Power spectral density and average power of AWGN

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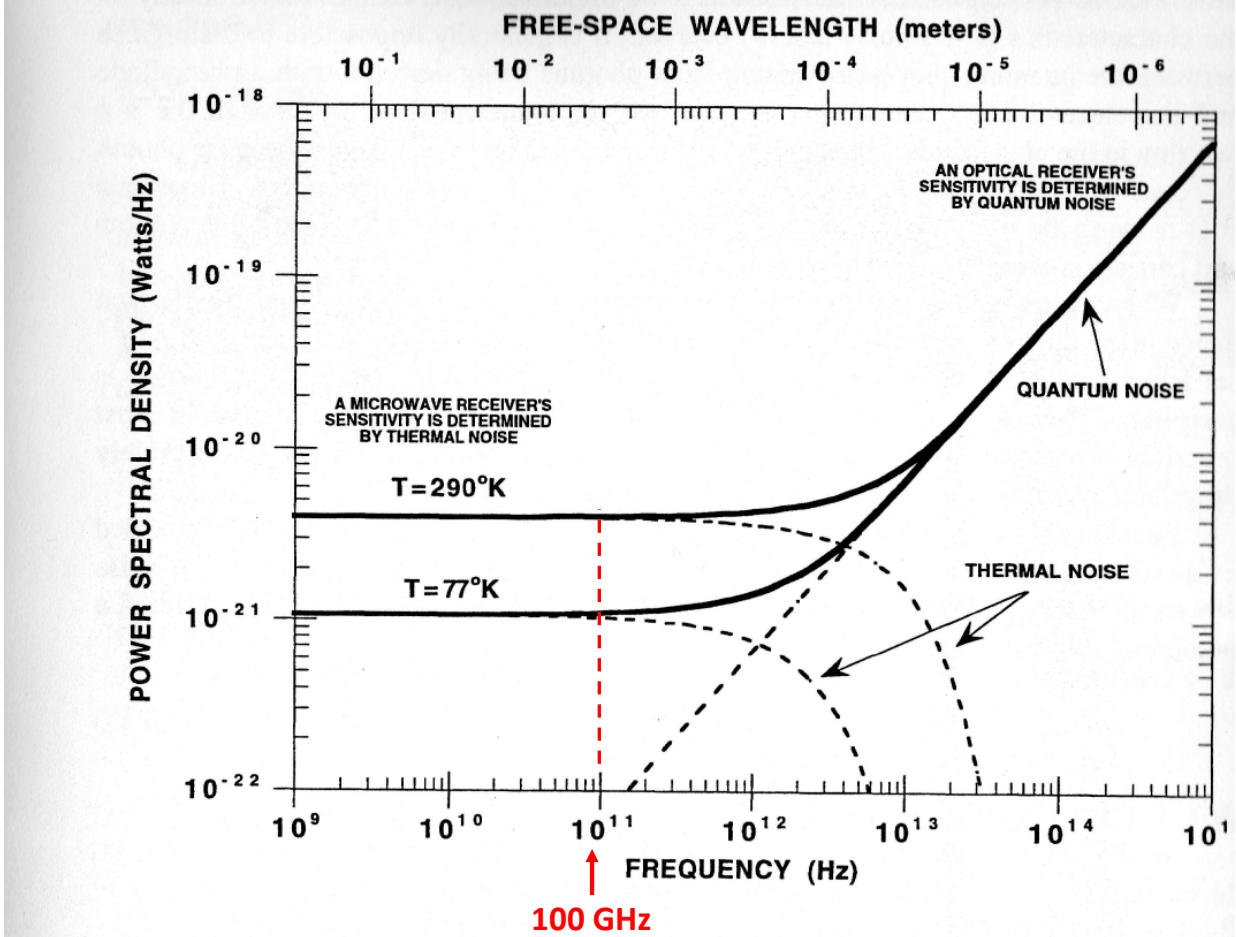
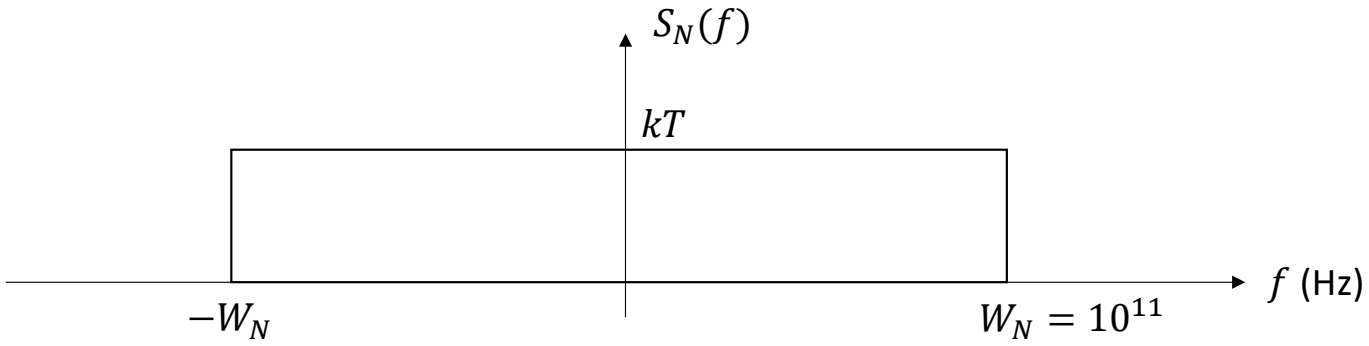


Figure 5.4 Fundamental limit of receiver noise density.

Simplified model of the PSD of AWGN*

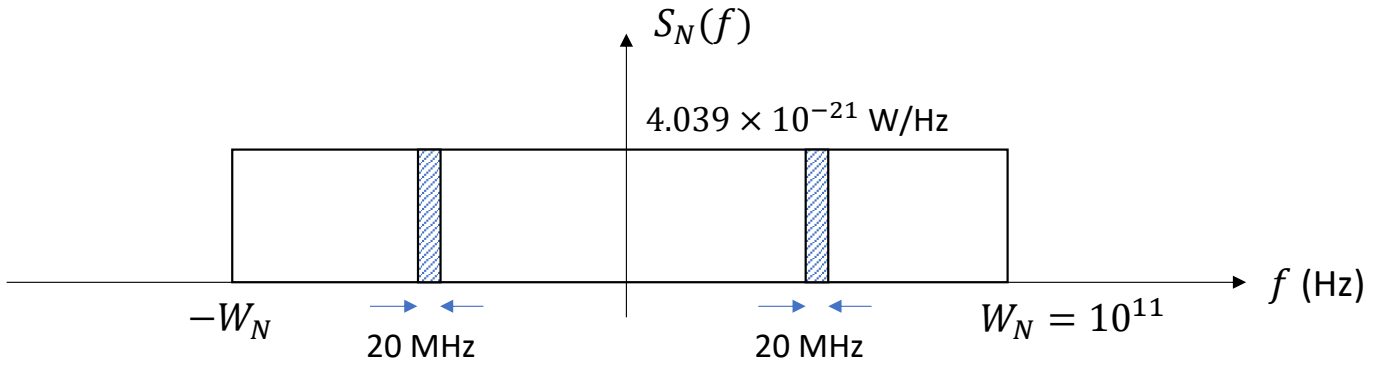


$k = 1.380649 \times 10^{-23}$ (Boltzmann's constant)
$T = 290$ K (Room temperature in Kelvin)

$kT = 4.039 \times 10^{-21}$ W/Hz $= -173.95$ dBm/Hz

* The figure in the previous slide shows the "unilateral" PSD with twice the amplitude

Example: Noise power over a 20 MHz bandwidth



Using $E\{N^2(t)\} = \sigma_N^2 = \int_{-\infty}^{\infty} S_N(f)\,df = \frac{N_0}{2}$:

$$\boldsymbol{\sigma_N^2} = 2 \times 20 \times 10^6 \times 4.039 \times 10^{-21} = \frac{\boldsymbol{N_0}}{\boldsymbol{2}} = 1.6016 \times 10^{-13}\ \text{W} = -97.9546\ \text{dBm}$$

NOTE: $\sigma_N^2 = kT \cdot BW$, where $BW = 2W$ for lowpass signals, $BW = 4W$ for bandpass (AM) signals, and W is the pulse bandwidth