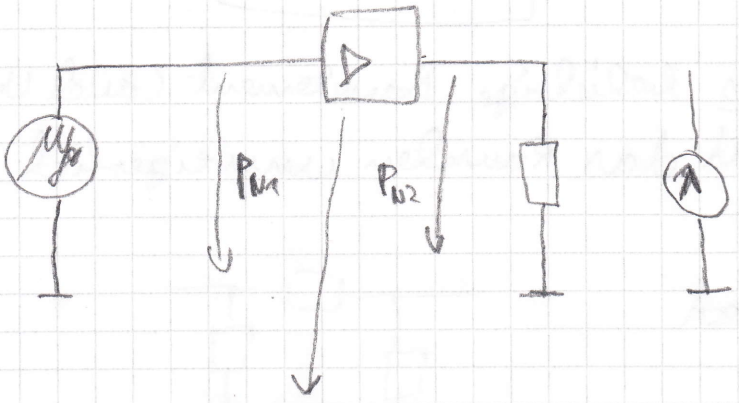
$$F_{ges} = \frac{P_{N3}}{V_{p1} V_{p2} \cdot P_{N1}} = 1 + \frac{P_{Z1}}{P_{N1}} + \frac{P_{Z2}}{V_{p1} \cdot P_{N1}}$$

$$= 1 + F_{Z1} + \frac{F_{Z2}}{V_{p1}}$$

Rauschgenerator

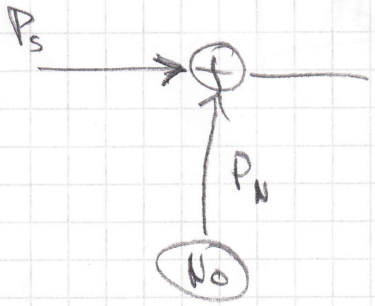


$$F = \frac{P_N^2}{V_p P_{N1}}$$

→ Teller durch Eigenrauschen der Messgerät

→ wird in der Praxis nicht verwendet

Übertragungssystem



$$SNR = \frac{P_S}{P_N}$$

$$P_N = N_0 \cdot f_g = N_0 \cdot B_K$$

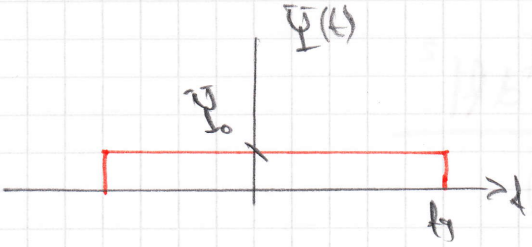
Basisband

$f_g = B_K$

$$SNR = \frac{P_S}{N_0 \cdot f_g}$$

$$N_0 = \frac{2 \Psi_0}{R} \qquad \Psi_0 = \frac{N_0}{2} R$$

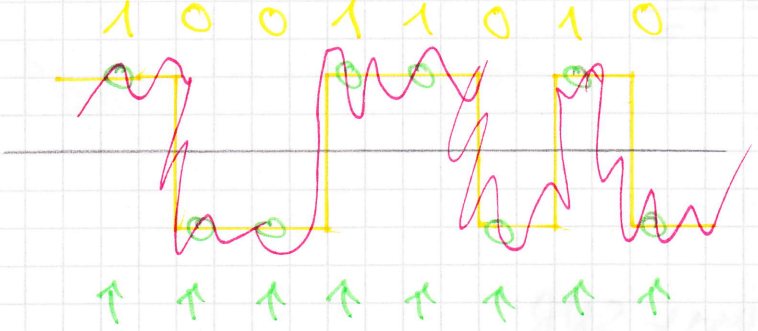
$$SNR = \frac{P_S \cdot R}{2 \Psi_0 \cdot f_g} = \frac{\hat{U}_{sig}^2}{2 \Psi \cdot f_g}$$



Rauschleistungsdichte in der Empfängerbandbreite (nach Eingangsfilter)

$$2\,\Psi_0\,f_g = \int_{-\infty}^{\infty} \Psi(f)\,df = \varphi_{xx}(0)$$

$$SNR = \frac{U_{seff}^2}{\varphi_{xx}(0)}$$



$$SNR = \frac{U_2^2(nT_s)}{\varphi_{nn}(0)} \rightarrow max!$$

$$U_2(f) = U_1(f)\cdot H(f)$$

$$u_2(t) = \int_{-\infty}^{\infty} U_1(f)\cdot H(f)\cdot e^{j2\pi ft}\,df$$

$$u_2(nT_s) = \int_{-\infty}^{\infty} U_1(f)\,H(f)\cdot e^{j2\pi nT_s f}\,df$$

$$\Psi_{NN}(f) = \Psi_0\,|H(f)|^2$$

$$\varphi_{nn}(\tau) = \int_{-\infty}^{\infty} \Psi_0\,|H(f)|^2\,e^{j2\pi\tau f}\,df$$

$$\varphi_{nn}(0) = \Psi_0 \int_{-\infty}^{\infty} |H(f)|^2\,df$$

$$SNR = \frac{\left| \int_{-\infty}^{\infty} U_1(f) H(f) e^{j2\pi n T_s f} df \right|^2}{\Psi_0 \int_{-\infty}^{\infty} |H(f)|^2 df}$$

$$SNR \leq \frac{\int_{-\infty}^{\infty} |U_1(f)|^2 df}{\Psi_0}$$

$$\int_{-\infty}^{\infty} |U_1(f)|^2 df = E \cdot R$$

$$N_0 = \frac{2\Psi_0}{R} \qquad \Psi_0 = \frac{N_0 \cdot R}{2}$$

$$SNR \leq \frac{E \cdot R}{N_0 \cdot \frac{R}{2}}$$

$$SNR \leq \frac{2E}{N_0} \leftarrow \max SNR$$

$\max SNR = \frac{2E}{N_0}$ ergibt sich für „=" in Ungleichung

$$\left| \int_{-\infty}^{\infty} U_1(f) H(f) e^{j2\pi n T_s f} df \right|^2 = \int_{-\infty}^{\infty} |U_1(f)|^2 df \int_{-\infty}^{\infty} |H(f)|^2 df$$

$$H(f) = \frac{1}{\lambda} U_1^*(f)$$

$$h_1(t) = \frac{1}{\lambda} u_1(-t)$$

$$[\lambda] = 1 V_s$$

Bsp