

Low-power radio design for the IoT

Exercise 5 (15.04.2021)

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Problem 1 Receiver Front-End

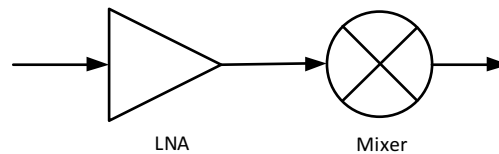


Figure 1: Block diagram of a receiver front-end

The system shown in Fig. 1 consists of a cascade of an LNA followed by a mixer. The system has the following specifications:

- Total Gain, $G_{\text{tot}} \geq 20$ dB
- Total Noise Figure, $NF_{\text{tot}} = 4$ dB
- Total IIP_3 , $IIP_{3\text{tot}} = 5$ dBm

1.1 LNA Design

- Design the LNA (calculate the gain) such that its noise figure $NF_{\text{LNA}} < 1$ dB. Calculate its IIP_3 if $IIP_{3\text{mixer}} = 20$ dBm. Assume the noise figure of the mixer $NF_{\text{mixer}} = 10$ dB.
- Design the LNA such that its noise figure $NF_{\text{LNA}} = 3$ dB. Calculate the IIP_3 assuming $IIP_{3\text{mixer}} = 20$ dBm. Assume the noise figure of the mixer $NF_{\text{mixer}} = 10$ dB.
- Comment on the results.

1.2 Mixer Design

- Assuming that the mixer stage contributes half of the total gain, compute the Noise Figure of the mixer such that the Noise Figure of the LNA is less than 1 dB.
- Assuming that the mixer stage contributes one-fourth of the total gain, compute the Noise Figure of the mixer such that the Noise Figure of the LNA is less than 1 dB.
- Comment on the results.