Formulário de Telecomunicações 2 (EEC4164)

Quantificação

$$\sigma_Q^2 = \frac{\Delta^2}{12} \qquad \left(\frac{S}{N}\right)_Q = \frac{3P}{m_{\max}^2}L^2 \qquad \left(\frac{S}{N}\right)_Q \approx 1{,}8 + 6N \text{ (dB)} \qquad L = 2^N$$

Transmissão de impulsos em banda-base

$$P_e = \sum_{i=1}^{M} p_i P_e(m_i) \qquad \frac{P(0)}{P(1)} = \frac{p_1(\gamma)}{p_0(\gamma)} \qquad P_e = \mathrm{Q}\left(\frac{\Delta V}{2\sigma}\right) \qquad P_{e_M} = \frac{2(M-1)}{M}\mathrm{Q}\left(\frac{\Delta V}{2\sigma}\right)$$

$$P(i,n) = \binom{n}{i}p^i(1-p)^{n-i} \qquad P_e(m \text{ saltos}) = \mathrm{Q}\left(\frac{\Delta V}{2\sigma\sqrt{m}}\right) \qquad P_e(m \text{ saltos}) = m\mathrm{Q}\left(\frac{\Delta V}{2\sigma}\right)$$

$$P_e = \mathrm{Q}\left(\sqrt{\frac{E_{s_0}+E_{s_1}-2\rho\sqrt{E_{s_0}E_{s_1}}}{2N_0}}\right) \qquad \rho = \frac{1}{\sqrt{E_{s_0}E_{s_1}}}\int_0^T s_0(t)s_1(t)\mathrm{d}t = \frac{\boldsymbol{s_0}\bullet\boldsymbol{s_1}}{\|\boldsymbol{s_0}\|\|\boldsymbol{s_1}\|}$$

$$\eta_{\max} = \frac{2E}{N_0} \qquad B = \frac{1}{2T}(1+\alpha) \qquad \boldsymbol{c}(n+1) = \boldsymbol{c}(n) + 2\mu e(n)\boldsymbol{a}(n)$$

Análise no espaço de sinal

$$s_i(t) = \sum_{j=1}^{N} s_{ij}\Psi_j(t) = \boldsymbol{s}_i \bullet \boldsymbol{\Psi},\ i = 1,\, 2,\, \ldots,\, M \qquad \boldsymbol{s}_i = [s_{i1},\, s_{i2},\, \ldots,\, s_{iN}]^{\mathrm{T}} \qquad \boldsymbol{\Psi} = [\Psi_1(t),\, \Psi_2(t),\, \ldots,\, \Psi_N(t)]^{\mathrm{T}}$$

$$s_{ij} = \frac{1}{K_j}\int_0^T s_i(t)\Psi_j(t)\mathrm{d}t \qquad K_j = \int_0^T \Psi_j^2(t)\mathrm{d}t \qquad E_{s_i} = \boldsymbol{s_i}^{\mathrm{T}}\boldsymbol{s_i} = \boldsymbol{s}_i \bullet \boldsymbol{s}_i = \|\boldsymbol{s}_i\|^2 \qquad d_{ik} = \|\boldsymbol{s}_i - \boldsymbol{s}_k\| \qquad \cos(\theta_{ik}) = \frac{\boldsymbol{s_i}\bullet\boldsymbol{s_k}}{\|\boldsymbol{s_i}\|\|\boldsymbol{s_k}\|}$$

$$P_e \leqslant \sum_{i=1}^{M}\sum_{\substack{k=1\\k\neq i}}^{M} p_i \mathrm{Q}\left(\frac{d_{ik}}{\sqrt{2N_0}}\right) \qquad P_e \leqslant \sum_{\substack{k=1\\k\neq i}}^{M_{\min}} \mathrm{Q}\left(\frac{d_{ik}}{\sqrt{2N_0}}\right),\ \frac{E_s}{N_0} \gg 1 \qquad P_b = \frac{2^{k-1}}{2^k-1}P_e \qquad \frac{P_e}{k} \leqslant P_b \leqslant P_e \qquad k = \log_2 M$$

Transmissão digital passa-banda

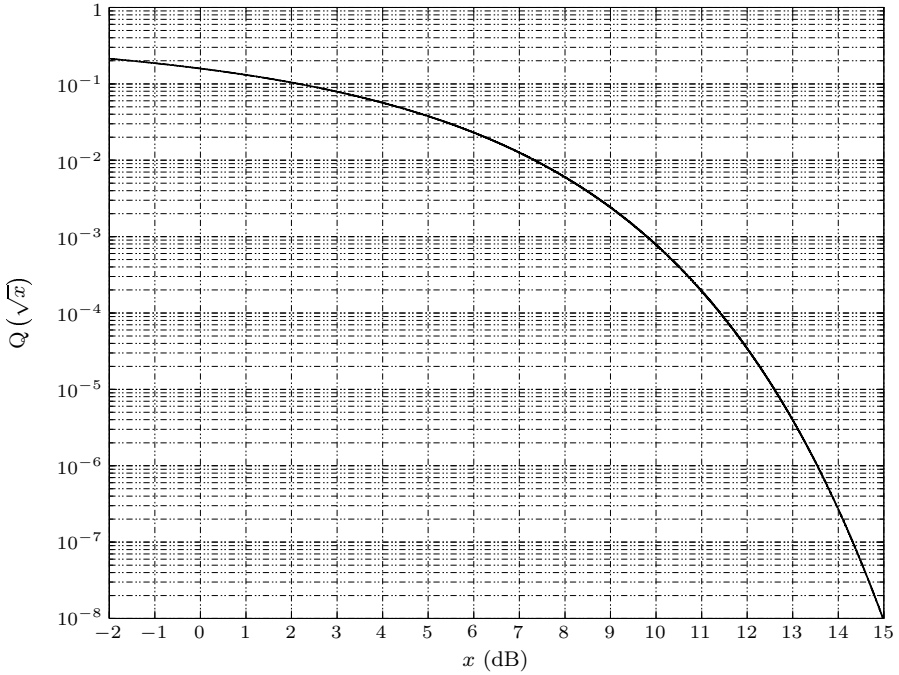
$$P_e = \mathrm{Q}\left(\sqrt{\frac{E_b}{2N_0}}\right) = \mathrm{Q}\left(\sqrt{\frac{\langle E_b\rangle}{N_0}}\right) \qquad P_e = \mathrm{Q}\left(\sqrt{\frac{2E_b}{N_0}}\right) = \mathrm{Q}\left(\sqrt{\frac{2\langle E_b\rangle}{N_0}}\right) \qquad P_e = \mathrm{Q}\left(\sqrt{\frac{E_b}{N_0}}\right) = \mathrm{Q}\left(\sqrt{\frac{\langle E_b\rangle}{N_0}}\right)$$

$$P_e = 2\left(1-\frac{1}{L}\right)\mathrm{Q}\left(\sqrt{\frac{2E_0}{N_0}}\right) \qquad P_e \approx 2\mathrm{Q}\left(\sqrt{\frac{2E_s}{N_0}}\sin\frac{\pi}{M}\right) \qquad P_e \approx 4\left(1-\frac{1}{\sqrt{M}}\right)\mathrm{Q}\left(\sqrt{\frac{2E_0}{N_0}}\right) \qquad E_0 = \frac{3\langle E_s\rangle}{2(M-1)}$$

$$P_e \leqslant (M-1)\mathrm{Q}\left(\sqrt{\frac{E_s}{N_0}}\right) \qquad P_e = \tfrac{1}{2}\mathrm{e}^{-\frac{E_s}{2N_0}} \qquad P_e = \tfrac{1}{2}\mathrm{e}^{-\frac{E_b}{4N_0}} \qquad P_e = \tfrac{1}{2}\mathrm{e}^{-\frac{E_b}{2N_0}} \qquad P_e = \tfrac{1}{2}\mathrm{e}^{-\frac{E_b}{N_0}}$$

Função $\mathrm{Q}\left(\sqrt{x}\right)$

$$\mathrm{Q}\left(\sqrt{x}\right) = \frac{1}{2}\mathrm{erfc}\left(\sqrt{\frac{x}{2}}\right)$$



dB	Factor
0	1,0
0,5	1,1
1	1,3
2	1,6
3	2,0
4	2,5
5	3,2
6	4,0
7	5,0
8	6,3
9	7,9
10	10,0

$$P_{\mathrm{dBm}} = 10\log_{10}(P_{\mathrm{mW}})$$

$$P_{\mathrm{dBW}} = 10\log_{10}(P_{\mathrm{W}})$$