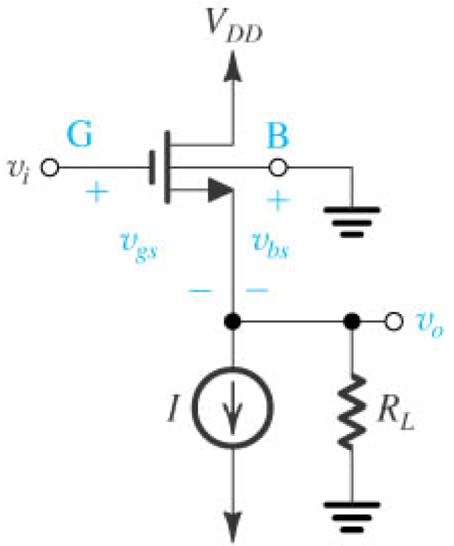
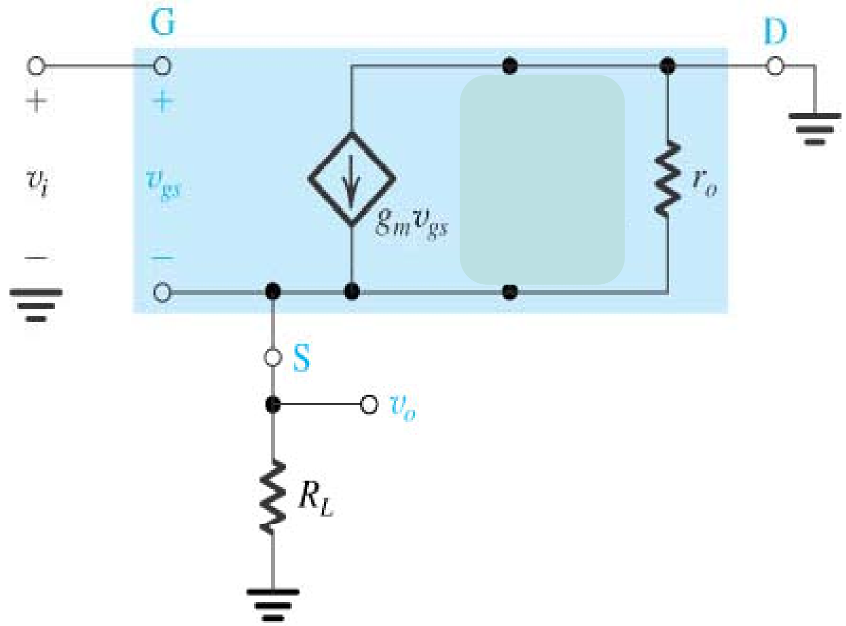
Lect. 27: Source Follower (Razavi 7.4)

Ignoring body effect



Source Follower
(Common-Drain Amplifier)

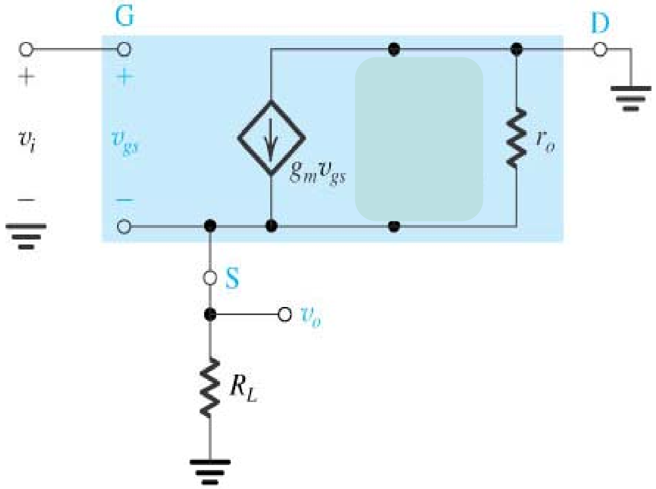


R_{in} =

$R_{out} = 1/g_m \parallel r_o$

Lect. 27: Source Follower

Voltage Gain



$$v_o = g_m v_{gs}\left(r_o \parallel R_L\right)$$

$$v_{gs} = v_i - v_o$$

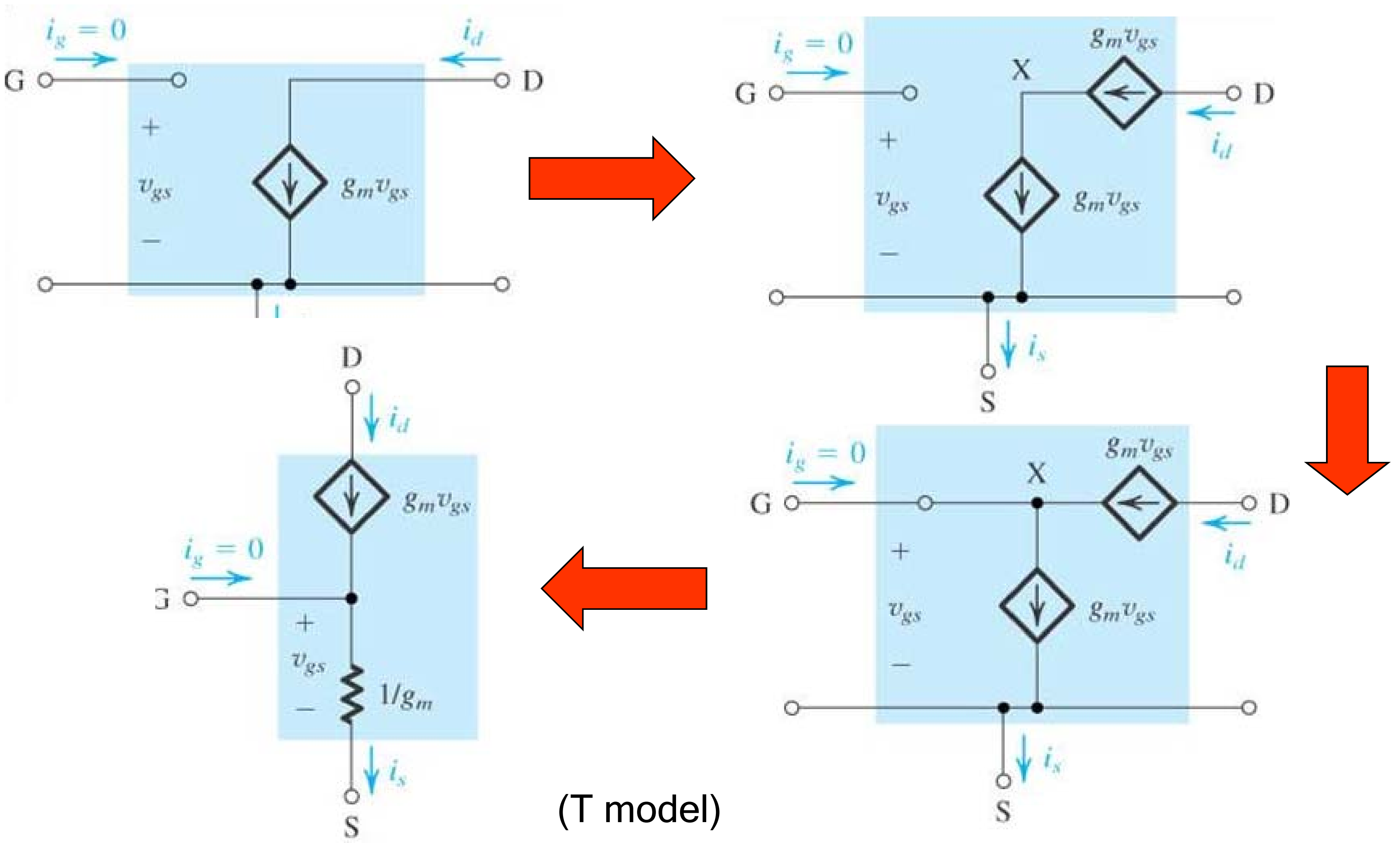
$$v_o = g_m(v_i - v_o)\left(r_o \parallel R_L\right)$$

$$v_o(1 + g_m \cdot r_o \parallel R_L) = v_i g_m \cdot r_o \parallel R_L$$

$$\therefore \frac{v_o}{v_i} = \frac{g_m \cdot r_o \parallel R_L}{1 + g_m \cdot r_o \parallel R_L}$$

$$= \frac{r_o \parallel R_L}{\frac{1}{g_m} + r_o \parallel R_L}$$

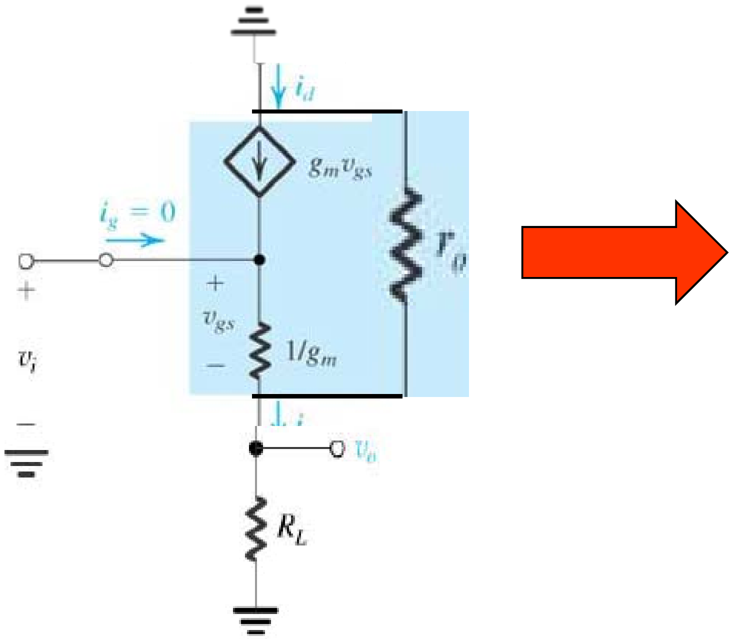
Lect. 27: Source Follower

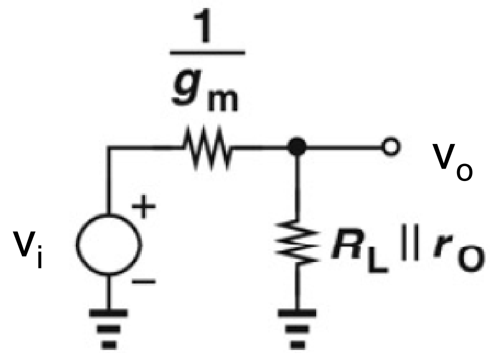


(T model)

Lect. 27: Source Follower

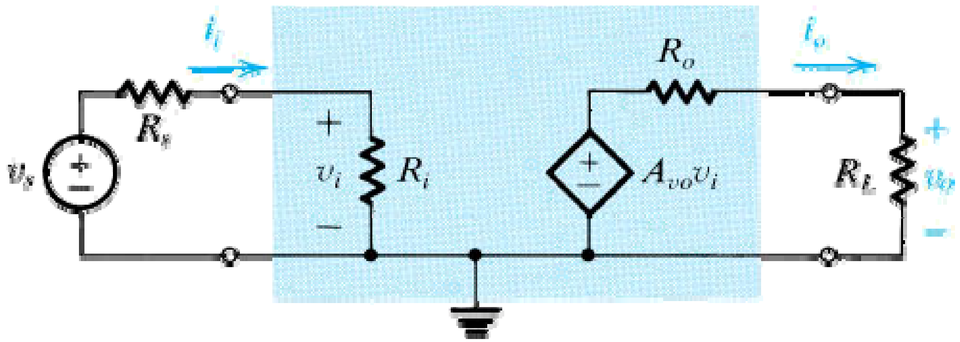
Voltage Gain using the T-model?





$$\therefore \frac{v_o}{v_i} = \frac{r_o \| R_L}{\frac{1}{g_m} + r_o \| R_L}$$

Lect. 27: Source Follower

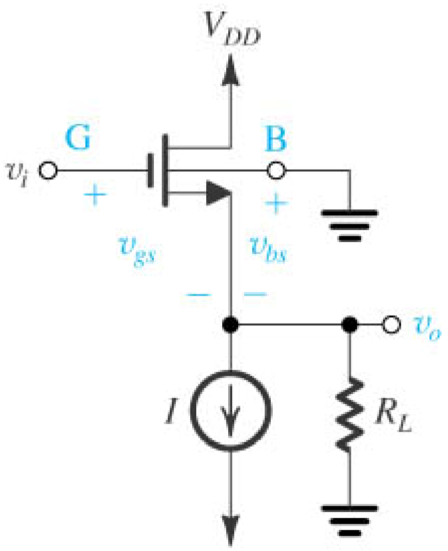


$$v_o = \frac{R_L}{R_L + R_o} A_{vo} v_i = \frac{R_L}{R_L + R_o} A_{vo} \frac{R_i}{R_i + R_s} v_s \quad \sim v_s$$

Source Follower: Large R_i, Small R_o, A_{vo} close to one

➔ Voltage buffer

Lect. 27: Source Follower



For $v_I = V_I + v_i$

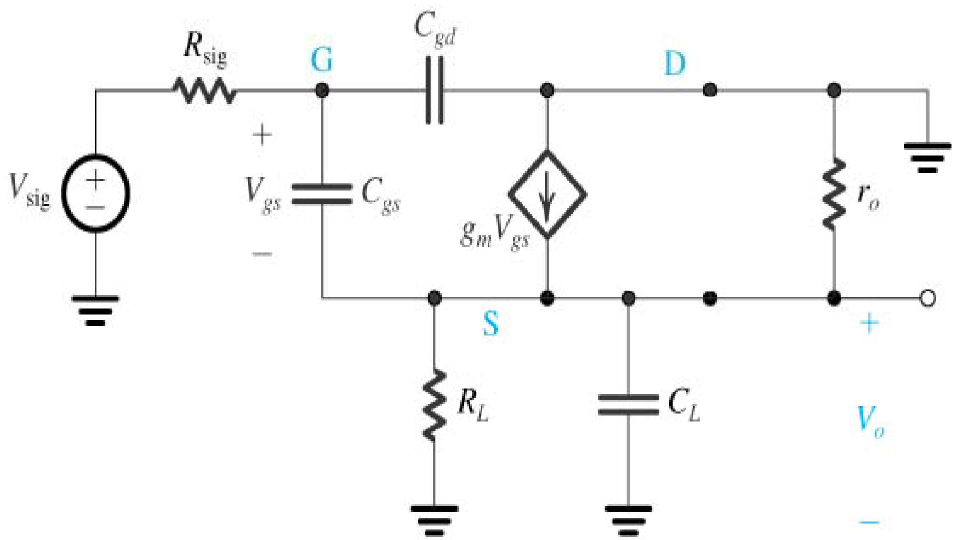
$v_O = V_O + v_o = V_O + v_i$

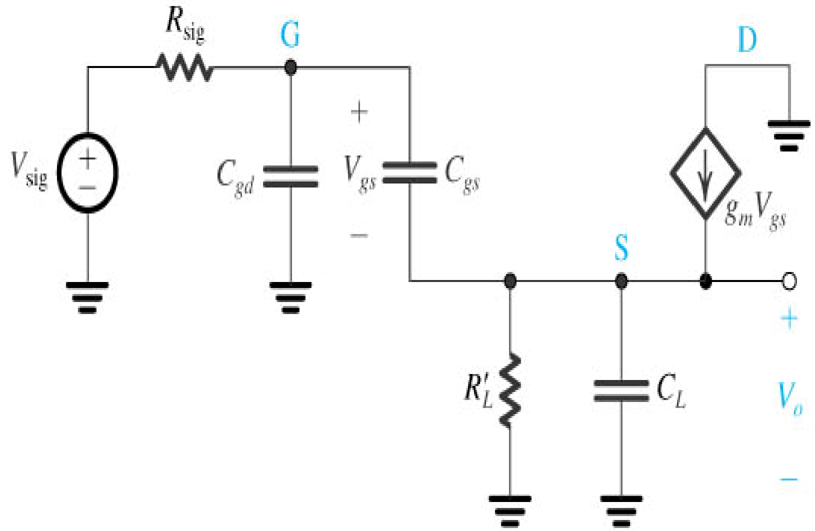
v_O shifts v_I by the amount of $(V_I - V_O = V_{GS})$

➔ Level shifter

Lect. 27: Source Follower

Frequency Response





Miller Effect?

Source Follower is fast!