Noise Figure Examples

1. The output signal-to-noise ratio (SNR) of certain amplifier is 10 dB and its *noise figure* $F_{\text{dB}} = 3$ dB. Then, the input SNR is

$$\left(\frac{S}{N}\right)_i = \left(\frac{S}{N}\right)_o + F_{\text{dB}} = 13 \text{ dB}.$$

2. If the SNR at the input of an amplifier is 20 dB, and its noise figure is equal to 5 dB, then the output SNR is

$$\left(\frac{S}{N}\right)_o = \left(\frac{S}{N}\right)_i - F_{\text{dB}} = 15 \text{ dB}.$$

3. The SNR of a DSL modem transmitter is 35 dB. The signal is sent through a telephone line using 20 repeaters, each with power gain $\mathcal{G}_{i,\text{dB}} = 20$ dB and noise figure $F_{i,\text{dB}} = 6$ dB, for $i = 1, 2, \cdots, 20$. The SNR at the receiver is:

$$\left(\frac{S}{N}\right)_R = \left(\frac{S}{N}\right)_T - F_{\text{dB}},$$

where $F_{\text{dB}} = 10 \log_{10}(F)$ and

$$F = F_1 + \frac{F_2 - 1}{\mathcal{G}_1} + \frac{F_3 - 1}{\mathcal{G}_1 \mathcal{G}_2} + \cdots + \frac{F_{20} - 1}{\mathcal{G}_1 \mathcal{G}_2 \cdots \mathcal{G}_{19}},$$

with $F_i = 4$ and $\mathcal{G}_i = 100$, for $i = 1, 2, \cdots, 20$. Therefore,

$$F = 4 + \frac{3}{100} + \frac{3}{10000} + \cdots + 3 \times 10^{-38} = 4.0303,$$

$F_{\text{dB}} = 6$ dB and

$$\left(\frac{S}{N}\right)_R = 35 - 6 = 29 \text{ dB}.$$