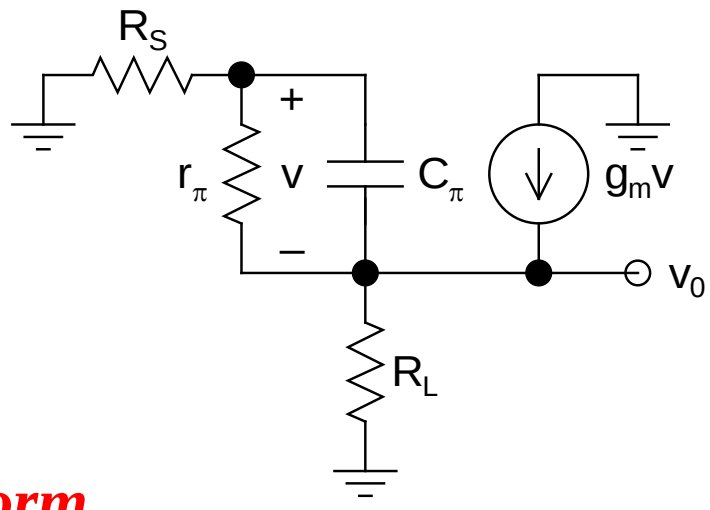
- Thus, the ***frequency response*** of this circuit looks like a ***staircase***, having ***two steps***

➢ C_π:

- R_π^0 ***can't be obtained by inspection***
- ***Analyze the circuit and show that***:

$$R_\pi^0 = r_\pi \,||\left(\frac{R_S + R_L}{1 + g_m R_L}\right)$$

$$\Rightarrow \tau_1 = R_\pi^0 C_\pi$$



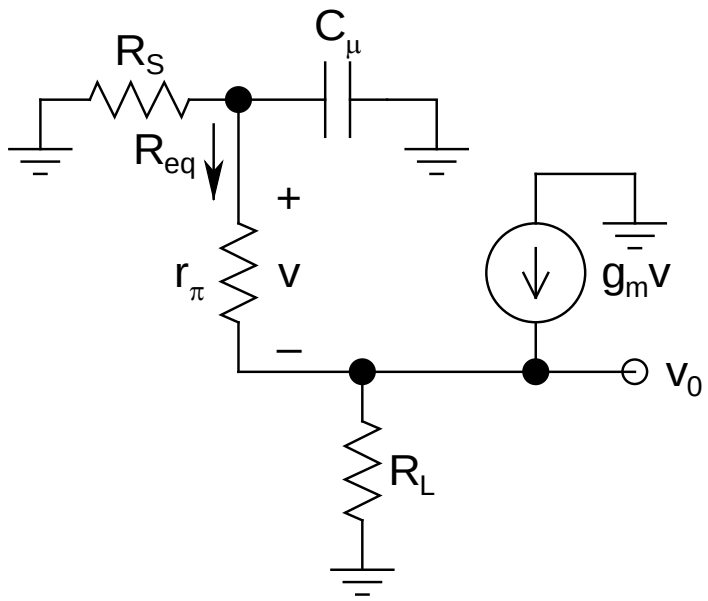
- This is another ***Standard Form*** and the ***topology should be carefully noted***

- ***C_μ***:
  - This is ***relatively straightforward***
  - ***By inspection***:

$$R_{eq} = r_\pi + (\beta + 1) R_L$$

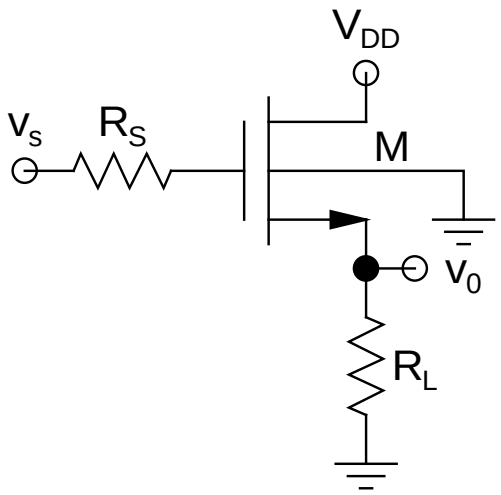
$$R_\mu^0 = R_S \,||\, R_{eq}$$

$$\Rightarrow \tau_2 = R_\mu^0 C_\mu$$

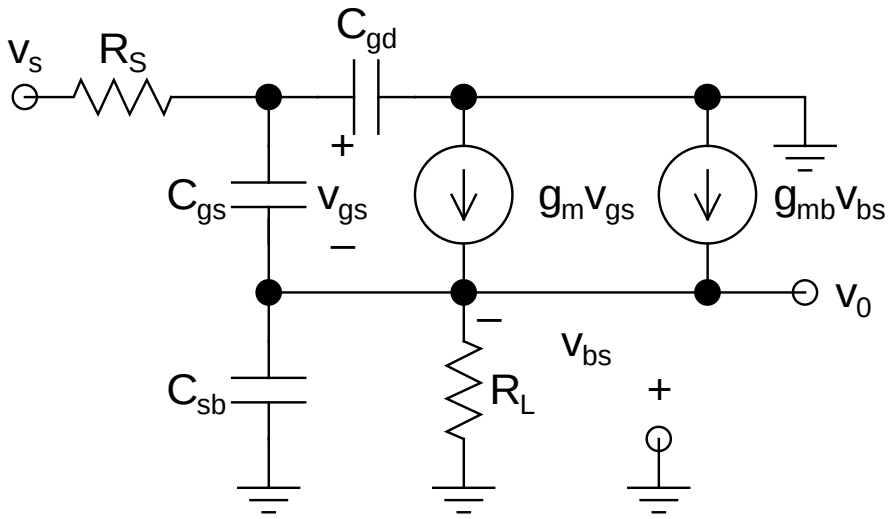


- ***This circuit also has reasonably good frequency response***

- ***CD***:



ac Schematic



High-Frequency Equivalent

➢ ***C_{db} absent due to obvious reason***

- $v_{bs} = -v_0$

  $\Rightarrow$ ***$g_{mb}v_{bs}$ is simple a conductance g_{mb}, in parallel with R_L***

  $\Rightarrow$ ***Club them to R*** $[= R_L \| (1/g_{mb})]$

- ***C_{gs}***:
  - ***Standard Form sans r_π*** (***CC***)

    $$\Rightarrow R_{gs}^{0} = \frac{R_S + R}{1 + g_m R}$$

    $$\Rightarrow \tau_1 = R_{gs}^{0} C_{gs}$$

- ***C_{gd}***:
  - ***By inspection***:

    $$R_{gd}^{0} = R_S$$

    $$\Rightarrow \tau_2 = R_{gd}^{0} C_{gd}$$

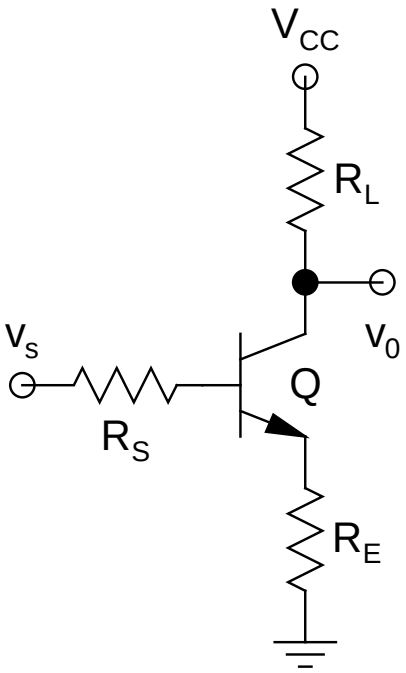
- ***C_{sb}***:
  - ***By inspection***:

    $$R_{sb}^{0} = R \,||\, (1/g_m)$$

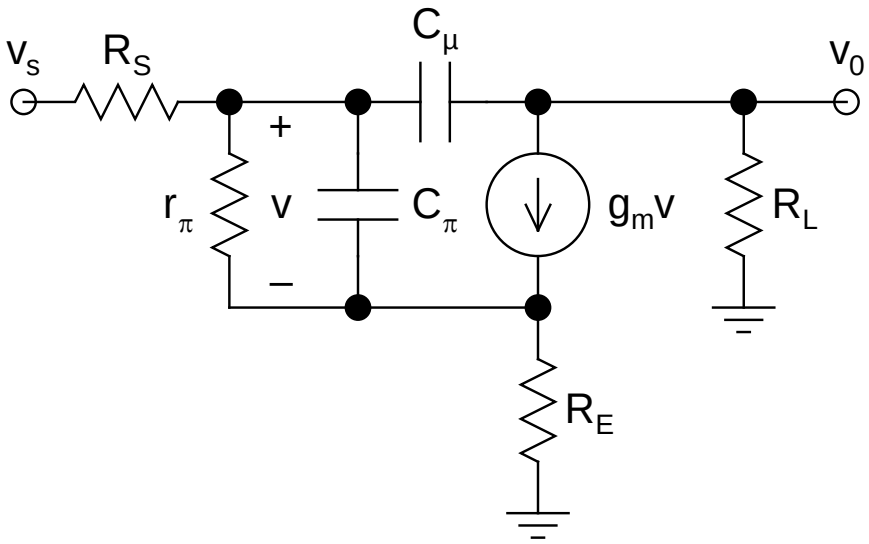
    $$\Rightarrow \tau_3 = R_{sb}^{0} C_{sb}$$

- ***Loving it***? :)

- ***CE(D)***:



ac Schematic



High-Frequency Equivalent

- C_π:
  - *Standard Form* (*similar to CC*, with R_L *replaced by* R_E)

$$\Rightarrow R_\pi^0 = r_\pi \| \left(\frac{R_S + R_E}{1 + g_m R_E} \right)$$

$$\Rightarrow \tau_1 = R_\pi^0 C_\pi$$

- C_μ:
  - *Slightly more complicated*
  - *Remove* C_π and *look across 2 terminals of* C_μ
  - *Can be represented by a 2-port network*

- ***Show that***:

  $R_{eq} = R_S \| R_\pi$

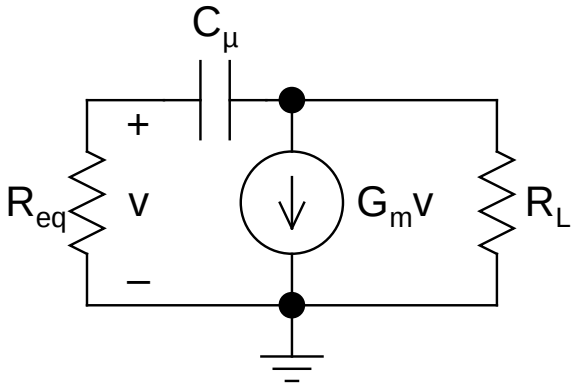
  with $R_\pi = r_\pi(1 + g_m R_E)$

  $G_m = g_m/(1 + g_m R_E)$

- This can be ***easily identified*** as a ***Three-Legged Creature***

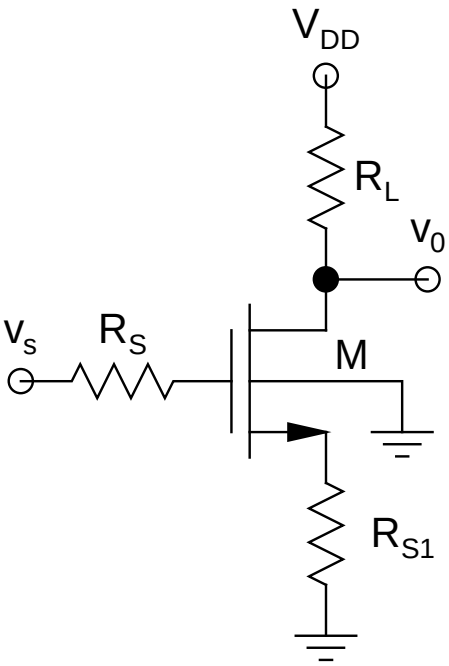
$$\Rightarrow R_\mu^0 = R_{eq} + R_L + G_m R_{eq} R_L$$

$$\Rightarrow \tau_2 = R_\mu^0 C_\mu$$

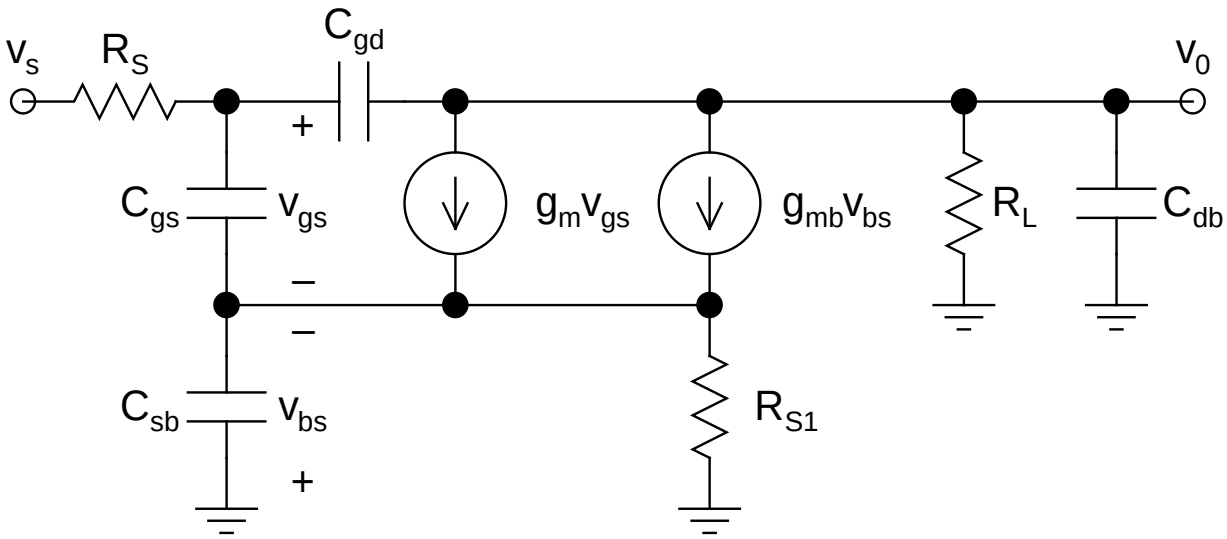


2-Port Representation of a CE(D) Stage

- ***CS(D)***:



ac Schematic



High-Frequency Equivalent