

ELEKTRONIKA 2

HÁZI FELADAT: PLL 3

Adatok: $f_1=10$ kHz; $f_2=100$ kHz;

$f_i(\text{PI})=0.174532925199433$;

$\omega_c=3141.59265358979$ rad/s;

$U_{\text{LSB}}=1$ V;

$i_{\text{DA_Max}}=1$ mA;

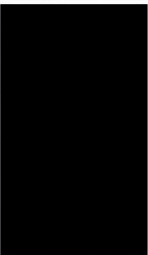
$U_{\text{ref}}=-0.005$ V;

$I_{\text{ref_Max}}=1$ mA;

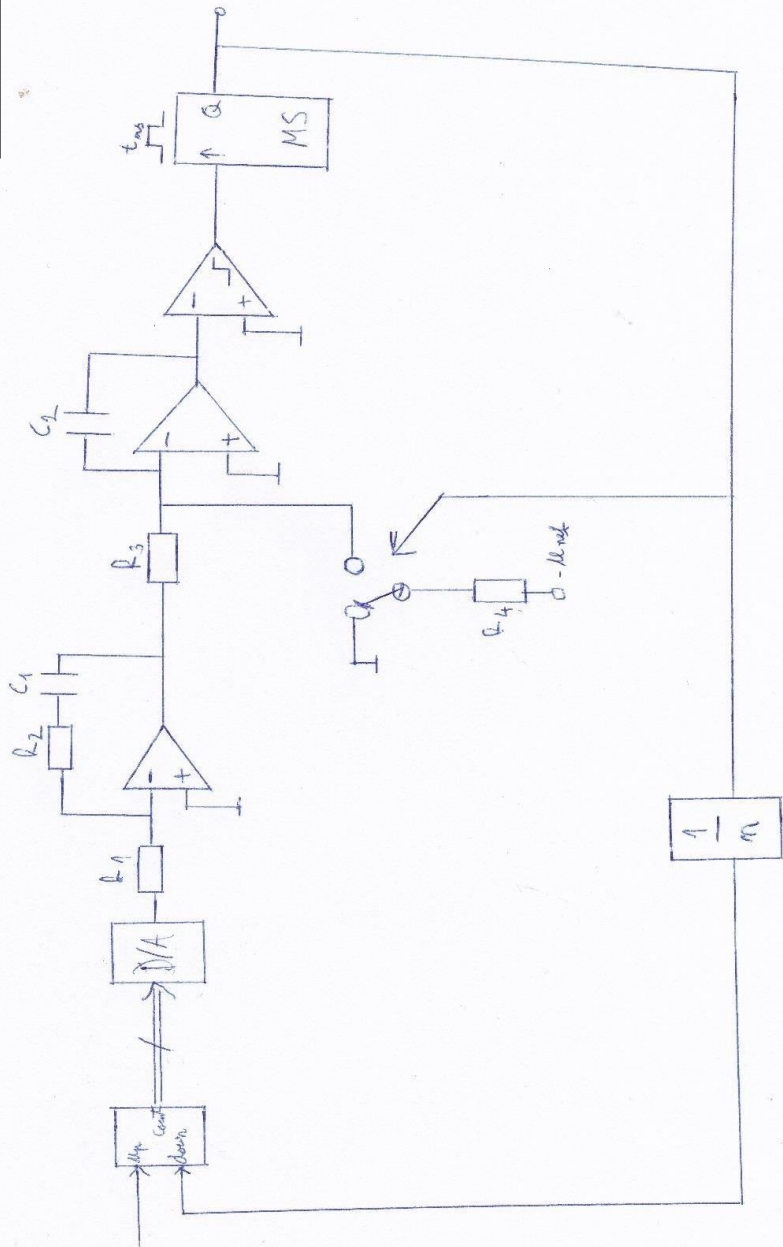
$U_{\text{A_Max}}=10$ V; $t_{\text{MS}}=5$

us;

Módosítás="A PI szabályozó műveleti erősítőjének 10mV-os offsetfeszültsége van.";



1.



$$f_2 = \frac{m}{m} \cdot f_1 \rightarrow m=1, \underline{n=10} \text{ / digitalis frequenzkonverter}$$

PD

$$K_{PD} = \frac{U_{LSB}}{2\pi} = \frac{1}{2\pi} \approx 0,16 \frac{V}{\text{rad}}$$

VFC

$$\frac{U_{ref}}{R_4} < I_{ref, max}$$

↓

$$R_4 = \frac{U_{ref}}{I_{ref, max}} = \frac{0,005}{1 \cdot 10^{-3}} = 5 \Omega \Rightarrow R_4 > 5 \Omega$$

$$f_{max} = \frac{1}{2 \cdot t_{ms}} = \frac{1}{2 \cdot 5 \cdot 10^{-6}} = 100 \text{ kHz}$$

$$\boxed{\frac{U_{ref}}{R_4} > \frac{U_{ve}}{R_3}}$$

$$U_{ve, max} = 10V \quad U_{ve, min} = 0V$$

$$\frac{U_{ve, max}}{R_3} = \frac{U_{ref}}{R_4} \cdot t_{ms} \cdot f_{max}$$

$$\frac{R_4}{R_3} = \frac{-U_{ref}}{U_{ve, max}} \cdot t_{ms} \cdot f_{max} = \frac{+0,005}{10} \cdot 5 \cdot 10^{-6} \cdot 100 \cdot 10^3 = \frac{1}{4000}$$

$$f_4 > 5 \Omega \xrightarrow{E48} R_4 = 100 \Omega$$

$$\frac{100}{R_3} = \frac{1}{4000} \rightarrow R_3 = 4000 \Omega \xrightarrow{E48} R_3 = 4020 \Omega$$

$$C_2 \cdot \mu_{be \max} = \left(\frac{\mu_{be \min}}{R_3} - \frac{\mu_{be \max}}{R_4} \right) \cdot t_{ms}$$

$$C_2 > \frac{\frac{-\mu_{be \min}}{R_3} - \frac{\mu_{be \max}}{R_4} \cdot t_{ms}}{\mu_{be \max}} = \frac{0}{402 \cdot 10^3} + \frac{0,005}{100} \cdot 5 \cdot 10^{-6}$$

$$C_2 > 25 \text{ nF} \xrightarrow{E12} C_2 = 100 \text{ nF}$$

$$K_D = \frac{R_4}{R_3 \cdot \mu_{be \max} \cdot t_{ms}} = \frac{100}{402 \cdot 10^3 \cdot 0,005 \cdot 5 \cdot 10^{-6}} = 9950,25$$

P1

$$T_n = \frac{1}{f_z} = \frac{1}{100 \cdot 10^3} = 10 \mu\text{s}$$

$$\varphi(P1) = -\frac{\pi}{2} + \arctg(\omega_c \cdot T_i)$$

$$T_i = \frac{\arctg(4000) + \frac{\pi}{2}}{\omega_c} = \frac{\arctg(4017) + \frac{\pi}{2}}{10000\pi} = 9,699 \cdot 10^{-6}$$

$$\frac{1}{K_{PD} \cdot \sqrt{1 + \frac{1}{\omega_c^2 \cdot T_i^2}} \cdot K_D \cdot \frac{20\pi}{\omega_c} \cdot \frac{1}{n}} = A_p$$

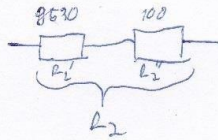
$$\frac{1}{20\pi \cdot \sqrt{1 + \frac{1}{(10000\pi)^2 \cdot (9,699 \cdot 10^{-6})^2}} \cdot 9950,25 \cdot \frac{20\pi}{10000\pi} \cdot \frac{1}{10}} = 0,096$$

$$R_1 = \frac{\mu\text{LSB}}{I_{\text{DA max}}} = \frac{1}{10^{-2}} = 100 \Omega$$

$$R_1 > 100 \Omega \rightarrow \underline{R_1 = 1000 \Omega}$$

$$R_2 = A_n \cdot R_1 = 0,096 \cdot 100 \cdot 10^3 = 9600 \Omega \xrightarrow{\text{E48}} 9500 \Omega + 100 \Omega$$

$$\underline{R_2 = 9630 \Omega}$$



$$\underline{C_1 = \frac{T_i}{R_2} = \frac{9,699 \cdot 10^{-6}}{9630} \approx 1 \text{ nF}}$$

Módosítás: Itt +10mV offset miatt a komparátor harszaboló vált így a konstans multivibrátor (kb) idéntel és váltózik. Erősebb nemlani fog a fősík, -és frekvenciánál.