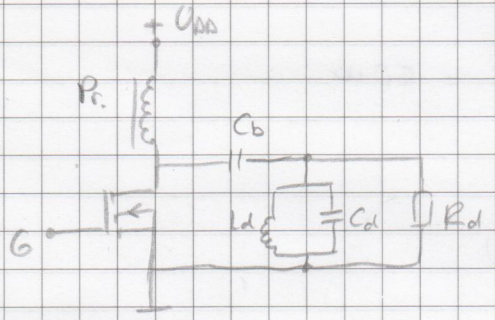
VF 13.04.2011.

(8.) PTF 10136
klasa C
$f = 1\ MHz$



Pojačala snage
- cilj - što manja disipacija ($>\eta$)
- kW
- kratki val 0.5 MW

$$\cos\Theta = \frac{U_P - U_{GG}}{U_{gm}} = \frac{1-(-1)}{5.85} = 0.342$$

$$\Theta = 70°$$

$$h_u = \frac{U_{dm}}{U_{DD}} = \frac{U_{DD} - U_{dmin}}{U_{DD}} = \frac{28-4}{28} = 0.857$$

$f_0(\Theta) = 0.252$ → istosmjerna komp.
$f_1(\Theta) = 0.436$ → 1. harmonik

$$P_{od} = U_{DD} \cdot I_{DS} = U_{DD} \cdot I_{d1m} \cdot f_0(\Theta) = 28 \cdot 1.1 \cdot 0.252 = 7.76\ W$$

$$P_u = \frac{U_{dm} \cdot I_{dm}}{2} = \frac{(U_{DD} - U_{dmin}) I_{d1m} f_1(\Theta)}{2} = \frac{(28+4) \cdot 1.1 \cdot 0.436}{2}$$

$$P_u = 5.75\ W$$

$$R_D = \frac{U_{dm}}{I_{dm}} = \frac{U_{DD} - U_{dmin}}{I_{d1m} \cdot f_1(\Theta)} = \frac{28-4}{1.1 \cdot 0.436} = 50\,\Omega$$

$$Q = \frac{R_D}{2\pi f L_d} \Rightarrow L_d = \frac{R_D}{2\pi f Q} = \frac{50}{2\pi 406 \cdot 12} = 0.663\,\mu H$$

$$C_d = \frac{1}{(2\pi f)^2 L_d} = 38.2\ nF$$

$$\eta = \frac{f_1(\Theta)}{2 f_0(\Theta)} \quad za\ h_u = 1$$

$$\eta = \frac{f_1(\Theta)}{2 f_0(\Theta)} \cdot h_u \quad za\ h_u < 1$$

$\Theta \downarrow \ \eta \uparrow$
$\Theta = 0 \Rightarrow \eta = 0$

9.

klasa B

U_{oss}

$U_{DD\,max} = \frac{U_{oss}}{2} = 14\,V$

$U_{DD} = U_{DD\,max} \cdot 0.8 = 11.2\,V$

$P_{DD} = P_u + P_d = P_{DD} \cdot \eta + P_d =$

$P_{DD} = \frac{P_d}{1-\eta} = \frac{0.8\,P_d}{1-\eta} = \frac{0.8 \cdot 25}{1-0.6} = 50\,W$

$P_u = P_{DD}\,\eta = 30\,W$

$P_{DD} = U_{DD} \cdot I_{os} = U_{DD}\, I_{dtm}\, f_0(\Theta)$

B klasa $\Theta = 90°$

$f_0(90°) = 0.318$

$f_1(90°) = 0.5$

$I_{dtm} = \frac{P_{DD}}{U_{DD}\, f_0(\Theta)} = \frac{50}{11.2 \cdot 0.318} = 14.03\,A$

$P_u = \frac{U_{dm}\, I_{dm}}{2} = \frac{U_{dm}\, I_{dtm}\, f_1(\Theta)}{2}$

$U_{dm} = \frac{2\,P_u}{I_{dtm}\, f_1(\Theta)} = \frac{2 \cdot 30}{14.03 \cdot 0.5} = 8.55\,V$

$U_{dmin} = U_{DD} - U_{dm} = 11.2 - 8.55 = 2.65\,V$

(10.) Dodatak nekom zadatku

$$K = K_{SK} + K_{KH} + K_{HO} = 0.5 + 0.2 + 0.8 = 1.5\ °C/W$$

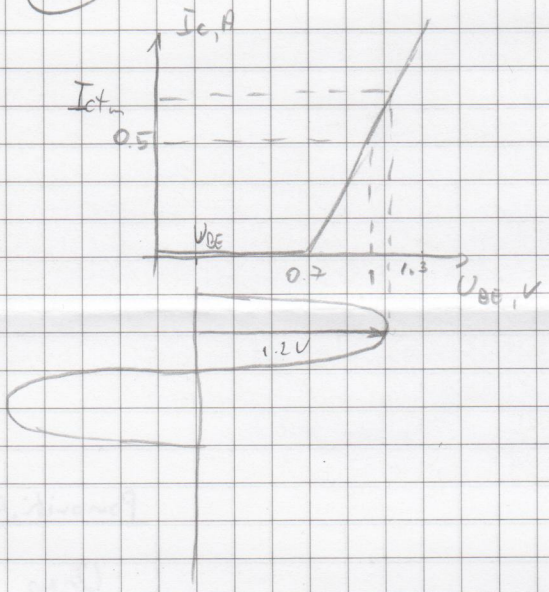
$$P_{dT} = \frac{T_S - T_0}{K} = \frac{130 - 50}{1.5} = 53.33\ W$$

$$P_{DC} = P_u + P_d = P_u + P_{dT}$$

$$\frac{P_u}{\eta} = P_u + P_{dT}$$

$$P_u = P_{dT}\frac{\eta}{1-\eta} = 53.33\ \frac{0.75}{0.25} = 160\ W$$

(11.) klasa C



$$I_c = \frac{5}{3}(U_{BE} - 0.7) \text{ za } U_{BE} > 0.7\ V$$

$$I_{ctm} = \frac{5}{3}(1.3 - 0.7) = \frac{5}{3} \cdot 0.6 = 1\ A$$

$$\cos\Theta = \frac{U_{Bez} - U_{BB}}{U_{Bem}} = \frac{0.7 - 0.1}{1.2} = 0.5$$

$$\Theta_c = 60°$$

$$I_{c0} = I_{ctm}\, f_0(\Theta) = 1 \cdot 0.218 = 0.218\ A$$

$$\eta = \frac{P_u}{P_{cc}} \qquad P_u = \frac{U_{cm}\, I_{cm}}{2} = \frac{(U_{cc} - U_s)\, I_{ctm}\, f_1(\Theta)}{2} = \frac{27 \cdot 1 \cdot 0.391}{2}$$

$$P_{cc} = U_{cc}\, I_{c0} = 28 \cdot 0.218 = 6.104\ W$$

$$P_u = 5.278\ W$$

$$\eta = \frac{5.278}{6.104} = 86.47\ \%$$

$$G = 10 \log \frac{P_u}{P_{u2}} = 10 \log \frac{5.278}{0.5} = 10.23\ dB$$

$$R_0 = \frac{U_{cm}}{I_{cm}} = \frac{27}{0.391} = 69\ \Omega$$

$$P_d = P_{cc} - P_u = 6.104 - 5.278 = 0.825\ W$$

$$P_{dt} = P_d + P_{u2} = 1.325\ W$$

$$K = \frac{T_S - T_0}{P_{dt}} = \frac{130 - 60}{1.325} = 90.53\ °C/W$$

$$R_{HO} = R - R_{SU} - R_{UH} = 90.53 - 13 - 6 = 69.53\ °C/W$$

(12.)

$$f_3(\Theta)_{max} = 0.185$$

$$\Theta = 40°$$

$$P_{ks} = \frac{U_{cm} I_{ctm}}{2} = \frac{U_{cm} \cdot I_{ctm} \cdot f_3(\Theta)}{2}$$

$$I_{ctm} = \frac{2 P_{ks}}{U_{cm} f_3(\Theta)} = \frac{2 \cdot 1}{(12-2)\ 0.185} = 1.081\ A$$

$$P_{cc} = U_{cc} \cdot I_{cs} = U_{cc} \cdot I_{ctm} f_0(\Theta) = 12 \cdot 1.081 \cdot 0.147 = 1.9\ W$$

$$\eta = \frac{1}{1.9} = 52.43\ \%$$

(13.)

$$\eta = 0.865$$

$$U_{cs} = 0 \Rightarrow h_u = 1$$

$$\eta = \frac{1}{2} h_u h_i$$

$$h_i = 2\eta = 1.73 \Rightarrow \Theta = 70°$$

$$h_i = \frac{f_1(\Theta)}{f_0(\Theta)}$$

$$P_k = \frac{U_{cm} \cdot I_{cm}}{2} = \frac{U_{cm} \cdot I_{ctm} f_1(\Theta)}{2}$$

$$I_{ctm} = \frac{2 P_k}{U_{cm} f_1(\Theta)} = \frac{2 \cdot 8}{12 \cdot 0.436} = 3.06\ A$$

$$I_{cs} = I_{ctm} f_0(\Theta) = 3.06 \cdot 0.252 = 0.77\ A$$

Pomoviti, pogledati

U_{CBO}
U_{CEO}
I_{cmax}
!!!

$$U_N = U_{cc} + U_{cm} = 2 U_{cc} = 24\ V < U_{CBO} = 30\ V \quad \checkmark$$

$$U_M = U_{cc} - U_{cm} \cos\Theta = 7.896 < U_{CEO(SUS)} = 20\ V \quad \checkmark$$

$$I_{ctm} = 3.06\ A < I_{cmax} = 3.5\ A \quad \checkmark$$

14.

$R = 10\ \Omega$

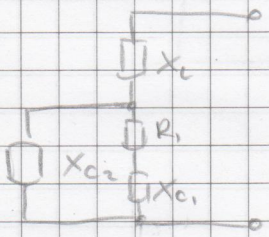
$L, C_1 = ?$

$$f_d = 160\ kHz = \frac{1}{2\pi R C_1} \Rightarrow C_1 = \frac{1}{2\pi f_d R} = \frac{1}{2\pi \cdot 160 \cdot 10^3 \cdot 10} = 99.47\ nF$$

$$f_g = \frac{R}{2\pi L} \Rightarrow L = \frac{R}{2\pi f_g} = \frac{10}{2\pi \cdot 32 \cdot 10^6} = 44.2\ nH$$

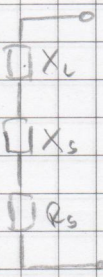
	f_d	f_g
C_2	$3014\ \Omega$	$13.4\ \Omega$
L	$0.04\ \Omega$	$10\ \Omega$

C_2 - služi za povećanje opteretnog otpora

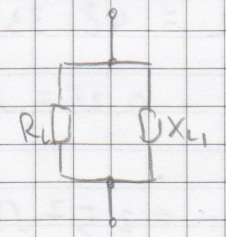


$f_1 = 132\ MHz$

$X_{C_1} = 0.012\ \Omega \approx 0$



$\Rightarrow$



$f_1 = 132\ MHz$

$$X_{C_2} = \frac{1}{2\pi f_1 C_2} = 3.65\ \Omega$$

$$X_L = 2\pi f_1 L = 36.66\ \Omega$$

$$R_S = \frac{R X_{C_2}^2}{R^2 + X_{C_2}^2} = 1.17\ \Omega$$

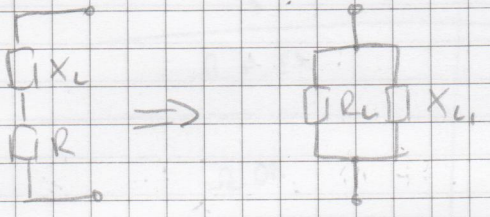
$$X_S = \frac{R^2 X_{C_2}}{R^2 + X_{C_2}^2} = 3.22\ \Omega$$

$$X_{S_1} = X_L - X_S = 36.66 - 3.22 = 33.44\ \Omega$$

$$R_L = \frac{X_{S_1}^2 + R_S^2}{R_S} = 950.84\ \Omega$$

$$X_{L_1} = \frac{X_{S_1}^2 + R_S^2}{X_{S_1}} = 43.48\ \Omega$$

bez C_2



$$R_L = \frac{X_L^2 + R^2}{R} = 144\ \Omega$$

$$X_{L_1} = \frac{X_L^2 + R^2}{X_L} = 39.59\ \Omega$$

$f_2 = 174\ MHz$

$$X_{C_2} = \frac{1}{2\pi f_2 C_2} = 2.77\ \Omega$$

$$X_L = 2\pi f_2 L = 48.33\ \Omega$$

$$R_S = \frac{R X_{C_2}^2}{R^2 + X_{C_2}^2} = 0.257\ \Omega$$

$$X_S = \frac{R^2 X_{C_2}}{R^2 + X_{C_2}^2} = 2.57\ \Omega$$

$$X_{S_1} = X_L - X_S = 45.75\,\Omega$$

$$R_L = \frac{R_S^2 + X_{S_1}^2}{R_S} = 8135\,\Omega$$

$$X_{L_1} = \frac{R_S^2 + X_{S_1}^2}{X_{S_1}} =$$

- nešto doć na test (samo za primjer iz predavanja)

bez C_2 za f_2

$$R_L = \frac{R^2 + X_L^2}{R}$$

$$X_{L_1} = \frac{R^2 + X_L^2}{X_L} =$$

(15.) π - četveropol

$$X_L = \frac{R}{1+Q^2}\left(Q + \sqrt{\frac{r_a}{R}(1+Q^2) - 1}\right)$$

(Q^2 zanemarimo i $Q > 10$)

$$\frac{r_a}{R} = \frac{4}{50} = \frac{4}{25}$$

$$X_L \approx \frac{R}{Q^2}\left(Q + \sqrt{\frac{r_a}{R}\cdot Q^2}\right) = \frac{R}{Q}\left(1 + \sqrt{\frac{r_a}{R}}\right)$$

$$Q \approx \frac{R}{X_L}\left(1 + \sqrt{\frac{r_a}{R}}\right) \approx \frac{70}{X_L}$$

(a) $f_d = 980\,kHz$

$$X_L' = 2\pi f_d L \doteq 7\,\Omega$$

$$Q' = \frac{70}{X_L'} = 10$$

$$X_2' = \frac{r_a}{\sqrt{\frac{r_a}{R}(1+Q^2) - 1}} = 2.05\,\Omega \Rightarrow C_2' = \frac{1}{2\pi f_d X_2'} = 79\,nF$$

$$X_1' = \frac{R}{Q'} = \frac{50}{10} = 5\,\Omega \Rightarrow C_1' = \frac{1}{2\pi f_d X_1'} = 32.5\,nF$$

(b) $f_0 = 1400\ kHz$

$X_L'' = 10\ \Omega \Rightarrow Q'' = 7$

$$X_2'' = \frac{r_a}{\sqrt{\frac{r_a}{R}(1+Q^2)-1}} = 3\ \Omega \qquad C_2'' = 37.6\ nF$$

$$X_1'' = \frac{R}{Q''} = \frac{50}{7} = 7.14\ \Omega \qquad C_1'' = 15.91\ nF$$

$$15.91 < C_1 < 32.48\ nF$$
$$37.6 < C_2 < 79.04\ nF$$

16.

$f = 3\ MHz$

$X_{C_s} = 0.53\ \Omega$

$X_{L_1} = 471.23\ \Omega$

$X_L = 10\ \Omega$

$X_s = 13.26\ \Omega$

$$r_I' = \frac{r_I^2 + X_s'}{r_I} = 48\ \Omega = \boxed{R_c}$$

$$X_s' = \frac{r_I^2 + X_s^2}{X_s} = 14.47\ \Omega$$

$X_o + X_p + X_s' = X_L$

$$C_s' = \frac{1}{2\pi f X_s'} = 3.66\ nF$$

$$X_L = X_{cuk} = \frac{1}{\omega C_{uk}} \Rightarrow C_{uk} = \frac{1}{\omega X_L} = 5.3\ nF$$

$$C_p = C_{uk} - C_o - C_s' = 5.3 - 0.03 - 3.66 = 1.6\ nF$$

$$P_u = \frac{(U_{cc} - U_s)^2}{2R_c} = \frac{(9-2)^2}{2 \cdot 48} = 0.51\ W$$

$U_u = 0.6V$, $U_{BB} = 0$

$$\cos\Theta = \frac{U_u - U_{BB}}{U_{bem}} = \frac{0.6-0}{2.02} = 0.297 \Rightarrow \Theta = 72.72°$$

$$P_{u2} = \frac{U_{bem}^2}{2r_I} \Rightarrow U_{bem} = \sqrt{2P_{u2}r_I} = \sqrt{2 \cdot 0.51 \cdot 4} = 2.02\ V$$