Subject :

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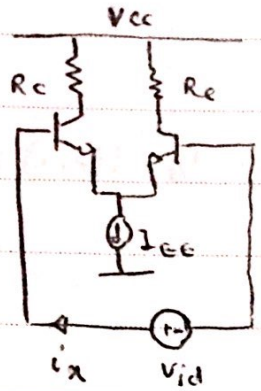
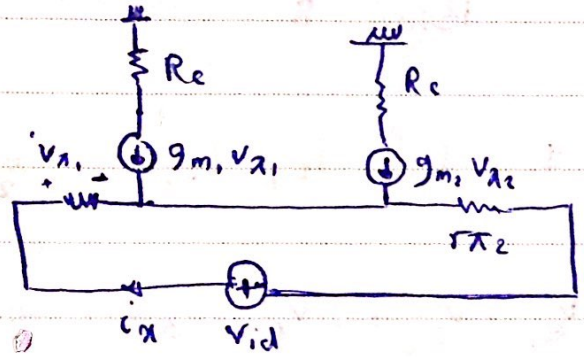
. Diff input res مقاومت ورودی تفاضلی



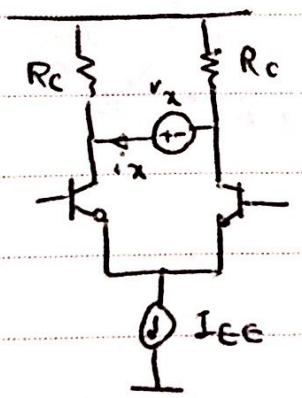
$R_{in} = \frac{V_{id}}{i_x}$

Small Signal



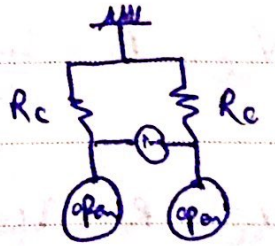
$-v_x + r_{\pi_1} i_x + r_{\pi_2} i_x = 0 \Rightarrow \frac{v_x}{i_x} = \underbrace{r_{\pi_1} + r_{\pi_2}}_{\text{match}} = 2r_\pi$

output Diff res مقاومت خروجی تفاضلی



Small Signal $R_{out} = v_x/i_x \Big|_{v_{in}=0}$

$\Rightarrow$



$\Rightarrow R_{out} = 2R_e$

VAHDAT

Subject :

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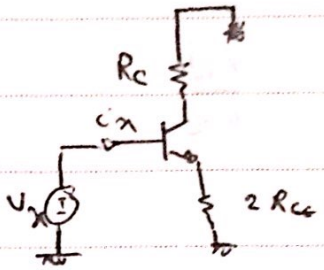
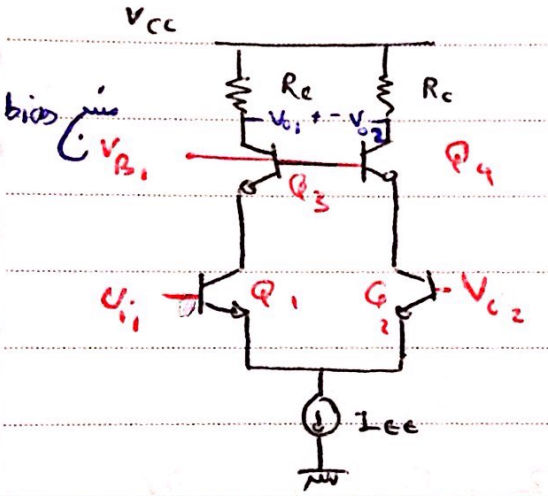
R_{in} : Common Mode

حيث المدخل متصل بمدار :



$$\Rightarrow R_{in} = r_\pi + (\beta+1) \times 2R_{EE}$$

Cascode diff pair



Bias :

$$I_{C1} = I_{C2} = I_{C3} = I_{C4} = \frac{I_{EE}}{2}$$

$$V_{E1} = V_{E2} = -V_{BE(ON)} = -0.7$$

$$V_{B3} = V_{B4} = V_{B1} \rightarrow \text{عند}$$

$$\Rightarrow V_{E3} = V_{E4} = V_{B1} - 0.7 = V_{C1} = V_{C2}$$

$$\Rightarrow V_{CG1} = V_{CE2} = V_{B1} - V_{BE(ON)} + V_{BE(ON)} = V_{B1}$$

$$V_{CB} = V_{C4} = V_{CC} - R_C \times \frac{I_{EE}}{2}$$

$$\Rightarrow V_{CE3} = V_{CE4} = V_{CC} - R_C \times \frac{I_{EE}}{2} - (V_{B1} - V_{BE(ON)})$$

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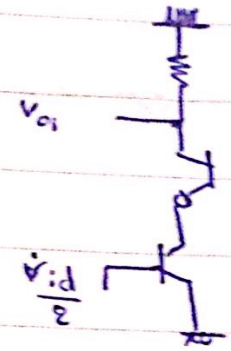
A_{vdm} : — half circuit



A_v : $-g_m R_c$

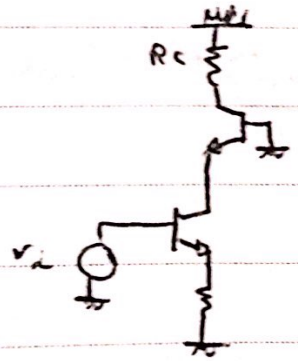
$A_{vdm} = \frac{V_{o1} - V_{o2}}{V_{i1} - V_{i2}}$ Single ended

$\frac{V_{o1}}{V_{id/2}} = -g_m R_c \Rightarrow \frac{V_{o1}}{V_{id}} = -\frac{1}{2} g_m R_c$

$A_{vd} = \frac{V_{o1} - V_o}{V_{id}} = \frac{-\frac{1}{2} g_m R_c V_{id}}{V_{id}} - \frac{\frac{1}{2} g_m R_c V_{id}}{V_{id}} = -g_m R_c$

* Same as Common Emmiter *

A_{vcm} — half circuit



$A_{vcm} = \frac{-R_c}{2R_{ee} + 1/g_m}$

* $A_{vdm} = \frac{V_{o1} - V_{o2}}{V_{i1} - V_{i2}}$ *

max output Swing

$V_{out(min)} = V_E + V_{CE(sat)}$

V_{CC} ——— $V_{o\,max}$

V_{CQ} ———

$V_{o(min)}$ ———

V_E

max out swing : $V_{CQ} = \frac{V_E + V_{CE(sat)} + V_{CC}}{2}$ =

$\sim V_E + V_{CE-sat}$

$\text{max swing}_{P.P} = \frac{V_{CC} - V_{omin}}{2}$