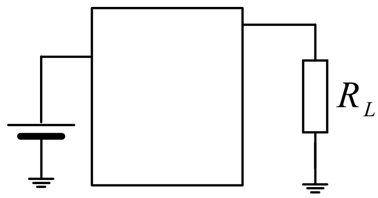
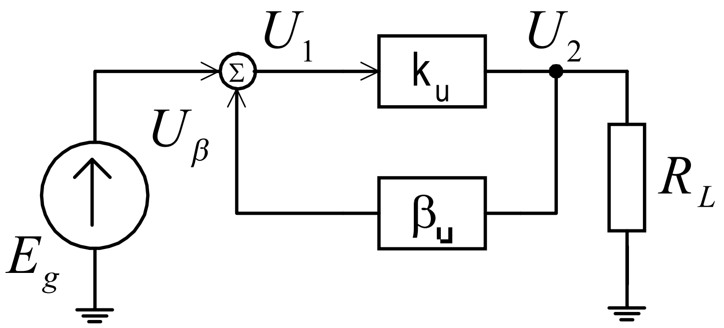
$$k_u(j\,\omega) = \frac{U_2}{U_1} = |k_u|\,\exp\left(j\,\varphi_u\right)$$

$$\beta_u(j\,\omega) = \frac{U_\beta}{U} = |\beta_u|\,\exp\left(j\,\varphi_\beta\right)$$



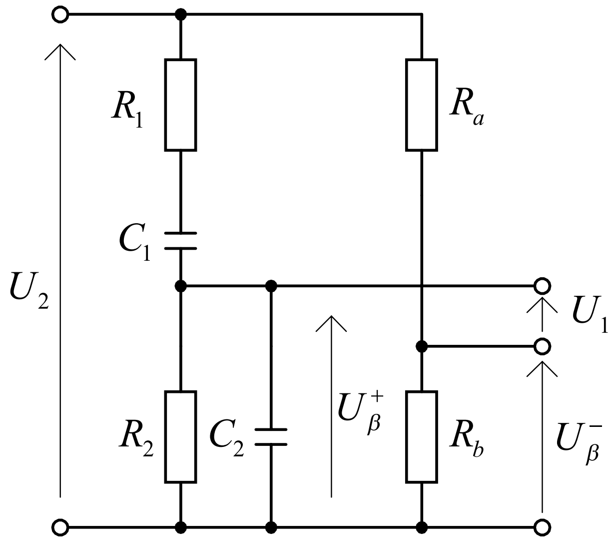


$$k_f(j\,\omega) = \frac{U_2}{E_g} = \frac{k_u(j\,\omega)}{1 - k_u(j\,\omega)\,\beta_u(j\,\omega)}$$

$$k_u(j\,\omega)\ \ \beta_u(j\,\omega) = \operatorname{Re}\left(k_u\ \beta_u\right) + j\ \operatorname{Im}\left(k_u\ \beta_u\right) =$$
$$= |k_u\ \beta_u|\,\exp\left[j\left(\varphi_k + \varphi_\beta\right)\right] = 1$$

$$|k_u\ \beta_u| = 1 = \operatorname{Re}\left(k_u\ \beta_u\right) = 1$$

$$\operatorname{Im}\left(k_u\ \beta_u\right) = 2 \quad n, \qquad \left(\varphi_k + \varphi_\beta\right) = 2 \quad n, \quad n = 0, 1, \ldots$$



$$\beta^+ = \frac{U_\beta^+}{U_2} = \frac{\beta_0^+}{1 + j\,Q^+ \nu} \qquad\qquad \beta^- = \frac{U_\beta^-}{U_2} = \frac{R_b}{R_a + R_b}$$

$$\nu = \frac{\omega}{\omega_0} - \frac{\omega_0}{\omega}$$

$$\omega_0^2 = \frac{1}{C_1\ R_1\ C_2\ R_2}$$

$$\beta_0^+ = \frac{1}{1 + \dfrac{C_2}{C_1} + \dfrac{R_1}{R_2}}$$

$$Q^+ = -\frac{\omega_0}{2}\,\frac{d\,\varphi_\beta}{d\,\omega}\bigg|_{\omega_0} = \beta_0^+\,\sqrt{\frac{C_2\ R_1}{C_1\ R_2}}$$

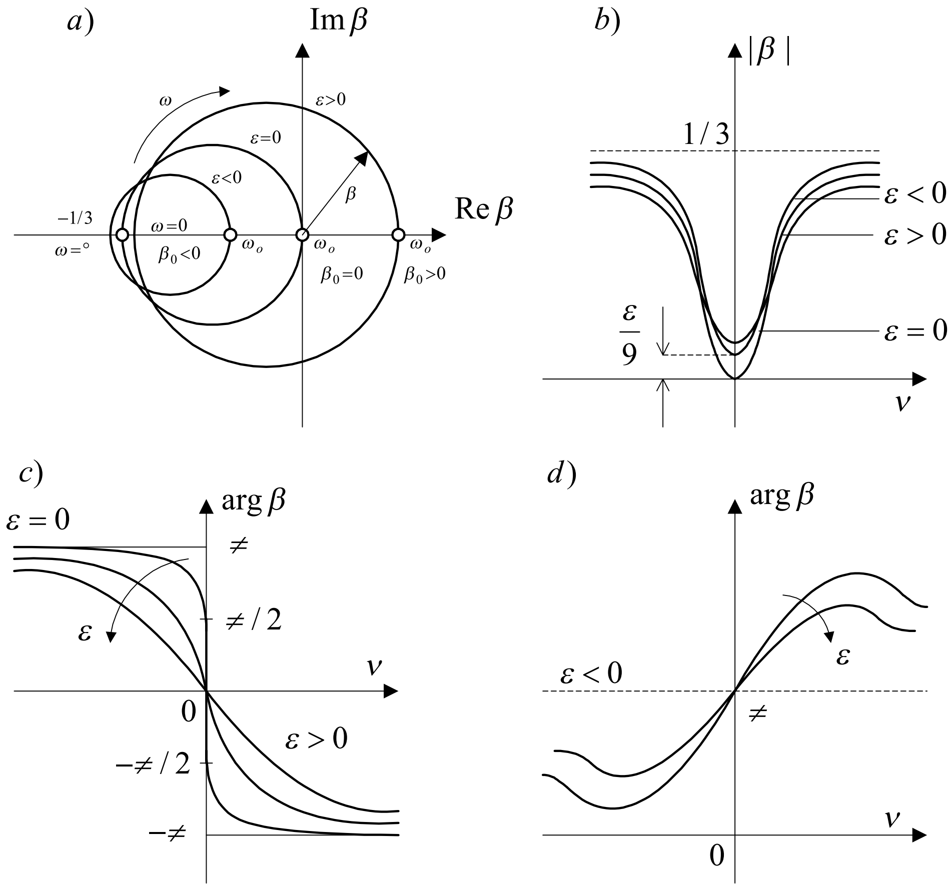
$$U_1 = U_\beta^+ - U_\beta^- = \beta^+\,U_2 - \beta^-\,U_2 = \left(\beta^+ - \beta^-\right)U_2 = \beta\,U_2$$

$$C = C_2 = C,\ R = R_2 = R,$$

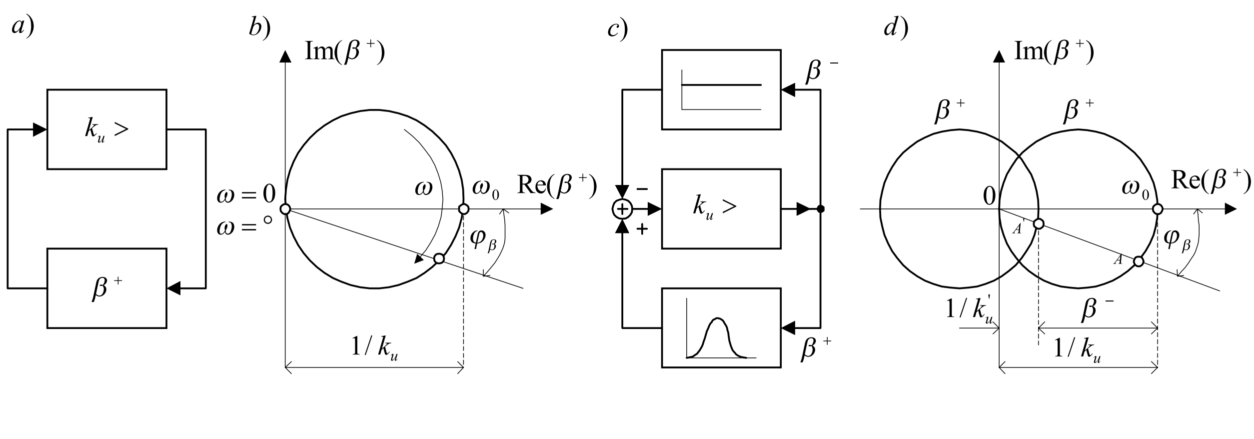
$$\beta^+ = \frac{1}{3 + j\,\nu} \qquad\qquad \omega_0 = 1/RC, \quad \beta_0^+ = 1/3, \quad Q^+ = 1/3$$

$$\beta^- = \frac{1}{3 + \varepsilon} \qquad\qquad R_a = \left(2 + \varepsilon\right)R_b,$$

$$Q = \frac{\omega_0}{2}\left|\frac{-2}{\varepsilon\,\omega_0}\right| = \frac{1}{|\varepsilon|} = \frac{1}{9\,|\beta_0|}$$



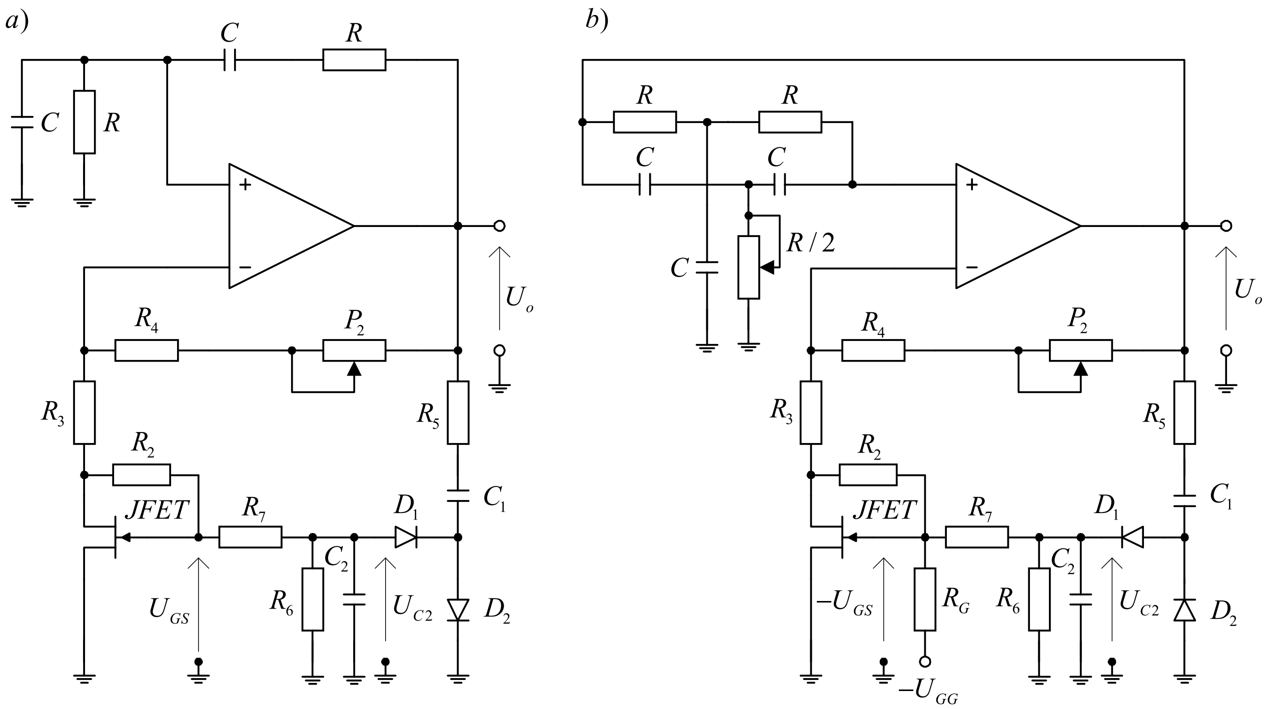
$$k_u(\omega_0)\,\beta(\omega_0) \geq 1 \qquad\qquad \varepsilon \geq \frac{9}{k_u(\omega_0)}$$

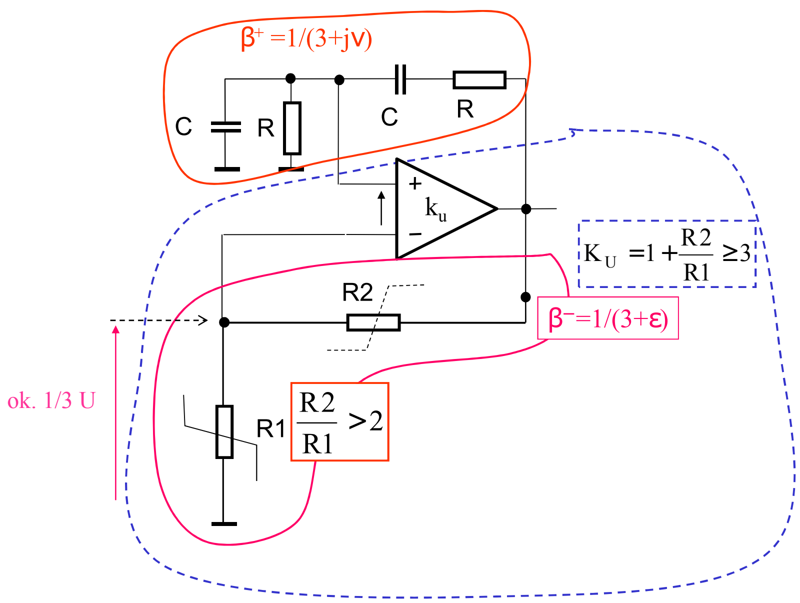


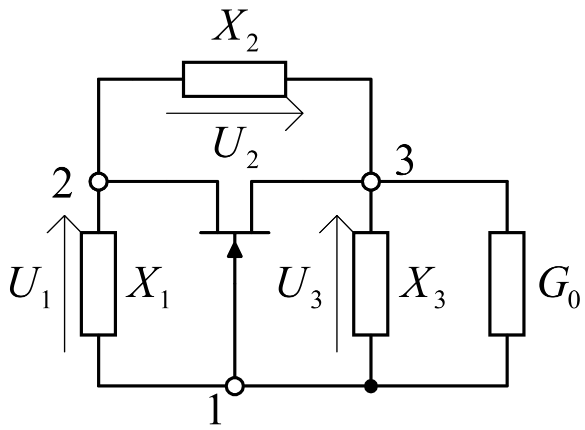
$$k_u^{'}\left[\beta^{+}(\omega_0)-\beta^{-}\right]=k_u^{'}\left(\beta_0-\beta^{-}\right)=k_u^{'}\quad\beta=1$$

$$\beta=\beta^{+}(\omega_0)-\beta^{-},\quad \beta_0=\beta^{+}(\omega_0)$$

$$Q=\frac{k_u^{'}}{k_u}Q^{+}$$

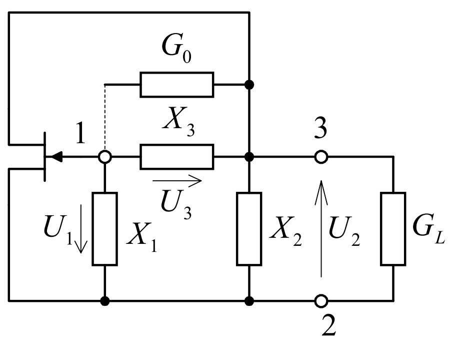


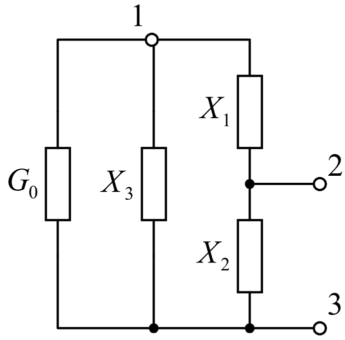




$$X_1 + X_2 + X_3 = 0$$

$$k_{u0}\left(\omega_0\right)\beta_u\left(\omega_0\right) = k_u\left(\omega_0\right)\frac{X_1}{X_1 + X_2} \geq 1$$





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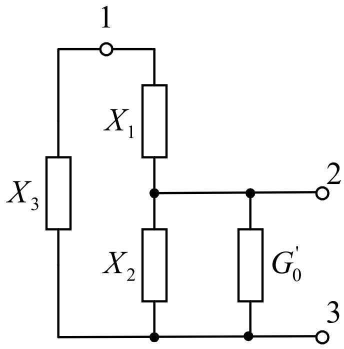


$$G_0^{'} = \frac{G_0}{p^2} \qquad\qquad p = \frac{X_2}{X_1 + X_2}$$

$$k_u(\omega_0) = \frac{-g_m}{g_{ds} + G_L + G_0 / p^2}$$

$$\beta_u\left(\omega_0\right) = \frac{X_1}{X_1 + X_2} = -\frac{X_1}{X_3} = 1 - \frac{1}{p}$$

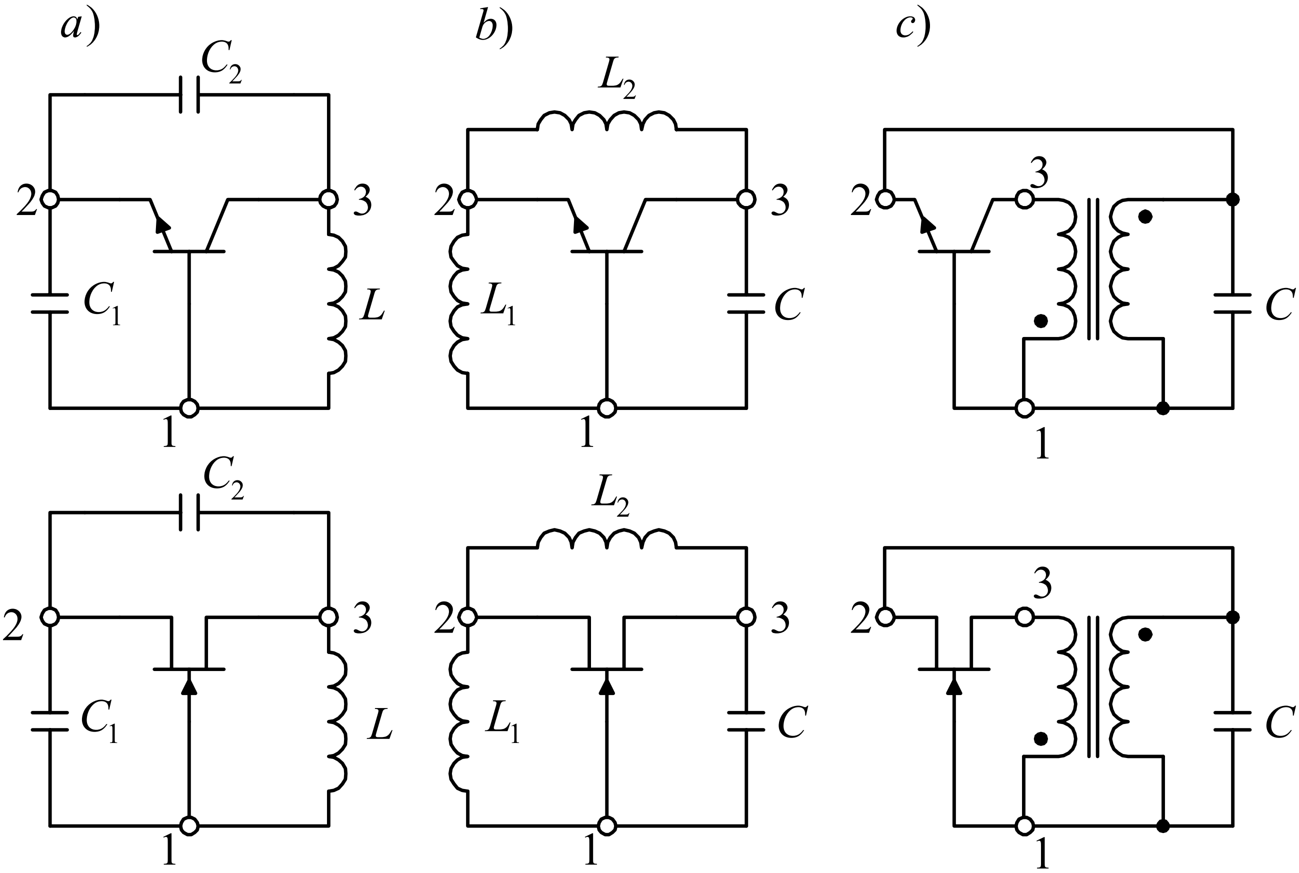
$$k_{u0}\left(\omega_0\right)\beta_u\left(\omega_0\right) = \left(\frac{-g_m}{g_{ds} + G_L + \dfrac{G_0}{p^2}}\right)\left(1 - \frac{1}{p}\right) = 1$$

$$p^2\left(g_{ds}+G_L+g_m\right)-p\,g_m+G_0=0$$

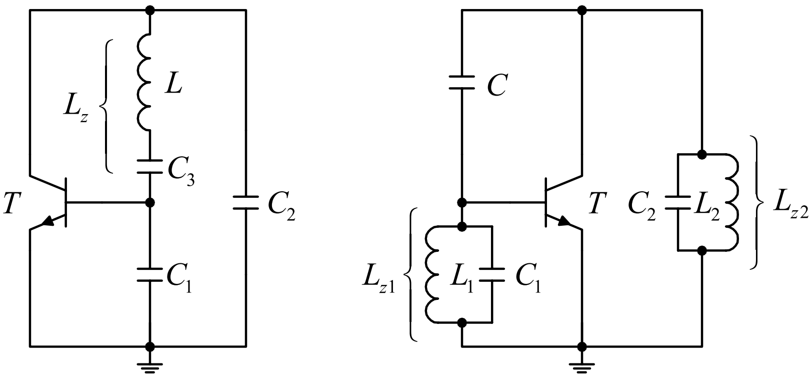
$$g_m^2\geq 4\,G_0\left(G_L+g_{ds}+g_m\right)$$

$$p_1=\frac{g_m+\sqrt{g_m^2-4\,G_0\left(g_{ds}+G_L+g_m\right)}}{2\left(g_{ds}+G_L+g_m\right)}\qquad \frac{g_m}{\left(g_{ds}+G_L+g_m\right)}-\frac{G_0}{g_m}\qquad \frac{g_m}{g_m+G_L}$$

$$p_1=\frac{X_2}{X_1+X_2}\qquad \frac{g_m}{g_m+G_L}\qquad\qquad \frac{X_1}{X_2}\qquad \frac{G_L}{g_m}$$



a) b)



$$L_z = L - \frac{1}{\omega^2 C_3}$$

Colpits

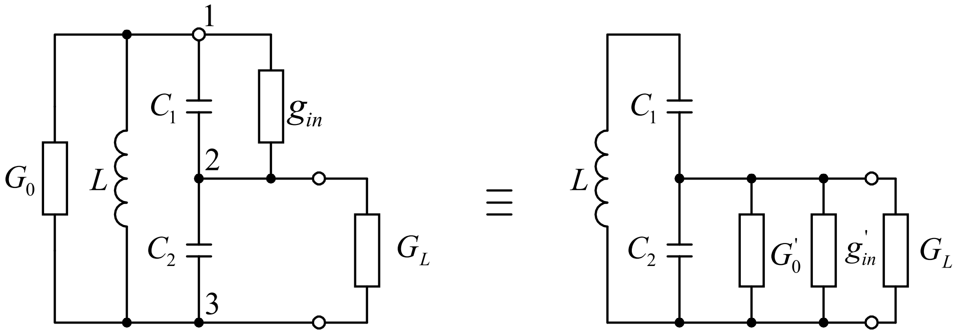
Hartley

$$\frac{C_2}{C_1} = \frac{G_L}{g_m}$$

$$\frac{L_1}{L_2} = \frac{G_L}{g_m}$$

$$\frac{1}{C_1} + \frac{1}{C_2} = \omega_0^2 \, L$$

$$L_1 + L_2 = \frac{1}{\omega_0^2 \, C}$$



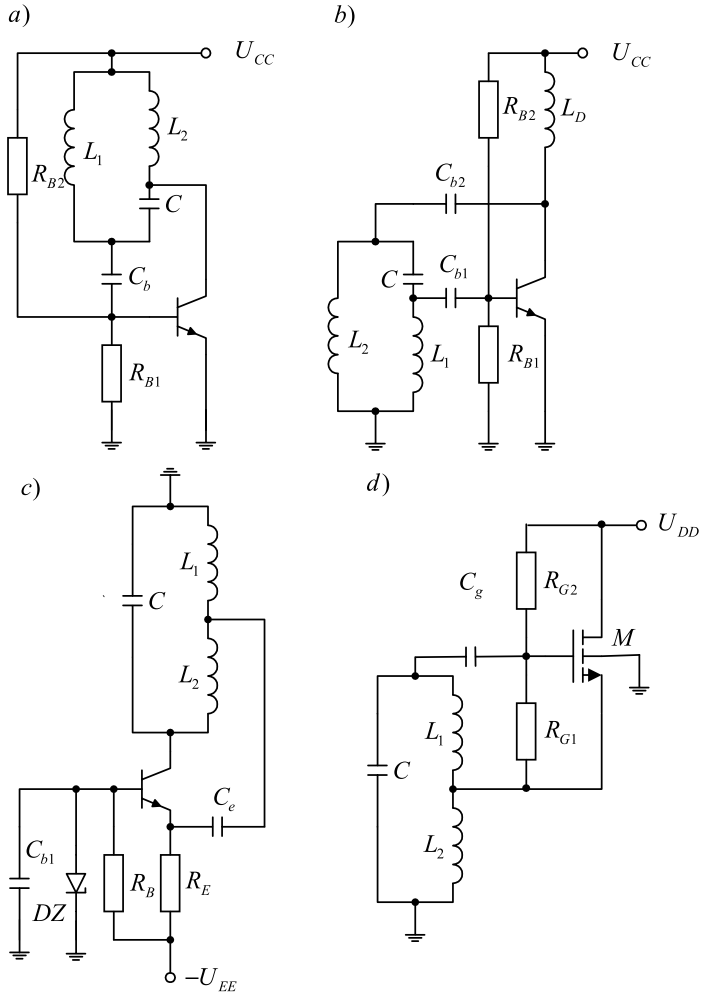
$$G_0' = \frac{G_0}{p^2}$$

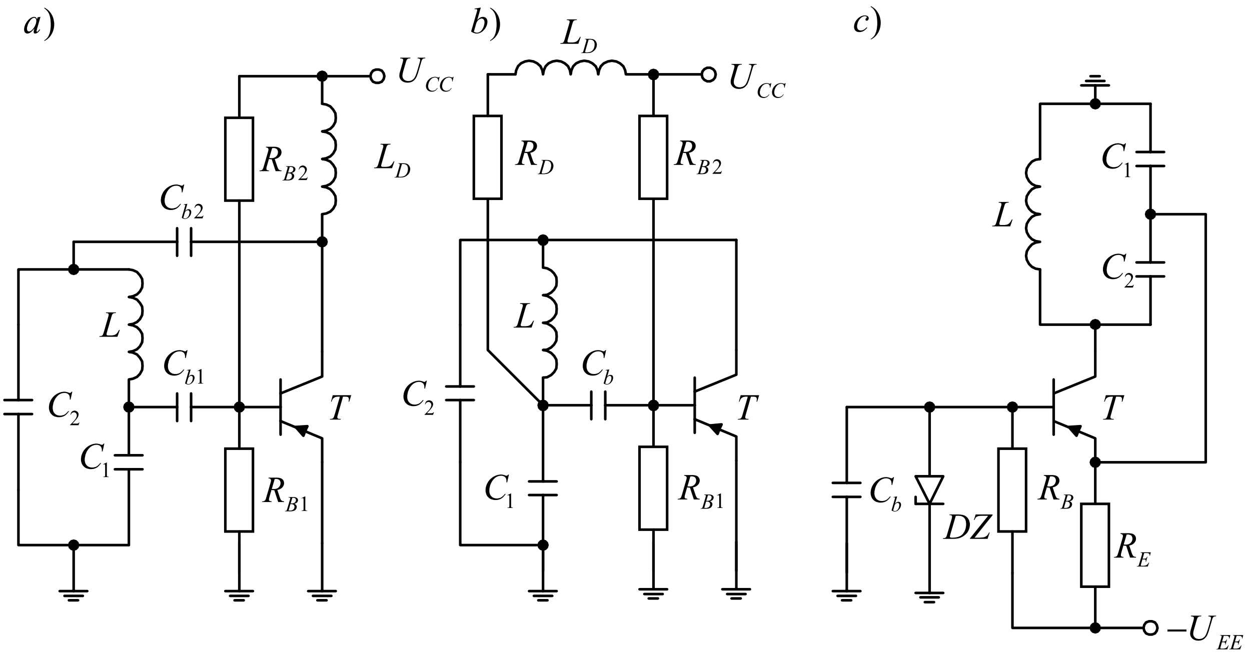
$$p_1 = \frac{X_2}{X_1 + X_2} = \frac{C_1}{C_1 + C_2}$$

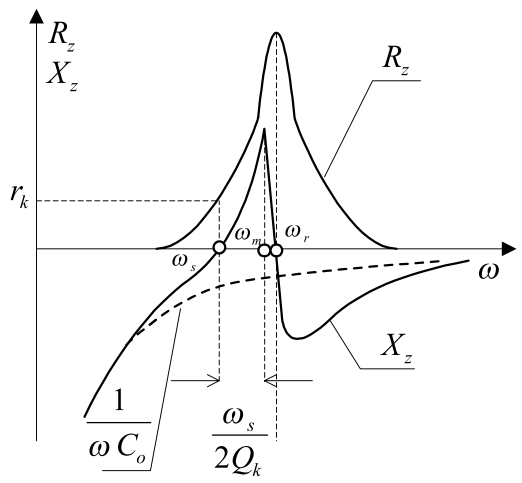
$$g_{in}' = g_{in} \left(\frac{X_1}{X_2}\right)^2 = g_{in} \left(\frac{C_1}{C_2}\right)^2 = \left(\frac{1}{p} - 1\right)^2$$

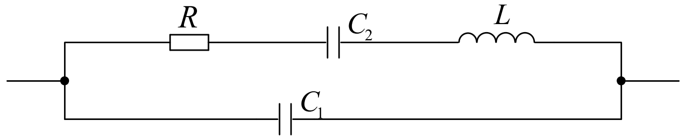
$$k_u\left(\omega_0\right) = \frac{-g_m}{g_{ce} + G_L + \dfrac{G_0}{p^2} + g_{in}\left(\dfrac{1}{p} - 1\right)^2}$$

$$G_0 < 0.2 \, \frac{g_m^2}{g_o + G_L + g_m}$$

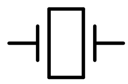

a)
U_{CC}
R_{B2}
L_1
L_2
C
C_b
R_{B1}
b)
U_{CC}
R_{B2}
L_D
C_{b2}
C
C_{b1}
L_2
L_1
R_{B1}
c)
L_1
C
L_2
C_e
C_{b1}
DZ
R_B
R_E
$-U_{EE}$
d)
U_{DD}
C_g
R_{G2}
M
R_{G1}
L_1
C
L_2


a)
U_{CC}
R_{B2}
L_D
C_{b2}
L
C_{b1}
C_2
C_1
T
R_{B1}
b)
L_D
U_{CC}
R_D
R_{B2}
L
C_b
C_2
T
C_1
R_{B1}
c)
C_1
L
C_2
T
C_b
DZ
R_B
R_E
$-U_{EE}$

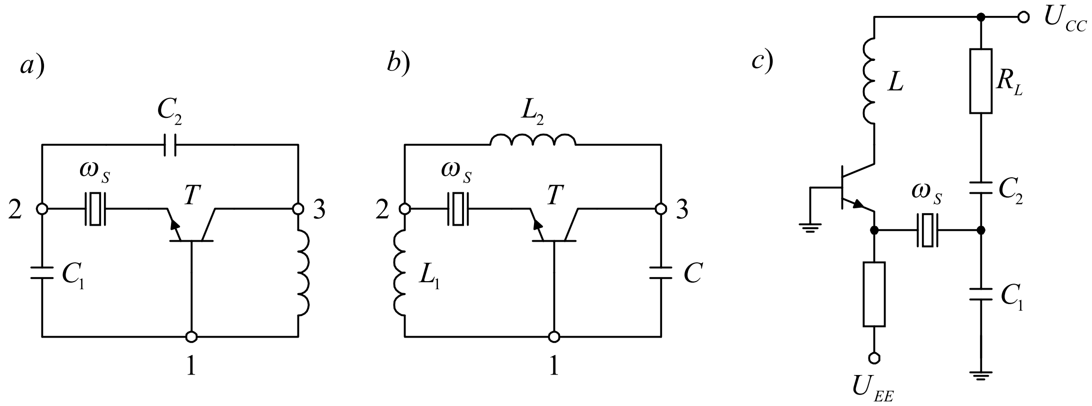


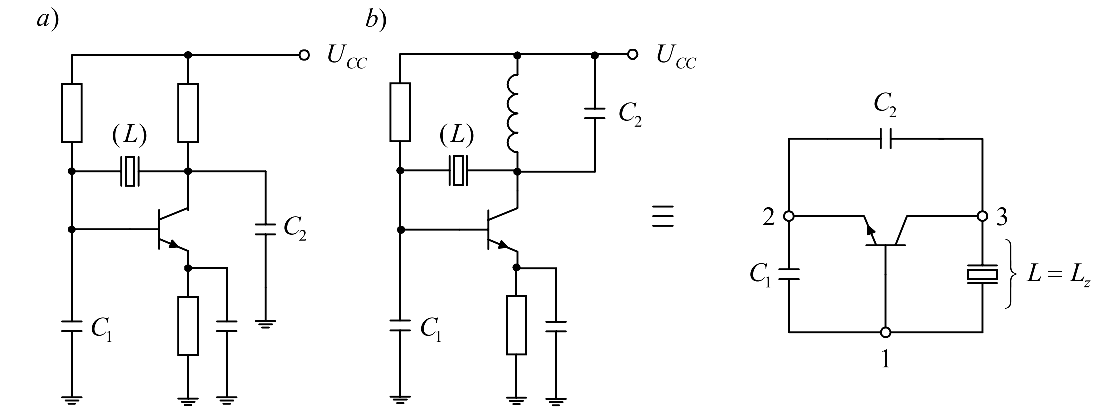


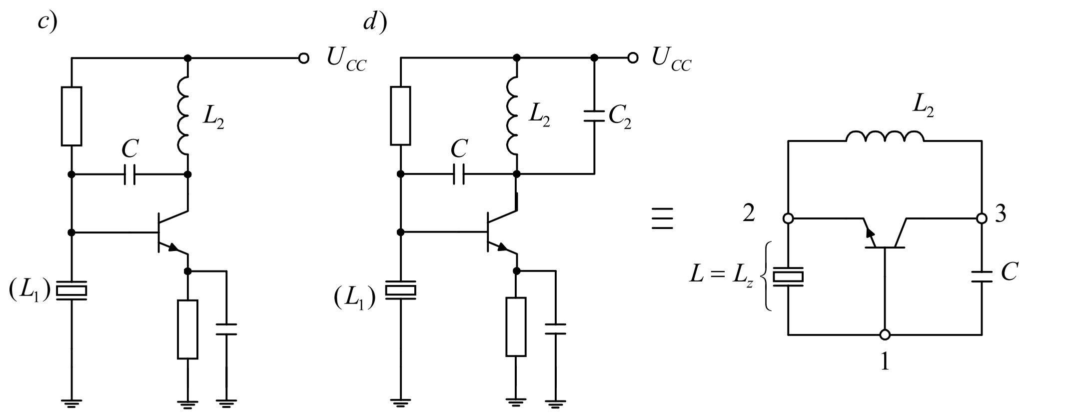
$$\omega_s = \frac{1}{\sqrt{LC_2}}$$

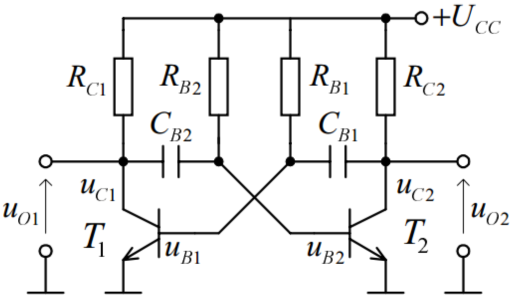


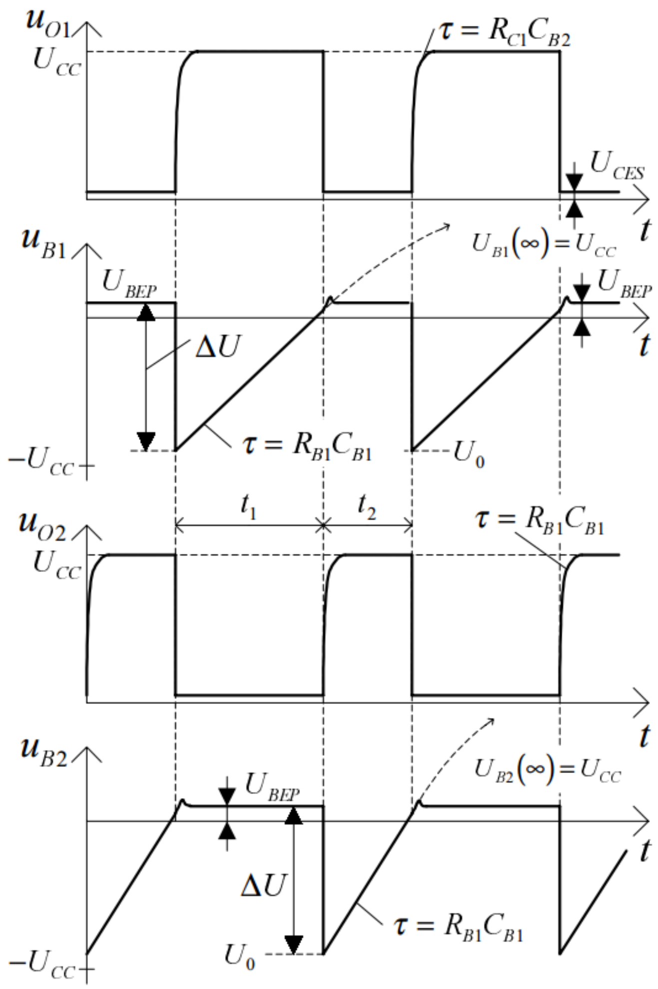
$$\omega_r = \frac{1}{\sqrt{L\left(\frac{1}{C_1}+\frac{1}{C_2}\right)}} = \omega_s\sqrt{1+\frac{C_2}{C_1}}$$











$$T = t_1 + t_2 = \frac{1}{f}$$

$$t_1 = R_{B1}C_{B1}ln\left(\frac{2U_{CC} - U_{BE} - U_{CES}}{U_{CC} - U_{BE}}\right) \approx 0.7R_{B1}C_{B1}$$

$$t_2 = R_{B2}C_{B2}ln\left(\frac{2U_{CC} - U_{BE} - U_{CES}}{U_{CC} - U_{BE}}\right) \approx 0.7R_{B2}C_{B2}$$