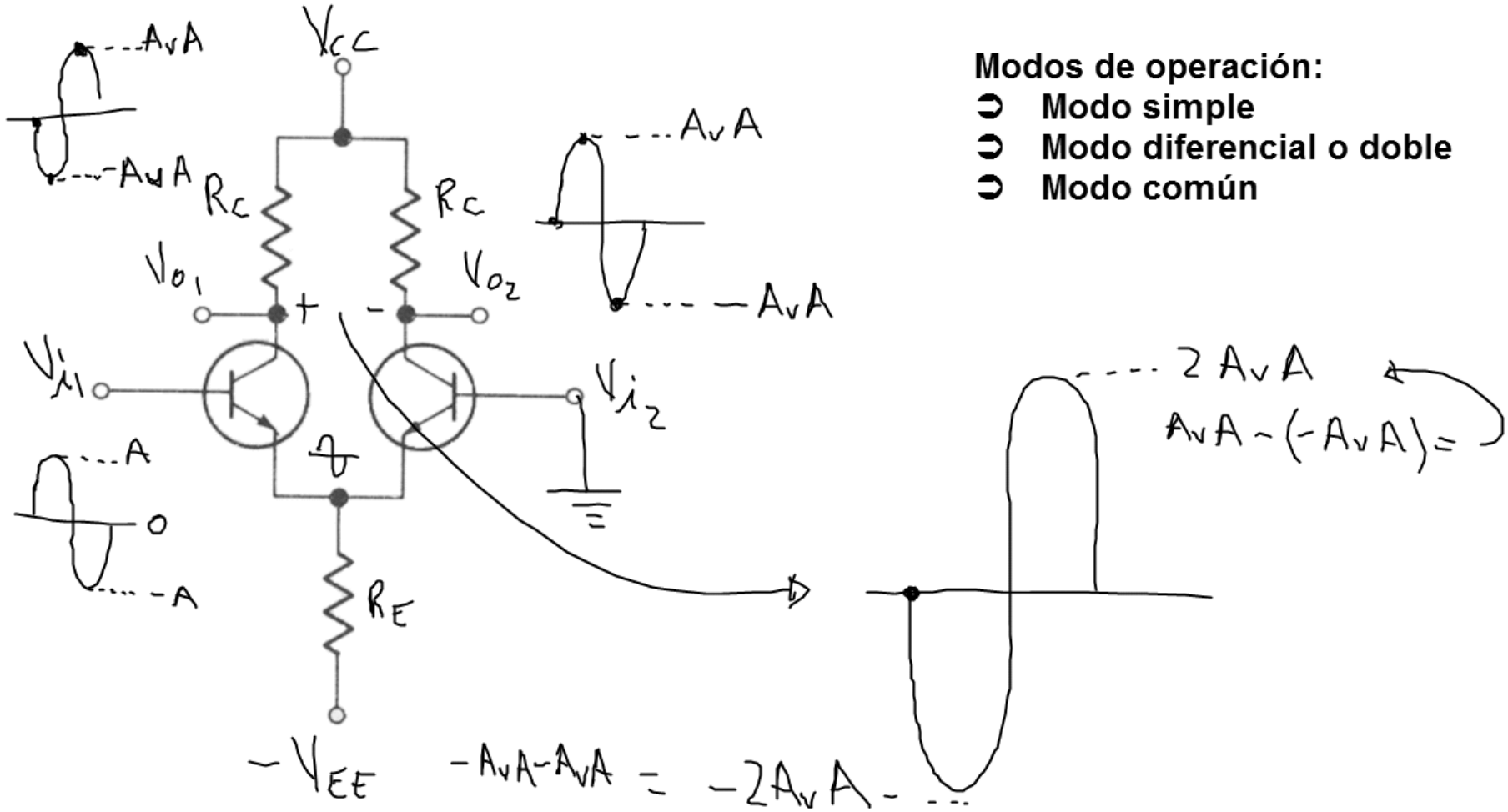
Amplificadores diferenciales

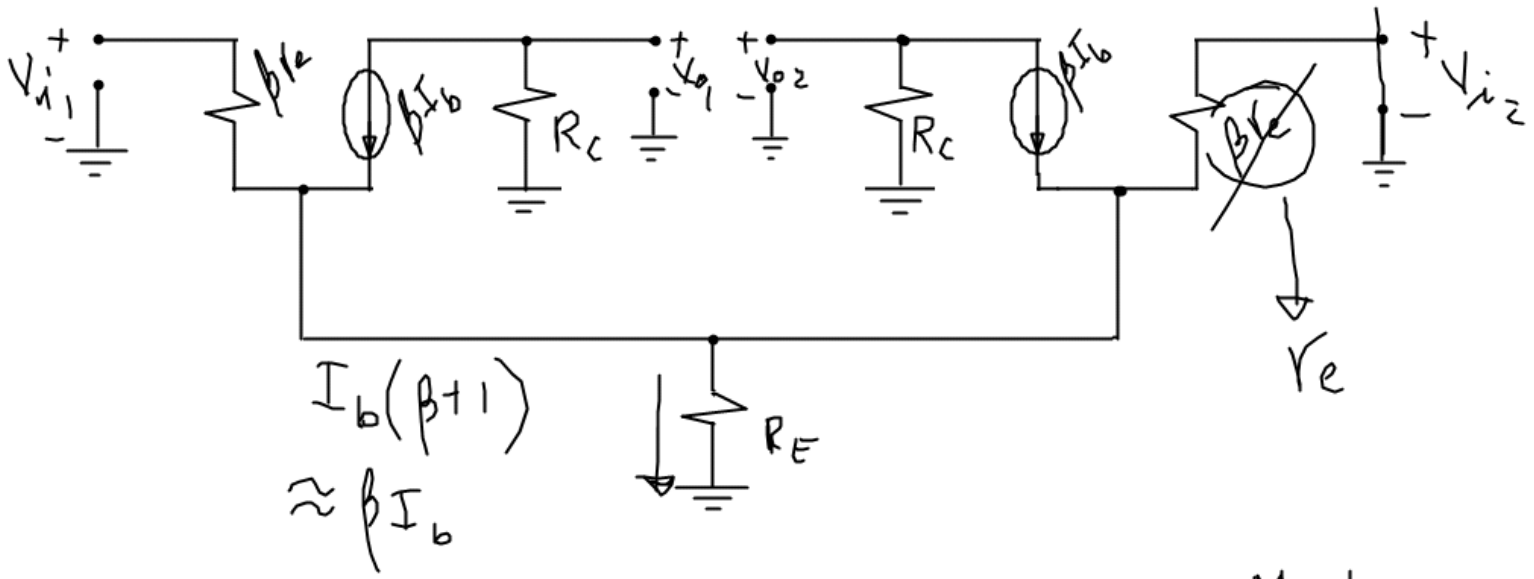


Modos de operación:

- **Modo simple**
- **Modo diferencial o doble**
- **Modo común**

Análisis en AC

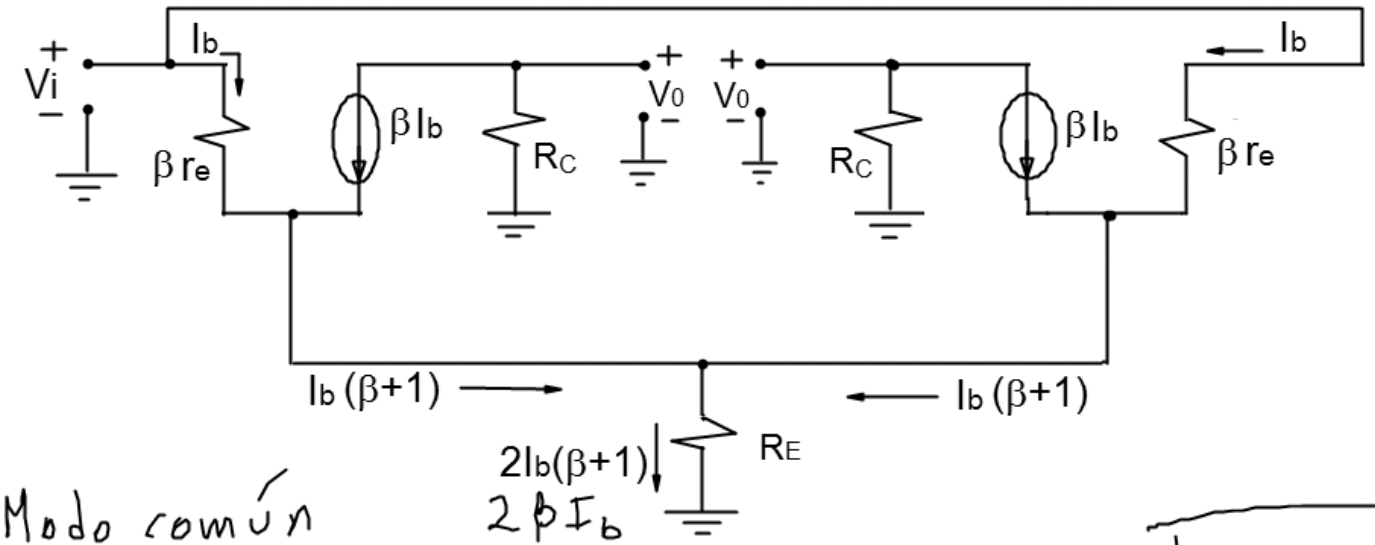
Modo simple y modo diferencial



Modo simple

$$A_V = \frac{V_o}{V_i} = \frac{\beta I_b R_C}{I_b \beta r_e + \beta I_b r_e} = \frac{R_C}{2 r_e}$$

Análisis en AC
Modo común



Modo común

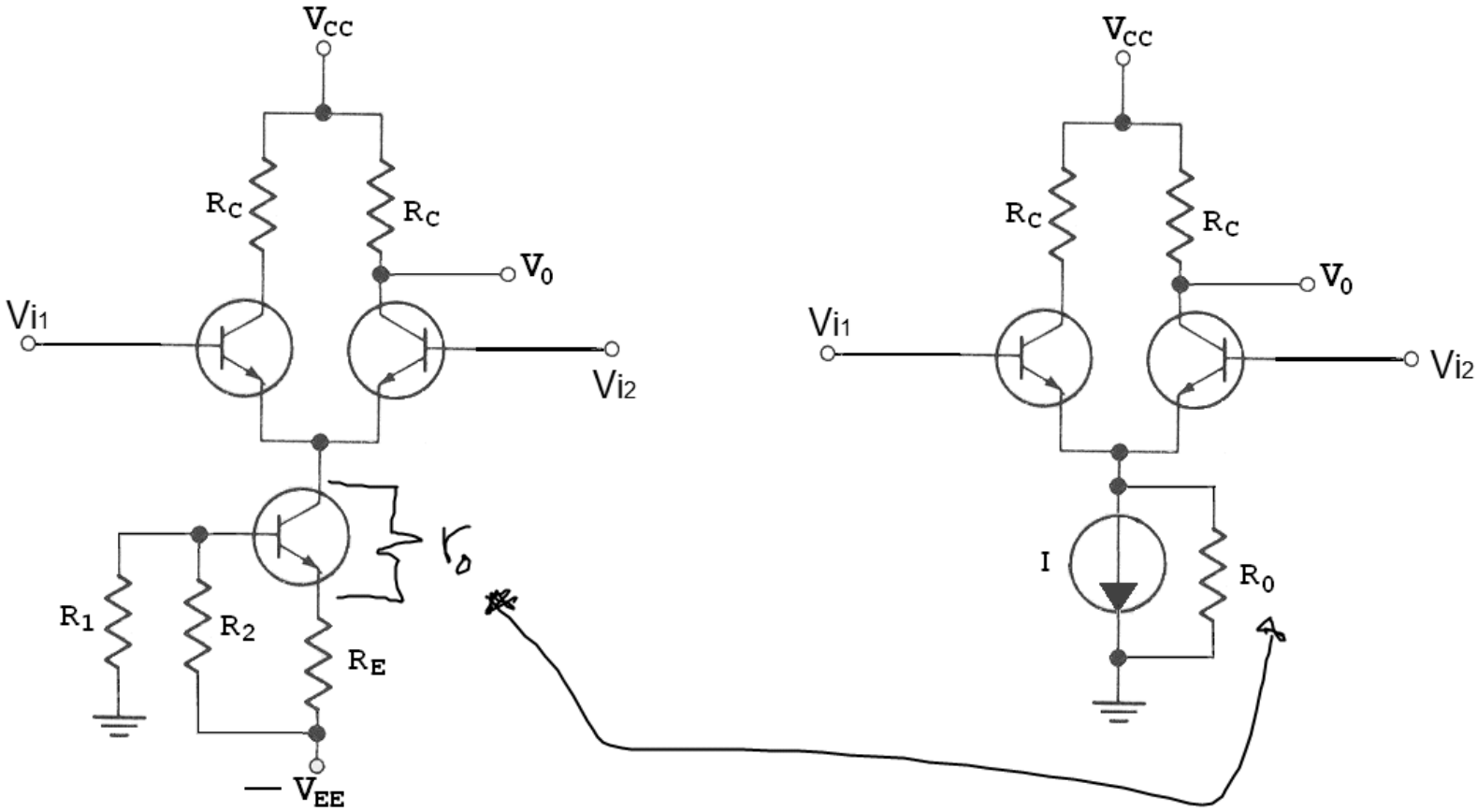
$2\beta I_b$

$$A_c = \frac{V_o}{V_{ic}} = \frac{\beta I_b R_c}{I_b \beta r_e + 2\beta I_b R_E} = \frac{R_c}{r_e + 2R_E}$$

r_o

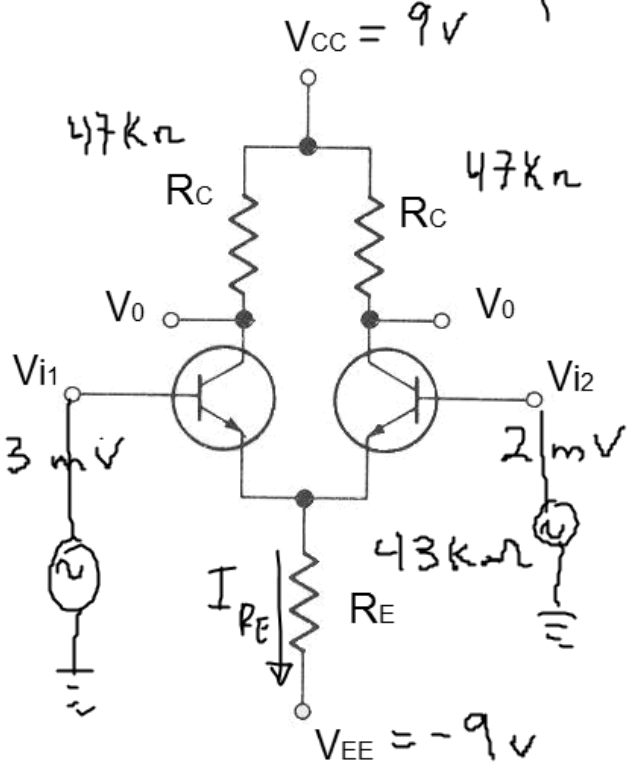
$(r_o + R_E)$

$$V_{ic} = \frac{1}{2}\left(V_{i1} + V_{i2}\right)$$


V_{CC}
R_C
R_C
V_0
V_{i1}
V_{i2}
R_1
R_2
R_E
r_o
$-V_{EE}$
V_{CC}
R_C
R_C
V_0
V_{i1}
V_{i2}
I
R_0

Ejemplo:

$\beta = 75$



$$I_{RE} = \frac{V_{EE} - 0.7V}{R_E} = \frac{9 - 0.7}{43k\Omega}$$

$$I_{RE} = 193\,\mu A$$

$$I_E = \frac{1}{2} I_{RE} = 96.5\,\mu A$$

$$r_e = \frac{26mV}{I_E} = 269\ \Omega$$

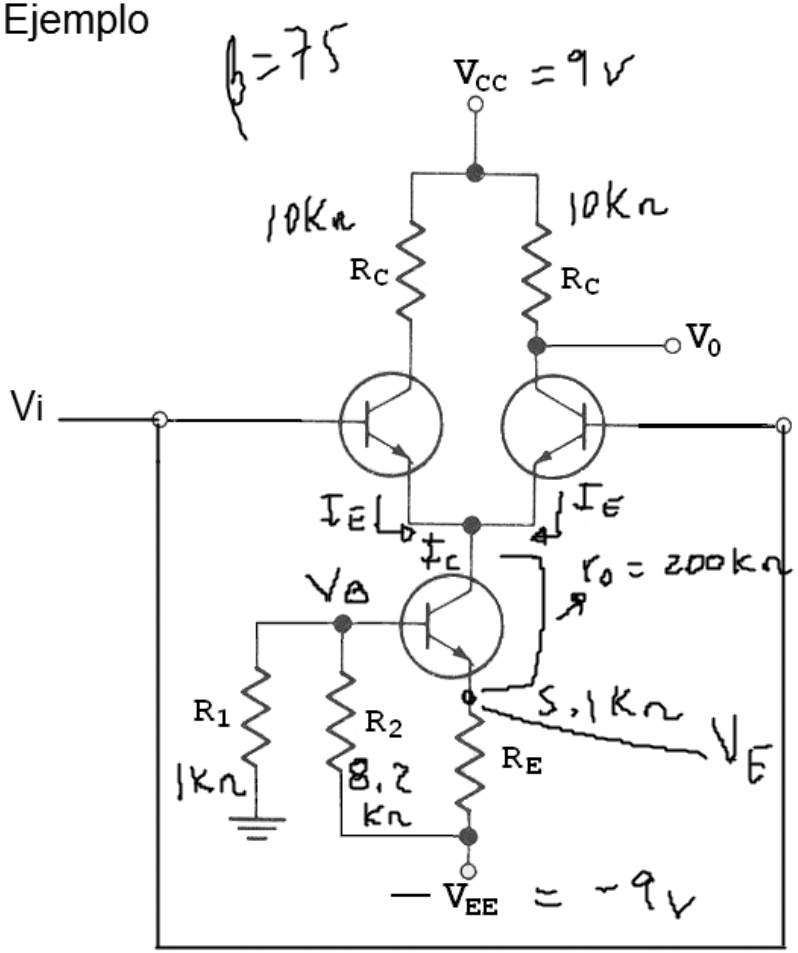
$$A_V = \frac{R_C}{2r_e} = \frac{47k\Omega}{2(269)} \approx 87.4 = A_d$$

$$A_C = \frac{R_C}{r_e + 2R_E} = \frac{47k\Omega}{269 + 2(43k\Omega)} = 0.54$$

Modo diferencial

$$V_{o_1} = A_V V_d = (87.4)(V_{i_1} - V_{i_2}) = (87.4)(3mV - 2mV) = 87.4\,mV$$

Ejemplo



$$V_{R_1} = \frac{1k\Omega}{1k\Omega + 8.2k\Omega}(-9)$$

$$V_{R_1} = -0.978V = V_B$$

$$V_{BE} = V_B - V_E$$

$$V_E = V_B - V_{BE}$$

$$V_E = -0.978 - 0.7$$

$$V_E = -1.678V$$

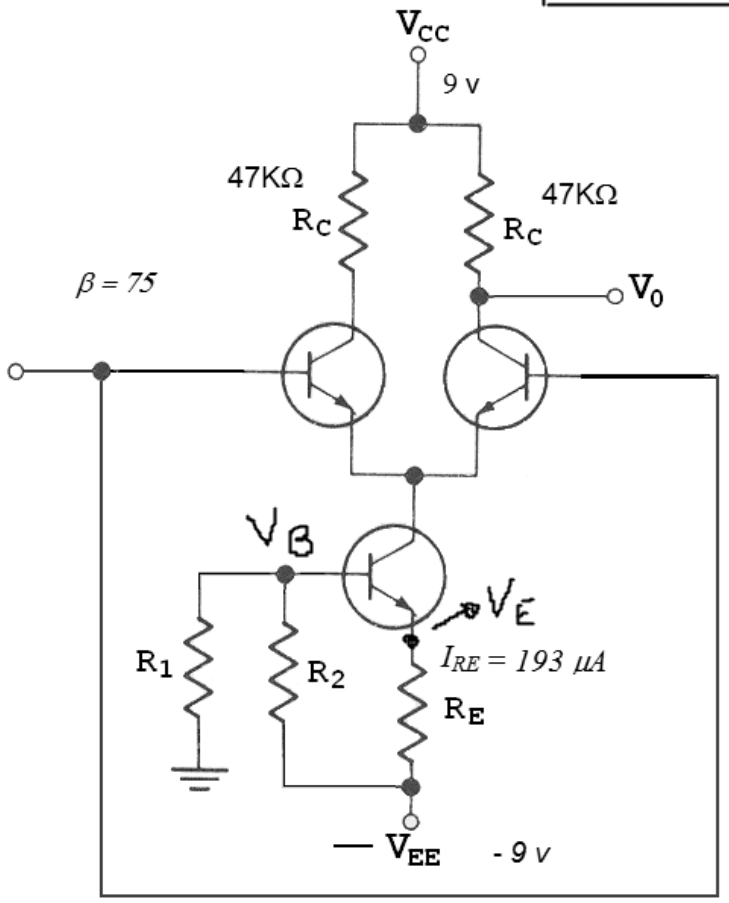
$$V_{RE} = V_E - V_{EE} = -1.678 - (-9)$$

$$V_{RE} = 7.322V = I_{RE} R_E$$

$$I_{RE} = \frac{7.322}{5.1k\Omega} = 1.44mA$$

Ejemplo:

$r_o = 100k\Omega$



$$\beta R_E \geq 10 R_1$$

$$R_1 \simeq R_2$$

$$V_{R_1} \simeq \frac{R_1}{R_1 + R_2}(-9)$$

$$V_{R_1} \simeq -4.5\ v \simeq V_B$$

$$V_E \simeq V_B - V_{BE}$$

$$V_E \simeq -4.5\ v - 0.7v \simeq -5.2v$$

$$V_{RE} \simeq V_E - V_{EE} \simeq -5.2 - (-9) \simeq 3.8v$$

$$R_E \simeq \frac{V_{RE}}{I_{RE}} \simeq \frac{3.8\ v}{193\mu A} \simeq 19689 \simeq 20K\Omega$$