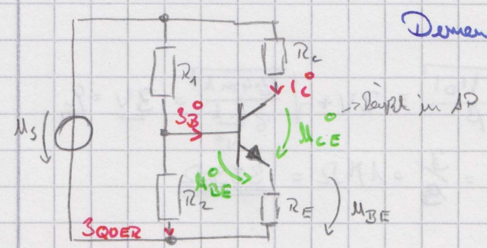
18.04.2011

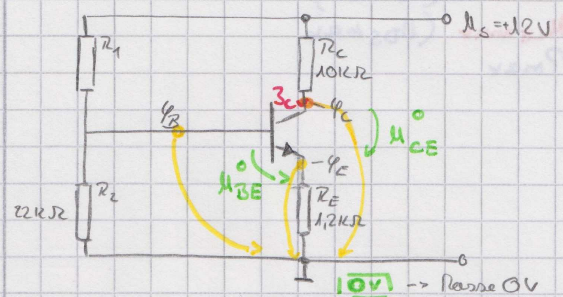
4-4 Standardschaltung zur AP-Einstellung bip. Transistor



Dimensionierungsempfehlung für die Praxis: $U_{RE} \approx (0,1 \dots 0,2) \cdot U_S \Rightarrow R_E$

$I_{QUER} \approx (10 \dots 20) \cdot I_B \Rightarrow R_1, R_2$

① Übung zur AP-Ermittlung am bipolaren Transistor



Gegeben: $U_{BE}^0 = 0,6V$; $I_C^0 = 0,5mA$; $B = 200$
R_2, R_C, R_E

Gesucht: $\varphi_B, \varphi_E, \varphi_C, R_1, U_{CE}^0$

Näherung: $|I_E'| = I_C'$

$U_{RC} = I_C \cdot R_C = 0,5mA \cdot 10k\Omega = \underline{5V}$

$U_{RE} = I_E \cdot R_E \approx I_C \cdot R_E = 0,5mA \cdot 1,2k\Omega = \underline{\underline{0,6V}}$

$\Big\} U_{CE}^0 = U_S - U_{RC} - U_{RE} = \underline{6,4V}$

$\varphi_{..}, \varphi_C$ -> Von da aus bis zur Masse
• Punkt ansetzen -> bis zur Masse

$\varphi_C = U_S V - U_{RC} = 12V - 5V = \underline{\underline{7V}}$

$\varphi_E = \underline{\underline{0,6V}}$

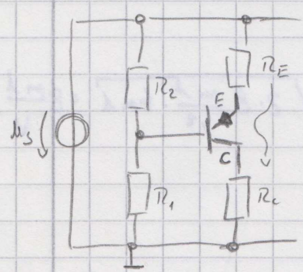
$\varphi_B = U_{BE}^0 + U_{RE} = \underline{\underline{1,2V}}$

$\Rightarrow U_{R2} = 1,2V \quad \rightarrow \quad \frac{R_1}{R_2} = \frac{U_1}{U_2} \quad \Rightarrow R_1 = \frac{U_1}{U_2} \cdot R_2 = \frac{10,8\,V}{1,2\,V} \cdot 22k\Omega = \underline{\underline{198k\Omega}}$

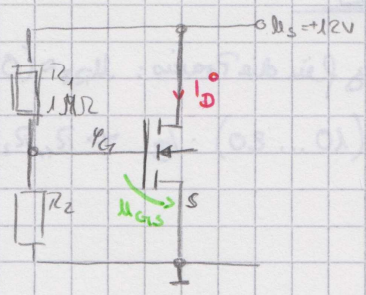
Simulation: $I_C^0 = 486\mu A \quad (T_j = 20°C)$

$$\Delta_C = \frac{I_C(80°) - I_C(-20°)}{I_C(80°C)} = \frac{617 - 366}{426} \cdot 100\% = \underline{\underline{35\%}}$$

Komplementäre Schaltung



4-9 ② SIGFET AP-Einstellung



Geg.: Transistor $\beta = 8\frac{mA}{V^2}$; $U_{TH} = +2V$; $I_D^\circ = 4mA$

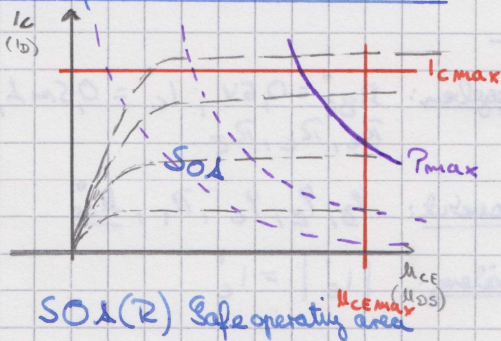
Ges.: R_2

$$U_{GS} = U_{TH} - \sqrt{\frac{2|I_D|}{\beta}} = 2V + \sqrt{\frac{2 \cdot 4mA}{8\frac{mA}{V^2}}} = 3V = U_G$$

$$\frac{R_1}{R_2} = \frac{9V}{3V} \Rightarrow R_2 = \frac{3}{9} \cdot 1M\Omega = 333k\Omega$$

13.04.2011

4-13 Kriterien für die Lage des AP's



- I_{Cmax} (I_{Dmax})
- U_{CEmax} (U_{DSmax})
- P_{max}

SOA(R) Safe operating area

4-14 ① Beispiel für Kleinsignalgrößen am bipo. Transistor

Gegeben: AP-Einstellung $I_C^\circ = 0{,}5mA$

Annahme: $\beta = 200$, $U_Y = 100V$

$$g_m = \frac{I_C^\circ}{U_T} = \frac{0{,}5mA}{26mV} = 0{,}019\,S = 19mS$$

$$r_\pi = \frac{1}{g_m} = \frac{26mV}{0{,}5mA} = 52\Omega$$

$$\beta \cdot r_\pi = 200 \cdot 52\Omega = 10{,}4k\Omega$$

$$r_{CE} = \frac{U_Y}{I_C} = \frac{100V}{0{,}5mA} = 200k\Omega$$

$$\beta \cdot r_{CE} = \underbrace{200 \cdot 200k\Omega}_{2 \cdot 10^2 \cdot 2 \cdot 10^5\,\Omega} = 4 \cdot 10^7\Omega = 40M\Omega$$

② Ergänzung zum Beispiel AP-Einstellung MOSFET

$U_Y = 80V$; $AP = \{U_{GS}^\circ = 3V; U_{DS} = 12V; I_D^\circ = 4mA\}$

Kleinsignalgrößen: $g_m = \sqrt{2 \cdot \beta \cdot |I_D^\circ|} = \beta\,|U_{GS} - U_{TH}| = \sqrt{2 \cdot 8\frac{mA}{V^2} \cdot 4mA} = 8\frac{mA}{V} = 8mS$

$\frac{1}{g_m} = 125\Omega$

$$r_{DS} = \frac{U_Y}{|I_D^\circ|} = \frac{80V}{4mA} = 20k\Omega$$