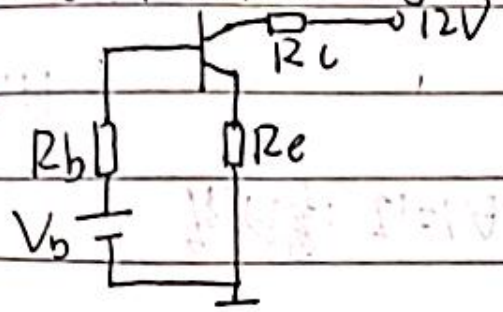
3.16. 作戴维宁等效 (1) $V_b = \frac{R_{b2}}{R_{b1}+R_{b2}} \times 12V = 3.49V$



$R_b = R_{b1} // R_{b2} = 5.82k\Omega$

$I_B R_b + I_B(1+\beta)R_e + V_{BE} = V_b$

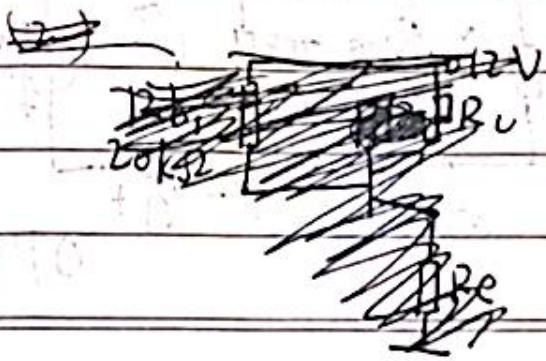
$I_B = 0.34mA$

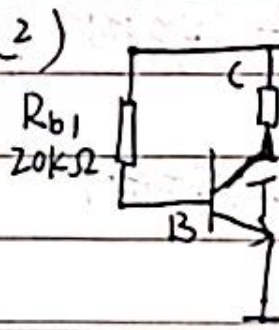
$I_C = \beta I_B = 16.66mA$

$V_{CE} = V_{CC} - I_C R_C - I_E R_e$

$= 3.39V$

(2)





可知 $V_{BE} > 0$ 正偏

假设放大, $I_B = \frac{12V - V_{BE}}{R_{b1}}$

$= 0.565mA$

$I_C = \beta I_B = 27.685mA$

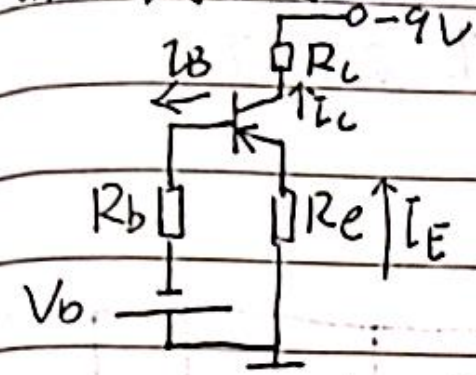
临界饱和时

$I_{CO} = \frac{12V}{R_C} = 25.532mA$

$I_C > I_{CO}$

故已饱和

3.7. 截止等效 (1) $R_b = R_{b1} // R_{b2} = 7.5k\Omega$



$V_b = \frac{R_{b2}}{R_{b1}+R_{b2}} \times 9 = 2.25V$

$I_B R_b + I_B(\beta+1)R_e + V_{EB} = V_b$

$I_B = 32.5\mu A$

$I_C = \beta I_B = 6.5mA$

$V_{CE} = I_C R_L + I_E R_e - 9V$

$= -1.19V$

(2)(a) $R_{b2} = 2k\Omega$, $V_b = \frac{2}{30+2} \times 9 = 0.5625V < 0.7V$

截止

(b) $R_{b1} = 15k\Omega$ $V_b = 3.6V$ $R_b = 6k\Omega$

$I_B R_b + I_B(\beta+1)R_e + V_{EB} = V_b$

$I_B = 62.8\mu A$

假设放大, $I_C = \beta I_B = 12.55mA$

临界饱和时 $V_{CE} = I_C R_C + I_E R_e - 9V = 0.7V$

$I_{C0} = 4.6mA < I_C$

已饱和

(b) ~~原时, $I_B = 32.5\mu A$ 假设放大 $I_C = 6.5mA$~~

同(1), $V_b = 2.25V$, $R_b = 7.5k\Omega$, $I_B = 0.3mA$

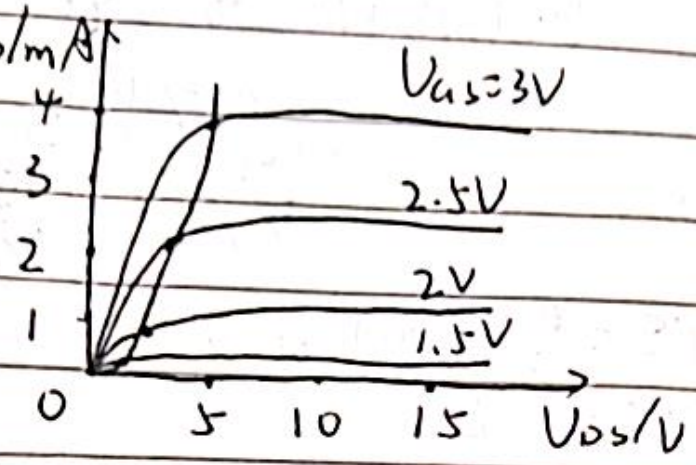
假设放大 $I_C = 60mA$

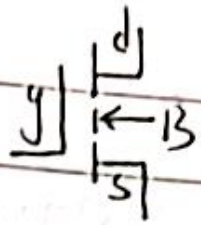
~~临界饱和时 $V_{CE} = I_C R_C + I_E R_e - 9V = -0.7V$~~

$I_{C0} = 7.54mA < I_C$

已饱和

3.18. (a)





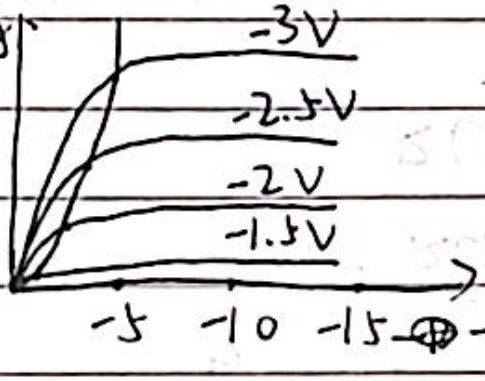
NMOS增强型

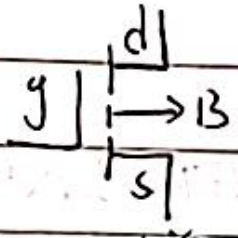
由图截止区 $V_{GS}<1V$

恒流区与可变电阻区的界线 $V_{GD}=V_{GS}-V_{DS}=V_T=1V$

$V_{GS}-V_{DS}=1V$

(b)



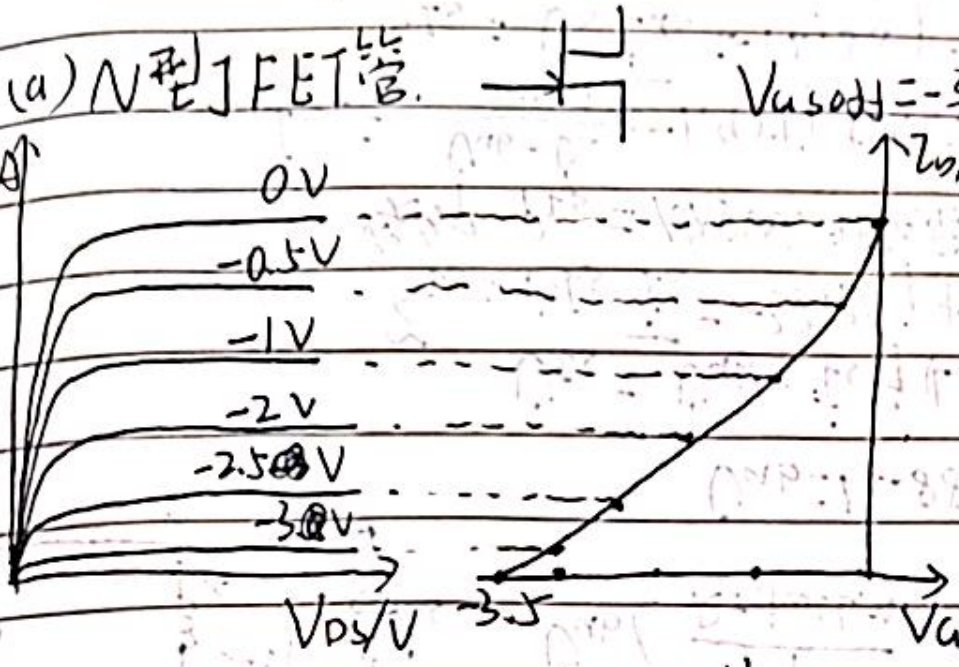


PMOS增强型

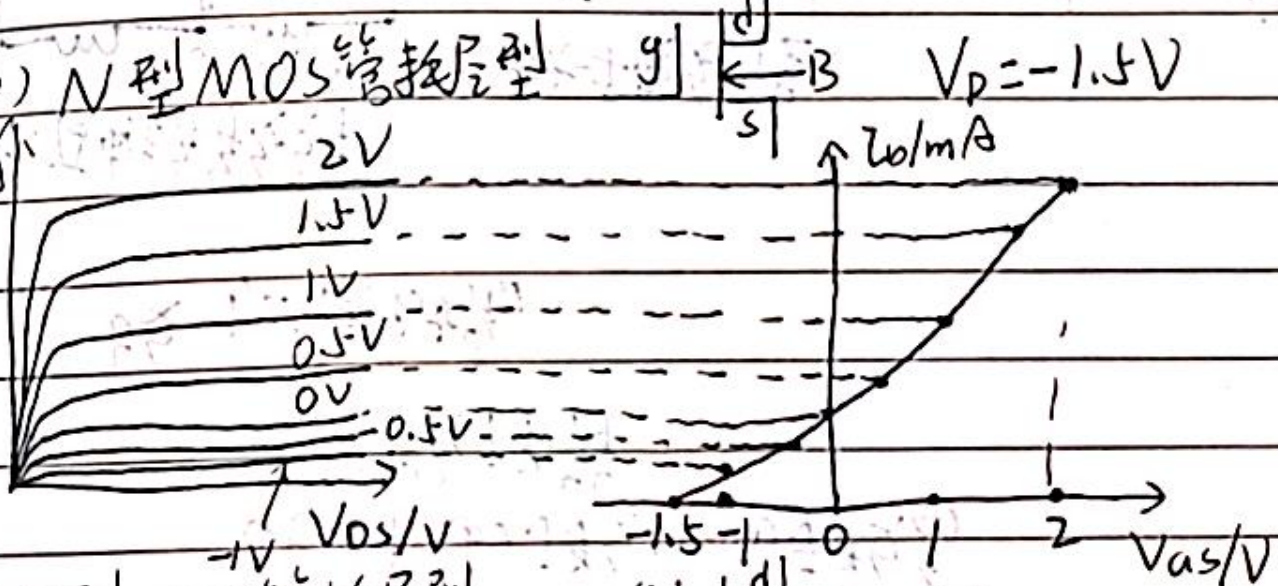
截止区 $V_{GS}<1V$

临界线 $V_{GD}=V_{GS}-V_{DS}=-1V$

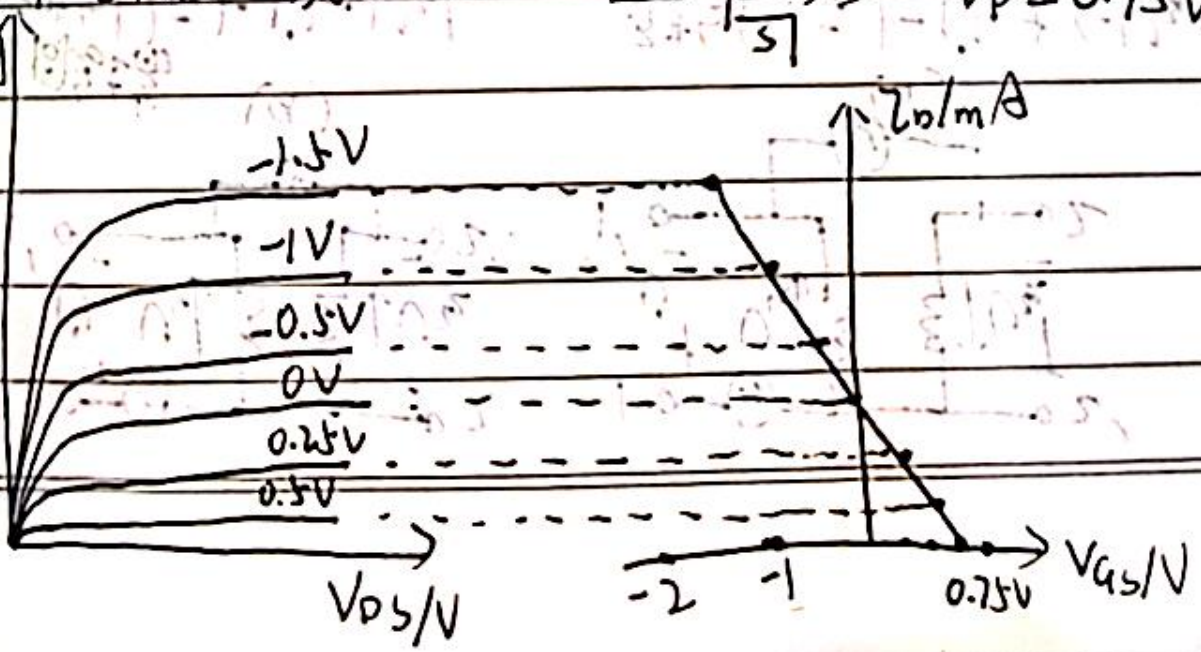
3.19. (a) N型JFET管



(b) N型MOS管耗尽型



(c) P型MOS管耗尽型



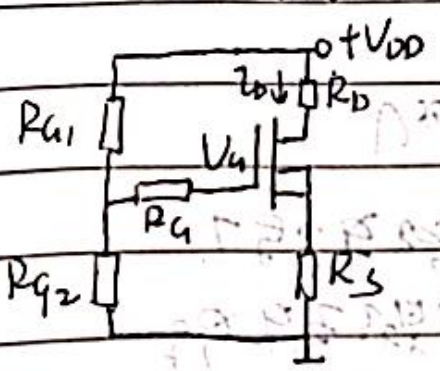
3.20, $I_D = I_{DSS}\left(1-\frac{V_{GS}}{V_P}\right)^2$

$V_{GS} = 1V$, $I_D = 0.18mA$

$g_m = \frac{\partial I_D}{\partial V_{GS}} = -\frac{2}{V_P}\sqrt{I_D I_{DSS}}$

代入 $g_m = 0.24mS$

3.23. 由图为混合偏置电路



$V_{GS} = V_{DD}\times\frac{R_{g2}}{R_{g1}+R_{g2}} - I_D R_S$，栅极无电流，无压降

$I_D = I_{DSS}\times\left(1-\frac{V_{GS}}{V_P}\right)^2$

$25I_D^2 - 32I_D + 4 = 0$

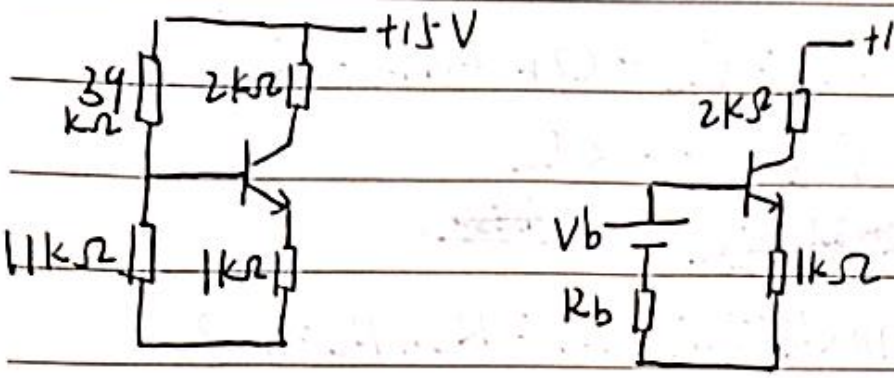
解 $I_D = 0.417mA$

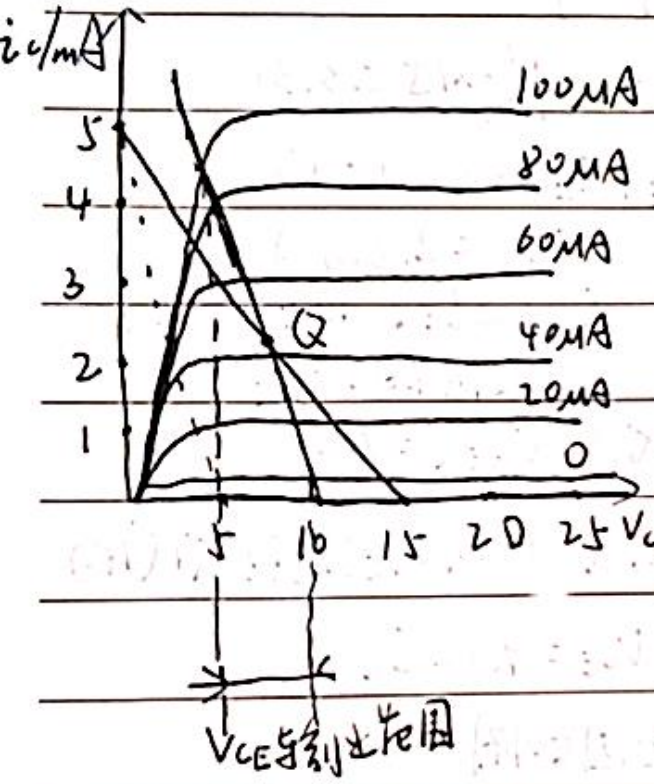
$V_{GS} = -0.17V$

$V_{DS} = V_{DD} - I_D(R_D+R_S) = 13.58V$

Date / /

1.4. 直流偏置电路





(1) $V_{CE} = V_{CC} - (1+2) I_C$

$= 15 - 3 I_C$

(2) 由图近似得出 $\beta = 50$

$V_b = \frac{11}{39+11} \times 15 = 3.3V$

$R_b = 39 // 11 = 8.58k\Omega$

$I_{BQ} = \frac{V_b - V_{BEQ}}{R_b + (1+\beta) \times 1} = 43.6\mu A$

$I_{CQ} = 2.18mA \quad V_{CE} = 8.45V$

(3) $R_C // R_L =$ | 过Q点斜率 -1 |

(4) 由图为 V_{CE} 范围

$\Delta V_{CE+} = I_{CQ} \times R_L' = 2.18V$

$\Delta V_{CE-} = V_{CEQ} - V_{CES}$ 由图 $V_{CES} \approx 5V$

$\Delta V_{CE-} = 3.45V$

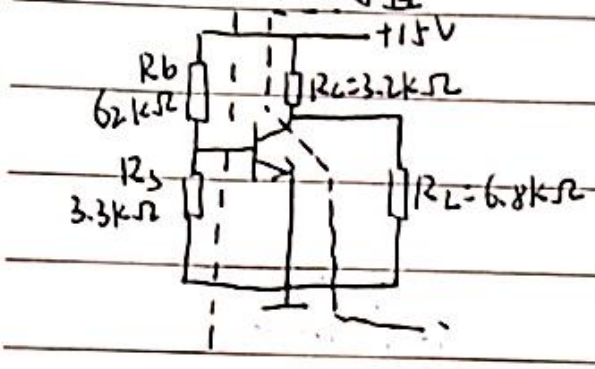
$V_{om} = 2.18V \quad V_o = \frac{2.18V}{\sqrt{2}} = 1.54V$

Mo Tu We Th Fr Sa Su

Memo No.

Date / /

1.7, (a) 直流偏置



对左侧戴维宁

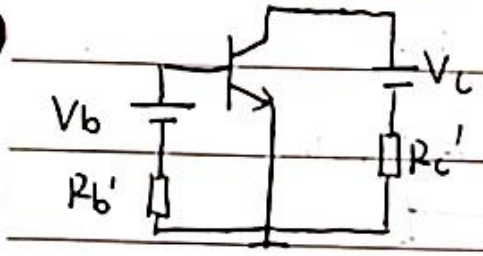
$V_b = \frac{3.3}{62+3.3} \times 15 = 0.758V$

$R_b' = R_b // R_S = 3.13k\Omega$

对右侧戴维宁

$V_c = \frac{6.8}{3.2+6.8} \times 15 = 10.2V$

$R_c' = 3.2 // 6.8 = 21.76k\Omega$

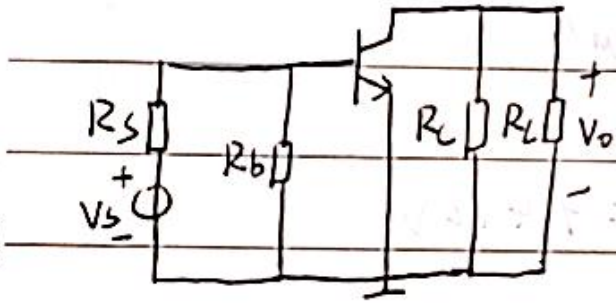


由图: $I_B R_b' + V_{BE} = V_b$

$I_B = 18.53\mu A$

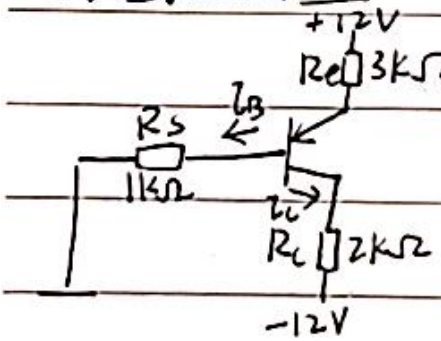
$I_C = \beta I_B = 0.927mA$

$V_{CE} = V_C - I_C R_c' = 8.18V$



交流通路

(b) 直流偏置



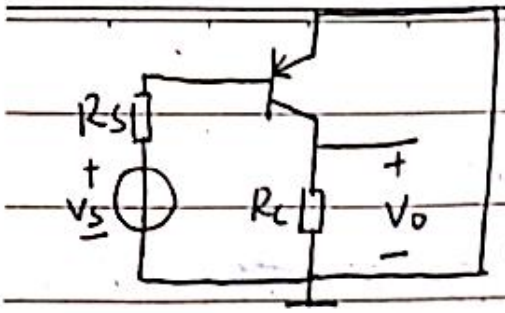
$I_E R_e + I_B R_S + V_{EB} = 12V$

$I_B = 73.4\mu A$

$I_C = \beta I_B = 3.67mA$

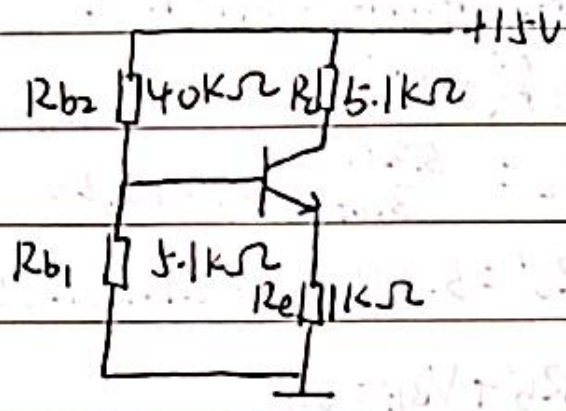
$V_{EC} = 24 - I_E \times R_e - I_C \times R_c = 5.43V$

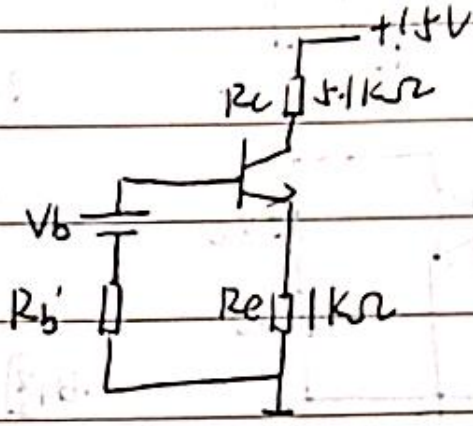
$V_{CE} = -5.43V$



交流回路

(c)





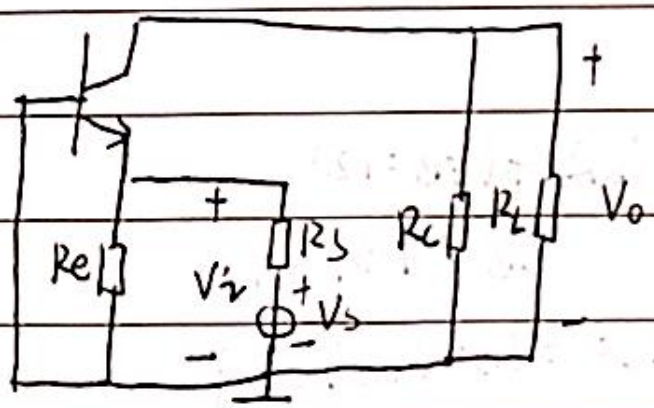
$$V_b = \frac{5.1}{40+5.1} \times 15 = 1.70V$$

$$R_b' = R_{b1} // R_{b2} = 4.52k\Omega$$

$$I_B = \frac{V_b - V_{BE}}{R_b' + (1+\beta) R_e} = 18\mu A$$

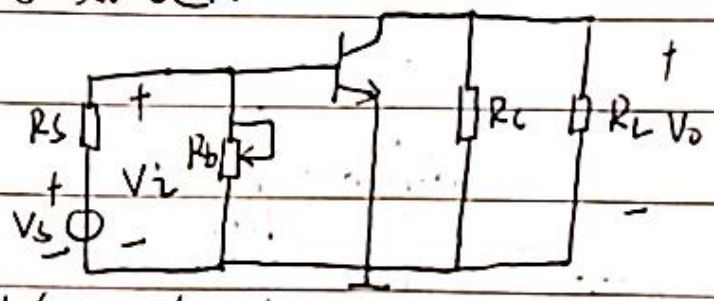
$$I_C = \beta I_B = 0.9mA$$

$$V_{CE} = 15V - I_C R_C - I_E R_E = 9.492V$$

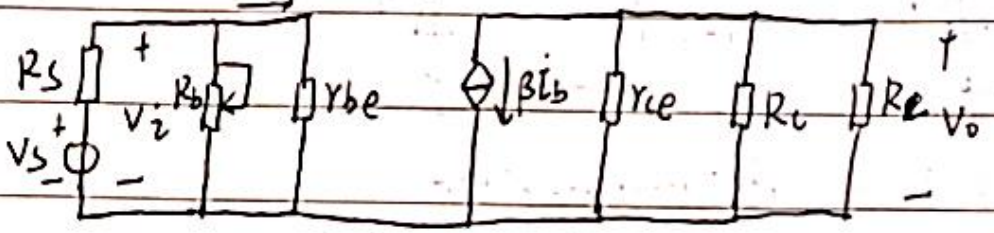


交流回路

1.8 交流通路



等效电路

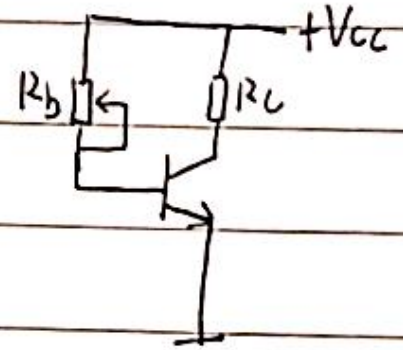


(1) $\dot{A}_V = \frac{\dot{V}_o}{\dot{V}_i} = \frac{-\beta \dot{I}_b (r_{CE} // R_C // R_L)}{\dot{I}_b r_{be}} \approx \frac{-\beta R_C // R_L}{r_{be}}$

$R_i = \frac{\dot{V}_i}{\dot{I}_i} = R_b // r_{be}$ 含 V_S 支路 R_L 接电子加压 $\dot{I}_b = 0$, $\beta \dot{I}_b = 0$

$R_o = \frac{\dot{V}_o'}{\dot{I}_o'} = R_C // r_{ce} \approx R_C$

(2) 直流偏置



$I_{BQ} R_b = V_{CC} - V_{BE}$ I_{BQ} 不多

$V_{CEQ} \approx V_{CC} - \beta I_{BQ} \cdot R_C$ β变小, V_{CE} 变大

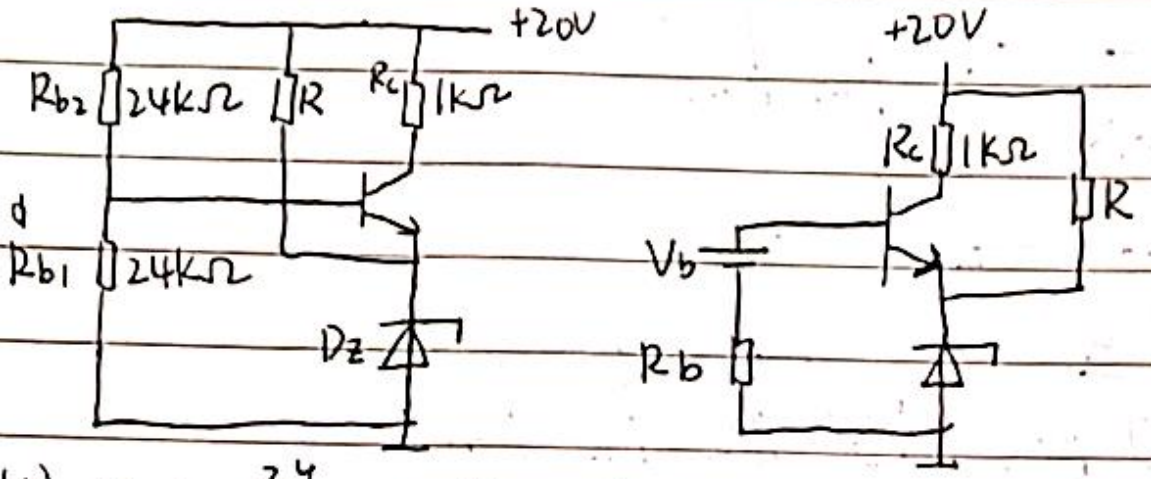
~~$\dot{A}_V$~~ $r_{be} = r_{bb'} + (1+\beta)\frac{V_T}{I_{EQ}}$

$= r_{bb'} + (1+\beta)\frac{V_T}{I_{BQ}}$ 不多

$|\dot{A}_V|$ 变小, R_i 不变, R_o 不变

(3) 饱和失真, 温度上升, 输出特性曲线上移, 工作点上移, 工作点偏上就会易引发饱和失真

1.11 直流偏置



(1) $V_b = \frac{24}{24+24} \times 20 = 10V$ $R_b = R_{b1} // R_{b2} = 12k\Omega$

因 $10V > V_Z = 6V$，二极管已击穿稳压

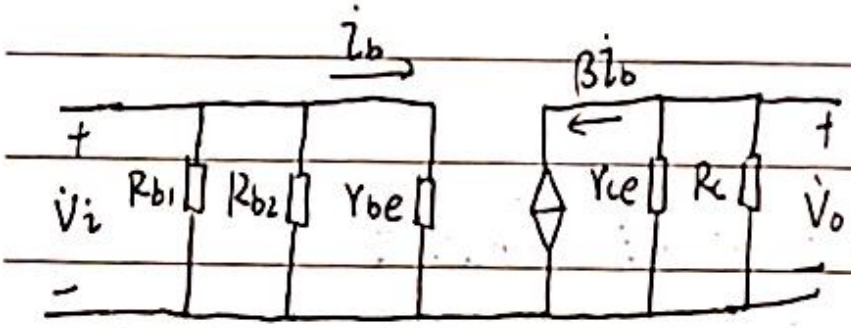
$$V_{BE} + V_Z + I_{BQ} R_b = V_b$$

$$I_{BQ} = 275\mu A$$

$$I_{CQ} = \beta I_{BQ} = [illegible] 5.5mA$$

$$V_{CEQ} = 20V - I_{CQ} R_c - V_Z = 8.5V$$

(2) 二极管处于稳压状态，看作直流恒压源，交流短路



(3) $$\dot{A}_V = \frac{\dot{V}_o}{\dot{V}_i} = \frac{-\beta \dot{I}_b \cdot (r_{ce} // R_c)}{\dot{I}_b \cdot r_{be}} \approx \frac{-\beta R_c}{r_{be}}$$

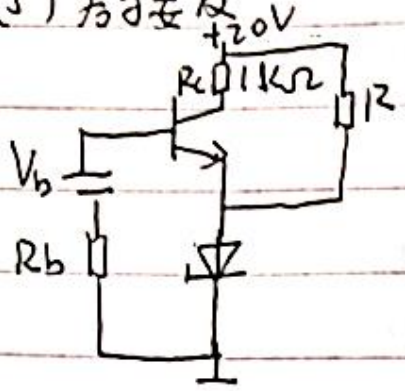
$$r_{be} = r_{bb}' + (1+\beta)\frac{V_T}{I_{EQ}}$$ $V_T = 26mV$, $r_{be} = 394.5\Omega$

$$\dot{A}_V = -50.69$$

$$R_i = \frac{\dot{V}_i}{\dot{I}_i} = R_{b1} // R_{b2} // r_{be} = 382\Omega$$

(4) 给稳压二极管限制流，使其稳定在稳压区工作

(5) 为接负



此时二极管正向导通 $V_Z = 0.7V$

$V_{BE} + V_Z + I_B R_b = V_b$

$I_B = 0.717\mu A$

$I_{CQ} = \beta I_B = 14.3mA$

$V_{CEQ} = 20 - R_L I_{CQ} - V_Z$

$= 5V$

二极管仍然起到稳压电压源作用，只不过电阻变小了

故仍有放大作用

$$A_V = \frac{-\beta R_L}{r_{be}}$$

$$r_{be} = r_{bb}' + (1+\beta)\frac{V_T}{I_{EQ}} = r_{bb}' + \frac{V_T}{I_{BQ}}$$ I_{BQ}↑ r_{be}↓

$|A_V|$↑ 故 A_V 变得更小，即 $|A_V|$ 变大

$R_i = R_{b1} // R_{b2} // r_{be}$ 也变小