Problem 9.16 An AM receiver, operating with a sinusoidal modulating wave and 80% modulation, has a post-detection signal-to-noise ratio of 30 dB. What is the corresponding pre-detection signal-to-noise ratio?

Solution

We are given that $k_a = 0.80$, and for sinusoidal modulation $P = 0.5$. A post-detection SNR of 30 dB corresponds to an absolute SNR of 1000. From Eq.(9.30),

$$SNR_{post}^{AM} = \frac{A_C{}^2}{2}\frac{k_a{}^2 P}{N_0 W}$$

$$1000 = \frac{A_c^2}{2N_0 W}(0.8)^2 0.5$$

Re-arranging this equation, we obtain

$$\frac{A_c^2}{2N_0 W} = 3125$$

From Eq. (9.26) the pre-detection SNR is given by

$$\begin{aligned} SNR_{pre}^{AM} &= \frac{A_C{}^2\left(1 + k_a{}^2 P\right)}{2N_0 B_T} \\ &= \frac{A_c^2}{2N_0(2W)}\left(1 + k_a^2 P\right) \\ &= \frac{3125}{2}\left(1 + (0.8)^2 0.5\right) \\ &= 2062.5 \end{aligned}$$

where we have assumed that $B_T = 2W$. This pre-detection SNR is equivalent to approximately 36 dB.