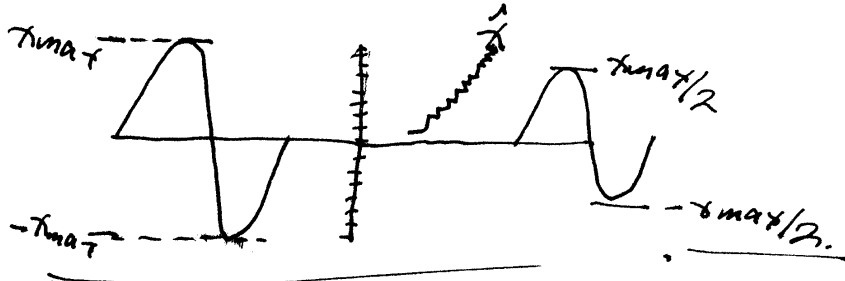


SQNR Example done in class.

$$\text{SQNR} = 10 \log \left(\frac{P_s}{\sigma_{\text{max}}^2} \right)^2 + 6.02n + 4.77$$

best sin wave:



$$x(t) = x_{\text{max}} \cos(\omega_s t)$$

$$P_x = \frac{x_{\text{max}}^2}{2} \quad \left\{ \begin{array}{l} \text{full} \\ \text{scale} \end{array} \right.$$

half scale

$$P_x = \left(\frac{x_{\text{max}}}{2} \right)^2 \frac{1}{2} = \frac{x_{\text{max}}^2}{8} = \frac{x_{\text{max}}^2}{2 \cdot 4}$$

$$\text{SQNR} = 10 \log \left(\frac{x_{\text{max}}^2}{2 (x_{\text{max}})^2} \right)^2 + 6.02n + 4.77$$

$$= 10 \log \frac{1}{2} + 6.02n + 4.77$$

$$= -3 + 4.77 + 6.02n = 1.77 + 6.02n \approx 6n \text{ dB}$$

Full scale square rule
6 dB/bit

$$\left. \begin{array}{l} \text{half} \\ \text{scale} \\ \text{sin wave} \end{array} \right\} \begin{array}{l} -4.2 + 6.02n \\ \approx 6(n-1) \end{array}$$