eletronica_basica_exerc

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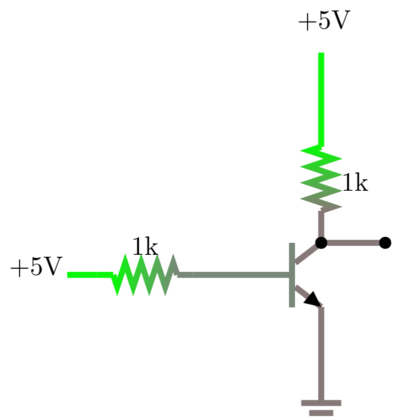
1 Principais Equações do BJT



$$I_E = I_B + I_C$$
$$\beta = \frac{I_C}{I_B}$$
$$I_C = \beta I_B$$
$$I_E = I_B + \beta I_B$$
$$I_E = (\beta + 1)\, I_B$$
$$V_{BE} = 0.7V$$

1.1 Região de Operação

Para $V_{CE=0}$
$$I_C = \frac{V_{CC_{ColletorEmissor}}}{R_C}$$
Para $I_C = 0$
$$V_{CC} = V_{CE}$$

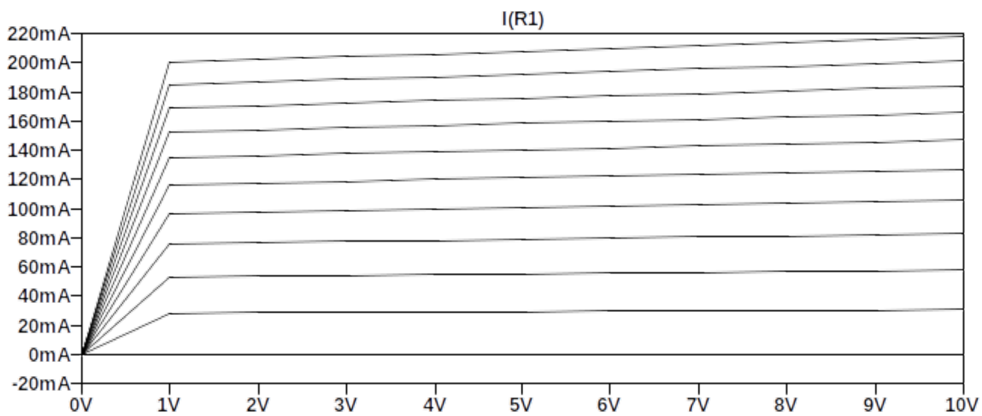
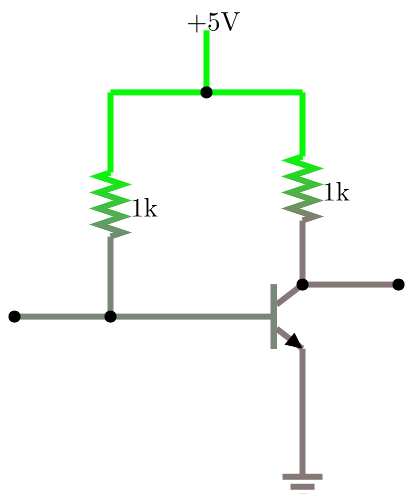


Figure 1: Eixo $Y = I_C$, eixo $X = V_{CE}$, I_B gera uma das linhas, encontrar a intecessão entre os pontos I_C e V_{CC} com a linha I_B

2 Polarização Fixa



$$V_{CC} - I_B R_B - VBE = 0$$
$$I_B = \frac{V_{CC} - V_{BE}}{R_B}$$
$$I_C = \beta I_B$$
$$V_C E + I_C R_C - V_{CC} = 0$$
$$V_{CE} = V_{CC} - I_C R_C$$

3 Operando como chave

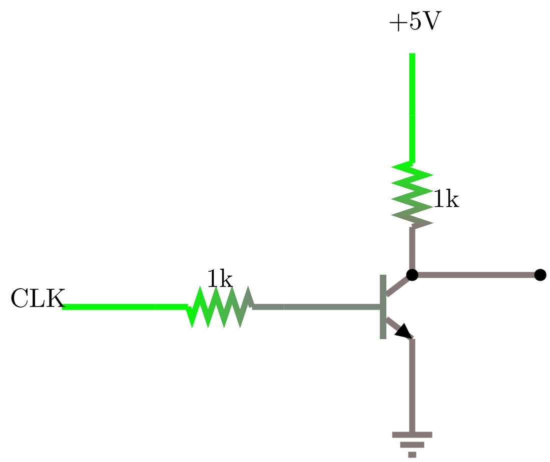
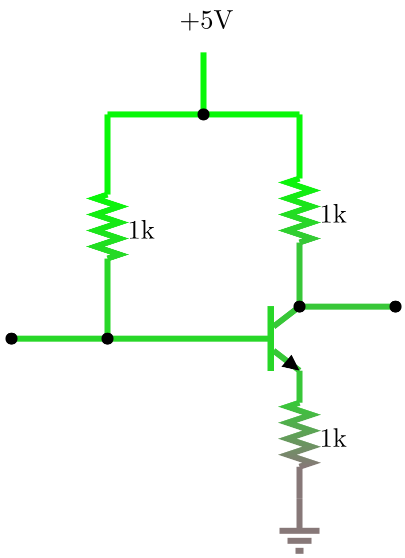


Figure 2: $V_I = CLK$

$$V_I = I_B R_B + V_{BE}$$
$$I_B = \frac{V_I - V_{BE}}{R_B}$$
$$V_B = V_I - I_B R_B$$
$$V_C = V_{CC} - I_C R_C$$

4 Polarização de Emissor



$$V_{CC} - I_B R_B - V_{BE} - (\beta + 1)\, I_B R_E = 0$$

$$I_B = \frac{V_{CC} - V_{BE}}{R_B + (\beta + 1)\, R_E}$$

$$V_{CC} - I_C R_C - V_{CE} - I_E R_E = 0$$

Para $hFe100$:

$$I_C \approx I_E$$

$$V_{CE} = V_{CC} - I_C\,(R_C + R_E)$$

$$V_B = V_{CC} - I_B R_B$$

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

$$V_C = V_{CC} - I_C R_C$$

5 Polarização por Divisor de Tensão

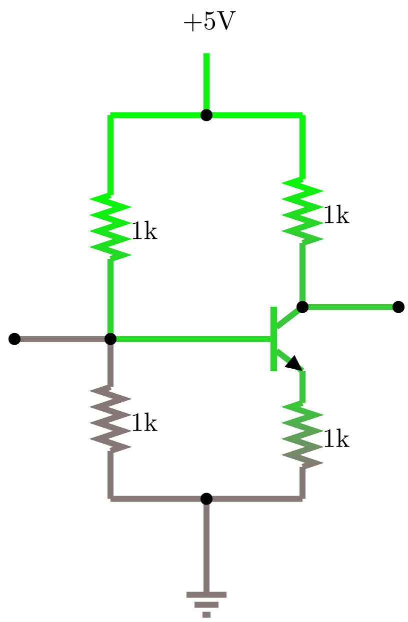


Figure 3: R_1 and R_2 are connected to the base of the transistor

5.1 Thevenim Theorem

$$R_{Th} = R_1 | R_2$$

$$E_{Th} = \frac{R_2}{R_1 + R_2} V_{CC}$$

5.2 Standard Equations

$$E_{Th} - I_B R_{Th} - V_{BE} - (\beta + 1)\, I_B R_E = 0$$

$$I_B = \frac{E_{Th} - V_{BE}}{R_{Th} + (\beta + 1)\, R_E}$$

$$V_{CC} - I_C R_C - V_{CE} - I_E R_E = 0$$

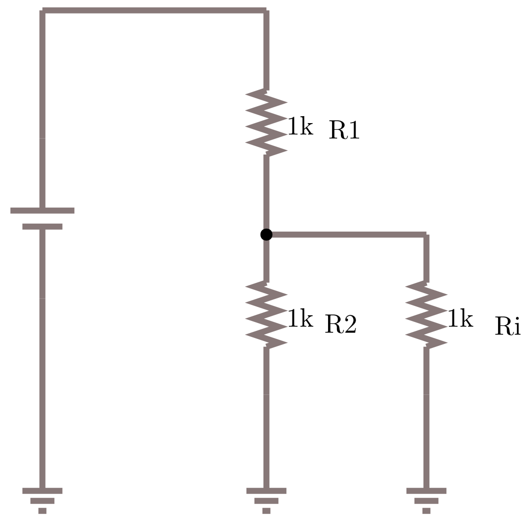
Para $hFe \geq 100$:

$$I_C \approx I_E$$

$$V_{CE} = V_{CC} - I_C\,(R_C + R_E)$$

$$V_B = V_{CC} - I_B R_B$$
$$V_E = V_B - V_{BE}$$
$$V_C = V_{CC} - I_C R_C$$

6 Polarização por Divisor de Tensão Simplificado



$$R_i = (\beta + 1)\, R_E \approx \beta R_E$$

Se $\beta R_E \geq 10 R_2$:

$$V_B = \frac{R_2 V_{CC}}{R_1 + R_2}$$

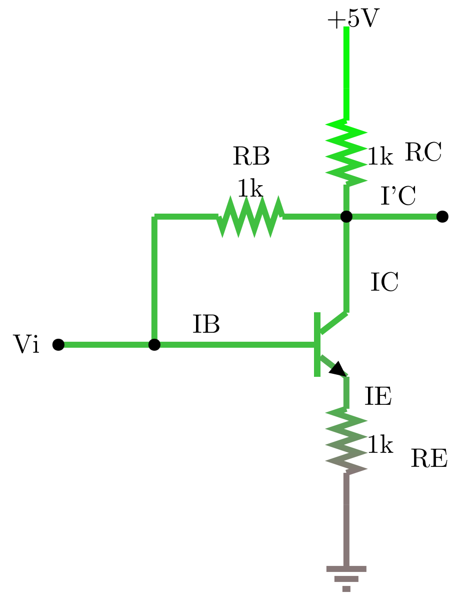
$$V_E = V_B - V_{BE}$$

$$I_E = \frac{V_E}{R_E}$$

$$I_{C_Q} \approx I_E$$

$$V_{CE_Q} = V_{CC} - I_C\,(R_C + R_E)$$

7 Realimantação de Tensão



$$V_{CC} - V_{BE} - \beta I_B \left(R_C + R_E\right) - I_B R_B = 0$$

$$I_B = \frac{V_{CC} - V_{BE}}{R_B + \beta \left(R_C + R_E\right)}$$

$$I'_C \approx I_C | I_E \approx I_C$$

$$I_C \left(R_C + R_E\right) + V_{CE} - V_{CC} = 0$$

$$V_{CE} = V_{CC} - I_C \left(R_C + R_E\right)$$