

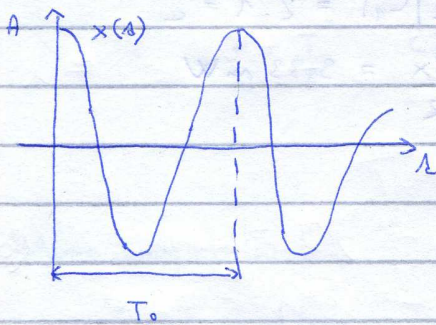
**Cvičení
Přechodů 5**

14.10.10

Úloha 1: Overle Parsevalova teoremu pro harmon. mg

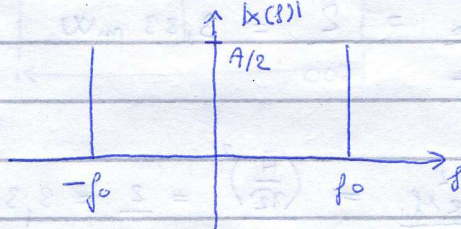
časová obl.

$$x(t) = A \cos 2\pi f_0 t$$



frekvencní obl.

$$X(f) = \frac{A}{2} [\delta(f - f_0) + \delta(f + f_0)]$$

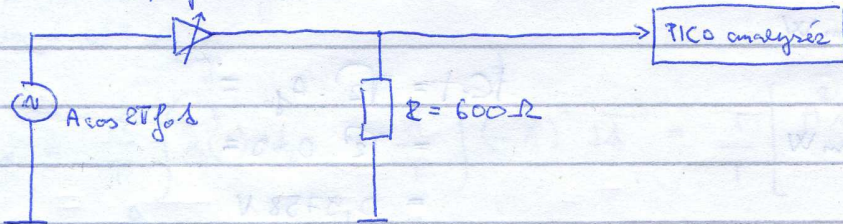


$$P_x = \frac{1}{T_0} \int_{-T_0/2}^{T_0/2} x^2(t) dt = \sum_{m=-1}^1 |C_m|^2$$

$$P_x = \frac{1}{T_0} \int_{-T_0/2}^{T_0/2} A^2 \cos^2(2\pi f_0 t) dt = \frac{A^2}{2}$$

$$\begin{aligned} |C_1| &= |C_{-1}| = \frac{A}{2} \\ \omega_1 &= 4 \\ \omega_2 &= 0 \end{aligned} \left\{ \begin{aligned} P_x &= 2|C_1|^2 = \\ &= 2\left(\frac{A}{2}\right)^2 = \frac{A^2}{2} \end{aligned} \right.$$

Schéma zapojení:



Parametry signálu:

$$A = 2V$$

$$f_0 = 2,083 \text{ kHz}$$

$$T_0 = 480 \mu s$$

Vypočítané hodnoty:

časová obl.

$$P_x = \frac{A^2}{2} = \frac{2^2}{2} = 2 \text{ W}$$

- lečšie je

$$P_R = \frac{P_x}{R} = \frac{2}{600} = 3,33 \text{ mW}$$

$$P_R = \frac{U_{R_{ef}}^2}{R} = \frac{\left(\frac{A}{\sqrt{2}}\right)^2}{R} = \frac{2}{600} = 3,33 \text{ mW}$$

frekv. obl.

$$|C_1| = \frac{A}{2} = 1$$

$$P_x = 2|C_1|^2 = 2 \cdot 1^2 = 2$$

$$P_R = \frac{P_x}{R} = 3,33 \text{ mW}$$

Namerané hodnoty:

$$\Sigma A \text{ (peak to peak)} = 4,078 \text{ V}$$

$$f_0 = 2,083 \text{ kHz}$$

$$U_{R_{ef}} = 1,411 \text{ V}_{ef}$$

$$P_x = \frac{\left(\frac{4,078}{2}\right)^2}{2} = 2,078 \text{ W}$$

$$P_R = \frac{2,078}{600} = 3,46 \text{ mW}$$

$$P_R = \frac{1,411^2}{600} = 3,32 \text{ mW}$$

PICO miera efektívnosti

hodnota dvojnásobného
spektra

$$f_0 = 2,084$$

$$A_{f_0} = 0,69 \text{ V}_{ef}$$

$$\begin{aligned} |C_1| &= \sqrt{2} \cdot A_{f_0} = \\ &= \sqrt{2} \cdot 0,69 = \\ &= 0,9758 \text{ V} \end{aligned}$$

$$P_x = 2 \cdot 0,9758^2 = 1,904 \text{ W}$$

$$P_R = \frac{1,904}{600} = 3,174 \text{ mW}$$

- v časovej oblasti je to presnejšie, pretože so zväčšujúcou sa analýzou
môže byť táto hodnota presnejšia

Úloha 2: Parsevalova teórema pre neharmonické sig.

Časová obl.

$$x(t) = \begin{cases} -A & 0 \leq t \leq T \\ 0 & T \leq t \leq 2T \end{cases}$$

$T = \frac{T}{2}$ $2T = T$

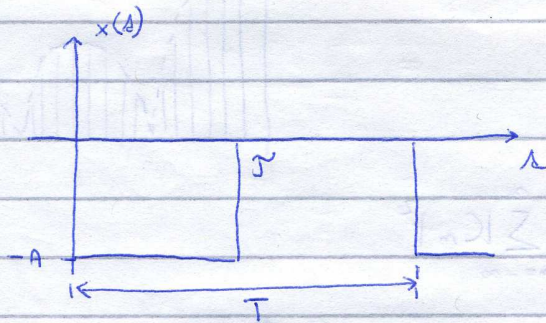
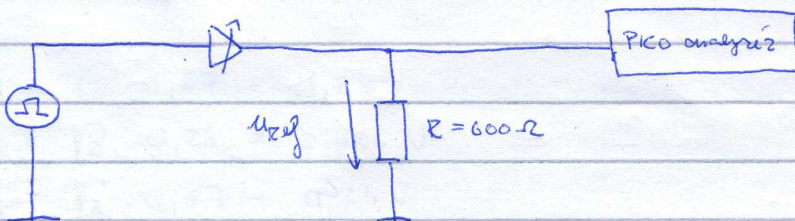


Schéma zapojenia:



Parametre signálu:

$A = -4 \text{ V}$

$f_0 = 1,33 \text{ kHz}$

$T_0 = 120 \mu\text{s}$

Vypočítané hodnoty:

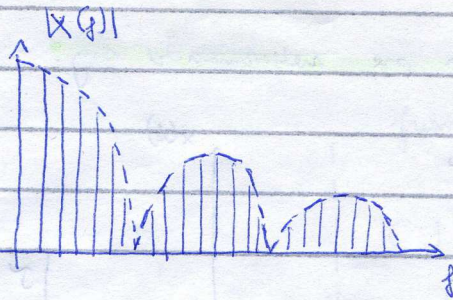
časová obl.

$$P_x = \frac{1}{T} \int_0^T x^2(t) dt = \frac{1}{T} \int_0^T (-A)^2 dt = \frac{1}{T} [A^2 t]_0^T = \frac{1}{T} [A^2 T] = \frac{A^2}{T}$$

$$= \frac{(-4)^2}{2} = 8 \text{ W}$$

frekv. obl.

$$X(f) = \frac{1}{T} \int_0^T x(t) \cdot e^{-j2\pi f t} dt = \dots \quad \left| \frac{A}{k} \right| \text{si} \left(\frac{mT}{k} \right) \quad k = \frac{T}{2}$$



Čim je T manje kym on
paličij širine

$$P_x = \sum_{n=-\infty}^{\infty} |C_n|^2$$

$$\text{ali } x(t) = \frac{\omega_0}{2} + \sum_{m=1}^{\infty} [\omega_m \cos \omega_m t + b_m \sin \omega_m t]$$

↑
DC složka

$$k = 2$$

$$|C_0| = \left| \frac{-A}{2} \right| = 2V \quad 4$$

$$|C_1| = \left| \frac{A}{k} \right| \text{si} \left(\frac{\pi}{k} \right) = 1,273V \quad 3,25V$$

$$|C_3| = \left| \frac{A}{k} \right| \text{si} \left(\frac{3\pi}{k} \right) = 0,424V \quad 0,36V$$

$$|C_5| = \left| \frac{A}{k} \right| \text{si} \left(\frac{5\pi}{k} \right) = 0,255V \quad 0,13V$$

$$|C_7| = \left| \frac{A}{k} \right| \text{si} \left(\frac{7\pi}{k} \right) = 0,182V \quad 0,066$$

$$|C_9| = \left| \frac{A}{k} \right| \text{si} \left(\frac{9\pi}{k} \right) = 0,151 \quad 0,04$$

$$P_x = \sum_{n=-9}^9 |C_n|^2 = 7,837W$$

$$P_R = \frac{7,837}{600} = 13,06mW$$

Numerai koeficienti:

Āsardā vērtība:

$$A = -3,996 \text{ V}$$

$$P_x = \frac{(-3,996)^2}{2} = 7,98 \text{ W}$$

$$P_R = \frac{7,98}{600} = 13,3 \text{ mW}$$

filtr. vērt.

$$\frac{a_0}{2} = -1,998 \text{ V} \rightarrow |C_0| = 1,998 \text{ V}$$

$$|C_1| = \sqrt{2} \cdot 0,87 = 1,23 \text{ V}$$

$$|C_3| = \sqrt{2} \cdot 0,28 = 0,396 \text{ V}$$

$$|C_5| = \sqrt{2} \cdot 0,17 = 0,24 \text{ V}$$

$$|C_7| = \sqrt{2} \cdot 0,11 = 0,156 \text{ V}$$

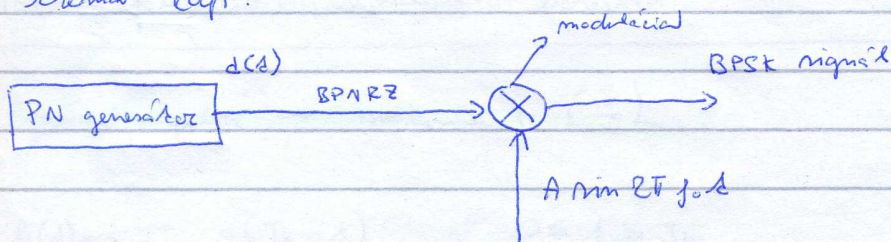
$$|C_9| = \sqrt{2} \cdot 0,09 = 0,127 \text{ V}$$

$$P_x = \sum_{n=-9}^9 |C_n|^2 = 1,998^2 + 3,0258 + 0,3136 + 0,1152 + 0,0487 + 0,0322 = 7,527$$

$$P_R = \frac{7,527}{600} = 12,54 \text{ mW}$$

Uzdevums 3. Zīmējiet pārveidošanas blokus BPSK signāla ģenerācijai.

Schémas kārta:



- vajadzējina modulētais
vāci šķēma

$$f_c = 100 \text{ kHz}$$

$$T = 120 \text{ } \mu\text{s}$$

$$\omega_{\text{null-to-null}} = \frac{2}{T} = 16,66 \text{ (pretořní pásmo) kHz}$$

$$\omega_{0\text{-to-null}} = \frac{1}{T} = 8,33 \text{ kHz}$$

Naměřené hodnoty:

ZP

$$\omega_{0\text{-to-null}} = 8,318 \text{ kHz}$$

PP

$$f_D = 91,72 \text{ kHz}$$

$$f_H = 108,3 \text{ kHz}$$

$$\omega_{\text{null-to-null}} = f_H - f_D = 16,58 \text{ kHz}$$

