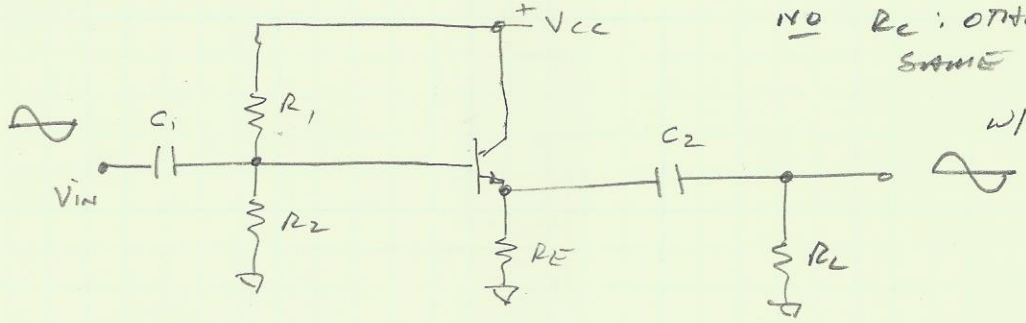
6-4 COMMON-COLLECTOR AMPLIFIER – EMITTER FOLLOWER

P. 291

- O/P IN ϕ W/ INPUT!
- TAKEN FROM EMITTER.

dc ANALYSIS – NOTE: NO R_C; OTHERWISE SAME AS C-E AMP. W/ V-DIVIDER BIAS.



AC ANALYSIS

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VOLTAGE GAIN

$$A_V \cong 1$$

$R_E \parallel R_L$

INPUT RESISTANCE

$$R_{in(base)} \cong \beta_{ac} R_e$$

$$R_{in(tot)} = R_1 \parallel R_2 \parallel R_{in(base)}$$

OUTPUT RESISTANCE

$$R_{out} \cong \left(\frac{R_s}{\beta_{ac}}\right) \parallel R_E$$

CURRENT GAIN

$$A_i = \frac{I_e}{I_{in}}$$

POWER GAIN

$$A_p \cong A_i \quad (\text{since } A_V \cong 1)$$

- SEE EX 6-9 P. 294.

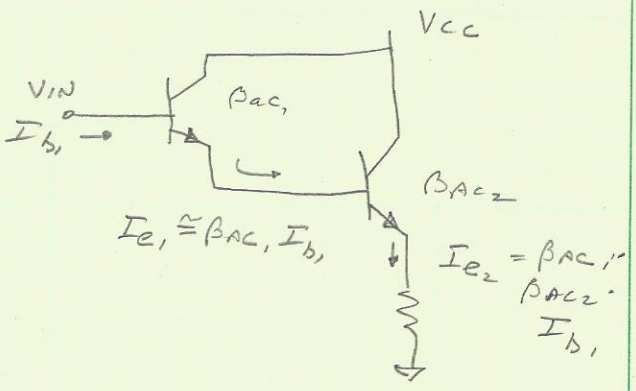
DARLINGTON PAIR p. 295

- β_{ac} : MAJOR FACTOR IN DETERMINING INPUT RESISTANCE OF AN AMPLIFIER

INPUT RESISTANCE CAN BE INCREASED VIA A "DARLINGTON" PAIR

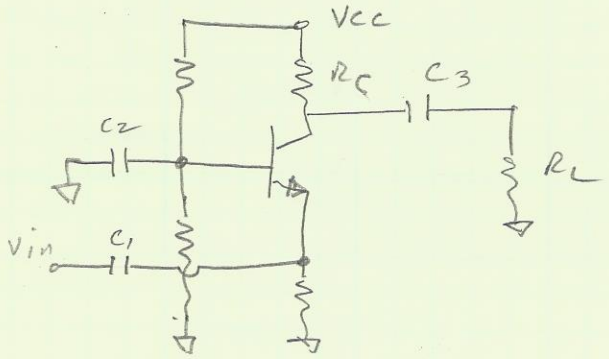
$R_{in} = \beta_{AC_1} \beta_{AC_2} R_E$

"SQUARE OF THE GAINS!"



6-5 COMMON BASE AMPLIFIER

(BASE is @ COMMON OR AC GROUND)



O/P IN ϕ w/ INPUT

INPUT RESISTANCE

R_{in}(emitter) $= r'_e$

O/P RESISTANCE

$R_{out} \cong R_C$

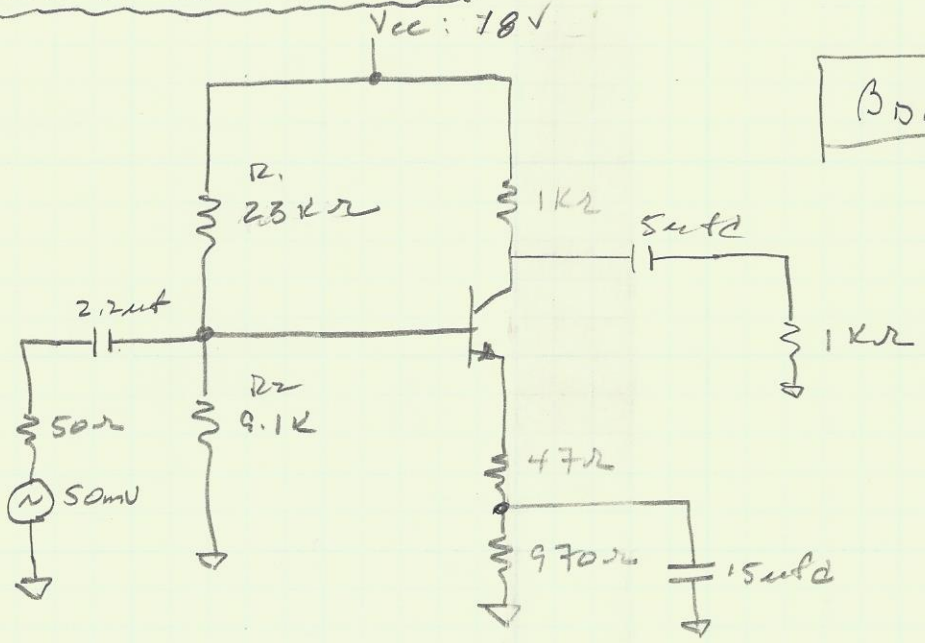
CURRENT GAIN

$A_i \cong 1$

POWER GAIN

$A_p = A_v$

COMMON EMITTER EXAMPLE



$\beta_{DC} = \beta_{AC} = 185$

dc ANALYSIS

① $V_B = \left(\frac{R_2}{R_1 + R_2}\right) V_{CC} = \left(\frac{9.1\,K\Omega}{(23 + 9.1)\,K\Omega}\right) 18V = 0.28(18)$

$\boxed{V_B = 5.1V}$

② $V_E = V_B - V_{BE} = 5.1 - 0.7$

$\boxed{V_E = 4.4V}$

③ $I_E = \frac{V_E}{R_{E1} + R_{E2}} = \frac{4.4V}{47\Omega + 970\Omega}$

$\boxed{I_E = 4.3\,mA}$

④ $I_E \cong I_C \cong 4.3mA$

⑤ $V_C = V_{CC} - I_C R_C$

$= 18V - (4.3mA)(1K\Omega)$

$= 18V - 4.3V$

$\boxed{V_C = 13.7V}$

⑥ $V_{CE} = V_C - V_E$

$= 13.7V - 4.4V$

$\boxed{V_{CE} = 9.3V}$

⑦ $I_{C(SAT)} = \frac{V_{CC} - V_{BE}}{R_C + R_{E1} + R_{E2}}$

$= \frac{18V - 0.7V}{1K\Omega + 47 + 970\Omega}$

$I_{C(SAT)} = \frac{17.3V}{2.017K\Omega}$

$\boxed{I_{C(SAT)} = 8.6mA}$

⑧ $\boxed{V_{CE\,C\text{-}O} = 18V}$

COMMON EMITTER EXAMPLE

AC ANALYSIS

① $r'_e = \frac{25\,mV}{I_E} = \frac{25\,mV}{4.3\,mA}$

$$\boxed{r'_e = 5.81\,\Omega}$$

② $R_{in(base)} = \beta_{AC}(r'_e + R_{E_1})$

$= 185(5.81\,\Omega + 47\,\Omega)$

$$\boxed{R_{in(base)} = 9.77\,K\Omega}$$

③ $R_{in(total)} = R_1 \parallel R_2 \parallel R_{in(base)}$

$= 23\,K\Omega \parallel 9.1\,K\Omega \parallel 9.77\,K\Omega$

$$\boxed{R_{in(total)} = 3.91\,K\Omega}$$

④ $A_V = \frac{R_C \parallel R_L}{R_{E_1}} = \frac{1K\Omega \parallel 1K\Omega}{47\Omega} = \frac{500\,\Omega}{47\,\Omega}$

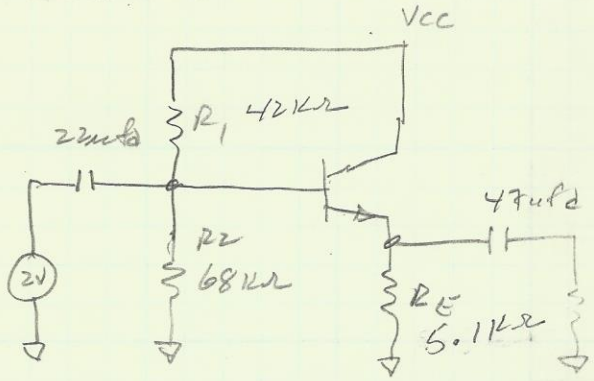
$$\boxed{A_V = 10.62}$$

⑤ $V_{out} = A_V \cdot V_{in}$

$= 10.62 \cdot 50mV$

$$\boxed{V_{out} = 0.532\,V}$$

EMITTER FOLLOWER EXAMPLE



$\beta_{DC} = \beta_{AC} = 190$

- DC ANALYSIS

① $V_B = \left(\frac{R_2}{R_1 + R_2}\right) V_{CC}$

$= \left(\frac{68K\Omega}{42K\Omega + 68K\Omega}\right) 18V$

$V_B = 11.13 V_{DC}$

② $V_E = V_B - V_{BE}$

$= 11.13 V_{DC} - 0.7V$

$V_E = 10.43 V_{DC}$

③ $I_E = I_C = \frac{V_E}{R_E}$

$= \frac{10.43V}{5.1K\Omega}$

$I_E = 2.05 mA$

④ $V_{CE} = V_{CC} - V_E$

$= 18V - 10.43 V_{DC}$

$V_{CE} = 7.57 V_{DC}$

⑤ $I_{C(SAT)} = \frac{V_{CC} - V_{BE}}{R_E}$

$= \frac{18V - 0.7V}{5.1K\Omega}$

$I_{C|SAT} = 3.39 mA$

$V_{CE_{C-O}} = 18V$

EMITTER FOLLOWER EXAMPLE (CONTINUED)

AC ANALYSIS

$R_{in(base)} = \beta_{ac} R_E$

$= 190 \cdot 5.1\,K\Omega$

$= 969\,K\Omega$

$R_{in(tot)} = R_1 \| R_2 \| R_{in(base)}$

$= (42K\Omega^{-1} + 68K\Omega^{-1} + 969K\Omega^{-1})$

$= 25.29K$

$A_V = 1$

$V_{out} \cong 2V$