

SCM model of V_{th}

$$\frac{V_{DD} - V_{out}}{R} = \frac{k_n}{2}(V_{th} - V_{TN})^2 \tag{2}$$

LCM model of V_{th}

Noise margin low (NML) $= V_{IL} - V_{OL}$
Noise margin high (NMH) $= V_{OH} - V_{IH}$

V_{OL}

$$\frac{k_n}{1 + \frac{V_{OL}}{E_{CN}L_N}}\left[(V_{DD} - V_{TN})V_{OL} - \frac{{V_{OL}}^2}{2}\right] = \frac{V_{DD} - V_{OL}}{R} \tag{3}$$

SCM model of V_{OL}

$$V_{OL} = \frac{V_{DD}}{1 + k_n R(V_{DD} - V_{TN})} \tag{4}$$

LCM model of V_{OL}

CMOS Inverter

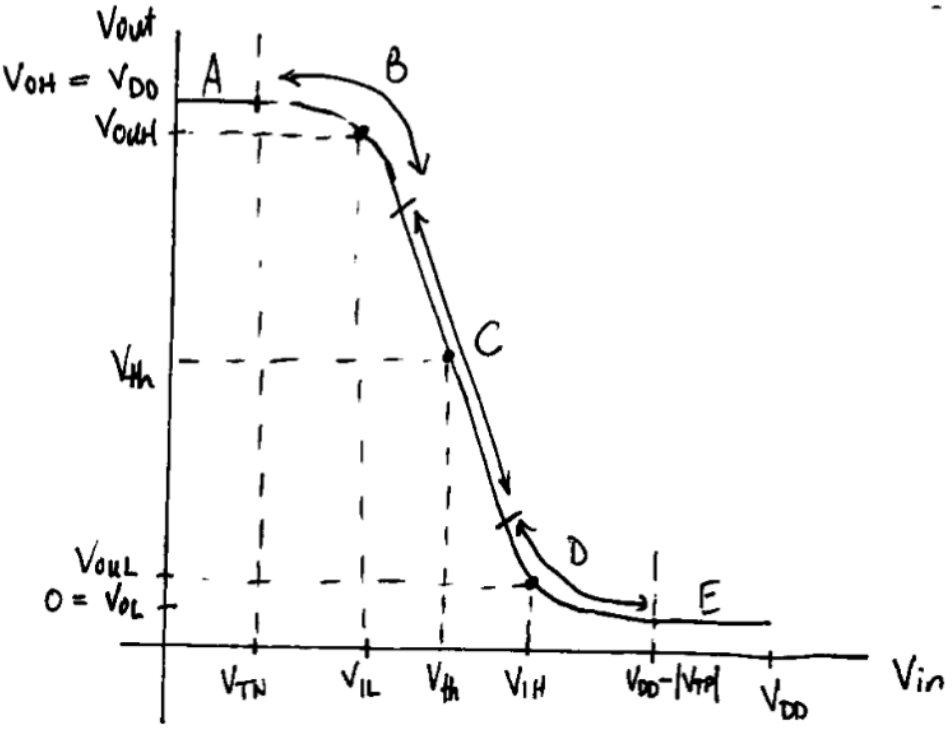

Figure 2: CMOS VTC

Range	PMOS	NMOS
A	OFF	ON
B	SAT	TRI
C	SAT	SAT
D	SAT	TRI
E	ON	OFF