FIND R_{IN} CE AMP ASSUME $r_o = \alpha$
AT MID BAND

$R_{IN} = R_i' + R_{IN_2}$

$R_B = R_{B_1} \| R_{B_2} = \dfrac{1}{\dfrac{1}{R_{B_1}} + \dfrac{1}{R_{B_2}}}$

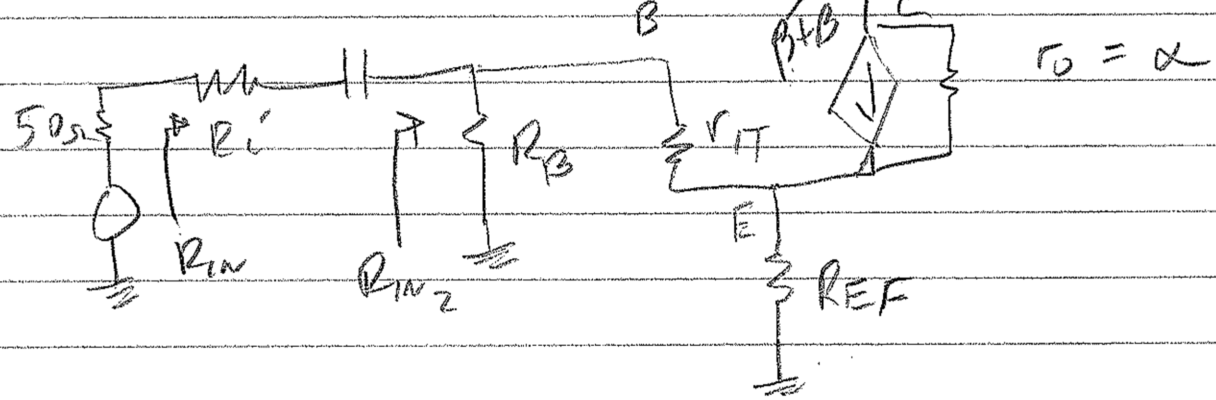
$R_{IN_2} = R_B \| R_{INBASE}$

R_{INBASE} = Impedance Looking in The Base of Transistor

$R_{INBASE} = r_\pi + R_{EF}(\beta+1)$

IF $R_{EF} = 0$ The $R_{INBASE} = r_\pi$

$$R_{IN} = R_i' + (R_{B_1} \| R_{B_2}) \| [r_\pi + R_{EF}(\beta+1)]$$



R_{EF} is the non ByPASSed Emitter Resistor

Find R_{IN} CC amp at midband

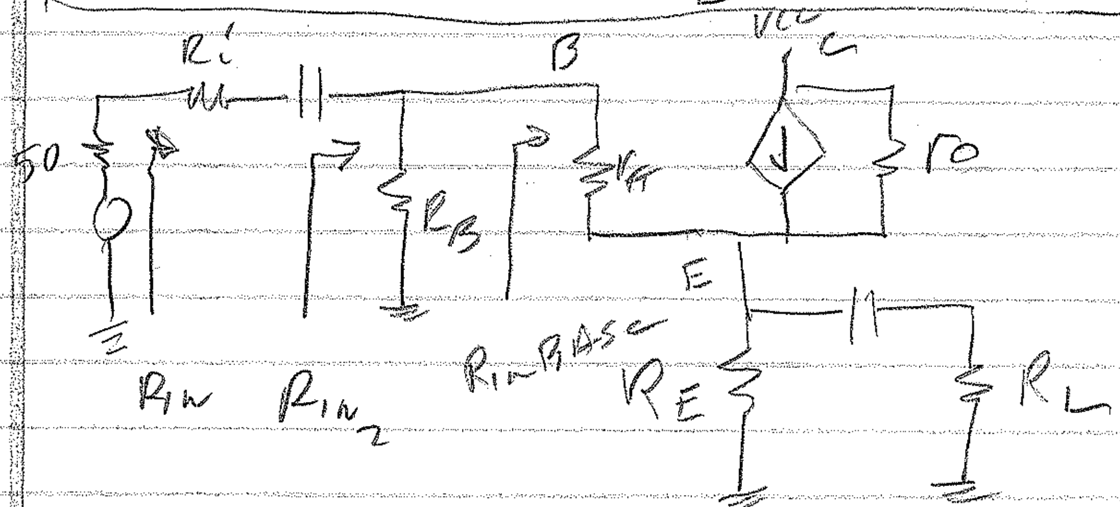
$R_{IN} = R_i' + R_{IN_2}$

$$R_B = R_{B_1} \| R_{B_2} = \frac{1}{\frac{1}{R_{B1}} + \frac{1}{R_{B2}}}$$

$R_{IN_2} = R_B \| R_{IN\,BASE}$

$R_{IN\,BASE} = r_\pi + [(R_E \| R_L \| r_o)(\beta+1)]$

$$R_{IN} = R_i' + (R_{B_1} \| R_{B_2}) \| [r_\pi + (R_E \| R_L \| r_o)(\beta+1)]$$



CS

Find R_{in} CS AMP AT MID BAND

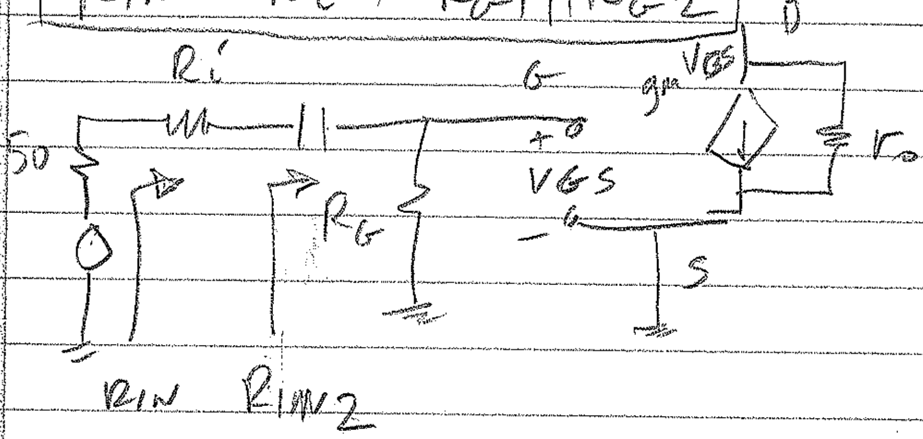
$R_{IN} = R_i' + R_{IN2}$

$R_G = R_{G1} \| R_{G2} = \dfrac{1}{\dfrac{1}{R_{G1}} + \dfrac{1}{R_{G2}}}$

$R_{IN2} = R_G \| R_{in\,Gate}$

$R_{in\,Gate} = \infty$

$$R_{IN} = R_i' + R_{G1} \| R_{G2}$$



CD

Find R_{IN} CD amp AT mid Band

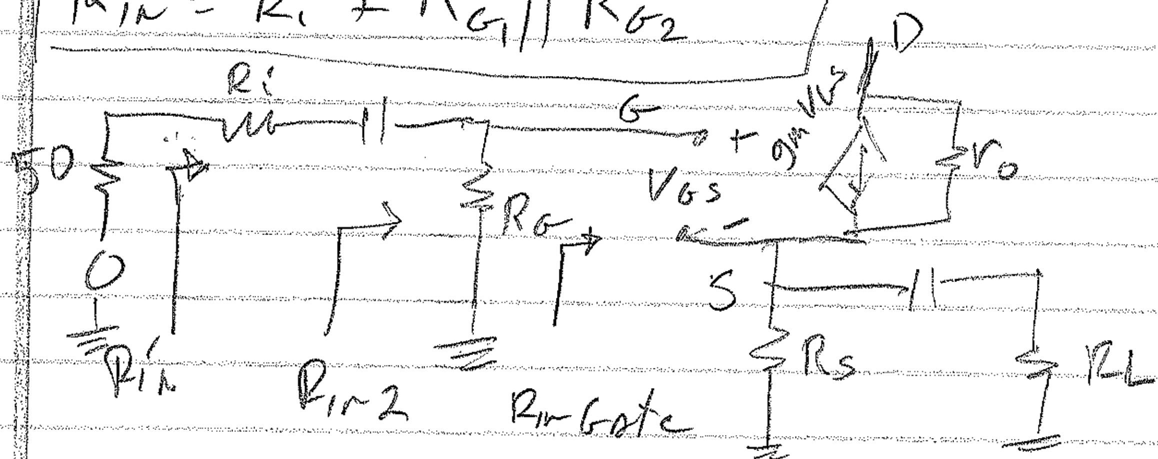
$R_{IN} = R_i + R_{IN2}$

$R_G = R_{G1} \| R_{G2} = \frac{1}{1/R_{G1} + 1/R_{G2}}$

$R_{IN2} = R_G \| R_{inGate}$

$R_{inGate} = \infty$

$R_{IN} = R_i + R_{G1} \| R_{G2}$



CE CC

Find R_{B1}, R_{B2} to meet R_{in} requirement.

$R_{in} = R_i + R_{in_2}$ give R_{in}

$R_{in_2} = R_{in} - R_i$ set

$R_{in_2} = R_B \| R_{in\,Base}$

$R_{in\,Base}$ is set by the bias / Q-point.

CE $R_{in\,Base} = r_\pi + R_{Ef}(\beta+1)$

CC $R_{in\,Base} = r_\pi + (R_E \| R_L \| r_o)(\beta+1)$

$$R_{in_2} = R_B \| R_{in\,Base} = \frac{1}{\frac{1}{R_B} + \frac{1}{R_{in\,Base}}}$$

solve for R_B

$$\frac{1}{R_B} = \frac{1}{R_{in_2}} - \frac{1}{R_{in\,Base}}$$

$$R_B = \frac{1}{1/R_{in_2} - \frac{1}{R_{in\,Base}}}$$

Given R_{in} = value

solve for R_{B1} and R_{B2} from R_B

$$R_B = \frac{1}{1/R_{B1} + 1/R_{B2}}$$

now solve for R_{B2}

$$\frac{1}{R_{B2}} = \frac{1}{R_{B1}} - \frac{1}{R_{B1}}$$

write R_{B1} in terms of R_{B2}

$$R_{B1} = \frac{V_{cc} - V_b}{\frac{V_b}{R_{B2}} + I_B}$$

Subitute in R_{B1}

$$\frac{1}{R_{B2}} = \frac{1}{R_B} - \frac{1}{\dfrac{V_{cc} - V_b}{\frac{V_b}{R_{B2}} + I_B}}$$

GIVE R_{IN} = VALUE CECC 7/9

Find R_{B_1}, R_{B_2} CONT.

REDUCE:

$$\frac{1}{R_{B2}} = \frac{1}{R_B} - \left(\frac{V_b/R_{B_2} + I_B}{V_{CC} - V_b} \right)$$

multiply by $V_{CC} - V_b$

$$\frac{V_{CC} - V_b}{R_{B_2}} = \frac{V_{CC} - V_b}{R_B} - \left(\frac{V_b}{R_{B2}} + I_B \right)$$

REARANGE

$$\frac{V_b}{R_{B2}} + I_B + \frac{V_{CC} - V_b}{R_{B2}} = \frac{V_{CC} - V_b}{R_B}$$

$$\frac{V_{CC}}{R_{B2}} + I_B = \frac{V_{CC} - V_b}{R_B}$$

$$\frac{V_{CC}}{R_{B2}} = \frac{V_{CC} - V_b}{R_B} - I_B$$

$$\boxed{R_{B2} = V_{CC} \Big/ \left(\frac{V_{CC} - V_b}{R_B} - I_B \right)}$$

$$\boxed{R_{B_1} = \frac{V_{CC} - V_b}{V_b/R_{B2} + I_B}}$$

GIVEN RIN = VALUE CS CD

Find R_{G1} and R_{G2}

$R_{IN} = R_i' + R_{IN2} \Rightarrow R_{IN2} = R_{IN} - R_i'$

$R_{IN2} = R_{G1} \| R_{G2} \| R_{IN\ Gate}$

$$R_G = R_{G1} \| R_{G2} = \frac{1}{\frac{1}{R_{G1}} + \frac{1}{R_{G2}}}$$

$R_{IN\ Gate} = \infty$

$R_{IN2} = R_G$

$$\frac{1}{R_G} = \frac{1}{R_{G1}} + \frac{1}{R_{G2}}$$

Solve R_{G2}

$$\frac{1}{R_{G2}} = \frac{1}{R_G} - \frac{1}{R_{G1}}$$

$$\boxed{R_{G1} = \frac{V_{dd} - V_G}{\frac{V_G}{R_{G2}}}}$$

$I_{R_{G1}} = I_{R_{G2}}$

$R_{G1} = \frac{\text{Voltage across}}{\text{Current in } R_{G1}}$

CS, CD

$$\frac{1}{R_{G2}} = \frac{1}{R_G} - \frac{1}{\frac{Vdd - V_G}{V_G / R_{G2}}}$$

$$\frac{1}{R_{G2}} = \frac{1}{R_G} - \frac{V_G / R_{G2}}{Vdd - V_G}$$

$$\frac{Vdd - V_G}{R_{G2}} = \frac{V_{DD} - V_G}{R_G} - \frac{V_G}{R_{G2}}$$

$$\frac{Vdd - V_G}{R_{G2}} + \frac{V_G}{R_{G2}} = \frac{Vdd - V_G}{R_G}$$

$$\frac{Vdd}{R_{G2}} = \frac{V_{CC} - V_G}{R_G} \Rightarrow \frac{R_{G2}}{Vdd} = \frac{R_G}{Vdd - V_G}$$

$$\boxed{R_{G2} = \frac{R_G \, Vdd}{Vdd - V_G}}$$

$$\boxed{R_{G1} = \frac{Vdd - V_G}{V_G / R_{G2}}} \qquad \boxed{R_{IN2} = R_G}$$

$$R_{IN} = R_i + R_{IN2}$$