

HOMWORK ASSIGNMENT #2

Prob. 1 Design a LNA that meets the following specs (use 0.5 μ m CMOS technology).
You can pick the LNA topology.

$$IIP3 \geq 7 \text{ dBm}$$

$$NF \leq 2.8 \text{ dB}$$

$$f_o = 2.4 \text{ GHz}$$

$$\text{Power Supply} = 3 \text{ V}$$

$$\text{Gain (voltage)} \geq 9 \text{ dB}$$

50 ohms matching.

$$\text{Input P - 1db} > -14 \text{ dBm}$$

Use the following figure of merit (FOM) to evaluate your design:

$$\text{FOM} = \{ f_o[\text{GHz}] S_{21}[\text{dB}] IIP3[\text{dBm}] \} / \{ f_t[\text{GHz}] NF[\text{dB}] PDV[\text{dBm}] \}$$

Prob. 2 Use a different LNA topology to solve again Prob. 1. This time the LNA topology has to be a current-reused LNA. See Liang-Hui and Huey-Ru Chung, "Design of a 5.7GHz 0.18 μ m CMOS Current-reused LNA for an 802.11a WLAN Receiver", *Microwave Journal*, pp132-136, February 2004.

Prob. 3.. A direct conversion Bluetooth receiver has the following blocks in the receive path:

Parameter/Block	LNA	Mixer	Filter	VGA
NF [dB]	3	-	32	30
Max. Gain [dB]	15	16	5	43
IIP3 [dBm]	-8	5	-	10

- (a) What should be the NF of the mixer referred to 50 Ohm to achieve an overall NF of less than 6.5dB?
- (b) Assume that the two tones are very close to each other and are at the adjacent channel frequency such that both the tones experience the same attenuation of the filter at the adjacent channel frequency. Derive the values for the IIP3 and the attenuation of the filter to achieve an overall system IIP3 of better than -13dBm? Please provide reasonable values for the IIP3 and attenuation of the filter. Justify your answer.
- (c) With the above calculated IIP3 of the filter, what should be the attenuation to relax the IIP3 specification of the VGA by 2.5dB while achieving the overall system IIP3? Explain.