

MS Exam Solution: ECE265 (Spring 2014)

a.

$$kT \cdot BW = -174 \text{ dBm} + 80 = -94 \text{ dBm}$$

3 pts for noise power in kT, 2 pts for final answer

b.

$$SFDR = \frac{2}{3}(IIP3 - MDS_{in})$$

$$IIP3 = 0 \text{ dBm} \quad MDS_{in} = -174 + 80 + 4 = -90 \text{ dBm}$$

$$SFDR = \frac{2}{3}(0 \text{ dBm} - (-90 \text{ dBm})) = 60 \text{ dB}$$

3 pts for the SFDR, 2 pts for final answer

c.

$$F_{total} = F_1 + \frac{F_2 - 1}{G_1} = 2 + \left(\frac{1.5}{\frac{1}{2}} \right) = 5 \rightarrow 7 \text{ dB}$$

4 pts for noise factor cascade, 2 pts for final answer

d.

$$IIP3_{total}^{-1} = IIP3_A^{-1} + G_A IIP3_B^{-1}$$

$$IIP3_{total}^{-1} = 0 + \frac{1}{2} \left(\frac{1}{1 \text{ mW}} \right) \rightarrow IIP3_{total} = 2 \text{ mW} \quad \text{or } 3 \text{ dBm}$$

4 pts for the IIP3 cascade of power, 1 pts for each term of IIP3 term, 2 pts for final answer.

e.

$$SFDR = \frac{2}{3}(IIP3 - MDS_{in})$$

$$IIP3 = 3 \text{ dBm} \quad MDS_{in} = -174 + 5 + 80 = -87 \text{ dBm}$$

$$SFDR = \frac{2}{3}(3 + 87) = 60 \text{ dB}$$

The SFDR doesn't change.

3 pts for the new SFDR calculation, 2 pts for conclusion that SFDR doesn't change.

f.

IM3 tones at 980 MHz and at 1.01 GHz.

2 pts for each IM3 tone

g.

Pim3 is

$$\Delta P = 2(IIP3 - P_{IN}) = 2(0 \text{ dBm} - 20 \text{ dBm}) = -40 \text{ dBm}$$

$$P_{IM3} = P_{IN} + \Delta P = -60 \text{ dBm}$$

4 pts for correct power level, 1 pt for recognizing that each IM3 power is the same.

h.

The filter knocks the power of the input tone at 1 GHz down by 10 dB. Therefore, the IM3 term at 1.01 GHz drops to -80 dBm. The IM3 term at 980 MHz drops to -70 dBm.

3 points for the correct evaluation of the ach of the IM3 power levels.

i.

The IIP3 has been improved by 10 dB since the IM3 tone is reduced by 10 dB. The filter is assumed to have a negligible impact on the noise. Therefore, the SFDR has improved by 6.6 dB to 66.6 dB.

3 pts for describing how the SFDR should improve with the higher IIP3 but the MDS is unchanged. 2pts for correct answer.