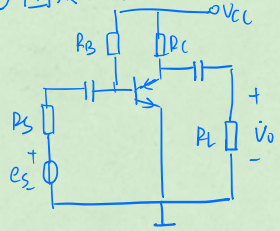
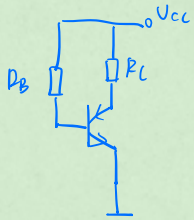
四种常见的交流放大电路求解方法.

静：I_b, I_c, U_{CE}　动 r_i r_o A_u.　当有求 r_o 时用4步

① 固定偏置放大电路



静 ⇒



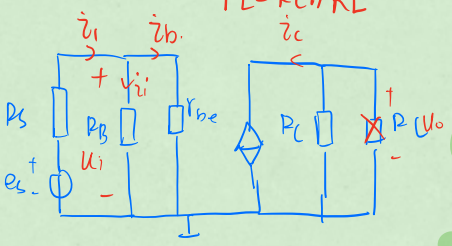
解：$I_B = \frac{U_{CC} - U_{BE}}{R_B}$

$I_c = \beta I_B$

$U_{CE} = U_{CC} - I_c R_c$

$R_L' = R_C // R_L$

动 ⇒



解 $A_u = \frac{\dot{U}_o}{\dot{U}_i} = \frac{\dot{i}_c \cdot R_L'}{\dot{i}_b \cdot r_{be}} = -\frac{\beta R_L'}{r_{be}}$

$r_i = \frac{\dot{U}_i}{\dot{I}_i} = \frac{\dot{U}_i}{I_1' + I_b} = R_B // r_{be}$.

$r_o = \frac{U_o}{\dot{i}_c} = R_c$.

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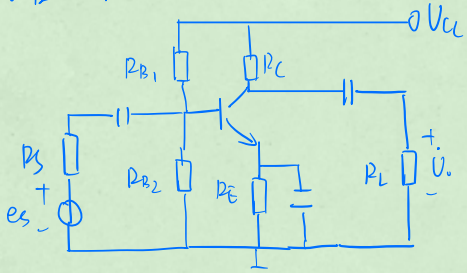
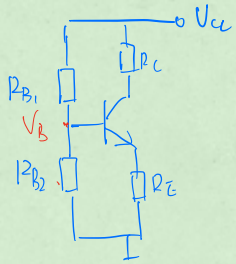
② 分压式偏置放大电路.



静 ⇒



解 $V_B = \frac{U_{CC}}{R_{B1} + R_{B2}} \cdot R_{B2}$

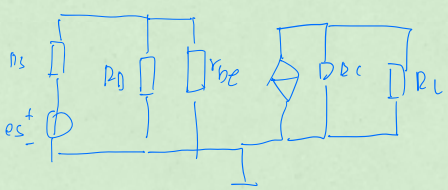
$I_c = I_E = \frac{V_B - V_{BE}}{R_E}$

$I_b = \frac{I_c}{\beta}$

$U_{CE} = U_{CC} - \dot{i}_C (R_C + R_E)$

$R_B = R_{B1} // R_{B2}$

动 ⇒



解：$r_i = r_{be} // R_B$

$r_o = R_C$

$A_u = \frac{\dot{U}_o}{\dot{U}_i} = \frac{\dot{i}_c \cdot R_L'}{\dot{i}_b \cdot r_{be}} = -\frac{\beta R_L'}{r_{be}}$

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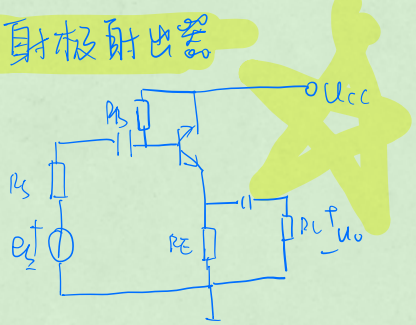
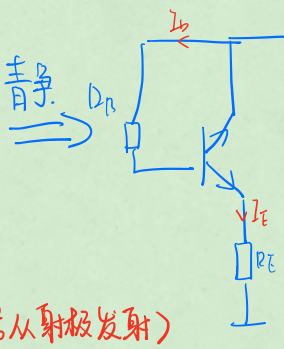
③ 射极射出器



静 ⇒



解：$U_{CC} = I_b R_B + U_{BE} + I_E R_E$

$= I_b R_B + U_{BE} + (1+\beta) I_b R_E$

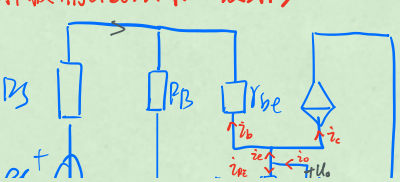
$I_b = \frac{U_{CC} - U_{BE}}{R_B + (1+\beta) R_E}$

$I_c = \beta I_b$

$U_{CE} = U_{CC} - I_E R_E$

(射极输出器从射极发射)

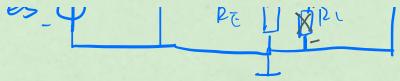
动 ⇒



记住

解：$r_i = [r_{be} + (1+\beta)(R_L // R_E)] // R_B$

$r_o = \frac{R_S' + r_{be}}{\beta}$ ⇐记住



$\dot{i}_o = (1+\beta)\dot{i}_b + \dot{i}_{RE}$

$= (1+\beta)\frac{\dot{U}_o}{(R_S // R_B)+r_{be}} + \frac{\dot{U}_o}{R_E}$

$\frac{\dot{U}_o}{a} + \frac{\dot{U}_o}{b} = \frac{(a+b)}{ab}\dot{U}_o$

$r_o = \frac{\dot{U}_o}{\dot{i}_o} = \frac{ab}{a+b}\dot{U}_o =$

$R_S' = R_S // R_B$

$R_E' = R_E // R_L$

$a = \frac{R_S' + r_{be}}{1+\beta}$ $\quad b = R_E'$

$r_{be} \approx 200 + (1+\beta)\frac{26}{I_E}$

$$A_u = \frac{\dot{U}_o}{\dot{U}_i} = \frac{(1+\beta)R_E'}{r_{be} + (1+\beta)R_E'}$$

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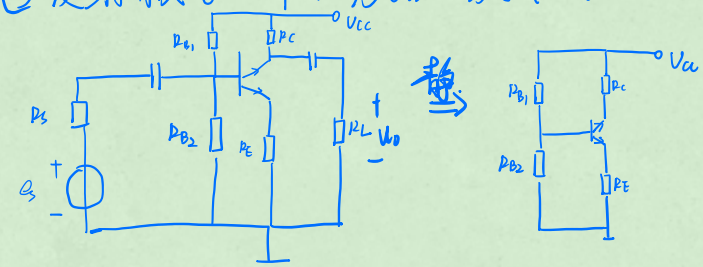
④ 发射极电阻未被旁路的放大电路



静 ⇒

解: $V_B = \frac{V_{CC}}{R_{B1}+R_{B2}} R_{B2}$

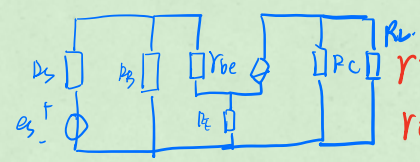
$I_E = I_C = \frac{V_B - V_{BE}}{R_E}$

$I_b = \frac{I_C}{\beta}$

$V_{CE} = V_{CC} - I_C(R_C + R_E)$

$R_B = R_{B1} // R_{B2}$

动 ⇒



$r_i = R_B // [r_{be} + (1+\beta)R_E]$

$r_o = R_C$

$$A_u = \frac{\dot{U}_o}{\dot{U}_i} = \frac{(1+\beta)\dot{i}_b(R_C // R_L)}{\dot{i}_b r_{be} + (1+\beta)\dot{i}_b R_E} = \frac{-\beta(R_C // R_L)}{r_{be} + (1+\beta)R_E}$$

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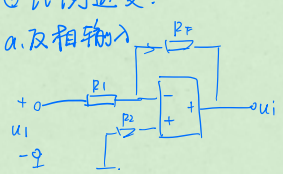
① 比例运算.

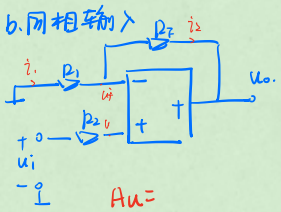
a. 反相输入



$A_u = -\frac{R_F}{R_1} = \frac{U_o}{U_i}$

$R_2 = R_1 // R_F$

b. 同相输入



$A_u =$

$\dot{i}_1 = -\frac{U_i}{R_1}$

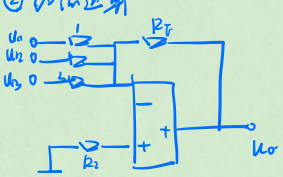
$\dot{i}_2 = \frac{U_i - U_o}{R_F}$

$-\frac{U_i}{R_1} = \frac{U_i}{R_F} - \frac{U_o}{R_F}$

$\frac{U_o}{R_F} = U_i(\frac{1}{R_1} + \frac{1}{R_F})$

$A_u = 1 + \frac{R_F}{R_1}$

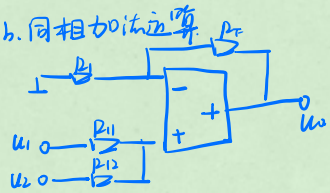
② 加法运算



$\dot{i}_{11} + \dot{i}_{12} + \dot{i}_{13} = \frac{U_{i1}}{R_1} + \frac{U_{i2}}{R_2} + \frac{U_{i3}}{R_3}$

$\dot{i}_o = -\frac{U_o}{R_F}$ 当 $R_1 = R_2 = R_3$

b. 同相加法运算



$U_+ = \frac{R_{12}}{R_{11}+R_{12}}U_1 + \frac{R_{11}}{R_{11}+R_{12}}U_2$

$\dot{i}_i = \frac{U_+}{R_1}$ $\quad \dot{i}_o = \frac{U_+ - U_o}{R_F}$ 令 $\dot{i}_i = \dot{i}_o$

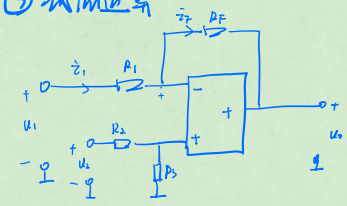
$u_o = -\frac{R_F}{R_1}(u_1+u_2+u_3)$

$R_2 = R_1 /\!/ R_2 /\!/ R_3 /\!/ R_F$

$u_o = (1+\frac{R_F}{R_1})u_+$

$R_{11} /\!/ R_{1N} = R_1 /\!/ R_F$

③ 减法运算



$u_+ = \frac{R_3}{R_2+R_3}u_2$

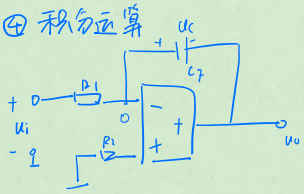
$i_1 = \frac{u_1-u_+}{R_1}$ $\quad i_F = \frac{u_+-u_o}{R_F}$

$\frac{u_1-u_+}{R_1} = \frac{u_+}{R_F} - \frac{u_o}{R_F}$

$\frac{u_o}{R_F} = u_+(\frac{1}{R_1}+\frac{1}{R_F}) - \frac{u_1}{R_1}$

$u_o = \left(\frac{R_3}{R_2+R_3}u_2(\frac{1}{R_1}+\frac{1}{R_F}) - \frac{u_1}{R_1}\right)R_F$

④ 积分运算



$i_1 = \frac{u_i}{R_1} = -C\frac{du_o}{dt}$