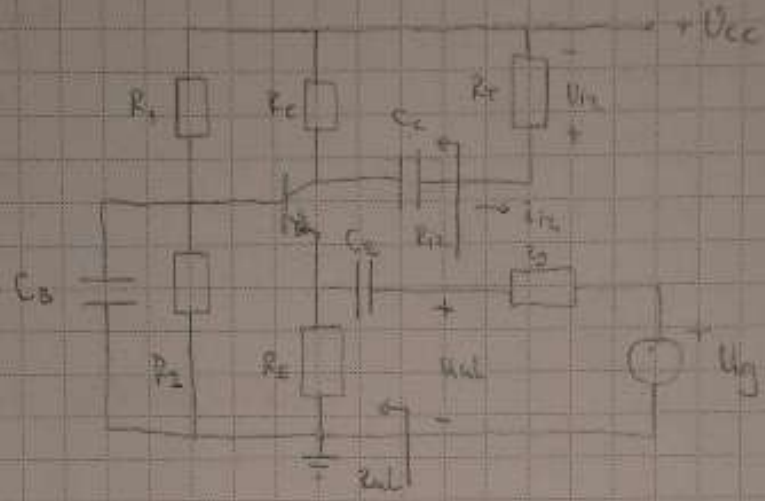
ZI 02.02.2007 => 2. SKUPINA

23)

$U_{CC} = 15\,V$
$R_g = 500\,\Omega$
$R_1 = 180\,k\Omega$
$R_2 = 27\,k\Omega$
$R_C = 5{,}6\,k\Omega$
$R_E = 4{,}7\,k\Omega$

$\beta = h_{fe} = 100$
$U_\gamma = 0{,}7\,V$
$U_T = 25\,mV$



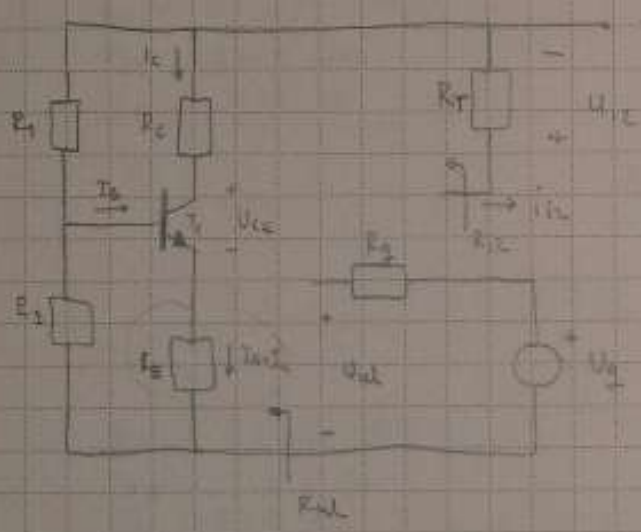
← Pogačeta se spoja tranzistora Latre

T

3.2

nadomestna shema

$I_{CQ} = 1{,}01\,mA$



$I_{CQ} = \beta \cdot I_{BQ}$

$I_{BQ} = \frac{I_{CQ}}{\beta} = 0{,}0101\,mA$

$U_{CEQ} = U_\gamma + 0{,}7\,V$

$U_{CC} = R_C (I_{BQ} + I_{CQ}) + U_{CEQ} + I_{CQ} \cdot R_E$

$R_V = \frac{R_1 R_2}{R_1 + R_2} = 23{,}48\,k\Omega$

$U_{BB} = \frac{R_2}{R_1 + R_2} \cdot U_{CC} = 1{,}96\,V$

$I_{BQ} = \frac{(U_{BB} - U_\gamma)}{R_B + (1+\beta) R_E}$

$R_B I_{BQ} + I_{BQ}(1+\beta) R_E = (U_{BB} - U_\gamma)$

$\therefore R_E = \frac{(U_{BB} - U_\gamma) - R_B I_{BQ}}{I_{BQ}(1+\beta)} = 1\,k\Omega$ ✓ (b)

02.02.2007.

3.3 $I_{CQ} = 0{,}934\ mA$
$U_{CEQ} = 8{,}774\ V$
$R_E = 1{,}1\ k\Omega$

$g_m, r_{BE} = ?$

$h_{fe} = \beta = 100$

$r_{BE} = \frac{U_T}{I_{BQ}} = 2676\ \Omega$

$I_{BQ} = \frac{I_{CQ}}{\beta}$

$g_m = \frac{h_{fe}}{r_{BE}} = 0{,}03736$

3.4. $g_m = 47{,}28\ mA/V$
$r_{BE} = 2115\ \Omega$
$R_E = 820\ \Omega$

$A_V = \frac{U_2}{U_1} = ?$

$A_V = g_m \cdot \frac{R_C R_L}{R_C + R_L} = 110{,}82$

3.5 $g_m = 47{,}28\ mA/V$
$r_{BE} = 2115\ \Omega$
$R_E = 820\ \Omega$

$R_{ab} = ?$

$R_{ab} = \frac{r_{BE}}{1 + h_{fe}} = 20{,}94\ \Omega$

$R_{ab} = \frac{R_E \cdot R_{ab}'}{R_E + R_{ab}'} = 20{,}92\ \Omega$

3.6 $g_m = 47{,}28\ mA/V$
$r_{BE} = 2115$
$R_E = 820\ \Omega$

$R_{in} = ?$

$R_{in} = R_C$

$R_{in} = 5{,}6\ k\Omega$

STABILIZATOR

Subject: ZI 3.2 2007 (B)

Date: => 2 skupine

$U_Z = 6.7\,V$
$I_{Zmin} = 2\,mA$
$P_{Zmax} = 0.5\,W$
$r_Z = 5\,\Omega$
$\beta \approx h_{FE} = 150$
$U_{BE} = 0.7\,V$

$R_T \geq 270\,\Omega$

$U_{ulmin} = 11\,V$
$U_{ulmax} = 19\,V$

4.1 $U_Z - U_{BE} - U_{iz} = 0$

$U_{iz} = U_Z - U_{BE} = \underline{\underline{6V}}$ ✓

4.2 $$R_{1min} = \frac{U_{ulmax} - U_Z}{\frac{P_{Zmax}}{U_Z} + \frac{U_{iz}}{(1+\beta)R_{Tmax}}}$$ ($\frac{U_{iz}}{(1+\beta)R_{Tmax}} = 0$, $R_{Tmax} \to \infty$)

$$R_{1min} = \frac{19 - 6.7}{\frac{0.5}{6.7}} = \underline{\underline{164.82\,\Omega}}$$ ✓

4.3 $$R_{1max} = \frac{U_{ulmin} - U_Z}{I_{Zmin} + \frac{U_{iz}}{(1+\beta)R_{Tmin}}}$$

$$R_{1max} = \frac{11 - 6.7}{2\cdot10^{-3} + \frac{6}{151\cdot 270}} = \underline{\underline{2002,63\,\Omega}}$$??

4.4. $$S_u = \frac{r_Z}{R_1 + R_Z} = \underline{\underline{4,975\cdot10^{-3}}}$$

$$R_1 \approx \frac{R_{1max} + R_{1min}}{2} = 1083$$

$R_1 = 1k\Omega$

4.5. $$R_{iz} = \frac{r_{be} + r_Z}{1 + h_{fe}}$$

$$r_{be} = \frac{U_T}{I_b} =$$

$$I_b = \frac{U_Z - U_{BE}}{(1+\beta)R_T}$$

$I_b =$

ZI 9.01.2007 D 1. chapitre

$U_{iz} = 8.5\,V$

$U_{ulmin} = 13\,V$
$U_{ulmax} = 20\,V$

$R_{1min} = 387\,\Omega$
$P_{1max} = 2840\,\Omega$

$\beta = h_{fe} = 100$

$U_{BE} = 0.7\,V$
$U_t = 25\,mV$
$R_r \geq 330\,\Omega$

4.1. $U_z - U_{BE} - U_{iz} = 0$

$U_z = U_{BE} + U_{iz} = 9.2\,V$

4.2.

$U_z = 8.21\,V$

$U_{iz} = 7.5\,V$

$$I_{zmin} = \frac{U_{ulmin} - U_z}{R_{1max}} - \frac{U_{iz}}{(1+\beta) R_{r\,min}} = 1.49\,mA$$

4.3 $U_z = 8.21\,V$
$U_{iz} = 7.5\,V$

$P_{zmax} = I_{zmax} \cdot U_z$

$P_{zmax} = 0.25\,W$

$$I_{zmax} = \frac{U_{ulmax} - U_z}{R_{1min}} - \frac{U_{iz}}{(1+\beta) R_{r\,max}}$$

$I_{zmax} = 30.42\,mA$

4.4. $R_1 = 1.8\,k\Omega$
$R_r = 820\,\Omega$
$U_z = 8.2\,V$
$I_{zmin} = 1.2\,mA$
$P_{zmax} = 750\,mW$
$r_z = 3\,\Omega$

$Su = ?$

$$Su = \frac{r_z}{R_1 + r_z} = 1.66 \cdot 10^{-3}$$

4.5

$$R_{iz} = \frac{r_{be} + r_z}{1 + h_{fe}} = 2.763\,\Omega$$

$$r_{be} = \frac{U_t}{I_b} = 276\,\Omega \qquad I_b = \frac{U_z - U_{be}}{(1+\beta) R_r} = 70.5\,\mu A$$

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4. $U_{iz} = 10V$

$U_{ulmin} = 15V$
$U_{ulmax} = 25V$

$R_{1min} = 185\ \Omega$
$R_{1max} = 3200\ \Omega$

$\beta \approx h_{FE} = 200$
$U_{BE} = 0.7V$
$U_T = 25mV$

$R_T \geq 390\ \Omega$

4.1

$U_Z - U_{BE} - U_{iz} = 0$

$U_Z = U_{BE} + U_{iz} = 10.7\ V$

4.2

$U_Z = 8.3\ V$

$I_{zmin} = \frac{U_{ulmin} - U_Z}{R_{1max}} - \frac{U_{iz}}{(1+\beta) R_{1min}}$

$I_{zmin} = 2mA$

$U_{iz} = U_Z - U_{BE} = 7.6$

4.3

$P_{zmax} = U_Z \cdot I_{zmax} = 0.75W$

$U_Z = 8.3V$

$U_{iz} = 7.6V$

$I_{zmax} = \frac{U_{ulmax} - U_Z}{R_{1min}} - \frac{U_{iz}}{(1+\beta) R_{1min}}$

$I_{zmax} = 0.09A$

4.4. $S_U = 0.0025$
$U_Z = 8.3\ V$
$R_1 = 2\ k\Omega$
$R_T = 820\ \Omega$

$r_z = ?$

$S_U = \frac{r_z}{R_1 + r_z}$

$S_U R_1 + S_U r_z = r_z$

$S_U R_1 = r_z (1 - S_U)$

$r_z = \frac{S_U R_1}{(1 - S_U)} = 5\ \Omega$

4.5

$R_1 = 1{,}8\ k\Omega$

$R_T = 820\ \Omega$

$U_Z = 8{,}3\ V$

$r_Z = 3\ \Omega$

R_{iZ}

$$R_{iZ} = \frac{r_{be} + r_Z}{1 + h_{fe}} = 2{,}71\ \Omega$$

$$r_{be} = \frac{U_t}{I_b} = 542\ \Omega$$

$$I_b = \frac{U_Z - U_{be}}{(1+\beta)\, R_T} = 4{,}61 \cdot 10^{-5}\ A$$

ZI 04.02.2008 => 2. SKUPINA

③

$U_{CC} = 18V$
$R_g = 500\Omega$
$R_1 = 47k\Omega$
$R_2 = 6,8k\Omega$
$R_C = 4,7k\Omega$
$R_T = 5,6k\Omega$

$\beta \approx h_{2e} = 180$
$U_\gamma = 0,7V$
$U_T = 0,25mV$

3.1. $R_E = 1k\Omega$

$I_{CQ}, U_{CEQ} = ?$

$U_{bb} = \frac{R_2}{R_1+R_2} \cdot U_{CC} = 2,78$

$I_{bQ} = \frac{(U_{bb} - U_\gamma)}{(R_b + (A+B)R_E)} =$

↳ $R_b = \frac{R_1 R_2}{R_1+R_2} = 5,54k\Omega$

$I_{bQ} = 8,45\mu A$

$I_{CQ} = \beta \cdot I_{bQ} = 1,52mA$

$U_{CEQ} = U_{CC} - R_C \cdot I_{CQ} - R_E (I_{bQ} + I_{CQ}) = 9,33V$ (b)

3.2 $I_{CQ} = 1,388mA$
$U_{CEQ} = 9,97V$
$R_E = 1,1k\Omega$

$I_{CQ} = \beta \cdot I_{bQ}$

g_m, r_{be} ?

$r_{be} = \frac{U_T}{I_{bQ}}$

$r_{be} = 3254\Omega$ (a)

$g_m = \frac{I_{CQ}}{U_T} = 55,52mA/V$

3.3. $g_m = 50,84mA/V$
$r_{be} = 3542\Omega$
$R_E = 1,2k\Omega$

$A_V = \frac{U_{iz}}{U_{vh}}$

$A_V = g_m \cdot \frac{R_C R_T}{R_C + R_T} = 129,86$ (e)

3.4 $g_m = 50.82\,mA/V$

$r_{be} = 3542\,\Omega$

$R_E = 1,2\,k\Omega$

$R_{ul} = ?$

$$R_{ul} = \frac{R_c R_{ul}'}{R_c + R_{ul}'} = \underline{\underline{13.26\,\Omega}}$$ (c)

$$R_{ul}' = \frac{r_{be}}{1 + h_{fe}} = 19.57\,\Omega$$

3.5 $g_m = 50.82\,mA/V$

$r_{be} = 3542\,\Omega$

$R_E = 1,2\,k\Omega$

$R_{iz} = ?$

$R_{iz} = R_C = \underline{\underline{4,7\,k\Omega}}$

(b)

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(3)

$U_{cc} = 15V$
$R_g = 500\Omega$
$R_1 = 180\,k\Omega$
$R_2 = 27\,k\Omega$
$R_c = 5{,}6\,k\Omega$
$R_T = 4{,}7\,k\Omega$
$\beta = h_{fe} = 100$
$U_\gamma = 0.7V$
$U_T = 25mV$

3.1 $I_{cq} = 1{,}19\,mA$

$R_E = ?$

$R_b = \frac{R_1 R_2}{R_1 + R_2} = 22.72\,k\Omega$

$U_{bb} = \frac{R_2}{R_1 + R_2} U_{cc} = 1.96V$

$I_{cq} = \beta \cdot I_{Bq} \Rightarrow I_{bq} = \frac{I_{cq}}{\beta} = 11.8\,\mu A$

$I_{Bq} = \frac{U_{bb} - U_\gamma}{R_b + (1+\beta) R_E}$

$I_{bq} R_b + I_{bq}(1+\beta) R_E = U_{bb} - U_\gamma$

$R_E = \frac{U_{bb} - U_\gamma - I_{bq} R_b}{(1+\beta) I_{bq}} = 824.75\,\Omega$ (a)

3.3 $g_m = 37{,}35\,mA/V$
$r_{be} = 2678\,\Omega$
$R_E = 1{,}1\,k\Omega$

$A_v = ?$

$A_v = -\frac{R_c R_T}{R_c + R_T} = 55.44$ (b)

3.2. $I_{cq} = 1{,}01\,mA$
$U_{CEq} = 8.34\,V$
$R_E = 1\,k\Omega$

(c)

$r_{be} = \frac{U_T}{I_{bq}} = 2475.25\,\Omega$

$g_m = \frac{I_{cq}}{U_T} = 40.4\,mA/V$

$r_{be} =$

3.4. $g_m = 37.35\,mA/V$

$r_{be} = 2678\,\Omega$

$R_E = 1,1\,k\Omega$

$R_{ul} = ?$

$$R_{ul}' = \frac{r_{be}}{1+h_{fe}} = 26.51\,\Omega$$

$$R_{ul} = \frac{R_c R_{ul}'}{R_c + R_{ul}'} = 25.89\,\Omega$$

(b)

3.5. $g_m = 37,35\,mA/V$

$r_{be} = 2678\,\Omega$

$R_E = 1,1\,k\Omega$

$R_{iz} = ?$

$R_{iz} = R_c$

$R_{iz} = 5,6\,k\Omega$

(c)

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(4)

$U_Z = 9.7\,V$
$I_{Zmin} = 4\,mA$
$P_{Zmax} = 500\,mW$
$r_Z = 10\,\Omega$
$B \approx h_{fe} = 150$
$U_{BE} = 0.7\,V$

$U_{ULmin} = 17\,V$
$U_{ULmax} = 27\,V$

$R_T \geq 470\,\Omega$

(4.1) $U_Z - U_{BE} - U_{iZ} = 0$

$U_{iZ} = U_Z - U_{BE} = 9\,V$ ✓

(4.2) $R_{1min} = \dfrac{U_{ULmax} - U_Z}{\dfrac{P_{Zmax}}{U_Z} + \dfrac{U_{iZ}}{(1+B)\,R_{Tmax}}}$

$R_{1min} = 336\,\Omega$ ✓

(4.3) $R_{1max} = \dfrac{U_{ULmin} - U_Z}{I_{Zmin} + \dfrac{U_{iZ}}{(1+B)\,R_{Tmin}}} = 1768\,\Omega$

(4.4) $R_1 = 1{,}1\,k\Omega$

$S_U = \dfrac{r_Z}{R_1 + r_Z} = 0.009$ ✓

(4.5) $R_1 = 1{,}1\,k\Omega$
$R_T = 680\,\Omega$

$r_{be} = \dfrac{U_T}{I_b} = 285.22\,\Omega$

$I_b = \dfrac{U_Z - U_{BE}}{(1+B)\,R_T} = 8.26 \cdot 10^{-5}\,A$

$R_{iZ} = \dfrac{r_{be} + r_Z}{1 + h_{fe}} = 1{,}95\,\Omega$

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$U_z = 9V$

$U_{e\min} = 15\ V$
$U_{e\max} = 25\ V$
$R_{1\min} = 198\ \Omega$
$R_{1\max} = 2430\ \Omega$
$\beta \approx h_{fe} = 150$
$U_{be} = 0.7\ V$
$U_T = 25mV$
$R_T \geq 330\ \Omega$

4.1. $U_z - U_{be} - U_{iz} = 0$

$U_z = U_{be} + U_{iz} = 9.7$

4.2

$U_z = 9.7\ V$

$U_{iz} = 9\ V$

$I_{z\min} = \frac{U_{e\min} - U_z}{R_{1\max}} - \frac{U_{iz}}{(1+\beta) R_{T\min}}$

$I_{z\min} = 2mA$

4.3. $U_z = 9.7V$

$P_{z\max} = U_z \cdot I_{z\max} = 0.75\ W$

$I_{z\max} = \frac{U_{e\max} - U_z}{R_{1\min}} - \frac{U_{iz}}{(1+\beta) R_{T\max}}$ = cp

$I_{z\max} = 23.12\ mA$

4.4. $R_1 = 1{,}2k\Omega$
$R_T = 680\ \Omega$
$U_z = 9.7$
$I_{z\min} = 1{,}5mA$
$P_{z\max} = 0{,}5W$
$r_z = 5\ \Omega$

$S_v = ?$

$S_v = \frac{r_z}{R_1 + r_z} = 3.47 \cdot 10^{-3}$

4.5.

$R_{iz} = ? \quad \frac{r_{be} + r_z}{1 + h_{fe}} = 1{,}32\ \Omega$

$r_{be} = \frac{U_T}{I_b} = 285.22\ \Omega \qquad I_b = \frac{U_z - U_{be}}{(1+\beta) R_T} = 8.72 \cdot 10^{-5}\ A$

DAIKIN
Air Conditioning

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By

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3.5. $g_m = 71,9\ mA/V$

$r_{be} = 2781\ \Omega$

$R_e = 3,3\ k\Omega$

$R_{i2} = ?$

$R_{i2} = R_e \parallel [(R_{g1} \parallel R_2 + r_{be})/(1+h_{fe})]$ (3276, 16,30)

$U_{cc} = 12V$
$R_g = 500\ \Omega$
$R_1 = 100\ k\Omega$
$R_2 = 150\ k\Omega$
$R_E = 3.3\ k\Omega$
$\beta \approx h_{fe} = 200$
$U_y = 0,7V$
$U_T = 25\ mV$

3.1 $R_E = 4,7\ k\Omega$

$I_{CQ}, U_{CEQ} = ?$

$R_B = \frac{R_1 R_2}{R_1 + R_2} = 60\ k\Omega$

$U_{bb} = \frac{R_2}{R_2 + R_1} \cdot U_{cc} = 7.2\ V$

$I_{bQ} = \frac{U_{bb} - U_y}{(R_B + (1+\beta)R_e)}$

$I_{bQ} = 6.47\ \mu A$

$I_{CQ} = \beta \cdot I_{bQ} = 1.294\ mA$

$U_{CEQ} = U_{cc} - R_e (I_{bg} + I_{cg}) = 5.89\ V$

$R_{i2} = 16.21\ \Omega$ (d)

(b)

3.2. $I_{CQ} = 1.54\ mA$
$U_{CQ} = 5.96\ V$
$R_E = 3.9\ k\Omega$

$g_m, r_{be} = ?$

$r_{be} = \frac{U_T}{I_{bg}} = 3246\ \Omega$

$g_m = \frac{h_{fe}}{r_{be}} = 61,6\ mA$

$I_{cg} = \beta \cdot I_{bg} \Rightarrow I_{bg} = 7.7\ \mu A$

3.3 $g_m = 71,9\ mA/V$
$r_{be} = 2781\ \Omega$
$R_e = 3,3\ k\Omega$

$A_i = ?$

$R_{L'} = r_{be} + (1+h_{fe}) \frac{R_e R_L}{R_e + R_T}$

$R_{L'} = 334431$

$R_L = \frac{R_B R_{L'}}{R_B + R_{L'}} = 50.892\ k\Omega$

$A_V = \frac{g_m \frac{R_e R_T}{R_e + R_T}}{1 + g_m \frac{R_e R_T}{R_e + R_T}} = 0.99$

3.4 (b)

$A_I = A_V \frac{R_L}{R_2} = 15.3$ (e)