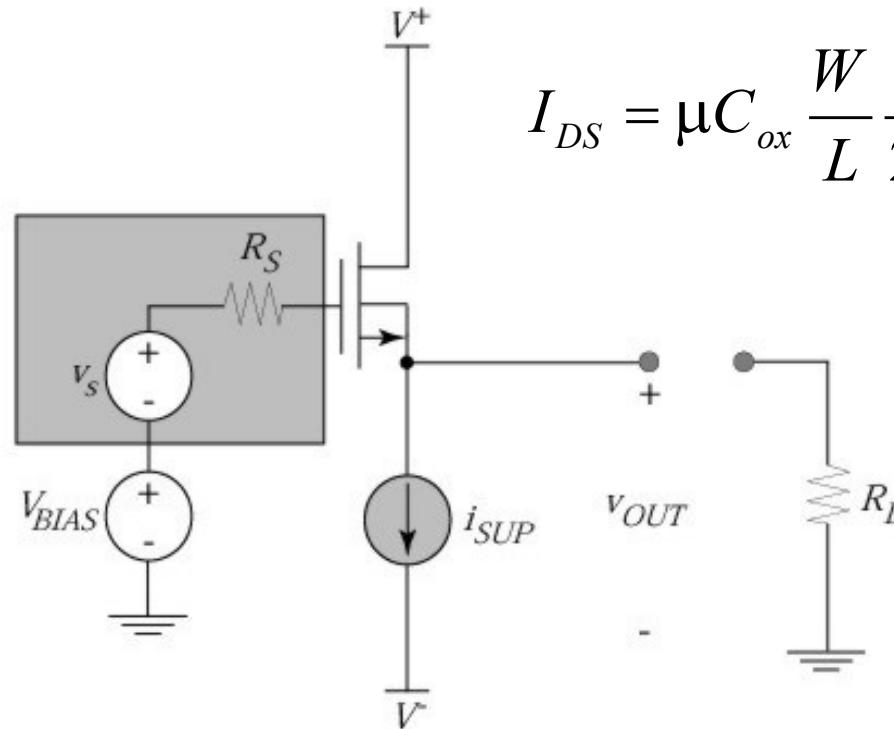


Common-Drain Amplifier

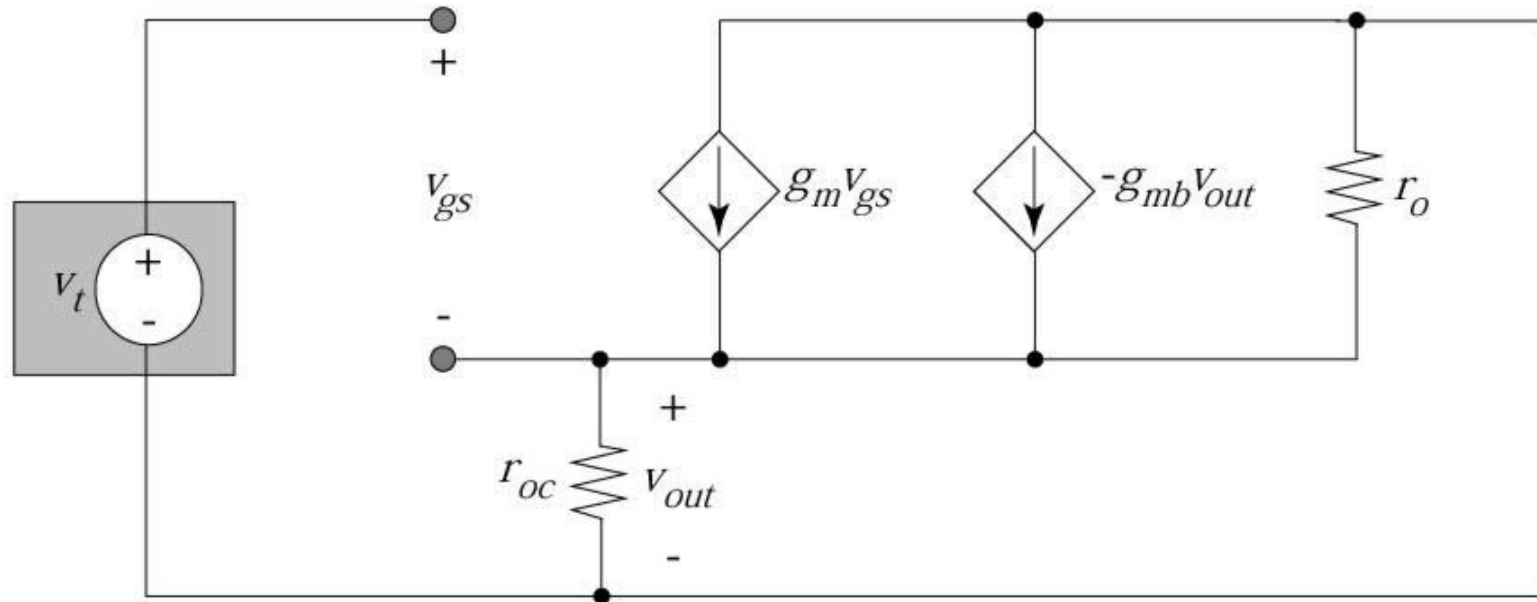


$$I_{DS} = \mu C_{ox} \frac{W}{L} \frac{1}{2} (V_{GS} - V_T)^2$$

$$V_{GS} = V_T + \sqrt{\frac{2I_{DS}}{\mu C_{ox} \frac{W}{L}}}$$

Weak I_{DS} dependence

CD Voltage Gain



Note $v_{gs} = v_t - v_{out}$

$$\frac{v_{out}}{r_{oc} \parallel r_o} = g_m v_{gs} - g_{mb} v_{out}$$

$$\frac{v_{out}}{r_{oc} \parallel r_o} = g_m (v_t - v_{out}) - g_{mb} v_{out}$$

CD Voltage Gain (Cont.)

KCL at source node: $\frac{v_{out}}{r_{oc} \parallel r_o} = g_m (v_t - v_{out}) - g_{mb} v_{out}$

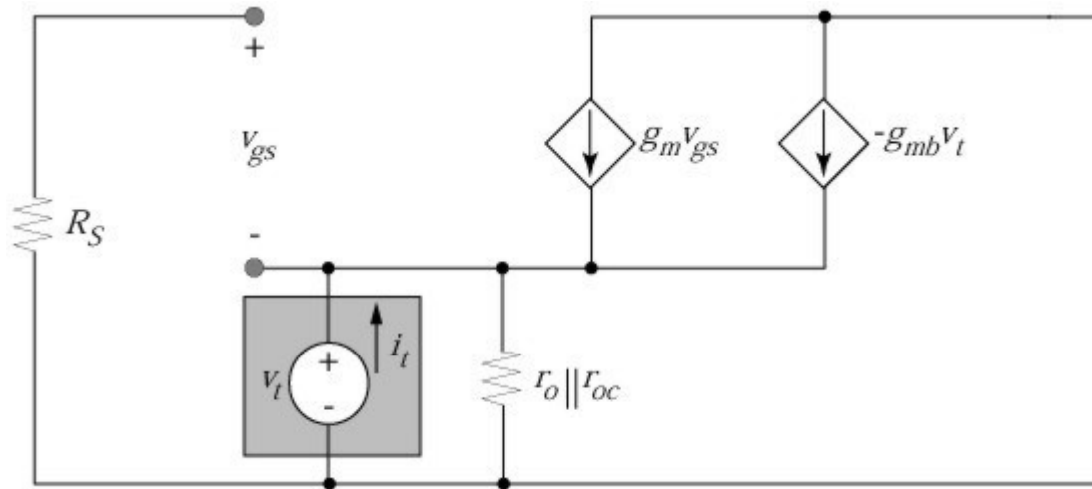
$$\frac{1}{r_{oc} \parallel r_o} + g_{mb} + g_m v_{out} = g_m v_t$$

Voltage gain (for v_{SB} not zero):

$$\frac{v_{out}}{v_{in}} = \frac{g_m}{\frac{1}{r_{oc} \parallel r_o} + g_{mb} + g_m}$$

$$\frac{v_{out}}{v_{in}} \approx \frac{g_m}{g_{mb} + g_m} \approx 1$$

CD Output Resistance



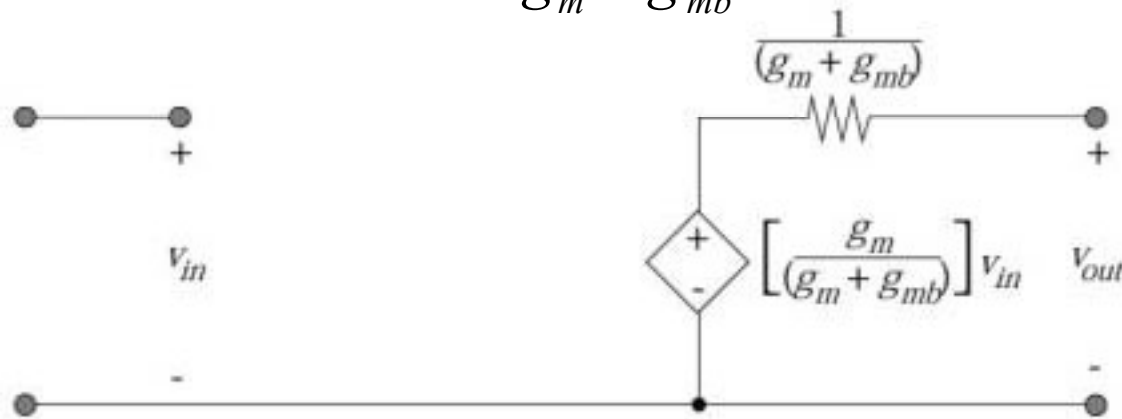
Sum currents at output (source) node:

$$R_{out} = r_o \parallel r_{oc} \parallel \frac{v_t}{i_t} \quad i_t = g_m v_t + g_{mb} v_t$$
$$R_{out} \approx \frac{1}{g_m + g_{mb}}$$

CD Output Resistance (Cont.)

$r_o \parallel r_{oc}$ is much larger than the inverses of the transconductances ϵ ignore

$$R_{out} \approx \frac{1}{g_m + g_{mb}}$$



Function: a voltage buffer

- High Input Impedance
- Low Output Impedance

	Transistor Type	
	NMOS	PMOS
Common Source/ Common Emitter (CS/CE)		
Common Gate/ Common Base (CG/CB)		
Common Drain/ Common Collector (CD/CC)		

