3.) Naloga

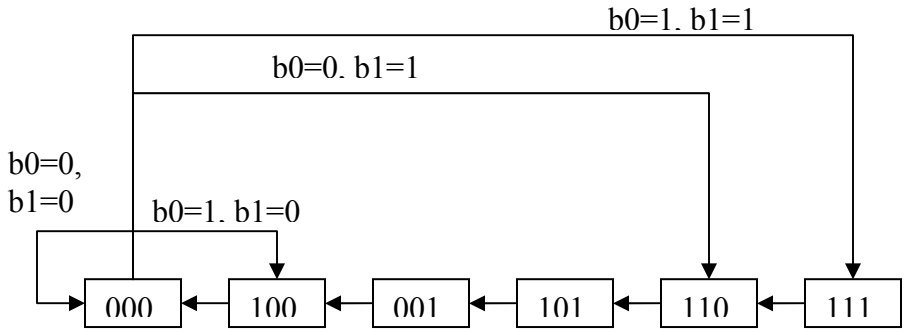


Diagram stanj je prikazan na sliki. Izbrali smo takšna stanja, da je Q_A že kar izhod iz vezja. Ker je sekvenca dolga več kot 4 pulze potrebujemo tri FF, ki jih označimo z Q_A, Q_B in Q_C. Vhodi v posamezne FF so tako definirani kot:

$$D_A = \overline{Q}_A\overline{Q}_B\overline{Q}_C b_0\overline{b}_1 + \overline{Q}_A\overline{Q}_B\overline{Q}_C b_1\overline{b}_0 + \overline{Q}_A\overline{Q}_B\overline{Q}_C b_1 b_0 + Q_A Q_B Q_C + Q_A Q_B\overline{Q}_C + \overline{Q}_A\overline{Q}_B Q_C$$

$$D_B = \overline{Q}_A\overline{Q}_B\overline{Q}_C b_1\overline{b}_0 + \overline{Q}_A\overline{Q}_B\overline{Q}_C b_1 b_0 + Q_A Q_B Q_C$$

$$D_c = \overline{Q}_A\overline{Q}_B\overline{Q}_C b_1 b_0 + Q_A Q_B\overline{Q}_C + Q_A\overline{Q}_B Q_C$$

Ko poenostavimo dobimo

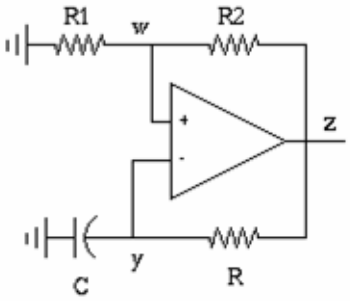
$$D_A = \overline{Q}_A\overline{Q}_B\overline{Q}_C(b_0 + b_1) + Q_A Q_B(Q_C + \overline{Q}_C) + \overline{Q}_A\overline{Q}_B Q_C = \overline{Q}_A\overline{Q}_B\overline{Q}_C(b_0 + b_1) + Q_A Q_B + \overline{Q}_A\overline{Q}_B Q_C$$

$$D_B = \overline{Q}_A\overline{Q}_B\overline{Q}_C b_1\overline{b}_0 + \overline{Q}_A\overline{Q}_B\overline{Q}_C b_1 b_0 + Q_A Q_B Q_C = \overline{Q}_A\overline{Q}_B\overline{Q}_C b_1 + Q_A Q_B Q_C$$

$$D_c = \overline{Q}_A\overline{Q}_B\overline{Q}_C b_1 b_0 + Q_A Q_B\overline{Q}_C + Q_A\overline{Q}_B Q_C = \overline{Q}_A\overline{Q}_B\overline{Q}_C b_1 b_0 + Q_A(Q_B \oplus Q_C)$$

Od tu narisati vezje ne sme biti težava.

1.) Naloga



Vezje bo osciliralo med napajalnima napetostima operacijskega ojačevalca ±15V (relaksacijski oscilator) Spodnja veja je RC člen in gre za polnjenje kondenzatorja z napetostjo z . Ko ta doseže vrednost w se predznak na operacijskemu ojačevalcu obrne in kondezator se začne prazniti dokler ponovno ne doseže napetosti w in potem se predznak obrne in igra se ponovi.

$z = y + IR$

$z = y + I_0 R \cdot \exp(-\frac{t}{\tau})$ polnjenje kondenzatorja (spodnja veja)

$w = z / \alpha \quad , \alpha = \frac{R_2}{R_1} + 1$ delilec napetosti (zgornja veja, z = ±15 V)

$I_0 R = z(1 + 1/\alpha)$ ko je z < 0 in y > 0 požene napetosna razlika tok

$z = y + z(1 + 1/\alpha) \cdot \exp(-\frac{t}{\tau})$

$z = w + z(1 + 1/\alpha) \cdot \exp(-\frac{t}{\tau})$ pogoj za obrat je da je y = w

$z = z/\alpha + z(1 + 1/\alpha) \cdot \exp(-\frac{t}{\tau})$

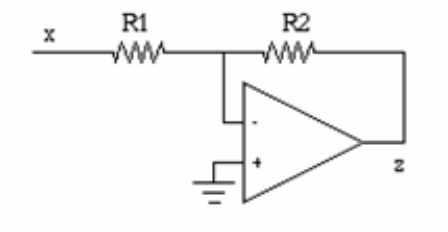
$1 - (1 + 1/\alpha) \cdot \exp(-\frac{t}{\tau}) = 1/\alpha$

$t = -\tau \ln(\frac{1 - 1/\alpha}{1 + 1/\alpha})$

$t = 1.1 \cdot 10^{-2} s$

$\nu = 1/2t = 45.5 Hz$

2.) Naloga



$\frac{x-\eta}{R_1}+\frac{z-\eta}{R_2}=0$, η = napetost na (-) vhodu op. oja.

$z = A(-\eta)$

$x-\eta\left(1+\frac{R_1}{R_2}\right)+\frac{R_1}{R_2}z=0$

$x+\frac{z(1+i\omega\tau)}{A_0}\left(1+\frac{R_1}{R_2}\right)+\frac{R_1}{R_2}z=0$

$$z=-\frac{x}{\left[\frac{R_1}{R_2}+\frac{1+\frac{R_1}{R_2}}{A_0}\right]+i\omega\tau\left[\frac{1+\frac{R_1}{R_2}}{A_0}\right]}\approx-\frac{R_2}{R_1}x\cdot\frac{1}{1+i\omega\tau\left[\frac{1+\frac{R_1}{R_2}}{A_0}\right]}$$

$$20\log\left|\frac{z}{x}\right|=20\log\left(\frac{R_2}{R_1}\right)-20\log\sqrt{1+\omega^2\tau^2\left(\frac{1+\frac{R_1}{R_2}}{A_0}\right)^2}$$

$$20\log\sqrt{1+\omega^2\tau^2\left(\frac{1+\frac{R_1}{R_2}}{A_0}\right)^2}=6$$

$$\omega^2\tau^2\left(\frac{1+\frac{R_1}{R_2}}{A_0}\right)^2=3 \quad , \quad \omega_0=\frac{A_0}{\left(1+\frac{R_1}{R_2}\right)\tau}=0.91\ \text{MHz}\approx 10^4/\tau$$

ω_0 je cutoff frekvenca na diagramu, od tu - 20db/dekad o vrednost pri $\omega = 0$ je 20db

$$\omega_{6\,db}=\sqrt{3}\cdot\frac{A_0}{\left(1+\frac{R_1}{R_2}\right)\tau}=1.7\ \text{MHz}$$