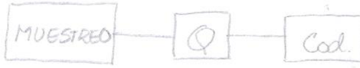
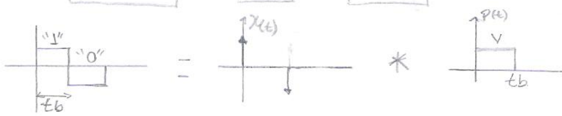
Sartinyas, 26/02/04.

COMUNICACIONES I

MODULACIÓN DIGITAL.





NO RETORNO A CERO
BIPOLAR.

$$R_x(\tau) = \sum \frac{R_n}{t_b}\,\delta(\tau + n t_b) \qquad R_n = \lim_{T\to\infty} \frac{t_b}{T} \sum_k a_k a_{n+k} \quad \left(\sum_k \to T/2t_b\right)$$

$$R_0 = \frac{1}{2} \qquad R_1 = \begin{cases} 10 = 0 \\ 01 = 0 \\ 11 = 1 \\ 00 = 0 \end{cases} \Rightarrow R_1 = \frac{1}{4} = R_n = \frac{1}{4}$$

Luego, para los códigos unipolares:

$$R_x(\tau) = \frac{1}{2t_b}\delta(\tau) + \sum_{n\neq 0} \frac{1}{4t_b}\delta(\tau + n t_b) = \frac{1}{2t_b}\delta(\tau) + \underbrace{\sum_n \frac{1}{4t_b}\delta(\tau+nt_b)}_{\text{Sumo en } n=0} - \underbrace{\frac{1}{4t_b}\delta(\tau)}_{\text{Resto en } n=0}$$

(para que sea periódica)

$$= \frac{1}{4t_b}\delta(\tau) + \sum \frac{1}{4t_b}\delta(\tau + n t_b) \xrightarrow{\mathcal{F}} \frac{1}{4t_b} + \frac{1}{4t_b}\cdot\overbrace{\frac{1}{t_b}}^{C_n}\sum \delta(f + n f_b) = G_x(f)$$

- CASO NRZ.
- CASO RZ.

$P(f) = |P(f)|\,e^{-j\pi f t_b/2}$

→ Siempre da cero los productos con Gx, porque dan Sinc(enteros) = 0, menos en cero que da 1 (*)

- **CASO NRZ UNIPOLAR** → $|P(f)|^2 = (V t_b)^2 \,\mathrm{Sinc}^2 f t_b$ (multiplico $|P(f)|^2 \cdot G_x(f)$)

$$= G_Y(f) = \underbrace{\frac{V^2 t_b}{4}\mathrm{Sinc}^2 f t_b}_{P_{AC}} + \underbrace{\frac{V^2 t_b^2}{4 t_b^2}\delta(f)}_{(*)} \to P_{DC}$$

Para hallar la potencia total, debo integrar $G_Y(f)$

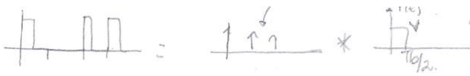
Para $A t_b \mathrm{Sinc}^2 f t_b \Rightarrow \int |x(t)|^2 dt = \int_{-\infty}^{\infty} \underbrace{|X(f)|^2}_{(V t_b)^2 \mathrm{Sinc}^2 f t_b} df = V^2 t_b \Rightarrow \int_{-\infty}^{\infty} t_b \mathrm{Sinc}^2 f t_b = 1$

P_{AC} = Potencia AC = $\frac{V^2}{4}$

P_{DC} = Potencia DC = $\frac{V^2}{4}$

$\Rightarrow$ Potencia total $\frac{V^2}{2}$

- **CASO RZ** UNIPOLAR →



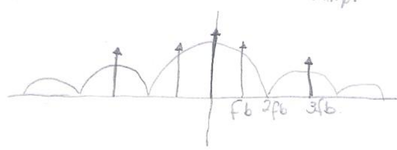
$$G_x = \mathcal{F}\left\{ \frac{1}{4T_b}\,\delta(\tau) + \sum \frac{1}{4t_b}\,\delta(\tau + n t_b) \right\} \Rightarrow$$ la misma G_x que en NRZ porque ambas son UNIPOLARES

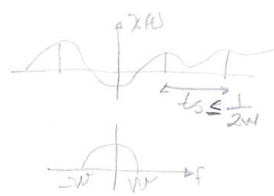
$$|P(f)|^2 = \frac{V^2 t_b^2}{4}\,\mathrm{Sinc}^2 f \frac{t_b}{2} \quad , \quad G_x(f) = \frac{1}{4t_b} + \sum \frac{1}{4t_b^2}\,\delta(f + n f_b)$$

$$G_y(f) = \frac{V^2 t_b}{16}\,\mathrm{Sinc}^2 f\frac{t_b}{2} + \underbrace{\frac{V^2 t_b^2}{16 t_b^2}\,\delta(f)}_{n=0} + \underbrace{\frac{V^2 t_b^2}{4}\,\mathrm{Sinc}^2\frac{1}{2}\,\frac{1}{4t_b^2}\,\delta(f + f_b)}_{n=1} + \underbrace{\frac{V^2 t_b^2}{4}\,\mathrm{Sinc}^2\frac{3}{2}\,\frac{1}{4t_b}}_{n=3} \dots$$

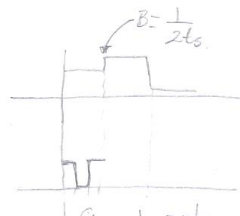
$n=2 \Rightarrow 0$

$$G_Y(f) = \frac{V^2 t_b}{16}\,\mathrm{Sinc}^2 f\frac{t_b}{2} + \frac{V^2}{16}\,\delta(f) + \sum_{\text{imp.}} \frac{V^2 t_b^2}{4}\,\mathrm{Sinc}^2\frac{n}{2}\,\frac{1}{4t_b^2}\,\delta(f + n f_b)$$





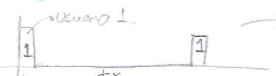
→ M



fs debe cumplir Nyquist.

$$f_b = \frac{1}{t_b} = \frac{1}{\frac{t_s}{3}} \Rightarrow f_b = 3 f_s \Rightarrow$$ el ancho de banda creció.

MULTIPLEXAJE:

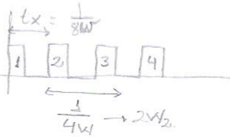


→ Hay capacidad para meter mas usuarios.

USUARIO 1 → W_1

USUARIO 2 → $2W_2$

$$t \leq \frac{1}{2w_1} \qquad W_1 = \frac{1}{2t_x}$$



$$B = \frac{1}{2t_x} = \frac{1}{2\frac{1}{8W}} = 4W$$

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