

در باره تطبیق امپدانس

$V_{A\text{NPN}} = 100V$, $\beta_{\text{NPN}} = 100$, $I_S = 10^{-10}$

$V_{A\text{PNP}} = 0.1V$, $\beta_{\text{PNP}} = 0.1$, $V_{BE} = 0.1V$

$V_{BE} = 0.1V$, $I_{S10K} = I_{S1K} = 0.1 I_S$

الف- جان نقطه بزرگتر است

ب- جان کوچکتر

$$I_{ref} = \frac{1K - 0.1V}{0.1V} = 890 \mu A = I_{C0}$$

widlar $\Rightarrow I_{C0} = \frac{V_T}{R_5} \ln \frac{I_{ref}}{I_{E10K}} = \frac{10\text{mV}}{1K} \ln \frac{890}{0.1} \Rightarrow I_{C0} = 0.1 \mu A$

$I_{C1} = I_{C7} = \frac{0.1V}{1K} = 0.1 \mu A$, $I_{C9} = I_{C10} = 890 \mu A = I_{C11} = I_{C12}$

$I_{C8} = I_{C6} = 0.1 \mu A$

$I_{C4} = \frac{V_{BE1}}{10K} = \frac{0.1V}{10K} = 10 \mu A$

$I_{C13} = I_{C14} = I_S e^{\frac{V_{BB}}{V_T}} = 10^{-10} e^{\frac{15}{0.025}} = 10 \mu A$

$$A_V = \frac{V_o}{V_{id}} = \frac{V_o}{V_i} \times \frac{V_i}{V_c} \times \frac{V_c}{V_{id}}$$

$$\frac{V_o}{V_{id}} = -\frac{1}{r} g_{m_r} R_{cT} \Rightarrow g_{m_r} = \frac{I_{c_r}}{V_T} = \frac{7 \mu A}{25 mV} = 1,1 mS$$

$$\frac{V_i}{V_c} = -g_{m_n} R_{cT} \Rightarrow g_{m_n} = \frac{I_{c_n}}{V_T} = \frac{140 \mu A}{25 mV} = 19,1 mS$$

$$R_{cIT} = R_{o_r} \parallel R_{o_\varepsilon} \parallel R_{i_v}$$

$$R_{o_r} = (1 + g_{m_r} R_{E_r}) r_{o_r} = (1 + 1,1 \times 1) 1 \mu A$$

$$R_{o_\varepsilon} = (1 + g_{m_n} R_{E_n}) r_{o_\varepsilon} = (1 + 19,1 \times 1) 50 \mu A$$

$$R_{i_v} = r_{r_v} + (1 + \beta) R_{E_T} = 1 \mu A + (1 + 100) 0,1 \mu A = 1,01 \mu A$$

$$R_{E_T} = 10^k \parallel r_{r_n} = 10^k \parallel 10 = 10^k$$

$$r_{o_r} = \frac{V_T}{I_c} = \frac{25 mV}{7 \mu A} = 1,1 \mu A$$

$$r_{o_\varepsilon} = \frac{100}{7 \mu A} = 14,3 \mu A$$

$$r_{r_v} = \frac{\beta}{g_{m_v}} = \frac{100}{19,1 mS} = 5,2 \mu A$$

$$g_{m_v} = \frac{I_{c_v}}{V_T} = \frac{V_o}{r_o} = 19,1 mS$$

$$r_{r_n} = \frac{\beta}{g_{m_n}} = \frac{100}{19,1 mS} = 5,2 \mu A$$

$$R_{cIT} = 0,1 \mu A \parallel 14,3 \mu A \parallel 10^k = 10^k \parallel 14,4 \mu A = 14,4 \mu A$$

$$\frac{V_o}{V_{id}} = -\frac{1}{r} (1,1) \times (19,1) = -21,01$$

$$R_{cIT} = R_{o_g} \parallel R_{i_r} = r_{o_g} \parallel V_o = 0,1 \mu A$$

$$R_{i_r} = R_{o_1} \parallel (r_{\pi_1} + (1 + \beta) R_L) = 10^k \parallel (100 + (1 + 100) 1) = 10^k \parallel 201 = 10^k$$

$$R_{o_g} = r_{o_g} = \frac{V_A}{I_c} = \frac{100}{7 \mu A} = 14,3 \mu A$$

$$R_{o_1} = r_{o_1} = \frac{V_o}{I_{c_1}} = 10^k$$

$$r_{\pi_1} = \frac{\beta}{g_{m_1}} = \frac{100}{19,1 mS} = 5,2 \mu A$$

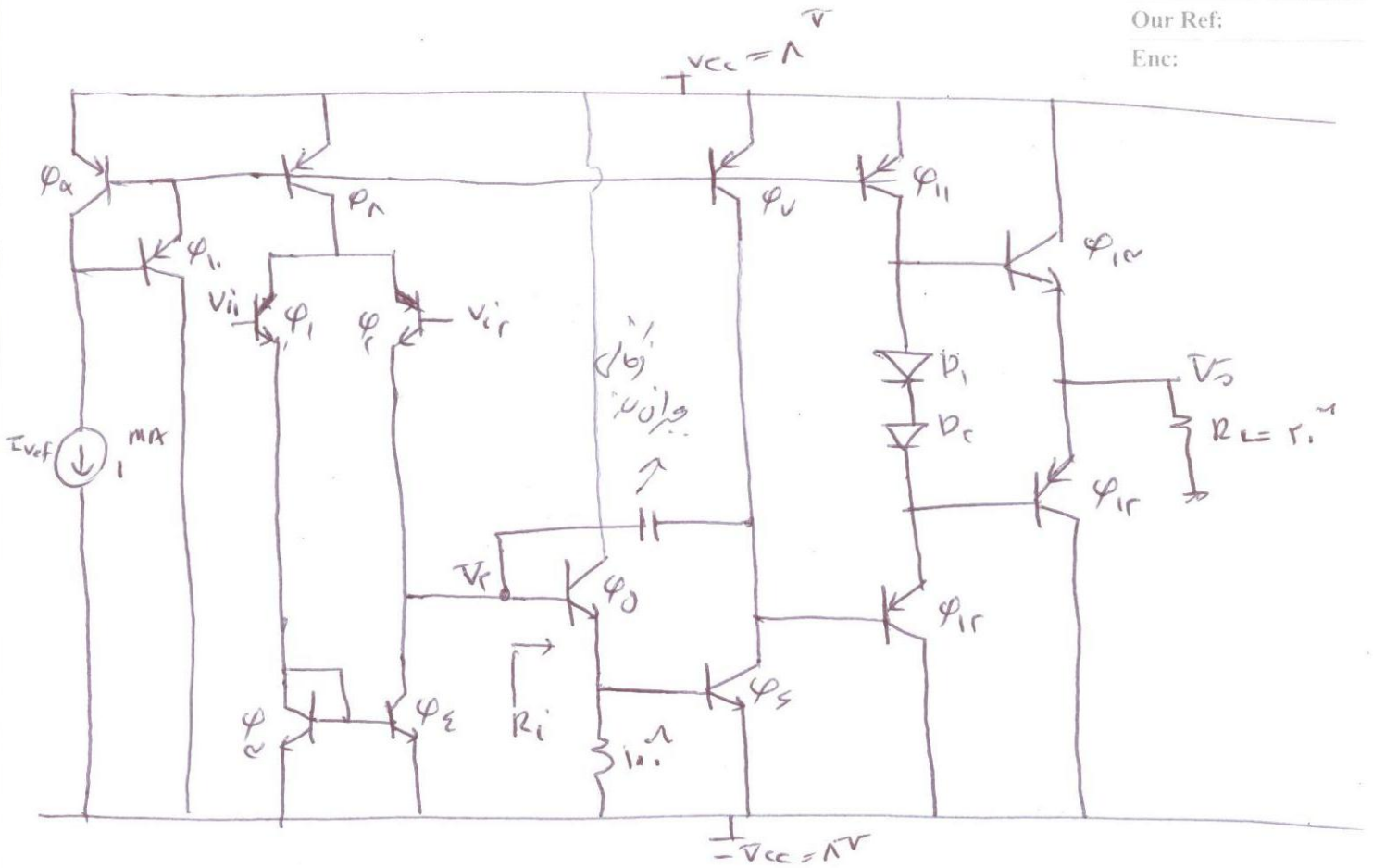
$$\frac{V_i}{V_c} = -g_{m_n} R_{cT} = -19,1 mS \times 0,1 \mu A = -1,91$$

$$A_V = (-21,01) (-1,91) = 40,12$$

Date: _____

Our Ref: _____

Enc: _____



$$A_v = \frac{V_o}{V_i} = \frac{V_{o1}}{V_i} \cdot \frac{V_{o2}}{V_{o1}} \cdot \frac{V_{o3}}{V_{o2}}$$

$$\frac{V_{o1}}{V_{i1}} = -g_{m1} (R_{o1} \parallel R_{i2})$$

$$\frac{V_{o2}}{V_{i2}} = -g_{m2} (R_{o2} \parallel R_{i3} \parallel R_{i1})$$