Z1)

ADP

$n = 12$

$U_{FS} = 5\ V$

$q = ?$

$\varepsilon_{max}\ [mV] = ?$

$SNR_{ADP} = ?$

$$q = \frac{U_{FS}}{2^n} = \frac{5}{2^{12}} = 1{,}22\ mV$$

$$\varepsilon_{RMS} = \frac{q}{\sqrt{12}}$$

$$\varepsilon_{max} = \frac{q}{\sqrt{12}} \cdot \sqrt{2} = \frac{q}{\sqrt{6}} = \frac{1{,}22 \cdot 10^{-3}}{\sqrt{6}} = 0{,}498\ mV = 498\ \mu V$$

$$SNR_{ADP} = 6{,}02\,n + 1{,}76\ dB = 74\ dB$$

Z2) Δ $f_m = 1\ kHz$

$U = \pm 1\ V \Rightarrow U_{FS} = 2\ V$

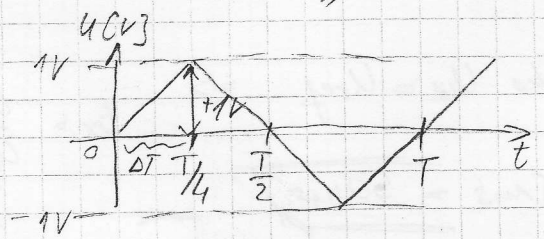
trokutasti napon → neparni harmonici

3. sljedeći harmonik je na 1 kHz,

ADP, $n = 8$

$$f_{s\,min} \geq 2 \cdot f_m = 2 \cdot 1\ kHz = 2\ kHz$$

$$T = \frac{1}{f} = 1\ ms$$



$$u = \int_0^{\frac{T}{4}} \frac{1V}{\frac{T}{4}}\,dt \qquad \Delta u = \frac{1V}{\frac{T}{4}}\,\Delta t \;/:\Delta t$$

$$SR = \frac{\Delta u}{\Delta t} = \frac{1V}{\frac{T}{4}} = \frac{4 \cdot 1V}{10^{-3}s} = 4000\ V/s$$

max brzina porasta ↗ i uvjeta $\Delta u < \frac{1}{2} LSB = \frac{q}{2}$

$$\Delta u = \frac{q}{2} = SR \cdot \Delta t$$

$$q = \frac{U_{FS}}{2^n} \qquad \frac{U_{FS}}{2^n} \cdot \frac{1}{2} = SR \cdot \Delta t \;/:SR$$

$$\Rightarrow \Delta t = \frac{U_{FS}}{2^{n+1}} \cdot \frac{1}{SR} = \frac{2}{2^9} \cdot \frac{1}{4000} = 976{,}56\ ns$$

23) ADP 2x pila

$f_{osc} = 400\ kHz$

$U_{ref} = 10\ V$

$N_0 = 10^4$ impulsa

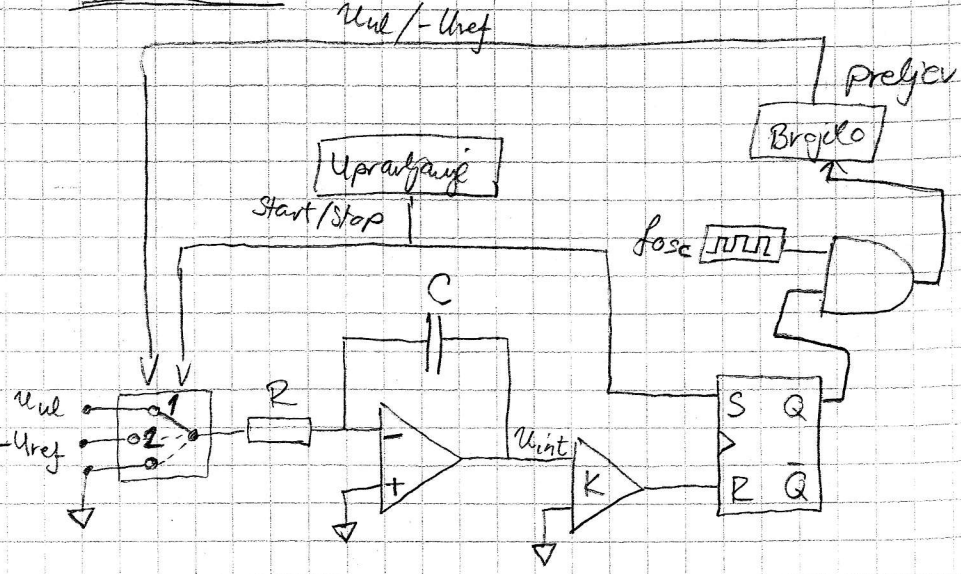
$t_{max} = ?$, $U_{ul} = ?$

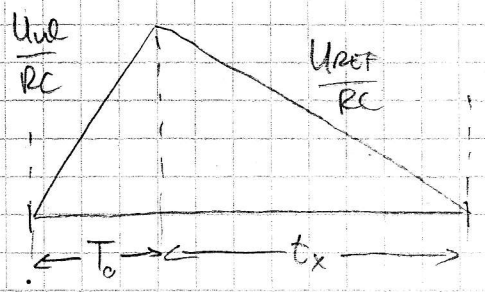
$U_{ul} = ?$ ako $U_{sm} = 500\ mV$

$f_{sm} = 50\ Hz$

$U_{mj} = 3{,}755\ V$

Bloc shema:





$\frac{U_{ul}}{RC} T_0 = \frac{U_{REF}}{RC} t_x$

$t_x = \frac{U_{ul}}{U_{ref}} \cdot T_0$

$T_0 = \frac{N_0}{f_{osc}} = \frac{10^4}{40 \cdot 10^6}$

$T_0 = 25\ ms$

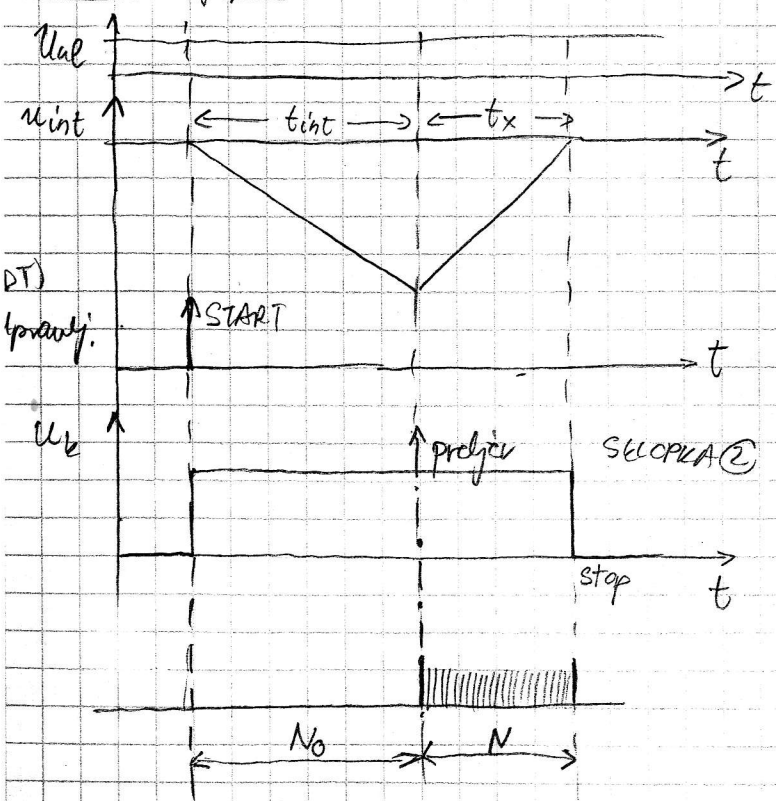
max trajanje 1 ciklusa => ako $U_{ul} = U_{ref}$ =>

$t_x = \frac{U_{ul}}{U_{ref}} \cdot T_0 = T_0 = 25\ ms$

$t_{max} = t_x + T_0 = 2{,}25\ ms = 50\ ms$

↳ za $U_{ul} = U_{ref} = 10\ V$

vremenski dijagram:



za N_{max}

$N = N_0 \cdot \frac{U_{ul}}{U_{ref}} = N_0 = 10^4$

$U_{IN} = \frac{1}{T_0} \int_0^{T_0} (U_{mj} + U_{sm} \cdot \sin(2\pi f t + \phi))\, dt$

$U_{IN} = \frac{1}{25\ ms} \cdot U_{mj} (25\ ms - 0) + \underbrace{\frac{U_{sm}}{T_0} \int_0^{T_0} \sin(2\pi f t)\, dt}_{I_1}$

$I_1 = \frac{U_{sm}}{T_0} \left(-\cos(2\pi f t)\Big|_0^{T_0}\right) \cdot \frac{1}{2\pi f}$

$= \frac{U_{sm}}{T_0} \left(\underbrace{-\cos(2 \cdot \pi \cdot 50 \cdot 25\ ms)}_{=0} + \underbrace{\cos(0)}_{=1}\right) \cdot \frac{1}{100\pi}$

$= \frac{800 \cdot 10^{-3}}{25 \cdot 10^{-3}} \cdot \frac{1}{100\pi} = \frac{1}{5\pi} = 0{,}06366\ V$

$U_{IN} = U_{mj} + 0{,}06366 = 3{,}755 + 0{,}06366 = 3{,}81866\ V$

Z4) ADP U/f

$U_{ul} = 2{,}5\,V$

$\tau = 220\,\mu s = RC$

$-U_{ref} = -3\,V \Rightarrow U_{ref} = 3\,V$

$t_{nabijanja\,C} = ?$

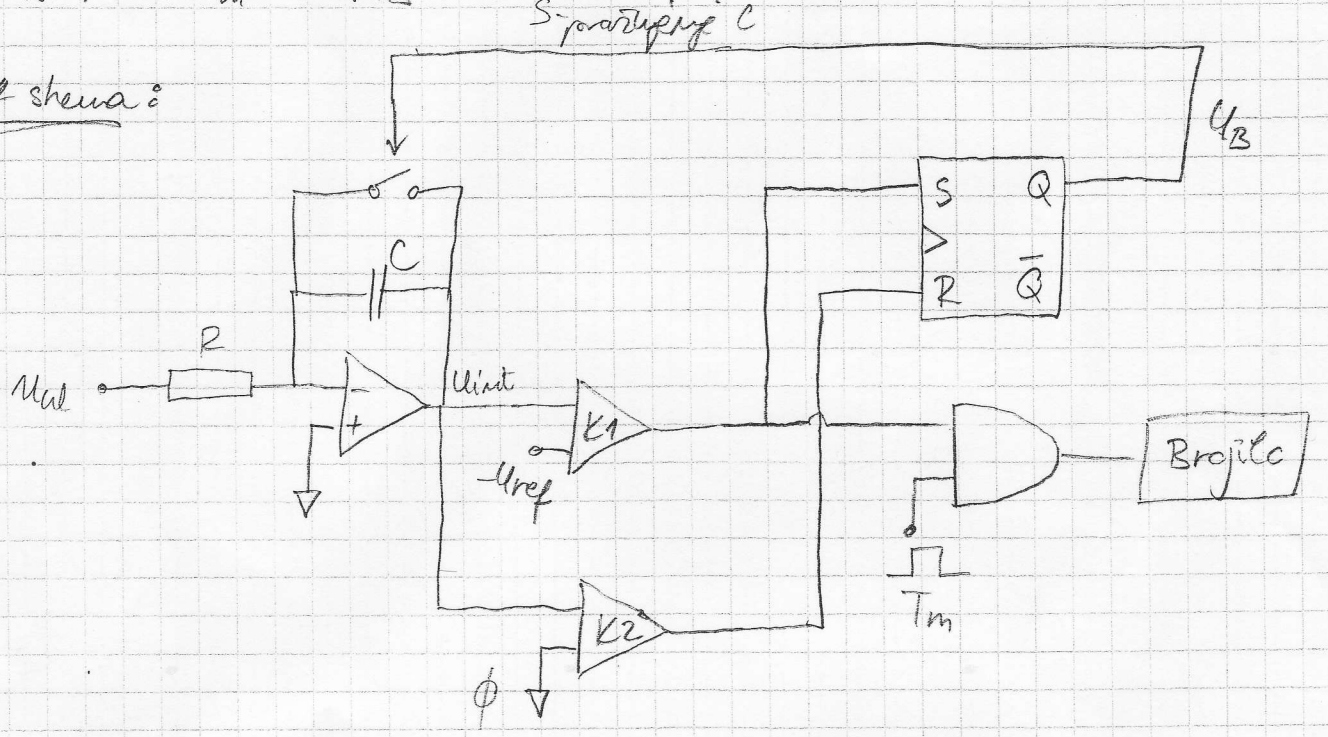
$N_m = ?$ ako $T_m = 250\,ms$

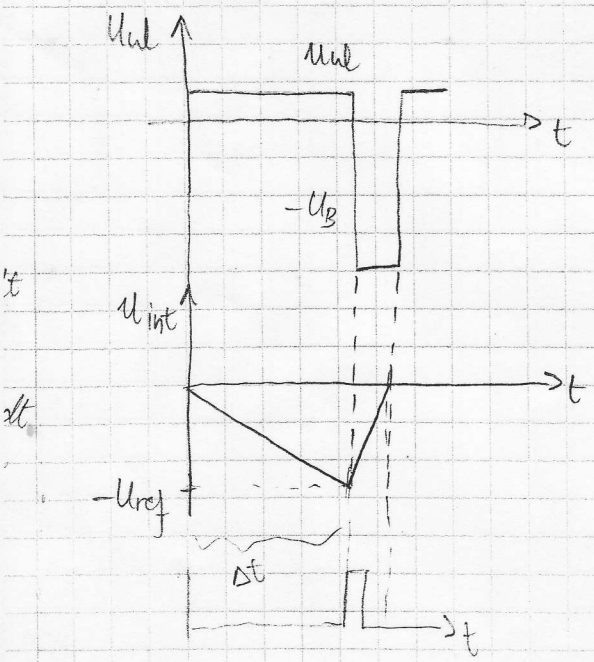
$T = \frac{N}{f}$

$f = \frac{U_{ul}}{RC \cdot U_{ref}}$

S-praznjenje C

blok shema:





$$U_{int}(T) = -\frac{1}{RC}\int_0^t U_{ul}\,dt$$

$U_{ref} = -U_{iz}$

$$-U_{ref} = -\frac{1}{RC} \cdot U_{ul} \cdot T$$

$$U_{ref} = \frac{1}{\tau} \cdot U_{ul} \cdot T \Rightarrow$$

$$T = \frac{U_{ref}}{U_{ul}} \cdot \tau = \frac{3}{2{,}5} \cdot 220\,\mu s$$

$T_{nabijanja\,C} = 264\,\mu s$

$$N_m = T_m \cdot f = T_m \cdot \frac{U_{ul}}{RC \cdot U_{ref}} = \frac{250 \cdot 10^{-3} \cdot 2{,}5}{220 \cdot 10^{-6} \cdot 3} = 946{,}947$$

$\Rightarrow$ 946 impulsa