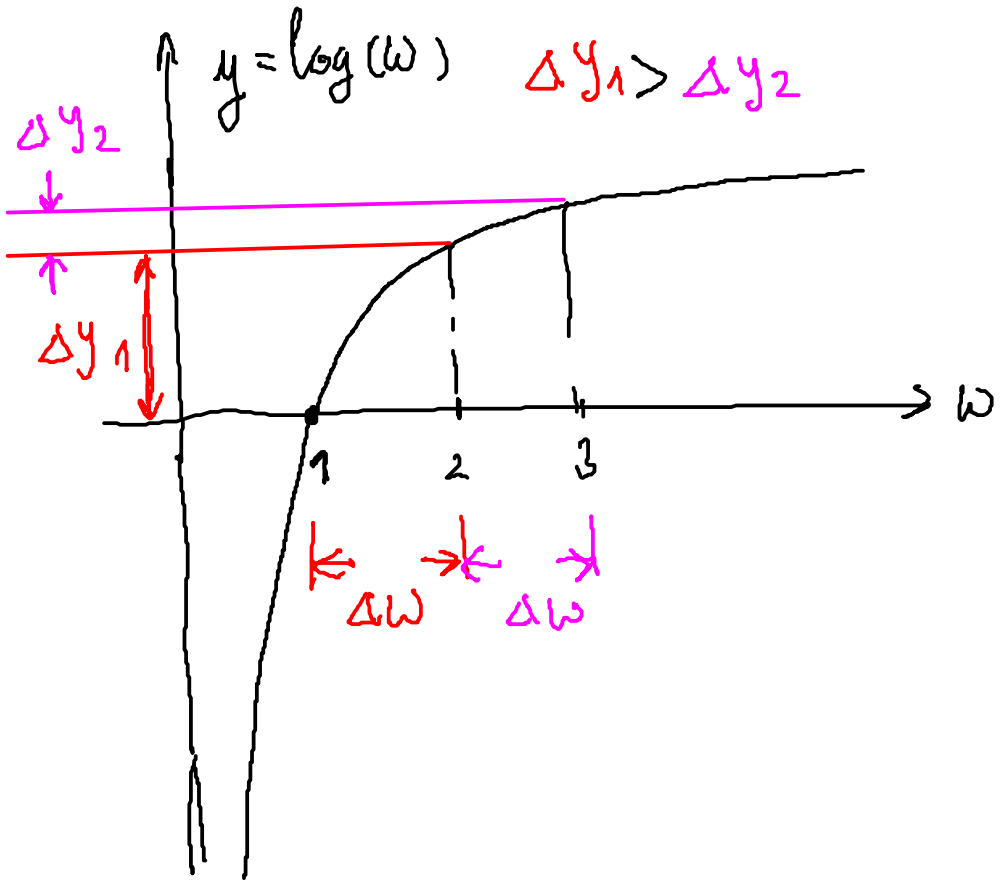
FREKVENCIJSKE KARAKTERISTIKE



$\log \equiv \log_{10}$

$\ln \equiv \log_e$

$$P_u = \frac{V_u^2}{R_u}, \quad P_i = \frac{V_i^2}{R_i} \Rightarrow \frac{P_i}{P_u} = \frac{R_u}{R_i} \cdot \frac{V_i^2}{V_u^2} = \frac{R_u}{R_i}\left(\frac{V_i}{V_u}\right)^2$$

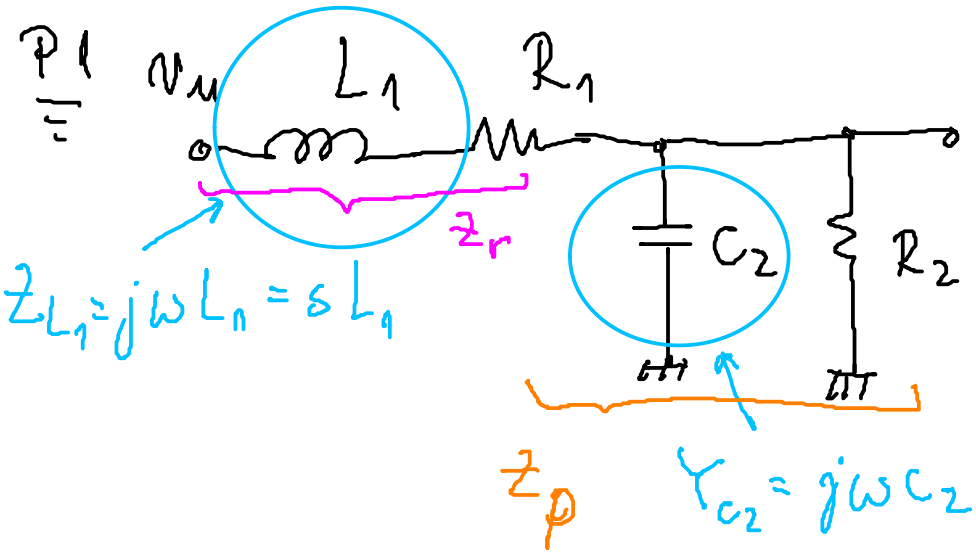
$A_u = \frac{V_i}{V_u}$

ZA SNAGU: $a_p = 10 \cdot \log\left|\frac{P_i}{P_u}\right|$ [dB]

ZA NAPON: $a_u = 20 \cdot \log\left|\frac{V_i}{V_u}\right|$ [dB] ✓

ZA STRUJU: $a_s = 20 \cdot \log\left|\frac{I_i}{I_u}\right|$ [dB]

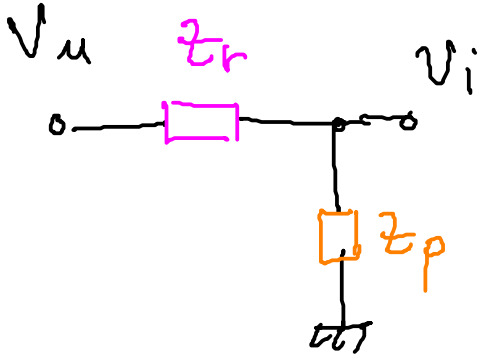
P1



$Z_{L_1} = j\omega L_1 = sL_1$

$Y_{C_2} = j\omega C_2 = sC_2$

$$H(s) = \frac{V_i}{V_u}$$



$$H(s) = \frac{V_i}{V_u} = \frac{Z_p}{Z_p + Z_r} = \frac{\frac{R_2}{1+sC_2R_2}}{\frac{R_2}{1+sC_2R_2} + R_1 + sL_1}$$

$$H(s) = \frac{R_2}{R_2 + (1+sC_2R_2)\cdot(R_1+sL_1)}$$

$$Z_r = R_1 + sL_1$$

$$Z_p = \frac{\frac{1}{sC_2}\cdot R_2}{\frac{1}{sC_2} + R_2} = \frac{R_2}{1+sC_2R_2}$$

$$H(s) = \frac{R_2}{R_2 + R_1 + s\left[C_2R_1R_2 + L_1\right] + s^2C_2R_2L_1}$$

$$H(s) = \frac{R_2}{R_2+R_1} \cdot \frac{1}{1 + s\left[C_2 \cdot (R_1 \| R_2) + \frac{L_1}{R_1+R_2}\right] + s^2 C_2 L_1 \frac{R_2}{R_1+R_2}}$$

$$H(s) = H_0 \cdot \frac{1}{1 + s \cdot a_1 + s^2 \cdot a_2}$$

$$H_0 = \frac{R_2}{R_1+R_2} \quad [/]$$

$$a_1 = C_2 (R_1 \| R_2) + \frac{L_1}{R_1+R_2} \quad [s]$$

$$a_2 = C_2 L_1 \cdot \frac{R_2}{R_1+R_2} \quad [s^2]$$

$s \equiv j\omega \left[\frac{rad}{s}\right]$

* OBIČNO SE DAJE DA SU POLOVI PRIJENOSNE FUNKCIJE, $H(s)$, ČISTO REALNI I RAZDVOJENI (MEĐUSOBNO UDALJENI JEDNU ILI VIŠE DEKADA).

$$H(s) = H_0 \cdot \frac{D(s)}{N(s)} \Rightarrow \begin{matrix} D(s) = 1 \\ N(s) = 1 + s \cdot a_1 + a_2 \cdot s^2 \end{matrix}$$

$$H(s) = \left(1 + \frac{s}{\omega_{p1}}\right) \cdot \left(1 + \frac{s}{\omega_{p2}}\right)$$

$$\left.\begin{aligned} s_{p1} &= -\omega_{p1} \\ s_{p2} &= -\omega_{p2} \end{aligned}\right\} \text{ POLOVI}$$

$$= 1 + s\left(\frac{1}{\omega_{p1}} + \frac{1}{\omega_{p2}}\right) + s^2 \frac{1}{\omega_{p1}\cdot\omega_{p2}} = 1 + a_1 \cdot s + a_2 \cdot s^2$$

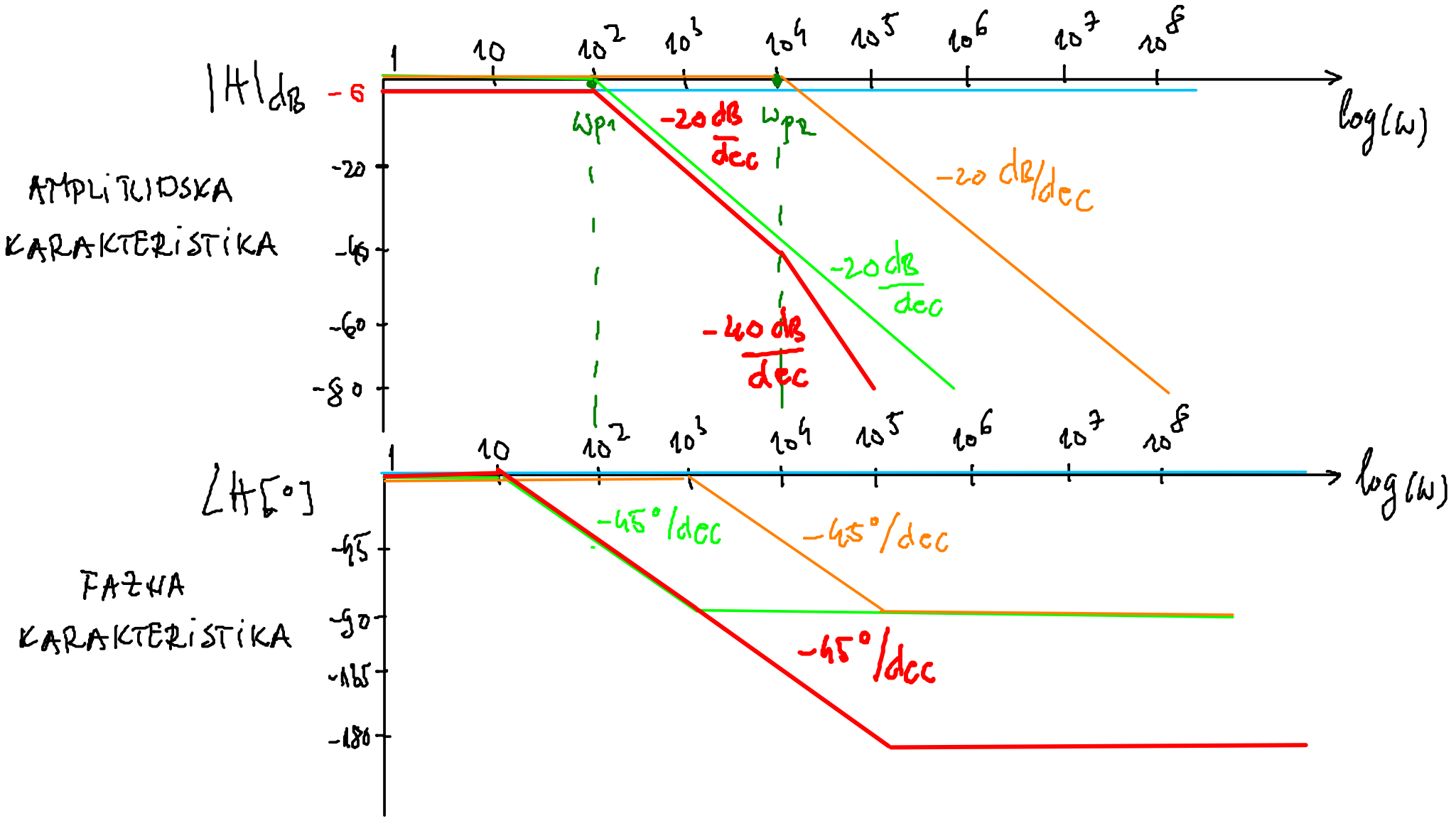
* Ako je $\omega_{p1} \leq 10 \cdot \omega_{p2}$: $\quad \frac{1}{\omega_{p1}} + \frac{1}{\omega_{p2}} = \frac{1}{\omega_{p1}}\left(1 + \frac{1}{10}\right) \approx \frac{1}{\omega_{p1}}$ $\quad \omega_{p2} = 10\,\omega_{p1}$

$$\frac{1}{\omega_{p1}} \approx a_1 \Rightarrow \omega_{p1} \approx \frac{1}{a_1}$$

$$\frac{1}{\omega_{p1}\cdot\omega_{p2}} = a_2 \Rightarrow \omega_{p2} \approx \frac{1}{a_2 \cdot \omega_{p1}}$$

$$H(s) = \frac{H_0}{\left(1+\frac{s}{\omega_{p1}}\right)\left(1+\frac{s}{\omega_{p2}}\right)} \quad ; \quad \omega_{p1} = 100 \text{ rad/s} \quad \omega_{p2} = 10^4 \text{ rad/s}$$

$$H_0 = \frac{1}{2}\Big|_{R_1=R_2} = \frac{R_2}{R_1+R_2}$$



* ZA KONJUGOVANO KOMPLEKSNE POLOVE: $s_{p_1} = s_{p_2}^*$

$$H(s) = \frac{1}{1 + s a_1 + s^2 a_2} = \frac{1}{1 + s\frac{1}{Q\cdot\omega_n} + \left(\frac{s}{\omega_n}\right)^2}$$

$$a_2 = \frac{1}{\omega_n^2} \quad i \quad a_1 = \frac{1}{Q\cdot\omega_n} \Rightarrow$$

$$\omega_n = \frac{1}{\sqrt{a_2}} \quad i \quad Q = \frac{1}{a_1\cdot\omega_n}$$

$$\text{ZA } \frac{1}{\sqrt{2}} \leq Q < \infty \Rightarrow \omega_{nd} = \frac{\omega_n}{k} \quad i \quad \omega_{ng} = k\cdot\omega_n$$

$$k = 10^{\frac{1}{2Q}}$$

P2

$Q = 2$

$p = 20\log(Q) = 6\,dB$

$\omega_n = 10^4\ rad/s$

$k = 10^{\frac{1}{2Q}} = \sqrt[4]{10} = 1.7783$

$\omega_n k = 1.7783 \times 10^4\ \frac{rad}{s}$

$\frac{\omega_n}{k} = 0.56234 \times 10^4\ \frac{rad}{s}$