

Problem 3.2.

For a particular case of AM using sinusoidal modulating wave, the percentage modulation is 20 percent. Calculate the average power in (a) the carrier and (b) each side frequency, expressing your results as percentages of total transmitted power.

Solution

For sinusoidal modulation, the AM wave is defined by

$$s(t) = A_c(1 + k_a m(t)) \cos(2\pi f_c t)$$

For $m(t) = A_m \cos(2\pi f_m t)$, we have (see Example 3.1)

$$s(t) = A_c \cos(2\pi f_c t) + \frac{1}{2}\mu A_c \cos[2\pi(f_c + f_m)t] + \frac{1}{2}\mu A_c \cos[2\pi(f_c - f_m)t]$$

(a) The average power in the carrier, expressed as a percentage of the total transmitted power, is (with $\mu = 20\%$)

$$\frac{\frac{1}{2}A_c^2}{\frac{1}{2}A_c^2 + \frac{1}{4}\mu^2 A_c^2} = \frac{1}{1 + 0.5\mu^2} = \frac{1}{1 + 0.5 \times 0.2^2} = \frac{1}{1 + 0.02} \approx 0.98$$

Expressing this result as a percentage, the result reads as 98%.

(b) The average power in each side frequency is therefore approximately 1%.