Problem 9.7 Compute the post-detection SNR in the lower channel for Example 9.2 and compare to the upper channel.

Solution

The SNR of lower channel is, from Eq. (9.59)

$$\text{SNR}_{\text{post}}^{\text{FM}} = \frac{3A_c^2 k_f^2 (P/2)}{2N_0 W^3}$$

where we have assumed that half the power is in the lower channel. Using the approximation to Carson's Rule $B_T = 2(k_f P^{1/2} + D) \approx 2k_f P^{\frac{1}{2}} = 200 \text{ kHz}$, that is, $k_f^2 P = B_T^2/4$ this expression becomes

$$SNR_{post}^{FM} = \frac{A_c^2}{2N_0 B_T} \frac{3}{2} \frac{(B_T / 2)^2}{W}$$
$$= SNR_{pre}^{FM} \frac{3}{8} \left(\frac{B_T}{W}\right)^3$$

With a pre-detection SNR of 12 dB, we determine the post-detection SNR as follows

$$SNR_{post}^{FM} = SNR_{pre}^{FM} \frac{3}{8} \left(\frac{200}{19}\right)^{3}$$
$$= 10^{12/10} \times 0.375 \times (10.53)^{3}$$
$$= 6.94 \times 10^{3}$$
$$\sim 38.4 \text{ dB}$$

(*The answer in the text for the lower channel is off by factor 0.5 or 3 dB.*) For the upper channel, Example 9.2 indicates this result should be scaled by 2/52 and

SNR^{FM}_{post} = SNR^{FM}_{pre}
$$\frac{3}{8} \left(\frac{200}{19}\right)^3 \square \frac{2}{52}$$

~ 24.3 dB

So the upper channel is $10\log_{10}(52/2) \approx 14.1$ dB worse than lower channel.

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