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γ_d $\beta=200$ $V_{BE}=0,7$ $V_T=25mV$ $I_{C1}=I_{C2}=0$ $V=I.R$

$$\frac{12-V_{E1}}{201I_{B1}} = 23.000$$

$$\frac{V_{B1}}{100.000} = I_{B1}$$

$$4723000 \cdot I_{B1} = 12 - V_{E1} + V_{B1}$$

$$I_{B1} = \frac{12 - 0,7}{4723000} = 2.392 \cdot 10^{-6} A$$

$$I_{E1} = 4,81 \cdot 10^{-4} A$$

$$I_{C1} = 4,785 \cdot 10^{-4} A$$

$$\frac{12-V_{E1}}{23000} = 4,81 \cdot 10^{-4}$$

$$V_{E1} = 11.063 V$$

$$V_{EC1} = 17.329 V$$

$$V_{C1} = -6.258 V$$

$$\frac{V_{E2} + 12}{4300} = 1,477 \cdot 10^{-3}$$

$$V_{E2} = -5,668 V$$

$$\frac{12-V_{C2}}{47000} = 1,470 \cdot 10^{-3}$$

$$V_{C2} = 4,76 V$$

$$V_{E2} = 0,98 V$$

$$(I_{C1} - I_{C2}) \cdot 12000 = V_{C1} + 12 = V_{B1} + 12 = V_{E1} + 11,3$$

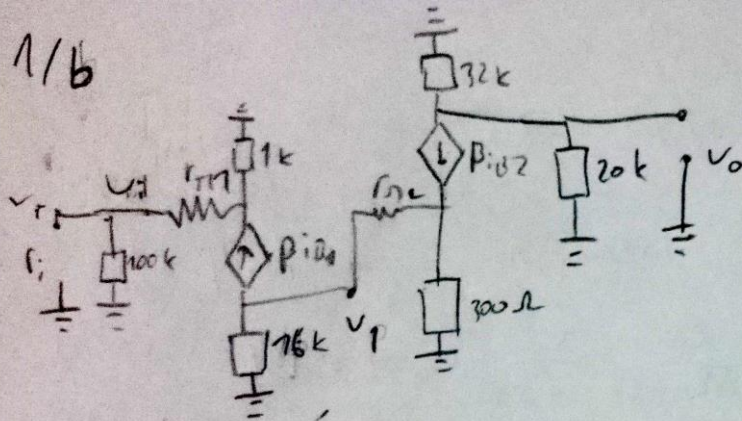
$$I_{C2} = 7,357 \cdot 10^{-6} A$$

$$I_{C2} = 1,470 \cdot 10^{-3} A$$

$$I_{E2} = 1,477 \cdot 10^{-3} A$$

$$V_{E2} = 201I_{B2} \cdot 4300 = 12 V$$

1/b



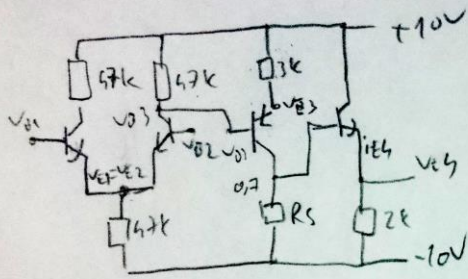
$$\frac{V_1}{V_i} = - \frac{R_c \beta}{r_{\pi}} = - \frac{76.000 \cdot 200}{27.10^3 / 2,392.10^{-2}} = - \frac{76.000 \cdot 200}{1,1287.10^{-4}} = -283,512$$

$$r_i = 100k \parallel 511 \quad r_1 \Rightarrow \frac{1}{100.000} + \frac{1}{1,1287.10^{-4}} \approx 1,2287.10^{-4} \Omega$$

$$\frac{V_1}{V_0} = - \frac{R_c \beta}{r_{\pi}} = - \frac{32000 \cdot 200}{27.10^3 / 2,352.10^{-6}} = -1742.686$$

$$\frac{V_0}{V_i} = \frac{V_1}{V_i} \cdot \frac{V_0}{V_1} = -283,512 \cdot - \frac{1}{1742,686} = 0,162$$

2)



$$\frac{10,7 - V_{B3}}{60300} + \frac{10 - V_{B3}}{4700} = 1,132 \cdot 10^{-4}$$

$$V_{B3} = 0,55V$$

$$V_{CE4} = 10V$$

$$V_{CE3} = 8,151V$$

$$V_{CE2} = 8,85V$$

$$V_{CE1} = 4,6204V$$

$$V_{E1} = V_{E2} = 0,7V$$

$$I_{E1} = I_{E2} = \frac{10,7}{47000} \cdot \frac{1}{2} = 1,138 \cdot 10^{-4}A$$

$$I_{C2} = 1,132 \cdot 10^{-4}A$$

$$I_{B3} + \frac{10 - V_{B3}}{4700} = I_{C2}$$

$$\frac{10 - V_{E3}}{3000} = I_{E3} = 20118,1A$$

$$I_{E3} = \frac{10 - V_{B3} + 0,7}{3000} = 20118,1A = 3,83 \cdot 10^{-4}A$$

$$I_{E3} = 3,8142 \cdot 10^{-4}A$$

$$V_{E4} = 0 \Rightarrow V_{B4} = V_{E3} = 0,7V$$

$$R_S = 9,3 \cdot 3,8142 \cdot 10^{-4} = 3,5472 \cdot 10^{-3}\Omega$$