1-3. PN结正偏时正向电流是扩散电流，数值较大，易导电；反偏时，方向电流是漂移电流，数值较小，几乎不导电。

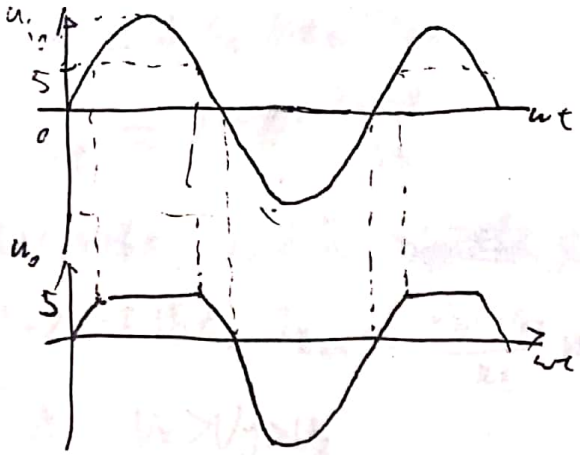
反向电压过大会失去导电性。

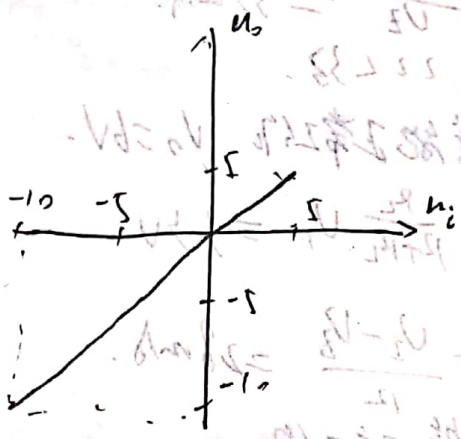
温度升高，正向特性左移，反向特性下移。对击穿特性的影响不定。

1-6 (1) $I \simeq \frac{10-0.7}{5.1} \simeq 1.82\text{mA}$

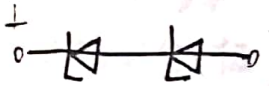
(2) 温度升高，$U_D$减小，I增大。

1-8



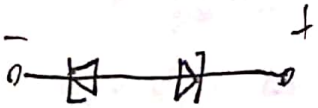

1-9. 串



15V

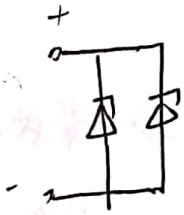
1.4V

6.7V

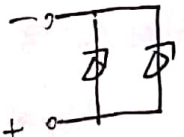


9.7V

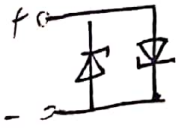
并



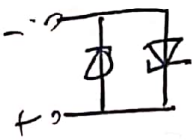
6V



0.7V



0.7V



0.7V

1-10 (1) 分段设 $V_o = V_Z = 6V$

$$I_o = \frac{V_Z}{R_L} = 6mA.$$

$$I = \frac{V_i - V_Z}{R} = 28mA$$

$$I_Z = I - I_o = 22mA$$

$$I_{Zmax} = \frac{P_{Zm}}{V_Z} = 33mA.$$

$$I_Z < I_{Zmax} < 33.$$

∴ 稳压管能正常工作 $V_o = 6V$.

(2) $V_o = \frac{R_L}{R+R_L} V_i = 3.3V$.

(3) $I_Z = \frac{V_i - V_Z}{R} = 28mA$.

稳压管正常工作

(4) $I_{Zmax} = \frac{V_i - V_Z}{R} = 2mA$

$2 < 10$

稳压管无法正常工作

2-1 (1) a, b, a, a.

(2) b

(3) a, b

(4) a, a, b

(5) b.

2-1b $A_o = \frac{\dot{V}_o}{\dot{U}_I} = -\frac{\beta(R_C // R_L)}{r_{be}} \approx -\frac{(R_C // R_L) I_{EQ}}{26mV}$

$R_i = R_{B1} // R_{B2} // r_{be}$

$r_{be} \approx (1+\beta)\frac{26mV}{I_{EQ}}$.

(1) $\beta$ 增大, $A_o$ 不变, ~~减小~~, $R_i$ 增大.

(2) $R_E$ 增大, $I_{EQ} \approx \frac{V_B - V_{BE}}{R_E}$ 减小, $A_o$ 减小, $R_i$ 增大.

2-4. A: $V_x > V_y > V_z$.

$V_{yx} = -0.3V$.

∴ X为发射极, Y为基极, Z为集电极, 为PNP型.

B. ~~$V_x$~~ $V_y > V_x > V_z$. $U_{xz} = 0.5V$.

X为基极, Y为集电极, Z为发射极, 为NPN型.

2-7 (a) PNP型应 $U_e > U_b > U_c$, 不能正放大.

改: $+V_{cc}$ 接 $-V_{cc}$, 电容反接

(b) 发射极不偏

改: $R_B$ 接 $V_{cc}$

(c) $V_b = V_{cc}$ 处于饱和区.

改. 基极与 $V_{cc}$ 间接 $R_B$.

(d) $I_B = 0$，无法正常放大。

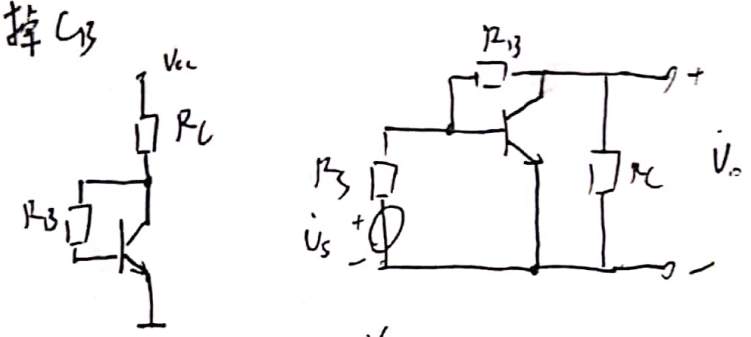
改：$R_B$ 接到 $V_{CC}$

(e)(f)(g) 可以正常放大。

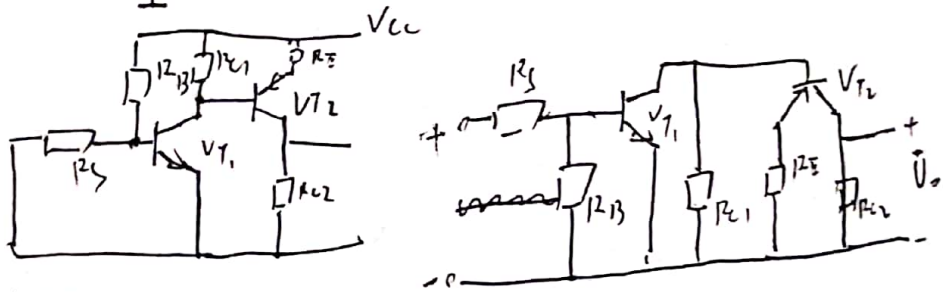
(h) 交流信号被电容短路，无法正常放大

改：去掉 $C_B$

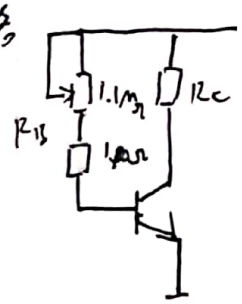
2-8 a)




b)



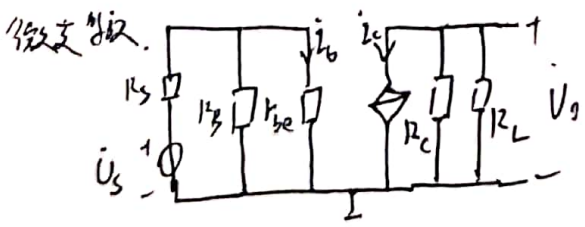

2-14 直流通路




$$I_{CQ} = \beta I_{BQ} = 0.5\,mA \Rightarrow I_{BQ} = 10\,nA$$

$$I_{BQ} = \frac{V_{CC} - V_{BEQ}}{R_B} \Rightarrow R_B = \frac{V_{CC} - V_{BEQ}}{I_{BQ}} = 1.13\,M\Omega$$

微变等效：




$$r_{be} = r'_{bb} + (1+\beta)\frac{26mV}{I_{EQ}} = r'_{bb} + \frac{26mV}{I_{BQ}} = 2.7\,k\Omega$$

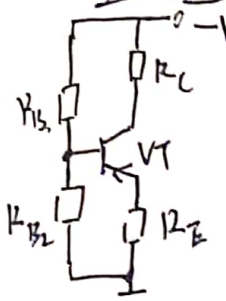
$$A_u = \frac{\dot{U}_o}{\dot{U}_i} = \frac{-\dot{I}_c(R_c /\!/ R_L)}{\dot{I}_b r_{be}} = \frac{-R_c /\!/ R_L \cdot \beta}{r_{be}} \approx -114$$

$$R_i = R_B /\!/ r_{be} \approx 2.7\,k\Omega$$

$$A_{us} = \frac{\dot{U}_o}{\dot{U}_s} = \frac{R_i}{R_i + R_s} A_u \approx -83$$

$$R_o = R_c = 16\,K\Omega$$

2-15 直流通路.




(1) $U_B = \frac{-V_{CC} R_{B2}}{R_{B1}+R_{B2}} = -4V$

$I_{CQ} = \frac{U_B + 0.3}{R_E} \approx -1.85mA$

$I_{BQ} = \frac{I_{CQ}}{\beta} \approx 30.83\mu A$

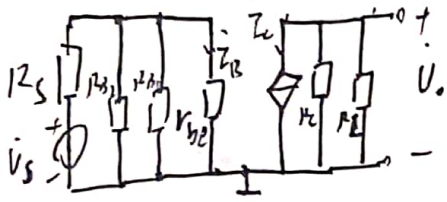
$U_{CEQ} \approx -V_{CC} + I_{CQ}(R_C + R_E) = -6.75V.$

(2) $U_{CEQ} \approx -V_{CC} + I_{CQ}(R_C + R_E) = -4V$

$\Rightarrow I_{CQ} = -2.4mA = \frac{U_B + 0.3}{R_E} \Rightarrow U_B = -4.8V$

$U_B = \frac{-V_{CC} \cdot R_{B2}}{R_{B1}+R_{B2}} \Rightarrow R_{B1} \approx 46.67 K\Omega$

(3) 微变等效电路:




$A_u = \frac{\dot{U}_o}{\dot{U}_i} = \frac{-\dot{I}_c(R_C // R_L)}{\dot{I}_B r_{be}} = \frac{-\beta R_C // R_L}{r_{be}}$

$r_{be} = r_{bb}' + (1+\beta)\frac{26mV}{I_{EQ}} \approx r_{bb}' + \frac{26mV}{I_{BQ}} = 100 + \frac{26mV}{40\mu A} = 750\Omega$

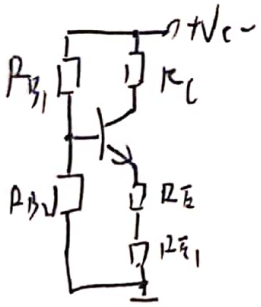
$R_i \approx R_{B1} // R_{B2} // r_{be} \approx 750\Omega$

$A_{us} = \frac{\dot{U}_o}{\dot{U}_s} = \frac{R_i}{R_s + R_i} A_u \approx -69.$

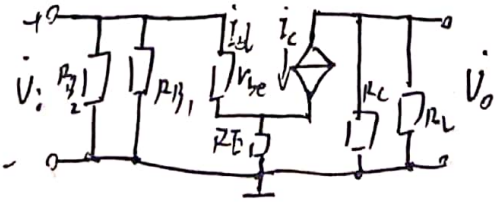
$R_o = R_C = 3K\Omega$

2-17

直流通路.




微变




$U_B = \frac{R_{B2} V_{CC}}{R_{B1}+R_{B2}} \approx 2.12V$

$I_E = \frac{U_B - 0.7V}{R_E + R_{E1}}$

$r_{be} = r_{bb}' + (1+\beta)\frac{26mV}{I_E}$

$R_i = R_{B1} // R_{B2} // [(1+\beta)R_E + r_{be}]$

联系方式:

$R_o = R_C = 8.2K\Omega$

$A_u = \frac{\dot{V}_o}{\dot{V}_i} = \frac{\dot{I}_L (R_C // R_B)}{\dot{I}_b [r_{be} + (1+\beta) R_E]} = -\frac{\beta R_L // R_B}{r_{be} + (1+\beta) R_E}$

当 $R_E = 0$ 时.

$I_E = 1.42mA$ $\quad r_{be} \approx 1.75K\Omega$ $\quad R_i \approx 1.60K\Omega$

$A_u \approx -181$ $\quad R_o = 8.2K\Omega$

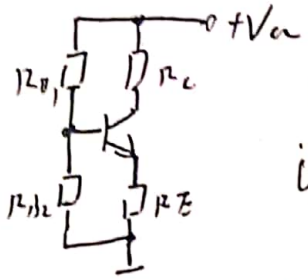
当 $R_E = 200\Omega$ 时.

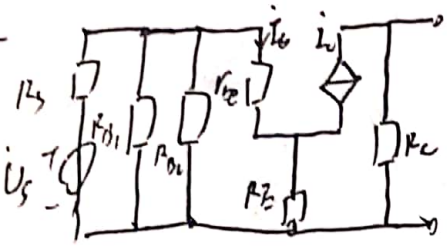
$I_E \approx 1.18mA$ $\quad r_{be} \approx 2.33K\Omega$ $\quad R_i \approx 6.34K\Omega$

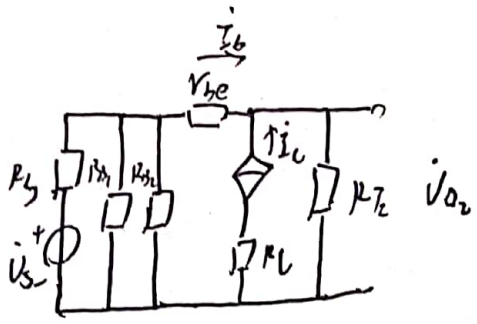
$A_u \approx -15.7$ $\quad R_o = 8.2K\Omega$

故. 当 $R_E$ 增大 $|A|$ 减小, $R_i$ 增大, $R_o$ 不变.

2-18 直流通路 微变.




(1) $U_B = \frac{R_{B2} \cdot V_{CC}}{R_{B1} + R_{B2}} \approx 4.30V$

$I_{EQ} = \frac{V_B - 0.7V}{R_E} \approx 1.8mA$

$I_{CQ} \approx I_{EQ} = 1.8mA$.

$U_{CEQ} = V_{CC} - I_{CQ}(R_E + R_C) = 2.8V$

(2) $r_{be} = r_{bb'} + (1+\beta)\frac{26mV}{I_E} \approx 1.76K\Omega$.

$R_i = R_{B1} // R_{B2} // [r_{be} + (1+\beta)R_E] \approx 8.22K\Omega$

$A_{us1} = \frac{\dot{V}_{o1}}{\dot{V}_S} = \frac{-\dot{I}_b R_C}{\dot{I}_b [r_{be} + (1+\beta) R_E]} \cdot \frac{R_i}{R_S + R_i}$

$\approx -0.79$.

$A_{us2} = \frac{\dot{V}_{o2}}{\dot{V}_S} = \frac{(1+\beta)\dot{I}_b R_E}{\dot{I}_b [r_{be} + (1+\beta) R_E]} \cdot \frac{R_i}{R_S + R_i}$

$\approx 0.80$

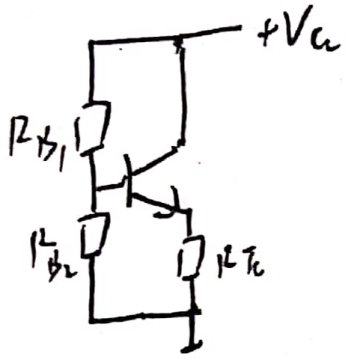
联系方式:_____

(3) $R_i = 6.22\,k\Omega$

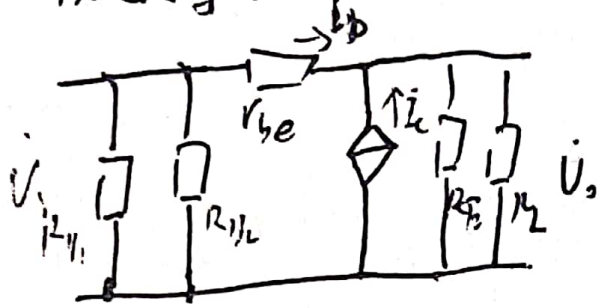
$R_{oi} = R_L = 2k\Omega$

$$R_{oL} = R_E \,//\, \frac{r_{be} + R_S // R_{B1} // R_{B2}}{1+\beta} \approx 33\Omega$$

2-19 直流通路：




微变等效




(1) $$V_{BQ} = \frac{R_{B2} V_{CC}}{R_{B1} + R_{B2}} = 4.9\,V$$

$$I_{EQ} = \frac{V_{BQ} - 0.7}{R_E} = 2.1\,mA$$

$$I_{CQ} = \frac{\beta}{1+\beta} I_{EQ} \approx I_{EQ} = 2.1\,mA$$

$$V_{CEQ} = V_{CC} - I_{EQ} R_E = 7.8\,V$$

(2) $$r_{be} = r_{bb'} + (1+\beta)\frac{26mV}{I_{EQ}} = 1.35\,k\Omega$$

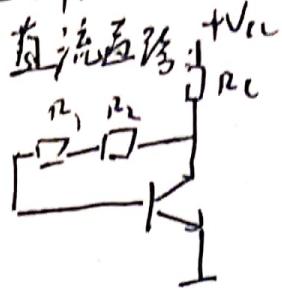
$$A_u = \frac{\dot{U}_o}{\dot{U}_i} = \frac{(1+\beta) R_L // R_E}{r_{be} + (1+\beta) R_L // R_E} = 0.99$$

$$R_i = R_{B1} // R_{B2} // [r_{be} + (1+\beta) R_L // R_E] \approx 21.9\,k\Omega$$

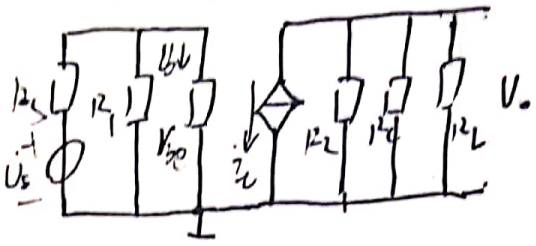
$$R_o = R_E // \frac{r_{be} + R_S // R_{B1} // R_{B2}}{1+\beta} \approx 5.6\,\Omega$$

2-24.

直流通路：




微变等效




(1) $I_{RC}=\frac{V_{cc}-U_{CEQ}}{R_c}=I_{BQ}+I_{CQ}=(1+\beta)I_{BQ}$

$I_{BQ}=\frac{V_{CEQ}-U_{BEQ}}{2R_1}$

$\therefore R_1=R_2\approx 62.7\,K\Omega$ $\quad I_{BQ}\approx 26.6\,mA$

(2) $r_{be}=r_{bb}'+(1+\beta)\frac{26mV}{I_{EQ}}\approx 0.1.28K\Omega$

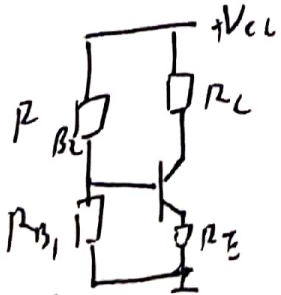
$A_u=\frac{\dot{V}_o}{\dot{V}_i}=\frac{-\beta(R_c/\!/R_L/\!/R_2)}{r_{be}}=-1.51$

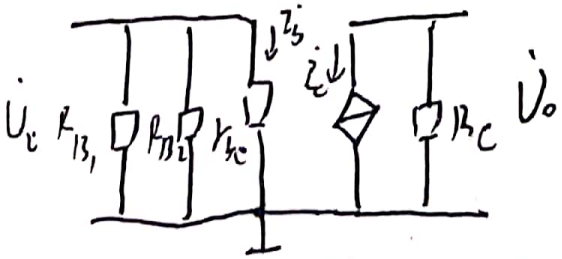
$R_i=r_{be}/\!/R_1\approx 1.25\,K\Omega$

$R_o=R_c/\!/R_2\approx 7.25\,K\Omega$

$A_{us}=\frac{\dot{V}_o}{\dot{V}_s}=\frac{R_i}{R_L+R_S}A_u=-84$

2-25 (1) 直流通路. 微变等效.




(1) $U_{BQ}=\frac{R_{B1}}{R_{B1}+R_{B2}}V_{cc}=5U_{BEQ}=3.5V$

$I_{EQ}=\frac{U_{BQ}-0.7}{R_E}=\frac{2.8V}{R_E}=1mA.$

$R_E=2.8K\Omega.$

$R_C=\frac{V_{cc}-(U_{B2}-U_{BE2})-U_{CE2}}{I_{C2}}=$ ~~5.2KΩ~~ 5.2KΩ

$V_{cc}=I_C(R_{B1}+R_{B2})$ $\Rightarrow$ $R_1=35K\Omega$, $R_L=85K\Omega$

$I_1R_{B1}=U_{BQ}$

(2) $A_u=\frac{-\beta R_c}{r_{be}}=-193$

$R_i=R_{B2}/\!/R_{B1}/\!/R_{be}=2.4\,K\Omega$

$R_o=R_C=5.2K\Omega$

联系方式：_____